OPERATING INSTRUCTIONS

# OD Precision

## Displacement Sensor

SICK
Sensor Intelligence.

# Contents

# 1 Safety precautions

Carefully read and understand the safety precautions before operation.

They provide important information to protect your health and property. Strictly follow this instruction manual, and do not apply any other installing/operating procedure which is not described in this manual.

## 1.1 Meanings of safety symbols

WARNING

Indicates a possible hazard that may result in death or serious injury if the product is used without observing the stated instructions.

Indicates a possible hazard that may result in personal injury or property damage if the product is used without observing the stated instructions.

## 1.2 Mandatory requirements

WARNING

This product cannot be used as a safety device to protect human body.

Do not disassemble or modify the product since it is not designed to automatically stop the laser emission when open. Disassembling or modifyingmay cause personal injury, fire or electric shock.

If smoke or abnormal smell occurs, stop operation and turn off power supply. If the problem requires a repair, contact the sales office or store where you purchased the product.

Use the supply voltage specified in the specifications.

Do not touch the controller unit and cable with wet hands. It may cause electric shock.

Use only the OD Precision  sensor head.

Do not connect/disconnect the sensor head connector, terminal board or wiring when the power is on.

## 1.3 Precautions for installation

WARNING

Installing the unit in the following conditions may result in fire, electric shock or product damage.

- High humidity
- High temperature e.g. in direct sunlight, etc.
- Much dust
- Poor ventilation
- Static electricity
- Corrosive gas or flammable gas
- Exposure to water, oil, or chemicals
- Direct exposure to vibration or impact

Do not apply electricity during wiring. Ensure that the analog output does not contact with other wiring.

WARNING

Avoid parallel wiring and placing in the same piping with high-voltage cable or power transmission cable, since they may cause electric noise resulting in malfunction. Keep the power and signal cords in short length.

Do not pull or apply impact forcibly since it may cause product damage.

When using switching regulator for power supply, ensure grounding the frame ground terminal.

Do not drop or give a shock to the product. This may damage product and measurement accuracy.

Wait for approximately 5 minutes as warming-up time after turning the power on.

## 1.4 Cautions for laser product

The sensor-head light source of the displacement sensor OD series is rated as Class 2(II)/ Class 1 (I) for OD5-25x) Red Laser Diode, and compliant with JIS C6802/IEC/FDA laser safety standard. Do not stare directly into the laser beam or the reflected laser beam on a mirrored surface.

For details, refer to the Instruction Manual of sensor head (8013569).

WARNING

When incorporating the unit into your product/machine, provide an end-user with information that it is a laser product and should be properly operated.

# 2 Specifications

*Tab. 1: Specification*

| **Model** | | **AOD5-N1**<br>**NPN input/output type** | **AOD5-P1**<br>**PNP input/output type** |
|---|---|---|---|
| Response time | | 0.1 ms / 0.8 ms | |
| Output rate | | 10 kHz / 1.25 kHz | |
| Number of connected sensor heads | | Max. 3 pcs | |
| Temperature drift | | ± 0.01 % F.S./°C (FS = Full Scale of measuring range) | |
| Communication | | RS 232/USB | |
| Connection type | | Terminal board | |
| Output | Analog output | Voltage output ± 10 V/F.S. (Output impedance 100 Ω, min load 10 kΩ) | |
| | | Current output 4 ... 20 mA/F.S. (Load impedance Max. 300 Ω) | |
| | Alarm output | NPN open collector | PNP open collector |
| | | Max. 100 mA/24 V DC (residual voltage Max. 1.8 V) | |
| | | Turns ON when the sensor head fails in measurement. | |
| | Control/Switching output | NPN open collector | PNP open collector |
| | | Max. 100 mA/24 V DC (residual voltage Max. 1.8 V) | |
| | | HI/LO setting for each line and Hysteresis setting are available. | |
| Input | Bank input | Turns ON when connected to GND | Turns ON when connected to 12 ... 24 V |
| | | 16 banks selectable | |
| | Hold input | Turns ON when connected to GND | Turns ON when connected to 12 ... 24 V |
| | | Measurement value holding (selectable in the menu) | |
| | Reset input | Turns ON when connected to GND | Turns ON when connected to 12 ... 24 V |
| | | Zero reset of Head A measurement value/Head B measurement value/Head C measurement value/Calculation value is available. | |
| | Laser off input | Turns ON when connected to GND | Turns ON when connected to 12 ... 24 V |
| | | Laser shutoff of Head A/Head B/Head C is available. | |
| Additional features | | Calculation setting (calculation formula, measurement value increase/decrease direction, set variable value of K, shift), hold settings, filter setting (filter, cut-off frequency), memory bank setting, RS 232 setting, memory copying function, measurement value display, digit number setting, display brightness setting, key illumination setting | |
| Indication | | 4.4'' LCD display | |
| Protection Class | | III | |
| Enclosure rating | | IP 20 | |
| Ambient temperature | Operating temperature | –10 °C... +45 °C (Non-condensing)/For storage: –20 ... +60 °C | |

| **Model** | | **AOD5-N1**<br>**NPN input/output type** | **AOD5-P1**<br>**PNP input/output type** |
|---|---|---|---|
| | Storage temperature | –20 °C ... +60 °C | |
| Supply voltage | | 12 V ... 24 V, DC ± 10 % | |
| Power consumption | | 350 mA/24 V (When connected with 3 sensor heads. Including analog current output) | |
| Operating humidity | | 35 % ... 85 % RH/For storage: 35 ... 85 % RH | |
| Vibration resistance | | 10 Hz ... 55 Hz, Double amplitude 1.5 mm, 2 h for XYZ axes | |
| Shock resistance | | 20 G (196 m/s$^2$) | |
| Housing material | | Chassis: Polycarbonate, Terminal board: Nylon 66 | |
| Weight | | Approx. 550 g (including terminal board) | |

**Pin Assignment of 50-pin Input/Output Terminal**

*Tab. 2: Pinning of I/O Expansion Cable*

| **No.** | **Description** | **Core color** | **Number of dots** | **Dot color** |
|---|---|---|---|---|
| 1 | Bank switch 0 input | orange | 1 | black |
| 2 | Bank switch 1 input | grey | | |
| 3 | Bank switch 2 input | white | | |
| 4 | Bank switch 3 input | yellow | | |
| 5 | Hold A input (for Head A) | pink | | |
| 6 | Hold B input (for Head B) | orange | 2 | |
| 7 | Hold C input (for Head C) | grey | | |
| 8 | Hold CAL input (for calculation result) | white | | |
| 9 | Hold reset input (common) | yellow | | |
| 10 | Zero reset A input (for Head A) | pink | | |
| 11 | Zero reset B input (for Head B) | orange | 3 | |
| 12 | Zero reset C input (for Head C) | grey | | |
| 13 | Zero reset CAL input (for calculation result) | white | | |
| 14 | Laser OFF A input (for Head A) | yellow | | |
| 15 | Laser OFF B input (for Head B) | pink | | |
| 16 | Laser OFF C input (for Head C) | orange | 4 | |
| 17 | – | grey | | |
| 18 | – | white | | |
| 19 | – | yellow | | |
| 20 | – | pink | | |
| 21 | – | orange | 5 | |
| 22 | – | grey | | |
| 23 | COM terminal (24 V output) | white | | |
| 24 | – | yellow | | |
| 25 | COM terminal (0 V output) | pink | | |

| No. | Description | Core color | Number of dots | Dot color |
|---|---|---|---|---|
| 26 | Alarm output A (for Head A) | orange | 1 | red |
| 27 | Alarm output B (for Head B) | grey | | |
| 28 | Alarm output C (for Head C) | white | | |
| 29 | Control output 1 | yellow | | |
| 30 | Control output 2 | pink | | |
| 31 | Control output 3 | orange | 2 | |
| 32 | Control output 4 | grey | | |
| 33 | Control output 5 | white | | |
| 34 | – | yellow | | |
| 35 | – | pink | | |
| 36 | – | orange | 3 | |
| 37 | – | grey | | |
| 38 | – | white | | |
| 39 | – | yellow | | |
| 40 | – | pink | | |
| 41 | – | orange | 4 | |
| 42 | – | grey | | |
| 43 | – | white | | |
| 44 | – | yellow | | |
| 45 | – | pink | | |
| 46 | – | orange | 5 | |
| 47 | – | grey | | |
| 48 | – | white | | |
| 49 | – | yellow | | |
| 50 | – | pink | | |

**Pin identification is by color code**

The color of the dots, the number of the dots and the color of the core are used to identify each pin.

**Example for Pin 6**

| Core color: orange | Number of dots: 2 | Dot color: black |
|---|---|---|

**Example for Pin 39**

| Core color: yellow | Number of dots: 3 | Dot color: red |
|---|---|---|

**Note** Use the half pitch connector of IEEEE1284.

Use the COM terminal only as the “COMMON” terminal of input/output of the product. Never use the terminal for any other application.

– Connection with the input terminal

– Load connection between the output terminal and COM terminal

The max current for each output terminal is 100 mA.

**Hold input**

Refer to chapter 6.6 “Setting hold”.

**Zero reset input**

Zero reset is performed when the input is ON for 110 ms or more. Zero reset is canceled when the input is ON for 1 s or more.

**Laser OFF input**

The sensor head laser is shut off when the laser OFF input is turned ON.

**Input time of the input terminals**

All input terminals are enabled when they are OFF or ON for 110 ms or more. The zero reset is enabled when it is ON for 110 ms or more, and is cleared when it is ON for 1 s or more.

**Alarm output**

When the sensor head cannot make a measurement, the corresponding alarm output turns ON.

**Control/Switching output**

Refer to chapter 6.2 “Setting control/switching output”.

**Bank switch input**

Refer to following table to switch between banks 1 to 15.

*Tab. 3: Bank switch Input via Expansion cable*

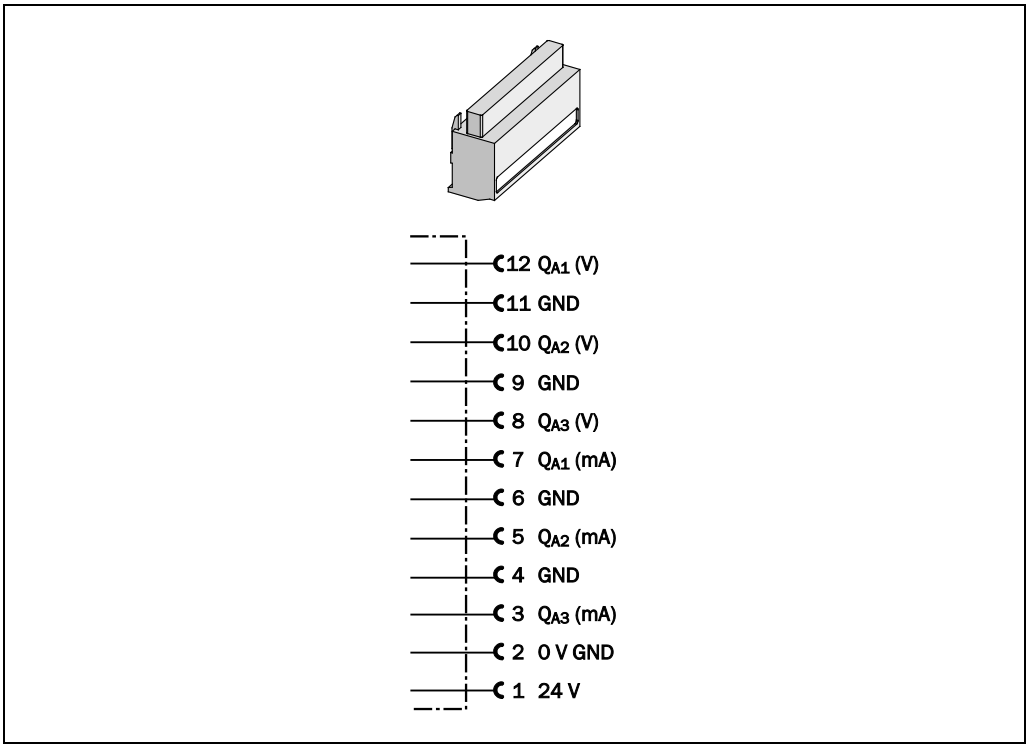
| Bank No. | Bank switch input | | | |
|---|---|---|---|---|
| | 3 | 2 | 1 | 0 |
| 0 | OFF | OFF | OFF | OFF |
| 1 | OFF | OFF | OFF | ON |
| 2 | OFF | OFF | ON | OFF |
| 3 | OFF | OFF | ON | ON |
| 4 | OFF | ON | OFF | OFF |
| 5 | OFF | ON | OFF | ON |
| 6 | OFF | ON | ON | OFF |
| 7 | OFF | ON | ON | ON |

| Bank No. | Bank switch input | | | |
|---|---|---|---|---|
| | 3 | 2 | 1 | 0 |
| 8 | ON | OFF | OFF | OFF |
| 9 | ON | OFF | OFF | ON |
| 10 | ON | OFF | ON | OFF |
| 11 | ON | OFF | ON | ON |
| 12 | ON | ON | OFF | OFF |
| 13 | ON | ON | OFF | ON |
| 14 | ON | ON | ON | OFF |
| 15 | ON | ON | ON | ON |

Refer also to chapter 6.8 “Setting bank”.

### Input/Output Terminal

*Fig. 1: Pin assignment of 12-pin input/output terminals*




**Note** All GND terminals are connected internally.

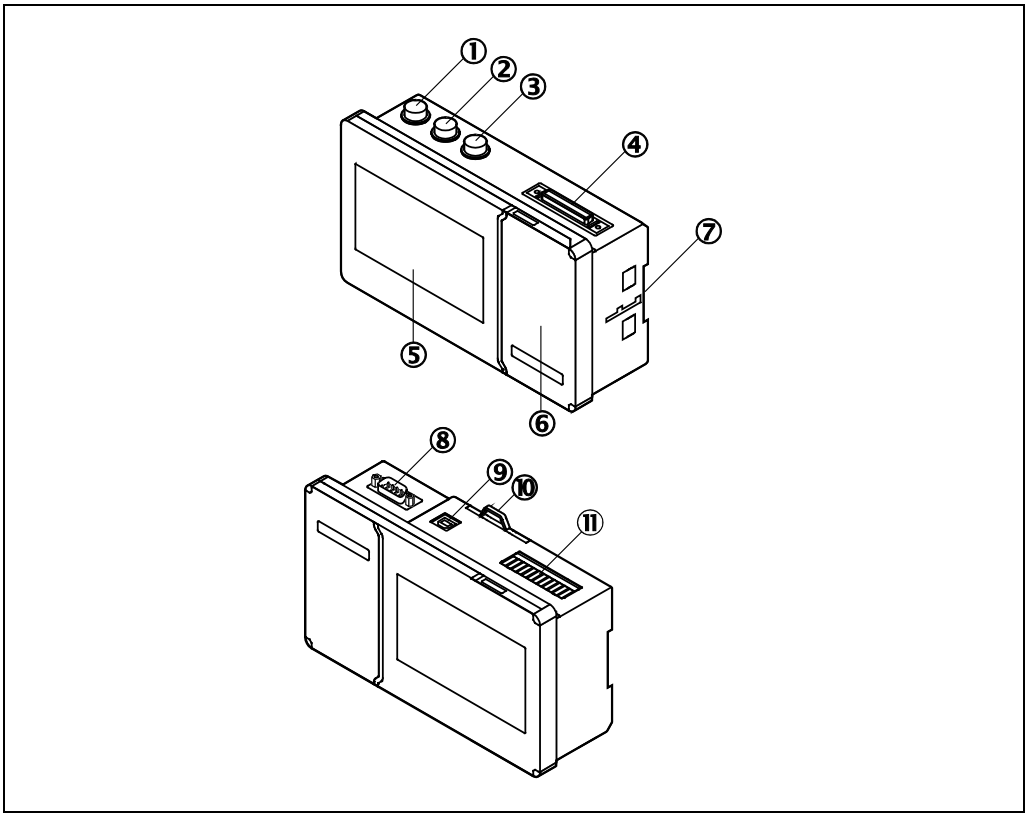
The voltage output is ± 10 V. The current output is 4 ... 20 mA.

Refer to chapter 6.3 “Setting analog output”.

# 3 Basic information before use

## 3.1 Parts identifications of controller

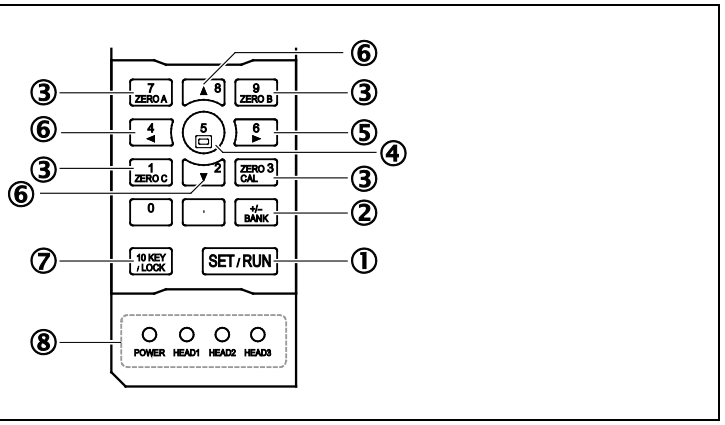
*Fig. 2: Parts identifications of controller*




① Sensor head A connection port
② Sensor head B connection port
③ Sensor head C connection port
④ Terminal board 50-pin extern
⑤ LCD display (see chapter 3.1.2 “LCD guide“)
⑥ Operation panel (see chapter 3.1.1 “Button names and operations”)
⑦ For panel mounting bracket (recommended window size 173 x 102 mm)
⑧ RS 232C interface
⑨ USB interface
⑩ Fastening handle DIN Rail
⑪ Terminal board (detachable)

### 3.1.1 Button names and operations

*Fig. 3: Buttons on controller unit*




① SET/RUN button:
Press this button to switch from RUN mode (Operation mode) into SET mode (Function setting mode) and back

② BANK button:
Switches current bank (0 ... 15).

③ ZERO RESET button:
Activates zero reset for the measurement value and calculated value of corresponding sensor head. Pressing either of these buttons again for over 1 s clears the zero reset condition.

④ Sheet toggle button:
In SET mode this button will let the cursor jump to the headline of the sheet, now use LEFT/RIGHT to toggle through the various sheets. (see chapter 4.1 “To switch RUN mode/SET mode”).

⑤ RIGHT/LEFT buttons:
In SET mode LEFT/RIGHT is used to adjust the setting for the currently highlighted parameter.
When the cursor is on the headline of the sheet LEFT/RIGHT is used to toggle through the various sheets.

⑥ UP/DOWN buttons:
In SET mode UP/DOWN is used to move cursor up or down. The option that the cursor is pointing on is highlighted.
Move curser to headline of each sheet to change sheet using “LEFT/RIGHT” buttons.

⑦ 10 KEY mode/LOCK:
Pressing this button over 1 s in the RUN mode locks all the button operation (key lock function). Pressing the button again for over 1 s clears the lock condition.
Pressing the button in SET mode enables to input numerals using numeric key (10 KEY input function). This operation is available in selecting the setting options where the numeric key is available (see chapter 4.1 “To switch RUN mode/SET mode”).

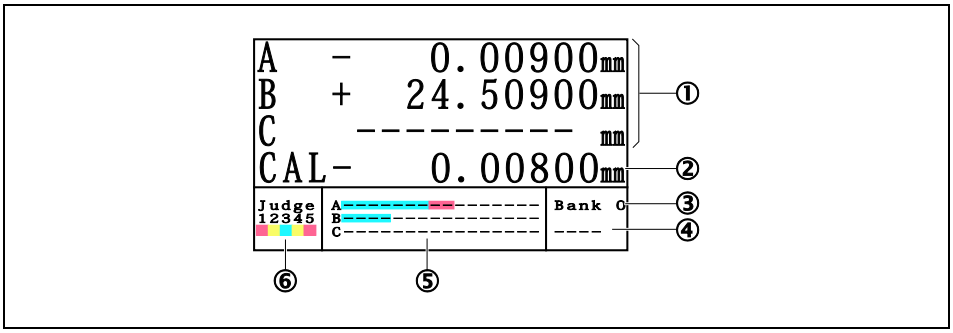
⑧ Status indication lamp:
Indicates power on/off condition and sensor head connection condition.

**Note** Buttons available in each mode are lit up.

Status indication lamp lights stay the same condition regardless of mode selection.

### 3.1.2 LCD guide

*Fig. 4: Example in the RUN mode menu*




① Displays the measured values of sensor heads A B and C.
When the measurement is not available, the value “2999.99999” is displayed (Referred to as alarm condition).
When no sensor head is connected, “----------“ is displayed.

② Displays the calculated values.

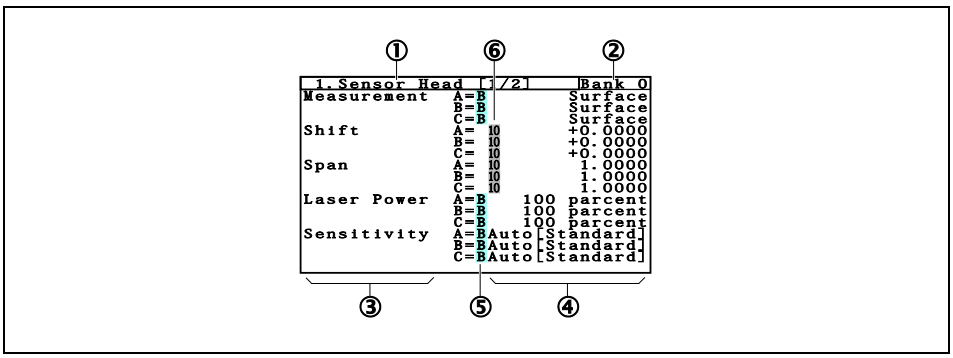
③ Displays the current bank number.

④ When the key lock is applied, the indication “LOCK” is displayed.

⑤ Displays the object position in the measuring range of each sensor head.
The red line indicates the center of the measuring range.

⑥ Displays the ON/OFF status of the / control outputs. (Remark: “control outputs” are often also referred to as “switching outputs”.)

*Fig. 5: Example in the SET mode menu*




① Displays the headline of the parameter sheet that can be set
- Sheet 1 to 3: Sensor Head (see chapter 6.1 “Settings of sensor head”)
- Sheet 4 and 5: Control Output (see chapter 6.2 “Setting control/switching output”)
- Sheet 6: Analog Output (see chapter 6.3 “Setting analog output”)
- Sheet 7: Calculation (see chapter 6.4 “Setting calculation“)
- Sheet 8: Hold (see chapter 6.5 “Using calculation”)
- Sheet 9: Filter (see chapter 6.6 “Setting hold”)
- Sheet 10: Bank (see chapter 6.7 “Setting filter”)
- Sheet 11: RS 232 (see chapter 6.8 “Setting bank”)
- Sheet 12: Memory, Complete Reset (see chapter 6.9 “Setting RS 232”)
- Sheet 13: Display/Key (see chapter 6.10 “Using memory function”)

② Displays bank Number.

③ Displays the setting title.

④ Displays the setting value.

⑤ Indicates that the setting corresponds to certain bank (no “B” means value is global and the same for each bank setting).

⑥ Indicates that the option can be set using 10 KEY (numeric key).

**Note** The display A/B/C next to the setting title corresponds to sensor head A/sensor head B/sensor head C respectively.

# 4 Basic operation

## 4.1 To switch RUN mode/SET mode

Switch from RUN mode to SET mode to change parameters of the sensors.

*Tab. 4: Modes*

| | |
|---|---|
| **1 Press** SET/RUN | Switches to SET mode from RUN mode.<br>Switches to RUN mode from SET mode. |
| **2 Press** SET/RUN **again** | Returns to the original mode. |

## 4.2 To change setting

*Tab. 5: Change settings*

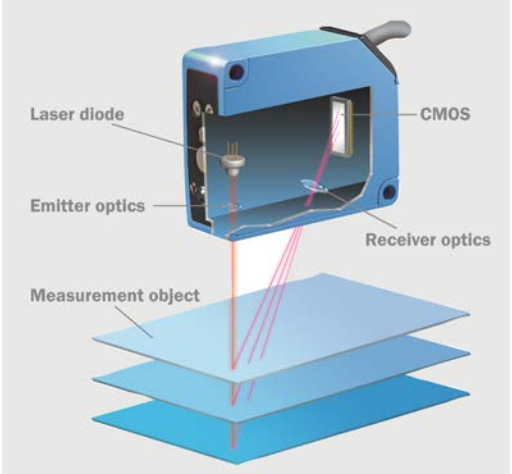
| | |
|---|---|
| **1 Press** SET/RUN | Go to the SET mode. |
| **2 Press** 5 | Move the cursor to the headline of the sheet. |
| **3 Press** +/- BANK | Select the bank to change. |
| **4 Press** 2 **or** 8 | Toggle through the parameters of the active sheet. |
| **5 Press** 4 **or** 6 | When headline is highlighted use these keys to toggle through the various sheets.<br><br>Use these keys to change the setting of the currently active parameter.<br>When the setting option allows 10 key (numeric key) operation, it is recommended to press 10 KEY /LOCK to adjust the value using all 10 keys. Pressing 10 KEY /LOCK again stores the selected value |
| **6 Press** SET/RUN | Save the setting, and return to the RUN mode. Important Note: When having used the 10KEY button to set a parameter it is important that this function is disabled first. |

# 5 First steps

## 5.1 Technology and functions

Short-Range Distance (Displacement) Sensors by SICK make use triangulation for distance measurement. This technology allows to measure distance to object but also thickness of transparent material with only one sensor head. The laser is reflected on the front and also on the back side of the material. The sensor sees both reflections and can thus measure the distance to both surfaces. The difference, which is calculated simultaneously internally equals the thickness of the material. Additionally is the light path bent when entering and exiting the material.
One single reference measurement for each material is enough to compensate this effect and ensure a precise thickness measurements. This chapter explains in brief how to set the sensor up for distance measurement or thickness measurement.

*Fig. 6: Measurement principle: Triangulation*




First step: Press “Set/Run” and move to sheet 3. In sheet 3 start the “Setup Execute” function by pressing “RIGHT” Details on the setup execute functions can be found in 5.3 “Safety precautionsSetup Execute function for application” on page 23.

In this setup the controller unit gives the following options:

- Measurement on surface:
  Distance to first surface is measured.
- Measurement of thickness of transparent material (=glass thickness):
  Distance between first and second surface is measured.
- Measurement of glass gap:
  Distance between 2nd and 3rd surface is measured
- Measuring to the rear side executof a transparent material (=rear):
  Distance to 2nd surface is measured. (so first surface is ignored)

Please be aware that not all options are available for all OD Precision sensor head types. Please refer to following table.

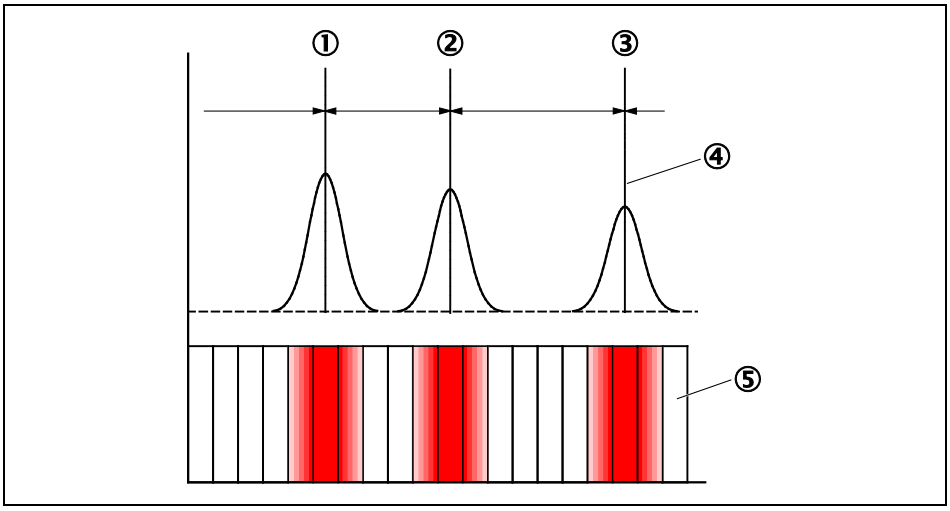
| Sensor type | Glass thickness | Glass gap | Rear | Remark |
|---|---|---|---|---|
| **OD5-25x01** | yes | not supported | not supported | |
| **OD5-30x05** | yes | yes | yes | only half the measurement range is available |
| **OD5-85x20** | yes | yes | yes | |
| **OD5-150x40** | not supported | not supported | not supported | |
| **OD5-350x100** | not supported | not supported | not supported | |
| **OD5-500x200** | not supported | not supported | not supported | |

*Tab. 6: Sensor types and availability of special functions*

Follow the instructions on the controller unit. When unable to get a measurement please see chapter 5.2.5 “Sensor does not show a measurement, what to do? on page 21 to resolve problems. Best is to start with optimizing alignment.

When measuring thickness of a transparent material it is important to reference to ensure accuracy of the measurement. Please see 5.2.4 “Referencing for glass thickness measurement” on page 19.

*Fig. 7: Exemplary light distribution on CMOS receiver element*




① Front of glass 1
② Rear of glass 1
③ 3rd surface behind glass (can be glass or any other material)
④ Barycenter
⑤ CMOS or CCD receiver with x number of pixel

## 5.2 Frequently Asked Questions on start-up

### 5.2.1 Minimum/maximum thickness of a transparent material?

The minimum thickness is specified as shown in the table below.

The maximum thickness is limited by the physical measurement range of the sensor head, please refer to the table below.

*Tab. 7: Min./Max. thickness of transparent materials for glass gap, rear and glass thickness measurement*

| **Sensor type** | **min. glass thickness** | **max. glass thickness** | **min. glass gap** | **max. thickness of glass in front of gap.** | **remark** |
|---|---|---|---|---|---|
| OD5-25T01 (thin light spot) | 0.2 mm | 2 mm | not supported | not supported | |
| OD5-25W01 (wide light spot) | 0,3 mm | 2 mm | not supported | not supported | |
| OD5-30T05 (thin light spot) | 0.7 mm | 5 mm | 0.5 mm | 4.5mm | only half the measurement range is available |
| OD5-30W05 (wide light spot) | 0.9 mm | 5 mm | 0.6 mm | 4.4mm | |
| OD5-85T20 (thin light spot) | 2 mm | 20 mm | 1.4 mm | 18.6 mm | only half the measurement range is available |
| OD5-85W20 (wide light spot) | 2 mm | 20 mm | 1.4 mm | 18.6 mm | |
| OD5-150T40 | not supported | not supported | not supported | not supported | not supported |
| OD5-150W40 | not supported | not supported | not supported | not supported | not supported |
| OD5-350W100 | not supported | not supported | not supported | not supported | not supported |
| OD5-500W200 | not supported | not supported | not supported | not supported | not supported |

### 5.2.2 Thickness limit of a the glass in front of the gap?

First, second and third peak must be within physical measurement range of the sensor. Be aware that OD5-85x and OD5-30x only half the measurement range is available (see table above).

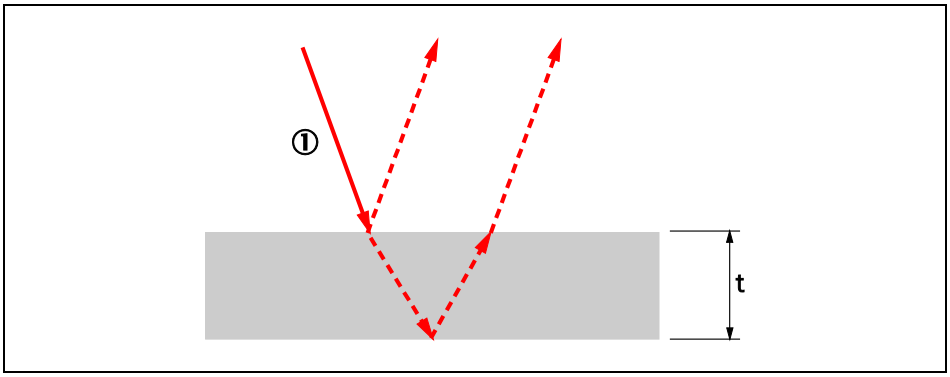
### 5.2.3 Measuring through a glass

This is possible, please ensure that the glass is placed closer to the sensor than the start of the measurement range. Also, it is best to tilt the glass by about 3° to ensure that reflections do not occur.

### 5.2.4 Referencing for glass thickness measurement

In addition to the remarks in 5.2.6 for measuring on transparent/reflective surfaces, the fact that the light path bends when entering a clear material should be considered. The degree of the bending is dependent on the refraction index of the material. In most cases this data is not easily available.

*Fig. 8: Laser path through transparent material*




① Laser

Easiest way to compensate is to reference the measurement of the sensor. The sensor then adjusts the “Span” factor accordingly and precise measurements for any object with the same light refraction index are achieved.

To reference, simply measure the thickness of the material manually once, compare the value to the thickness measurement of the sensor and adjust the span factor according to following formula. An example is shown on the following page.

$$Span(new) = t(ODmeasuredvalue) \div t(referencevalue) * Span(current)$$

*t = thickness of material*

*Tab. 8: Referencing for measuring thickness of transparent material*

| |
|---|
| Referencing the sensor is only necessary when measuring glass thickness /glass gap/ rear. Activate these measurement modes in the “Setup Execute” on sheet 3 on the controller unit. For details refer to 5.3 “Setup Execute function for application” on on page 23.<br><br>Referencing is best explained with an example:<br><br>In this case the result for glass thickness measurement shows: 1.517 mm = t(ODmeasuredvalue) |
| Thickness of the material is now measured manually. E.g. with a measuring gauge.<br><br>Result:<br>Reference glass plate thickness is 1.599 mm = t(referencevalue)<br><br>This means that the calibration Span factor of the sensor must be adapted for this material to accommodate to the light refraction index. |
| The Span factor can be changed on sheet 1 on the controller unit.<br>The default value for glass is 0.6666<br>The correct value for this material is calculated with the following formula:<br>**Span(new) = t(ODMeasuredValue) / t(reference value * Span(current)**<br><br>Result: Span(new) = 1.517 mm / 1.599 mm * 0.6666 = 0.6420<br><br>When adjusting the Span to 0.6420 the ODMeasuredValue changes to 1,599 mm, the actual thickness. |

### 5.2.5 Sensor does not show a measurement, what to do?

Best is to check what the sensor actually sees. Press “Set/Run” to enter menu. Adjust the setting “Operation” to light distribution of “A”, “B” or “C” on sheet 3 on the controller unit. Press “Set/Run” to see the light distribution. A more detailed explanation can be found in chapter 6.1.11 on page 38.

This graphic visualizes the light remission on the receiver element. In this example two peaks are visible. Both surpass the threshold level (indicated by the blue horizontal line).

- For more information on the blue line refer to chapter 6.1.11 “Monitor light distribution curve on CMOS receiver element” on page 38.
- For setting the threshold level refer to chapter 6.1.6 “Set threshold” on page 33.

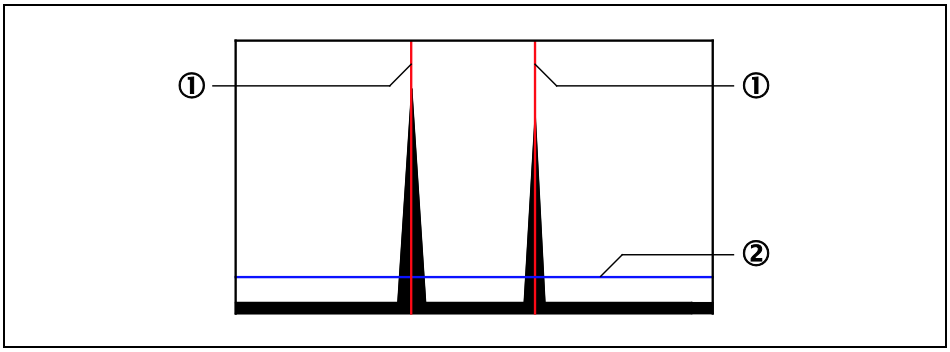
The measurement value is indicated by the red vertical line. For glass thickness measurement you will see two red lines.

- For more information on the red line refer to chapter 6.1.11 “Monitor light distribution curve on CMOS receiver element” on page 38.

If nothing is visible this may be because alignment is not optimized or object is placed outside of measuring range. Tilting the sensor vertically by up to 15° helps to find the best alignment.

Remark: Laser power can be adjusted manually to increase peak intensity, refer to 6.1.4 Set laser power on page 32 . Sensitivity can be adjusted manually, refer to 6.1.5 Set sensitivity on page 32. Threshold level can be adjusted manually to ignore smaller peaks, refer to chapter 6.1.6 “Set threshold” on page 33.

*Fig. 9: Light distribution curve on the CMOS receiver element*




① Measured barycenter
② Set threshold level

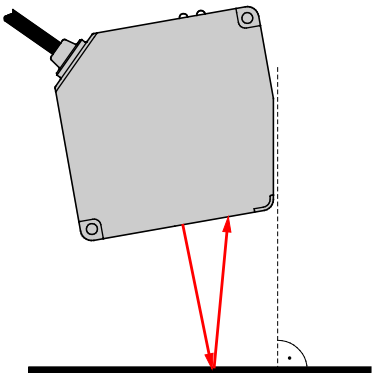
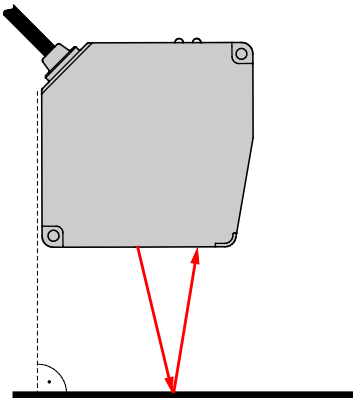
### 5.2.6 What is the best alignment for measuring on glass?

The 24 mm ... 26 mm sensor type (OD5-25x01) is pre-set with a special housing for specular reflection. The optical axis of this type is at approx. 45° angle. This allows for the sensor face of the OD5-25x01 to be mounted parallel to the target surface.

Please be aware that any other sensor head must be mounted at an angle when measuring specular reflection.

Please refer to the following schematic.

*Fig. 10: Alignment of sensor head for measuring on reflective material*

|  |  |
|---|---|
| Any OD Precision Sensor head (except OD5-25x01) | OD Precision OD5-25x01 (24 mm ... 26 mm type) |
| Sensor is mounted at an angle. The angle differs by type. The tilted side of the sensor housing serves as a good indication of the optimum mounting angle. | Sensor is mounted vertically to target. |

## 5.3 Setup Execute function for application

### 5.3.1 Activate Setup Execute function

*Tab. 9: Setup execute function*

| | |
|---|---|
| **1 Select “3. Sensor Head [3/3]”** | Change the headline to “Sensor Head” |
| **2 Select “Setup execute”** | Select “yes” |
| **3 Press** [SET/RUN] | The setup wizard starts up. |
| **4 Change the setting** | For the operation of “setup execute” wizard, refer to the following description. |

The setup wizard consists of two operations

**1 Basic setting:** Choose this option to set the sensor up in an application

**2 Calibration:** Choose this option to accommodate for compensating tilted alignment.

**Note** When the setup wizard starts up, follow the operation guide appearing at the bottom of menu. There are several steps in the setup wizard. For setting and selecting each step, follow the steps below;

1. Select the preferred step, and press [6] .
2. Perform setting by selecting [▲ 8], [▼ 2], and by moving to next step with [6]
3. When the sequence reaches the last step, “Press [SET/RUN] to Complete” is displayed. Press [SET/RUN] to finish.
   Pressing [SET/RUN] completes the setup wizard, and all settings not part of the wizard are set to standard values, unless “keep current setting” was chosen.

The setup wizard can be cancelled in process. To cancel, press the [10 KEY /LOCK] key.

Not all options in each step can be selected. Those options are displayed in gray.

### 5.3.2 “Basic Setting” Setup Execute

**Page 1 Select Sensor Head.**

Choose the sensor head to be set.

**Page 2 Select Installation**

Select whether measuring on glossy/shiny material using specular reflection of e.g. glass, mirror, stainless steel or measuring on diffuse reflection of e.g. cardboard, rubber, tires, etc.

**Page 3 Select Target**

Select measuring mode:

1. Measurement on surface of target
   = Distance to first surface is measured.
2. Measurement of thickness of transparent material (=glass thickness)
   = Distance between first and second surface is measured.
3. Measurement of glass gap
   = Distance between 2nd and 3rd surface is measured
4. Measuring to the rear side executof a transparent material (=rear)
   = Distance to 2nd surface is measured. (so first surface is ignored)

Note: For “diffuse” only option “surface of target” can be selected.

**Page 4 Select Material**

Select the material of the target: Glass, mirror or Metal, Plastic, etc.

**Page 5 Select average**

Select the dynamic moving average. This means that the average of the selected number of measurements is calculated and given out at the selected output rate (e.g. 10kHz) Output rate during operation is not influenced by the selected averaging.

Be aware: When a distance change takes place the time until the new distance is given out is dependent on the chosen averaging. Refer to 6.1.7 “Set moving average” on page 34.

**Page 6 Select Status during alarm**

Please select the status that is given out during alarm: Clamp or hold.

**Page 7 Anti Interference**

Please activate anti interference when measuring thickness of transparent, semi transperant or very thin material.

**Page 8 Other function**

Please select whether the settings for Shift, Span, Sensitivity, Threshold level, Baud rate and Sampling period are set to default or whether previously chosen settings schould be kept.

Are set to standard settings:

Set all above settings to factory default. It is possible to further adjust these parameters manually in later steps.

Keep current setting:

Choose this option if all above parameters are already set to specific values and should not be reset to default.

**Page 9 Page Finish**

Please press “SET/RUN” to finish the wizard.

### 5.3.3 “Calibration” Setup Execute

This function is used to compensate for an offset that results from tilted alignment. For more information refer to 5.3 “Setup Execute function for application” on page 23.

**Page 1 Select Sensor Head**

Choose the sensor head to set.

**Page 2 Set Measurement / Correct value**

This page shows the following:

*Tab. 10: Calibration function*

| | |
|---|---|
| Point A Meas. Value: | This is the measured value at point A. Press button "5" to make a measurement. |
| Point A Corr. Value: | This is the actual distance at point A. |
| Point B Meas. Value: | This is the measured value at point B. Press button "5" to make a measurement. |
| Point B Corr. Value: | This is the actual distance at pont B. |

By setting actual measurement values (Meas. Value) and correct values (Corr. Value), calibration automatically decides shift and span values.

**Important Note:**

- Use 10 KEY button to input values. Also the current measurement value can be input by pressing button 5.
- Point A must be closer to the sensor than point B.
- The sensors must be measuring default distance to object. (no manual Zeroing)
- The sign of the measurement must be positve. ("Far side +") This is default setting.
- An example can be found on the following page.

**Examplary Procedure:**

**1a**. Place a gauge block of a known thickness on the target. Read measurement value by pressing “5”. This value is “Point A Meas. Value”.

**1b**. Enter the “Point A Corr. Value”. Typically choose the exact same value as “Point A Meas. Value” since the actual distance to the target is unknown in most cases. Use 10 KEY button.

**2a**. Remove gauge block. Read measurement value by pressing “5”. This value is “Point B Meas. Value”.

**2b**. Calculate “Point B Corr. Value”. Formula: “Point A Meas. Value” + “thickness of gauge block”. Enter the caluclated value using 10 KEY button.

**3**. Press “Set/Run” to finish the Calibration procedure.

**Application Example:**

To find “corr. values” a reference material of a known thickness is needed.

Typically a gauge block is used. In this case the gauge block has a thickness of 2mm.

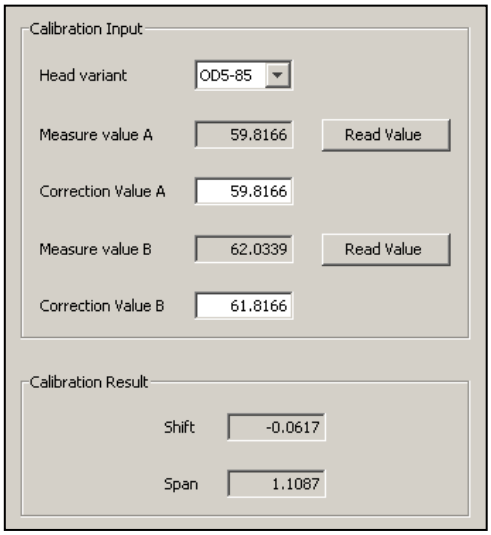



*Fig. 11: Example of calibration of OD5-85x20 using SOPAS software*

**Be aware:**

- Point A must be closer to the sensor than point B.
- The sensors must be measuring default distance to object. (no manual Zeroing)
- The sign of the measurement must be positve. ("Far side +") This is default setting.

## 5.4 Setup execute function for calibration

For best results alignment must be considered, see following figures which illustrates the resulting error of tilted alignment.

Please refer to 5.3.3 “Calibration” Setup Execute on page 25 for the according procedure.

*Fig. 12: Perfect alignment*

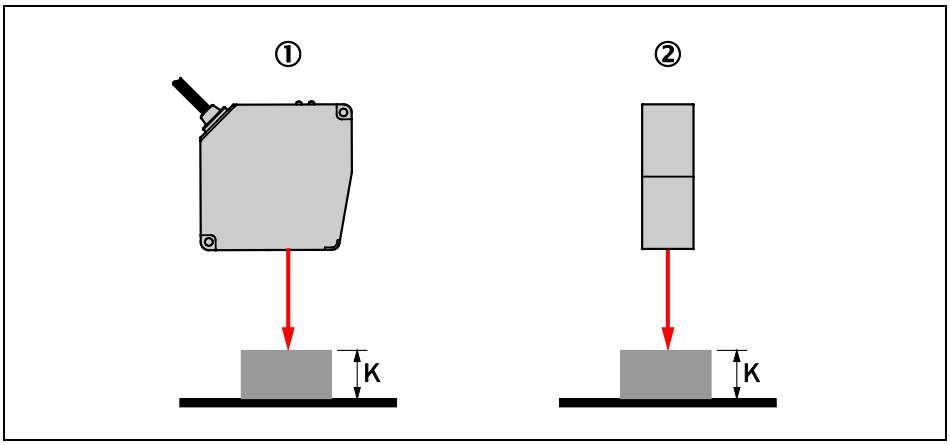
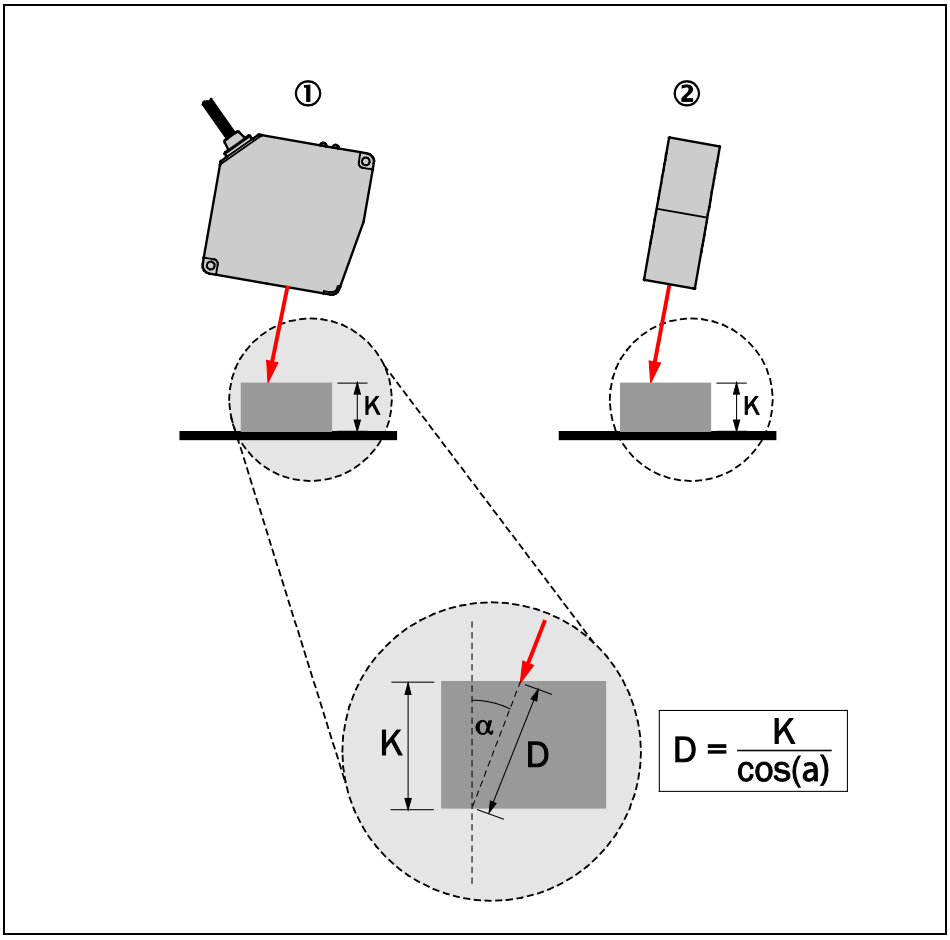
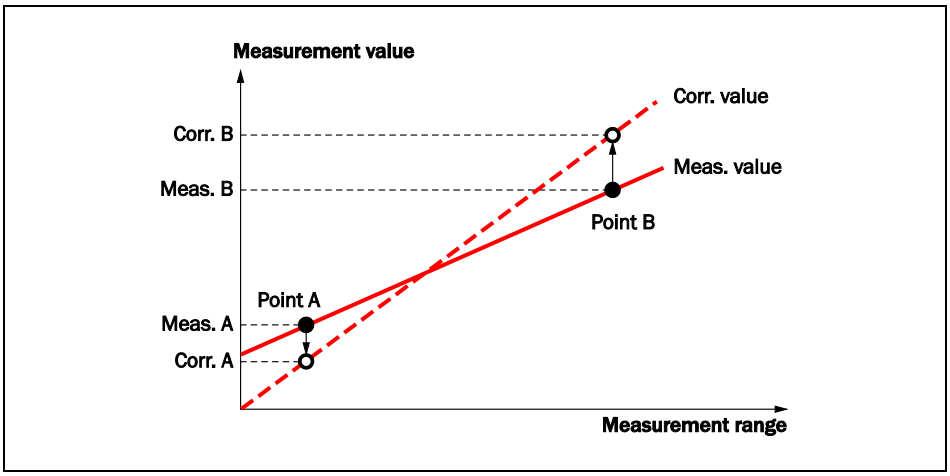



*Fig. 13: Error due to sensor tilt*




① Side-view
② Front-view

*Fig. 14: Schematic of the result of the calibration*



# 6 Settings

## 6.1 Settings of sensor head

### 6.1.1 Set measurement function, choose measurement target

*Tab. 11: Set measurement function, choose measurement target*

| | |
|---|---|
| **1 Select "1. Sensor Head [1/3]"** | Change the headline to "Sensor Head". |
| **2 Select "Measurement A, B, or C"** | A/B/C corresponds to the sensor head |
| **3 Change the setting** | Select the measurement target. |
| **4 Press** SET/RUN | |

**Note**

1. Setting to "Surface" measures the distance to the first surface visible to the sensor. This setting is available for all sensor heads.
2. Setting to "Glass Thickness" measures the distance from the front to the back side of a transparent object (such as glass) This means a measurement to the first surface visible to the sensor is taken. Simultanisouly a measurement to the second surface visible to the sensor is taken. The sensor then automatically calculates the distance inbetween and gives out the thickness value."Glass Thickness" can only be used for some OD Precision sensor head types.
   In setting to "Glass Thickness", it is important for precise measurement to set the calibration span to the correct value to compensate for the light refraction index of the measured material. Refer to chapter 6.1.3 "Set calibration (span)".
3. Setting to "glass gap" the distance between the second and third surface is measured This means a measurement to the second surface visible to the sensor is taken. Simultanisouly a measurement to the third surface visible to the sensor is taken. The sensor then automatically calculates the distance inbetween and gives out the gap thickness value. "Glass gap" can only be used for some OD Precision sensor head types.
4. Setting to "rear" the distance to the second surface is measured
   This means a measurement to the second surface visible to the sensor is taken. "Rear" can only be used for some OD Precision sensor head types.

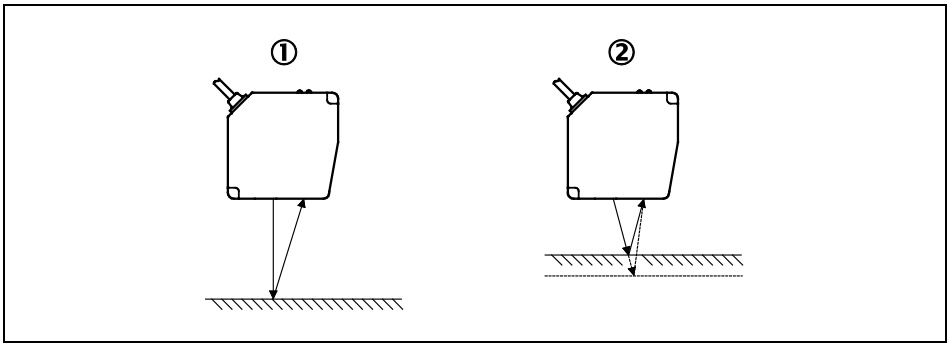
*Tab. 12: Sensor type and function availability*

| Sensor type | Glass thickness | Glass gap | Rear | Remark |
|---|---|---|---|---|
| **OD5-25x** | yes | not supported | not supported | |
| **OD5-30x** | yes | yes | yes | only half the measurement range is available |
| **OD5-85x** | yes | yes | yes | |
| **OD5-150x** | not supported | not supported | not supported | not supported |
| **OD5-350x** | not supported | not supported | not supported | not supported |
| **OD5-500x** | not supported | not supported | not supported | not supported |

Setting can be variable for each bank.

Default: "Surface"

*Fig. 15: Reflection types*




① Diffuse reflection type
② Specular reflection type

### 6.1.2 Set calibration (shift)

*Tab. 13: Set calibration (shift)*

| | |
|---|---|
| **1 Select “1. Sensor Head [1/3]”** | Change the headline to “Sensor Head”. |
| **2 Select “Shift A, B, or C”** | A/B/C corresponds to the sensor head A, B and C. |
| **3 Change the setting** | Set the shift of sensor head measurement value (-0.1000 to +0.1000). |
| **4 Press** SET/RUN | |

**Note** Calibration(shift) is not the “offset/ shift” value. Instead this value is used to accommodate for systematic error caused by different light refraction indices e.g. for glass thickness measurement. Set the value by the proportion of measurement error to the measurement range.

Manual setting example:
Sensor head: 85 mm ± 20 mm type, measurement value: displayed as “+85.400 mm”
To calibrate the value to 85.000 mm, set –0.0100 by the following calculation.
(85.000 – 85.400)/(20 x 2) = –0.0100

This setting value does not change by zero reset, the value is stored globally and not stored in a bank.

This setting allows 10 KEY (numeric key) function.

Setting the measurement target to “Glass Thickness” influences this value (see chapter 6.1.1 “Set measurement function, choose measurement target”).

Default: “0.0000”

### 6.1.3 Set calibration (span)

*Tab. 14: Set calibration span*

| | |
|---|---|
| **1 Select “1. Sensor Head [1/3]”** | Change the headline to “Sensor Head” |
| **2 Select “Span A, B, or C”** | A/B/C corresponds to the sensor head A,B and C. |
| **3 Change the setting** | Set the span of sensor head measurement value. (0.0000 to 3.9999) |
| **4 Press** SET/RUN | |

**Note** Set the value by the proportion of measurement error to to the measurement range. It is used for:

- Performing calibration of sensor head Please refer to chapter 5.4 “Setup execute function for calibration” on page 27.
- Setting the measurement target to “Glass Thickness”refer to chapter 5.2.4 “Referencing for glass thickness measurement” on page 19.

Manual setting example:
Sensor head: 85 mm ± 20 mm type, measurement value error of 0,1mm; 10.100 mm
To calibrate the value to 10.000 mm, set 1.0100 by the following calculation.
10.100/10.000 = 1.0100

When choosing “Glass Thickness” mode, the following setting is necessary (Refer to chapter 6.1.1 “Set measurement function, choose measurement target“).

- Input reciprocal of glass refraction (nd) to be measured as span setting value. Example: Input “0.5435” when; nd = 1.84
- When the glass thickness is known, adjust the input value by referencing the actual measurement value. Refer to chapter chapter 5.2.4 “Referencing for glass thickness measurement” on page 19.
  Note that the more span value increases, the more the measurement value decreases.

This setting value does not change by zero reset. the value is stored globally and not stored in a bank.

This setting allows 10 KEY (numeric key) function.

Default: “1.0000”

### 6.1.4 Set laser power

*Tab. 15: Set laser power*

| | |
|---|---|
| **1 Select “1. Sensor Head [1/3]”** | Change the headline to “Sensor Head” |
| **2 Select “Laser Power A, B, or C”** | A/B/C corresponds to the sensor head A, B or C. |
| **3 Change the setting** | Select the laser power. |
| **4 Press** SET/RUN | |

**Note** For measuring an object with specular reflection of light (such as mirror or glass), set the laser power low. (Normally 1 [Minimum])
For measuring on any other objects (objects with diffuse reflection of light), set the laser power high. (Normally 5 [Maximum])

Turning this setting to “OFF” will turn the laser off. This setting is stored in the active bank.

Default: “5 [Maximum]”

### 6.1.5 Set sensitivity

*Tab. 16: Set sensitivity*

| | |
|---|---|
| **1 Select “1. Sensor Head [1/3]”** | Change the headline to “Sensor Head”. |
| **2 Select “Sensitivity A, B, or C”** | A/B/C corresponds to the sensor head A, B or C. |
| **3 Change the setting** | Select the sensitivity. |
| **4 Press** SET/RUN | |

**Note** For “Auto” the receiving sensitivity is dynamically adjusted to light remission of the target surface. Auto adjustment may take up to 2 ms when the object-remission is extreme and changes instantaneously.
If the above case causes any problem, the sensitivity can be set to a fixed level.The optimum fixed sensitivity can be checked by reviewing the light distribution on the CMOS receiver element. Please refer to chapter 6.1.11 “Monitor light distribution curve on CMOS receiver element” on page 38.

Setting is stored in the active bank.

Default: “Auto”

### 6.1.6 Set threshold

*Tab. 17: Set threshold*

| | |
|---|---|
| **1 Select “2. Sensor Head [2/3]”** | Toggle to sheet “Sensor H”. |
| **2 Select “Thresh Level A, B, or C”** | A/B/C corresponds to the sensor head |
| **3 Change the setting** | Select the threshold value. |
| **4 Press** SET/RUN | |

**Note** The algorythm measures the distance to the object by evaluating the cross point of the barycenter of the peak of the light distribution and the threshold line. When the receiving waveform is extremely asymmetric (such as semitransparent object or object with very challenging surface condition), high thresholds can reduce the measurement error. When setting the threshold to 1 or more, ensure the receiving waveforms are always higher than the threshold for every object to be measured. (Any waveform lower than threshold is ignored)

The relationship between light distribution waveform and threshold can be reviewed with with the “Monitor light distribution curve on CMOS receiver element function“ in chapter 6.1.11 on page 38.

When choosing “Automatic”, the threshold is dynamically auto-adjusted (Threshold is automatically set to relatively high thresholds). Note that the resolution can be deteriorated.

Setting can be variable for each bank.

Default: “0”

### 6.1.7 Set moving average

*Tab. 18: Set moving average*

| | |
|---|---|
| **1 Select “2. Sensor Head [2/3]”** | Toggle to sheet “Sensor Head”. |
| **2 Select “Average A, B, or C”** | A/B/C corresponds to the sensor head |
| **3 Change the setting** | Select the number of measurement values for the averaging. |
| **4 Press** SET/RUN | |

**Note**

Large moving average count is advantageous to resolution and unexpected irregularity of object surface. Small moving average count is advantageous to sensitive reaction to distance changes.

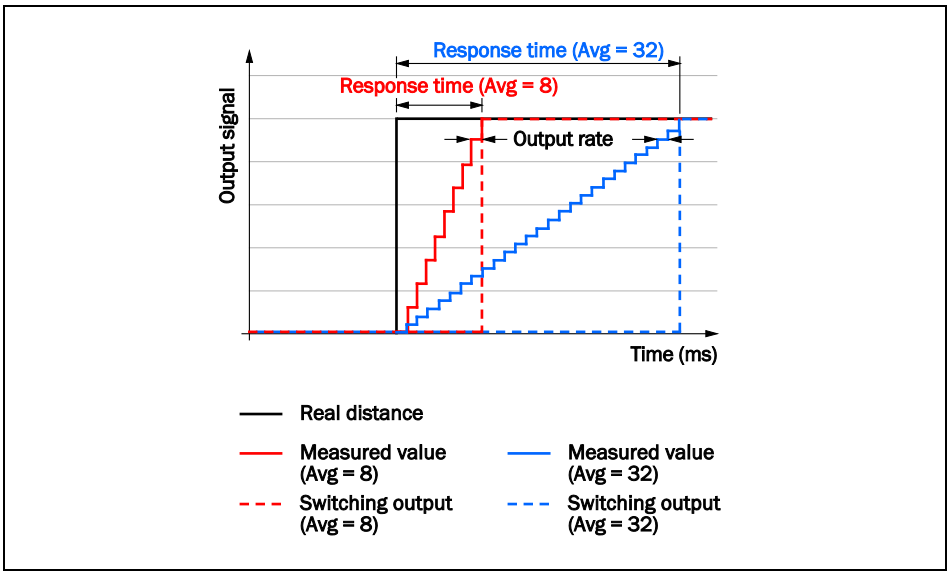
This sensor uses dynamic moving averaging. On start-up the selected number of measurement values are collected, then averaging takes place and the average is given out. From then on its one-in/ one-out, meaning that the next measurement value is collected and the average is taken immediately. This means the output rate is unaffected, but response time is affected. Please refer to the figure below.

For large distance changes, the response time can be roughly calculated by the following expression. (Sampling frequency x moving average count)

The following figure shows the relationship between the moving average, output rate and response time. Avg = 32 means that the average of 32 values is taken. Avg = 8 means that the average of 8 measurements is taken. In each case averaging is moving/dynamic, as compared to block averaging. With block averaging the average of the chosen number of measurements, e.g.32, is taken, then given out. Then the sensor waits for the next 32 measurements to be taken, takes the average and gives out the result. This means that the output rate is reduced by 32.

Default: “256”

*Fig. 16: Moving average and response time*



### 6.1.8 Set the communication speed

*Tab. 19: Set communication speed*

| | |
|---|---|
| **1 Select “2. Sensor Head [2/3]”** | Toggle to sheet “sensor head setting.” |
| **2 Select “Baud [kbps] A, B, or C”** | A/B/C corresponds to the sensor head A, B and C. |
| **3 Change the setting** | Select the communication speed between sensor head and controller. |
| **4 Press** SET/RUN | |

**Note** Values higher than 921.6 kbps will transfer all the sampling data of sensor head to the controller.
When the cable length between sensor head and controller is very long (approx. >25m), select slow communication speed to avoid loss of data.

Default: “921.6 kbps”

### 6.1.9 Set the measurement value at alarm

*Tab. 20: Set Clamp / Hold function*

| | |
|---|---|
| **1 Select “2. Sensor Head [2/3]”** | Toggle to sheet “sensor head setting.” |
| **2 Select “During Alarm A, B, or C”** | A/B/C corresponds to the sensor head A, B and C |
| **3 Change the setting** | Select the measurement value at alarm. Clamp or Hold. |
| **4 Press** SET/RUN | |

**Note** This option defines the measurement value the sensor gives out when it is unable to measure.

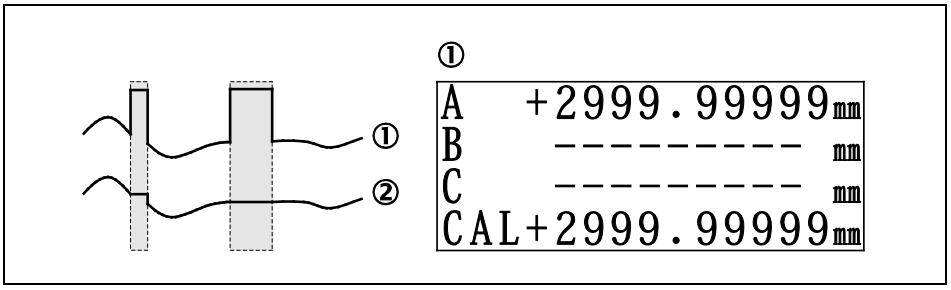
- When set to “Clamp” the sensor gives out 2999.99999 mm as measurement value indicating that no measurement could be taken.
- When set to “Hold” the sensor gives out the last good measurement before it became unable to measure.

In both cases the “Alarm Output” is activated. For evaluating the Alarm Output the I/O Expansion cable is necessary.

Please refer to the following schematic.

Default: “Clamp”

*Fig. 17: Clamp/Hold function*




① Clamp
② Hold

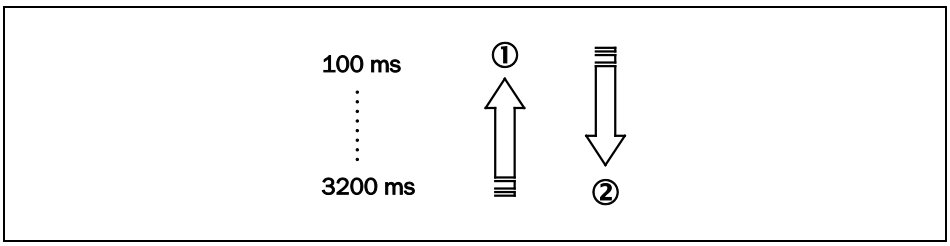
### 6.1.10 Set sampling period

*Tab. 21: Set sampling period*

| | |
|---|---|
| **1 Select "2. Sensor Head [2/3]"** | Toggle to sheet "sensor head setting." |
| **2 Select "Sampling Per. A, B, or C"** | A/B/C corresponds to the sensor headA, B and C. |
| **3 Change the setting** | Set the sampling period. |
| **4 Press** SET/RUN | |

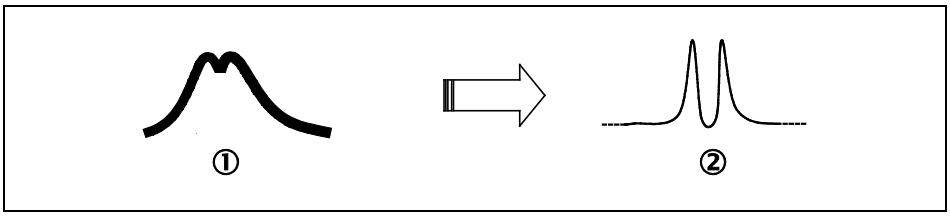
**Note** Shorter sampling period results in faster response time, longer sampling period enhances the resolution and the capability to measure on very dark material.

*Fig. 18: Sampling period consequences*




① Fast response time
② High-capability to measure on dark material

*Fig. 19: Light distribution curve*




① High-Sensitivity and high sampling period
② Low-Sensitivity and high sampling period

Default is as follows:

*Tab. 22: Sampling period default values*

| Sampling Period | Sensor Head |
|---|---|
| 100 µs | OD5-25x01 24 ... 26 mm |
| | OD5-30x05 25 ... 35 mm |
| | OD5-85x20 65 ... 105 mm |
| | OD5-150x40 110 ... 190 mm |
| 800 µs | OD5-350x100 250 ... 450 mm |
| | OD5-500x200 300 ... 700 mm |
| | OD5-25x01 24 ... 26 mm |

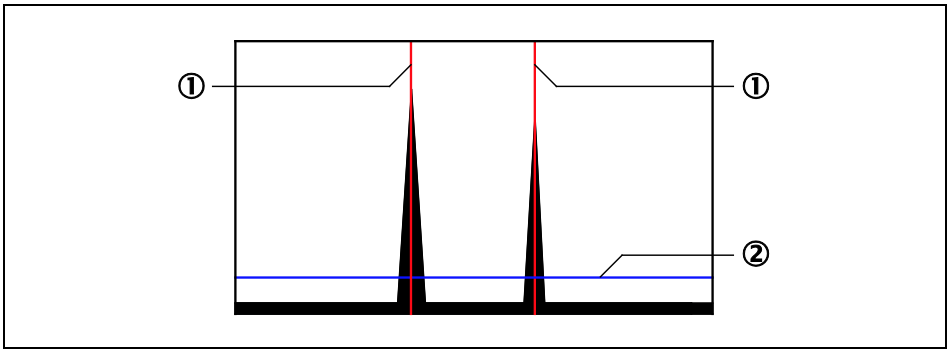
### 6.1.11 Monitor light distribution curve on CMOS receiver element

*Tab. 23: View light distribution on CMOS receiver element*

| | |
|---|---|
| **1 Select “3. Sensor Head [3/3]”** | Toggle to sheet “sensor head setting.” |
| **2 Select “Operation”** | A/B/C corresponds to the sensor headA, B and C. |
| **3 Change the setting** | Choose “light distribution A/B/C” or “measurement”. |
| **4 Press** SET/RUN | |

**Note** Use this function to monitor what the sensor actually sees. This function shows the light remission on the receiver element. (CMOS element)

*Fig. 20: Light distribution curve on CMOS receiver element*




① Red line
② Blue line

**Red Line on light distribution function**

A red line indicates the measurement value of the sensor. It shows the position of the barycenter of a remission peak.

- When the measurement target is set to “Surface”, only one red line will appear on the first peak closest to the sensor.
- When the measured target is set to “Glass Thickness” two red lines will appear, one on the first and one on the second peak. One line indicates the front side of the glass/transparent material and the other indicates the rear side.
- When the measurement target is set to “Rear” one red line will appear. This red line will appear on the second peak, not on the first peak as with “surface” mode.
- When measurement target is set to “Glass gap” then two red lines will appear. One on the second and one one the third peak.

**Blue Line of light distribution function**

A blue line appears at the position set by the Receiving Waveform Threshold Setting (see chapter 0 “

Set threshold“).

**Note** Receiving waveform does not appear if no sensors are connected.

Measurement operation stops while monitoring the receiving waveform. Measurement is continued when returning to “Measurement” from “Light Distrib” in the menu.

Default is “Measurement”.

### 6.1.12 Prevent mutual interference

*Tab. 24: Set anti-interference mode*

| | |
|---|---|
| **1 Select “3. Sensor Head [3/3]”** | Toggle to sheet “sensor head setting.” |
| **2 Select “Anti interfere”** | |
| **3 Change the setting** | Select the Anti Interfere (mutual interference prevention) function. |
| **4 Press** SET/RUN | |

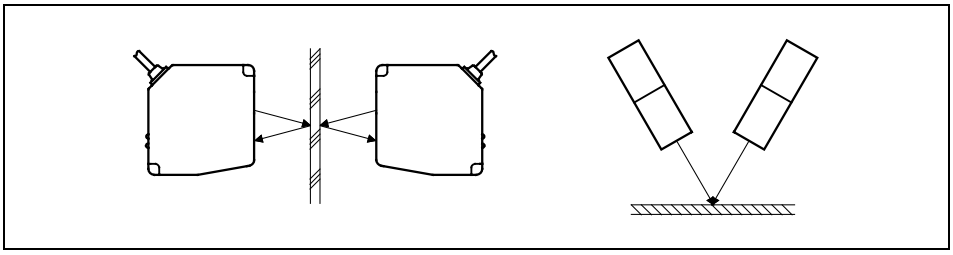
**Note** Default is “Off”, which allows the measurement with measuring frequency stated in the specification. Measurement timing of each sensor head is asynchronous.
Setting to “A and B” allows synchronous measurement timing between sensor head A and sensor head B (alternate measurement), Lasers are pulsed, reducing the mutual interference.
In the setting “A and B” the measuring frequency is 6 times slower, the data storage time of image sensor is not influenced, so no sensitivity adjustment is necessary.

It is recommended to activate the function to avoid negative influences in the following cases.

- When thickness measurement with two sensor heads is performed on transparent or semi-transparent material.
- When measurement is performed in a way that laser light of sensor head A is reflected to sensor head B. Refer to following figure.

Default: “Off”

*Fig. 21: Mutual interference*



### 6.1.13 Set sensor head type

*Tab. 25: Set sensor head type manually*

| | |
|---|---|
| **1 Select “3. Sensor Head [3/3]”** | Toggle to sheet “sensor head setting.” |
| **2 Select “Model A, B or C”** | A/B/C corresponds to the sensor head A, B and C. |
| **3 Change the setting** | Select the head type to be connected. |
| **4 Press** SET/RUN | |

*Tab. 26: Sensor head types*

| | |
|---|---|
| **AUTO** | Every time the power is turned on, the head type code is read-out and the setting is automatically adjusted. This function is active even when the head is not connected. |
| 25 mm | One can also manually choose the connected sensor head. |
| 30 mm | |
| 85 mm | |
| 150 mm | |
| 350 mm | |
| 500 mm | When the head is not connected, select this option. |
| No connection | |

After the setting is changed, be sure to turn the power ON again.

Default: “AUTO”

## 6.2 Setting control/switching output

### 6.2.1 Set upper limit/lower limit

*Tab. 27: Set control/switching output*

| | |
|---|---|
| **1 Select “4. Control Output [1/2]”** | Toggle to sheet “Control Output” |
| **2 Select Upper or Lower to set** | Q1 to 5 correspond to control output 1 to 5.<br>“Upper” corresponds to upper limit, and “Lower” corresponds to lower limit. |
| **3 Change the setting** | Set the upper limit and lower limit of control/switching output.<br>(–2999.9999 to +2999.9999 mm) |
| **4 Press** SET/RUN | |

**Note** This setting allows 10 KEY (numeric key) function. Setting can be variable for each bank.

Default:
Q1 Upper “+1.0000”
Lower “–1.0000”
Q2 Upper “+2.0000”
Lower “–2.0000”
Q3 Upper “+3.0000”
Lower “–3.0000”
Q4 Upper “+4.0000”
Lower “–4.0000”
Q5 Upper “+5.0000”
Lower “–5.0000”

### 6.2.2 Set hysteresis

*Tab. 28: Set hysteresis*

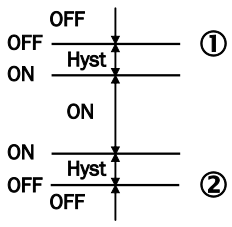
| | |
|---|---|
| **1 Select “4. Control Output [1/2]”** | Toggle to sheet “Control Output” |
| **2 Select Hysteresis** | |
| **3 Change the setting** | Set hysteresis of control output.<br>(0.0000 to 2999.9999 mm) |
| **4 Press** SET/RUN | |

**Note** Hysteresis is the difference in distance between the switch-on and switch-off points of a switching output. Hysteresis is necessary for stable switching when the measured distance fluctuates around the switching point that has been set. The hysteresis can be set freely. The free choice allows an ideal compromise between precise switching and stable behavior in each individual application.

This setting allows 10 KEY (numeric key) function. This setting is a global setting, it is set for all control output, upper and lower limit values, as well as to all banks.

Default: “0.0000”

*Fig. 22: Hysteresis*




① Upper
② Lower

### 6.2.3 Set delay

*Tab. 29: Set delay function*

| | |
|---|---|
| **1 Select “4. Control Output [1/2]”** | Toggle to sheet “Control Output” |
| **2 Select “Delay”** | |
| **3 Change the setting** | Select the delay mode (timing control). |
| **4 Press** SET/RUN | |

**Note**

The following delay modes of the control/switching outputs can be chosen.

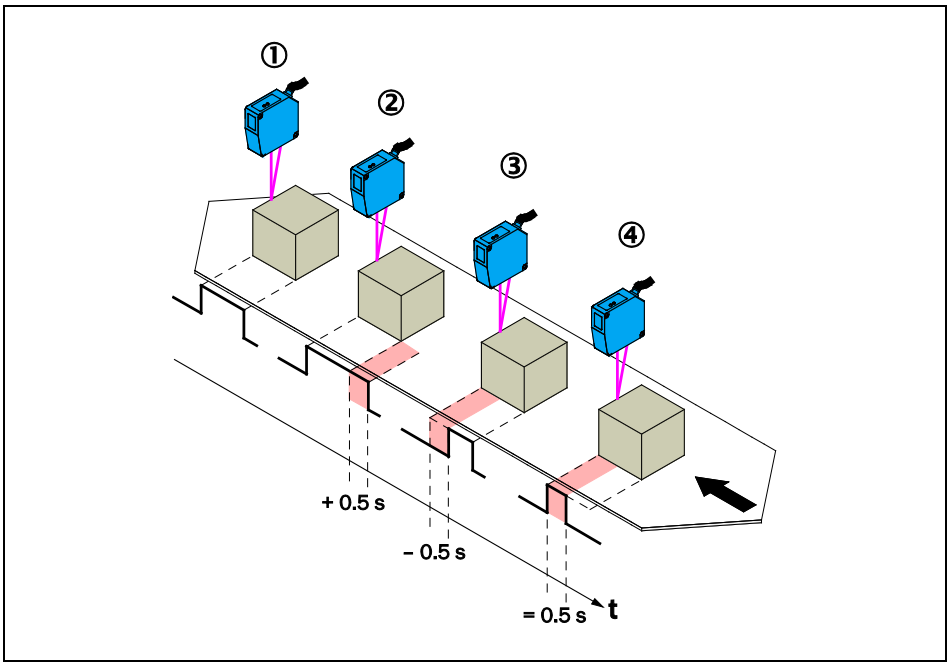
- “Off”: Timer is deactivated
- “Off Delay”: Switching OFF of the control/switching output is delayed for set period. Short signals (bursts) are suppressed.
- “On Delay”: Switching ON of control/switching output is extended by the configured time to allow for the use of slower control system.
- “1 Shot”: The signal given out always remains active for the same period of time regardless of the duration of the input signa

The time period is set in “Delay time setting” (see following chapter 6.2.4 “Set delay time”).

This setting is set for all control/switching outputs.

Default: “Off”

*Fig. 23: Timing/delay functions*




① OFF
② OFF DELAY: OFF delay
③ ON DELAY: ON delay
④ 1 SHOT: Fixed and once only switching duration

### 6.2.4 Set delay time

*Tab. 30: Set delay time*

| | |
|---|---|
| **1 Select “4. Control Output [1/2]”** | Toggle to sheet “Control Output” |
| **2 Select Timer** | |
| **3 Change the setting** | Set the delay time of control output.<br>(0 to 60000 ms) |
| **4 Press** SET/RUN | |

**Note** When the delay setting is “Off”, this setting is disabled (see chapter 6.2.4 “Set delay time”).

This setting allows 10 KEY (numeric key) function.

This setting is set for all control/switching output.

Default: “0 ms”

### 6.2.5 Set control/switching output source

*Tab. 31: Set judgement source*

| | |
|---|---|
| **1 Select “5. Control Output [2/2]”** | Toggle to sheet “Control Output” |
| **2 Select Source to set** | Q1 to Q5 correspond to control/switching output 1 to control/switching output 5. |
| **3 Change the setting** | “A” : Measurement value of sensor head A<br>“B” : Measurement value of sensor head B<br>“C” : Measurement value of sensor head C<br>“CAL”: Calculation value |
| **4 Press** SET/RUN | |

**Note** The control/switching output source (A/B/C/CAL) corresponds to four (4) values displayed in the RUN mode.

For calculation value, refer to the description of Setting calculation (see chapter 6.4 “Setting calculation”).

Default: “A”

## 6.3 Setting analog output

### 6.3.1 Set upper/lower limit

*Tab. 32: Set analog output*

| | |
|---|---|
| **1 Select “6. Analog Output”** | Toggle to sheet “Analog Output” |
| **2 Select Upper or Lower to set** | Port 1 to Port 3 correspond to analog output 1 to analog output 3.<br>“Upper” is upper limit value, and “Lower” is lower limit value. |
| **3 Change the setting** | Set upper limit value and lower limit value of analog output.<br>(–2999.9999 to +2999.9999 mm) |
| **4 Press** SET/RUN | |

**Note**

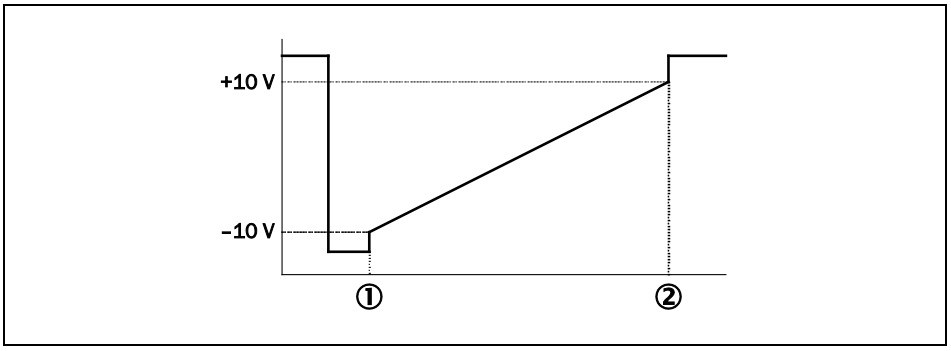
Value set to “Upper” corresponds to +10 V ( or 20 mA) of analog output.
Value set to “Lower” corresponds to –10 V (or 4 mA) of analog output.

When the value exceeds Upper limit, the maximum value is given out.
When the value remains below the Lower limit, the minimum value is given out.
(When the value is out of measurement range of sensor, maximum value is given out.)

There are two analog outputs: voltage output and current output. Both are active at the same time.

Default: Lower limit = start of measuring range, Upper limit = end of measuring range.

*Fig. 24: Analog output*




① Lower
② Upper

### 6.3.2 Set output source

*Tab. 33: Set source for output*

| | |
|---|---|
| **1 Select “6. Analog Output”** | Toggle to sheet “Analog Output” |
| **2 Select Source to set** | Port 1 to Port 3 correspond to analog output 1 to analog output 3. |
| **3 Change the setting** | “A” : Measurement value of sensor head A<br>“B” : Measurement value of sensor head B<br>“C” : Measurement value of sensor head C<br>“CAL”: Calculation value |
| **4 Press** SET/RUN | |

**Note** The output source (A/B/C/CAL) corresponds to the four (4) values displayed in the RUN mode.

For the calculation value, refer to the calculation setting (see chapter 6.4 Setting calculation on page 46).

Default: Port 1 = “A”, Port 2 =“B”,Port 3 = “C”

## 6.4 Setting calculation

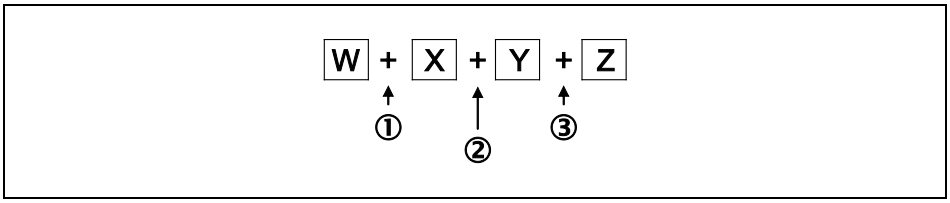
### 6.4.1 Set calculation

*Tab. 34: Setting calculation*

| | |
|---|---|
| **1 Select “7. Calculation”** | Toggle to sheet “Calculation”. |
| **2 Select calculation formula to set** | Select either Value of W, Operator 1, Value of X, Operator 2, Value of Y, Operator 3 or Value of Z.<br>For calculation structure, refer to the following description. |
| **3 Assign Calulation value to output** | Set the calculation value used as source of control output and/or analog output. Refer to chapter 6.2.5 “Set control/switching output source” on page 43 and chapter 6.3.2 “Set output source” on page 45. |
| **4 Press** SET/RUN | |

**Note** The following calculation structure is used.

*Fig. 25: Operators to program calculations*




① Operator 1
② Operator 2
③ Operator 3

The following options are available for Operator 1 to Operator 3:
“+” : Addition (+)
“–” : Subtraction (–)

For the other variables (W/X/Y/Z), select from the followings:
“A” : Measurement value of sensor head A
“B” : Measurement value of sensor head B
“C” : Measurement value of sensor head C
“K” : Constant K (see chapter 6.4.3 “Set value of K”on page 47)
“0” : 0

Setting is stored in the active bank.

Default:
Value of W “A”
Operator 1 “+”
Value of X “0”
Operator 2 “+”
Value of Y “0”
Operator 3 “+”
Value of Z “0”

The default caluclation therefore is: A+0+0+0+0 = A, this means that Cal = A.

### 6.4.2 Change algebraic sign of measurement value

*Tab. 35: Set algebraic sign of measurement value*

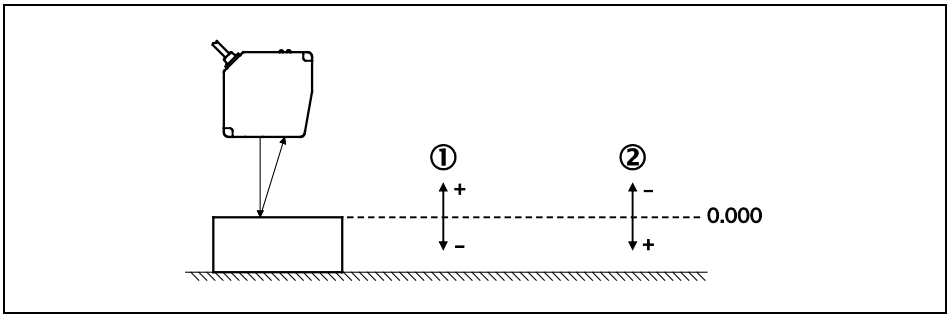
| | |
|---|---|
| **1 Select “7. Calculation”** | Toggle to sheet “Calculation”.. |
| **2 Select “Sign A, B, or C”** | A/B/C corresponds to sensor head A, B or C. |
| **3 Change the setting** | Select the algebraic sign. Refer to figure below. |
| **4 Press** SET/RUN | |

**Note** Setting to “Far side+” means that the measurement value increases as the object moves further away from the sensor head. Measurement value sign is positive. (This is default)

Setting to “Near side+” reverses the algebraic sign (± sign) and the measurement value increases as the object moves closer to the sensor head. Measurement value sign is negative.

Default: “Far side+”

*Fig. 26: Near/Far side +, change algebraic sign*




① For Near side+, negative sign of measurement value
② For Far side+ , positive sign of measurement value

### 6.4.3 Set value of K

*Tab. 36: Set value of constant “K”*

| | |
|---|---|
| **1 Select “7. Calculation”** | Toggle to sheet “Calculation”.. |
| **2 Select “Value of K”** | |
| **3 Change the setting** | Set the constant K for calculation setting. (–2999.9999 to +2999.9999 mm) |
| **4 Press** SET/RUN | |

**Note** Use this setting when a constant K is used for the calculation formula.

This setting allows 10 KEY (numeric key) function. Setting is stored in the active bank.

Default: “0.0000”

### 6.4.4 Set shift/offset

*Tab. 37: Set shift/ offset*

| | |
|---|---|
| **1 Select “7. Calculation”** | Toggle to sheet “Calculation”.. |
| **2 Select “Shift A, B, C” or CAL** | A/B/C corresponds to sensor head A, B and C.<br>CAL corresponds to the calculation value. |
| **3 Change the setting** | Sets the shift/offset value of the measurement of the sensor head and the calculation value (–2999.9999 to +2999.9999 mm). |
| **4 Press** SET/RUN | |

**Note** This setting is used to set the measurement value to zero (0) using the zero reset function.
This setting allows 10 KEY (numeric key) function. Setting is stored in the active bank.
Default: “0.0000”

## 6.5 Using calculation

### 6.5.1 Calculation examples

Various applications with two or three sensor heads are possible. E.g. flatness, thickness and centricity measurement. Following figure shows some calculations.

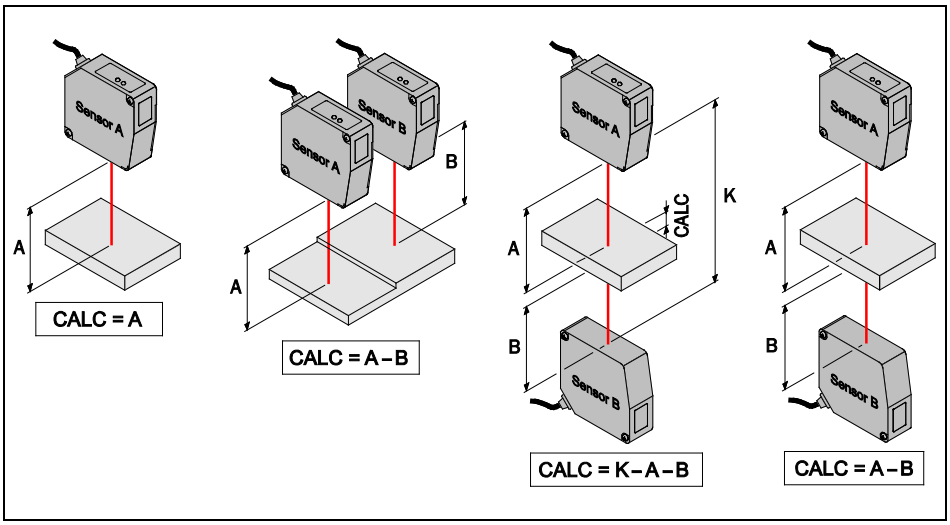



*Fig. 27: Exemplary calculation functions*

A Distance A
B Distance B
CALC Thickness
K Distance K

### 6.5.2 Thickness calculation

A reference material of a known thickness is placed between the two sensor heads and a “Zeroing”of both sensor heads is performed. The following formula is then used to calculate the thickness of any object placed between the sensor heads.

K-A-B=0

K = thickness of a reference object

A= measurement of sensor head A

B= measurement of sensor head B

Note the following procedure:

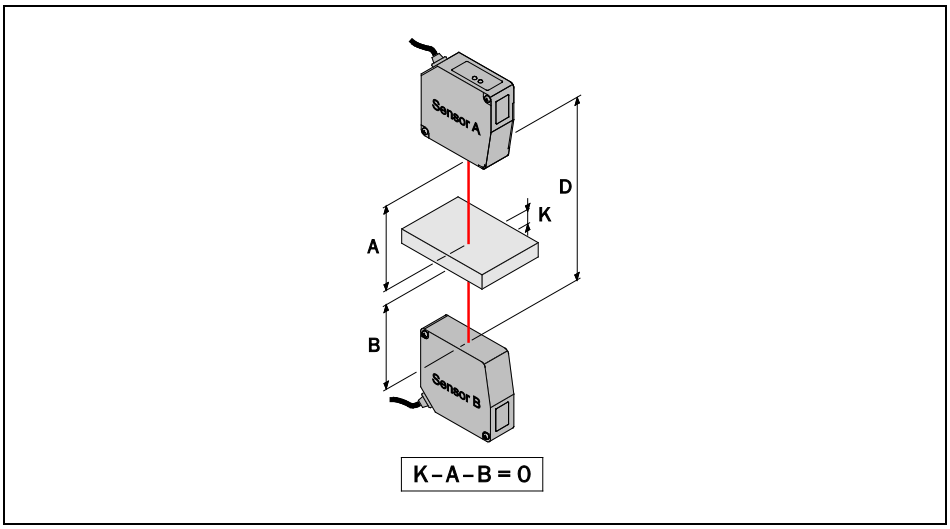
1.) Set “K” to the thickness of the reference object (e.g. gauge block)

2.) Place the reference object between the two sensor heads. (within the measurement range of each sensor head)

3.) Conduct Zeroing of the used sensor heads.

Calculation result now represents thickness of the object placed in-between the two sensor heads.

*Fig. 28: Calculation; Thickness with two sensor heads*




A Distance A
B Distance B
K Known Thickness K
D Distance D

When measuring the thickness of any material with 2 sensor heads from two sides, alignment becomes very important for accurate measurement.

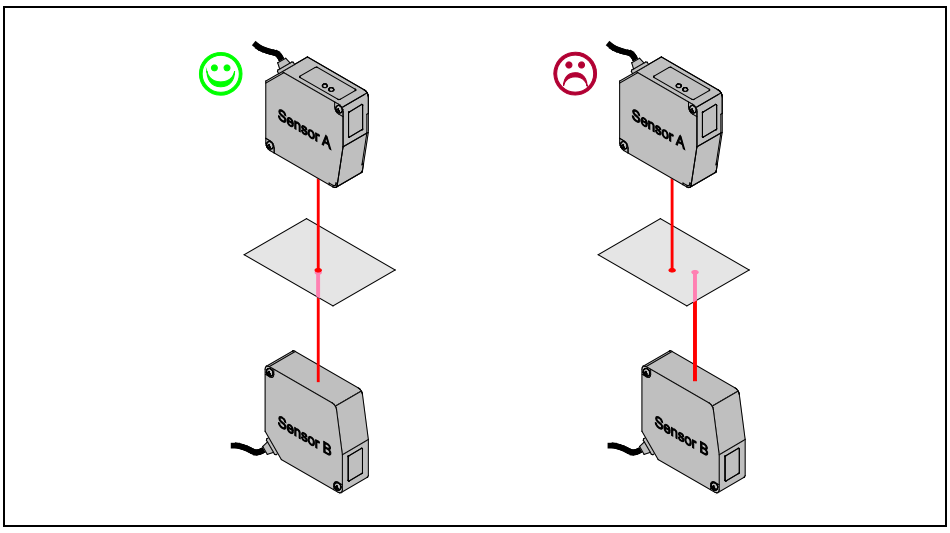
Error in alignment will result in inaccurate measurements, unless each of the sensor heads is calibrated beforehand (e.g. with the calibration wizard) to compensate errors in alignment.

Also ensure that the object is within the measurement range of each individual sensor.

When measuring thickness with two sensor heads, anti-interference mode must be activated when the material is transparent, semi-transparent, or very thin. In this case sampling frequency is 6 times longer as the lasers are pulsed.

Note: One can easily check alignment by placing a paper in-between the two sensor heads. If two light spots are visible on the paper, then alignment is incorrect. Move the paper within the measurement range to ensure only one light spot is visible on the paper throughout the full measurement range.

*Fig. 29: Alignment for measuring with two sensor heads*



## 6.6 Setting hold

*Tab. 38: Hold functions*

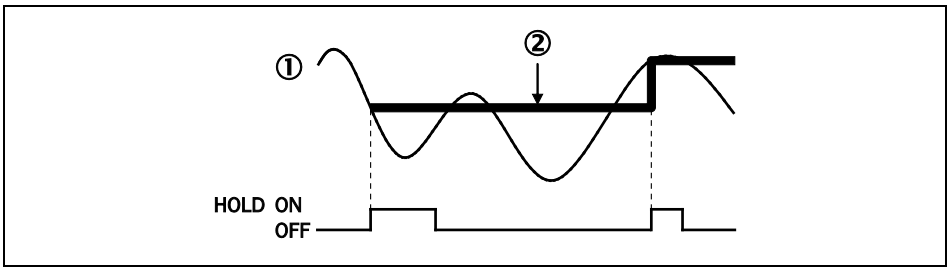
| | |
|---|---|
| **1 Select “8. Hold”** | Toggle to sheet “Hold”.. |
| **2 Select “Head A, B, C” or “Calculated Val”** | A/B/C corresponds to sensor head A, B and C.<br>Calculated Val corresponds to the calculation value. |
| **3 Change the setting** | Select HOLD function. Refer to list below for the different options. |
| **4 Press** SET/RUN | |

**Note** The selected HOLD function is triggered using the Hold Input and Reset Input. The inputs are accessible via the I/O Expansion cable. There are seven setting options as follows:

“Off”: HOLD is deactivated

“Sample”: Sample HOLD. The current measurement value is held when at the rising edge.

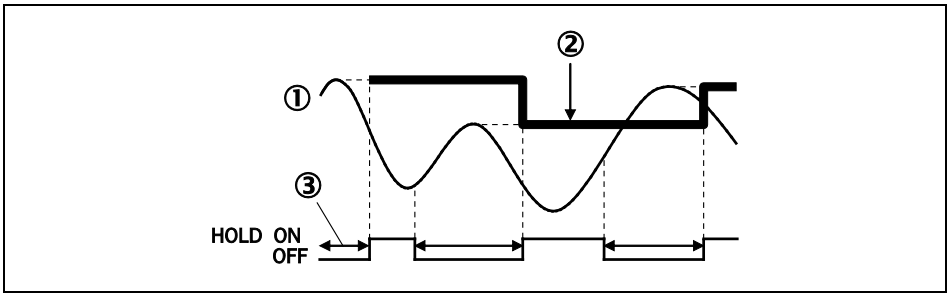
*Fig. 30: Sample hold function*




① Measurement value
② Sample holding value

“Peak”: Peak HOLD. "Peak": Peak HOLD. The peak value is being held.

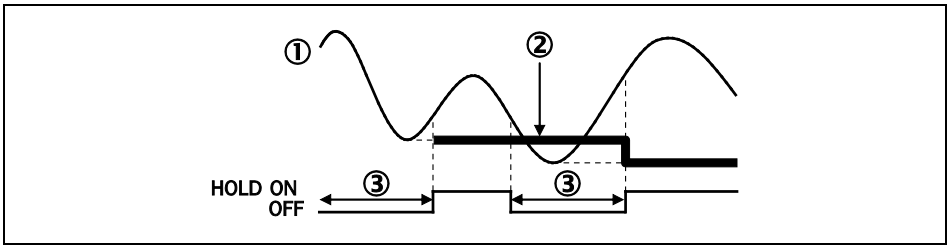
*Fig. 31: Peak hold function*




① Measurement value
② Peak holding value
③ Period of sampling

"Bottom": Bottom HOLD. The bottom value is being held.

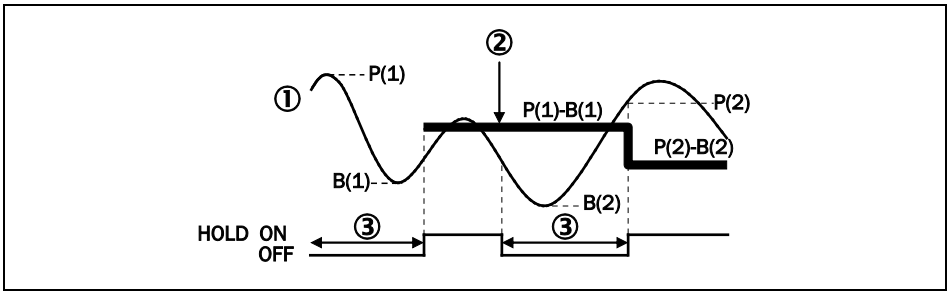
*Fig. 32: Bottom hold function*




① Measurement value
② Bottom holding value
③ Period of sampling

"Peak to Peak": Peak to Peak HOLD. The difference between peak and bottom value is being held.

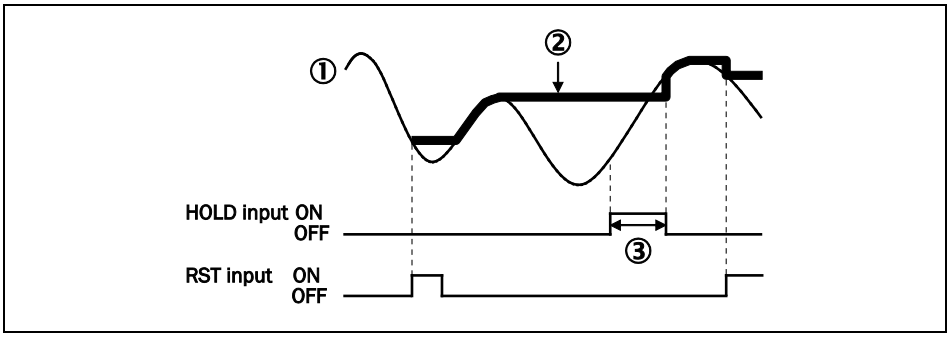
*Fig. 33: Peak to peak hold function*




① Measurement value
② Peak to peak holding value
③ Period of sampling

"Auto Peak": Auto Peak HOLD. The peak value is automatically held. Function is activated with rising edge on Reset Input. The function is deactivated when Hold input is ON. The Reset Input sets the held measurement value to the current measurement value.

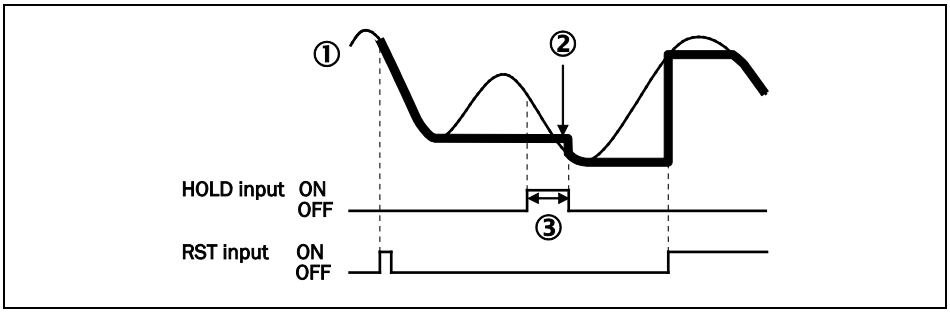
*Fig. 34: Auto peak hold function*




① Measurement value
② Auto peak holding value
③ Stop of revision

"Auto Bottom": Auto Bottom HOLD. The bottom value is automatically held. Function is activated with rising edge on Reset Input. The function is deactivated when Hold input is ON. The Reset Input sets the held measurement value to the current measurement value.

*Fig. 35: Auto bottom hold function*




① Measurement value
② Auto bottom holding value
③ Stop of update

Default: "Off"

## 6.7 Setting filter

### 6.7.1 Set filter function

*Tab. 39: Set filter function*

| | |
|---|---|
| **1 Select “9. Filter”** | Toggle to sheet “Filter”.. |
| **2 Select “Filter”** | |
| **3 Change the setting** | “Off”: Filtering is not applied<br>“Hi pass” : “High pass filter” is applied<br>“Lo pass” : “Low pass filter” is applied |
| **4 Press** SET/RUN | |

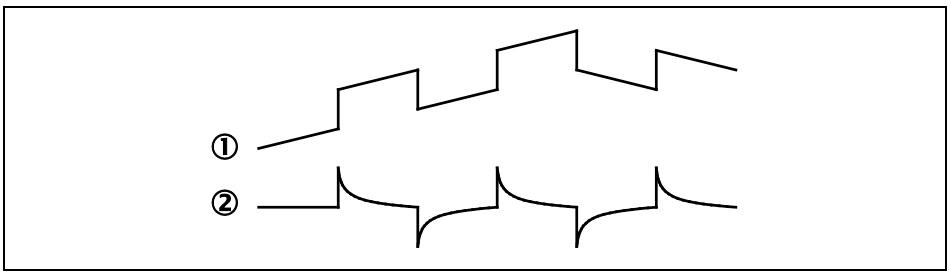
**Note** To set filter to “Hi pass” or “Lo pass”, moving average must be set to “1” (deactivated) (see chapter 6.1.7 “Set moving average” on page 34).

Setting to “Hi pass” ignores the changes of the measurement value with a frequency lower than the cut-off frequency. In this setting, the measurement value is “0.00000” when the object stops moving.

Setting to “Lo pass” ignores the changes of the measurement value with a frequency higher than the cut-off frequency.

Example of result with “Hi pass” filter

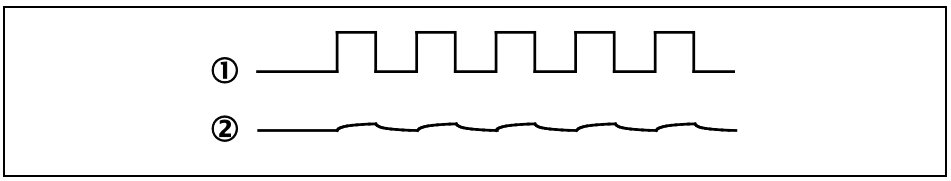
*Fig. 36: Hi-Pass Filter*




① Off
② Hi pass

Example of result with “Lo pass” filter

*Fig. 37: Deactivated filter*




① Off
② Lo pass

Default: “Off”

### 6.7.2 Set frequencies of filter functions

*Tab. 40: Set filter settings*

| | |
|---|---|
| **1 Select “9. Filter”** | Toggle to sheet “Filter”. |
| **2 Select “Frequency”** | |
| **3 Change the setting** | Select the filter frequency for filter setting. |
| **4 Press** SET/RUN | |

**Note**

Frequencies available:

*Tab. 41: Hi-/Low- pass filter frequencies*

| Setting value | Cut-off frequency applicable when Hi pass is selected | Cut-off frequency applicable when Lo pass is selected |
|---|---|---|
| Hi: 650/Lo: 2000 | 650 Hz | 2000 Hz |
| Hi: 350/Lo: 800 | 350 Hz | 800 Hz |
| Hi: 200/Lo: 400 | 200 Hz | 400 Hz |
| Hi: 100/Lo: 200 | 100 Hz | 200 Hz |
| Hi: 50/Lo: 100 | 50 Hz | 100 Hz |
| Hi: 25/Lo: 50 | 25 Hz | 50 Hz |
| Hi: 15/Lo: 20 | 15 Hz | 20 Hz |
| Hi: 10/Lo: 10 | 10 Hz | 10 Hz |

Example: “Hi pass” filter is chosen and filter frequency “Hi: 650/Lo: 2000” is chosen. This means that any change of the measurement value with a frequency lower than 650 Hz is ignored.

“Lo pass” is selected. This means that changes of the measurement value with a frequency higher than 2000 Hz are ignored.

Default: “Hi: 650/Lo: 2000”

## 6.8 Setting bank

*Tab. 42: Change bank*

| | |
|---|---|
| **1 Select “10. Bank”** | Toggle to sheet “Bank”.. |
| **2 Select Bank** | |
| **3 Change the setting** | Select active memory bank. A total of 16 banks is available. (0...15) |
| **4 Press** SET/RUN | |

**Note** Many parameter settings are stored in the active bank. This is indicated by the small blue “B” sign next to the parameter. Some parameter settings are stored globally and will remain the same for each bank. These are the parameters whithout a blue “B” next to them.

When bank function is not required, select “0”.

The bank setting after power ON is as follows:

- When the bank switching input (in I/O 50-pin input/output connector) is bank 0 (all OFF): bank is set to bank 0
- Bank can always be changed by pressing the “+/-BANK” button.
- When the bank switching input is other than bank 0: bank according to bank switching input signal is activated. For the list of available signals refer to chapter “Bank switch input” on page 10.

## 6.9 Setting RS 232

*Tab. 43: Change settings of RS232 communication*

| | | |
|---|---|---|
| **1** | **Select “11. RS232”** | Toggle to sheet “RS232”. |
| **2** | **Change the setting** | Adjust the setting to that of communication device. |
| **3** | **Press** SET/RUN | |

**Note** Default: Baud “115200”
Data “8”
Parity “None”

## 6.10 Using memory function

### 6.10.1 Copy data

*Tab. 44: Copy data from bank to bank*

| | |
|---|---|
| **1 Select “12. Memory”** | Toggle to sheet “Memory”.. |
| **2 Select “Copy from”** | Select the bank to copy from. All settings stored in this bank will then be copied. Use “Initial setting” to restore to default. |
| **3 Select “(Copy) to”** | Select the destination bank number to copy the bank settings to.To copy to all<br>banks, select “All Bank”. To reset device choose “Complete Reset”. |
| **4 Select “Execute”** | Selects “Yes” |
| **5 Press** SET/RUN | Copying is executed. |

**Note** Use this setting to copy the setting value to other bank.

### 6.10.2 Return bank setting to Default (initialization)

*Tab. 45: Return bank to default settings*

| | |
|---|---|
| **1 Select “12. Memory”** | Toggle to sheet “Memory”.. |
| **2 Select “Copy from”** | Select “Initial setting”. |
| **3 Select “(Copy) to”** | Select bank to reset to default values.<br>To reset all banks to default, select “All Bank”.<br>To reset common settings to default, select “Common settings”. |
| **4 Select “Execute”** | Selects “Yes” |
| **5 Press** SET/RUN | The initialization starts. |

**Note** When choosing “Complete Reset” for “Copy to ... “ the setting “Copy from” becomes inactive.

### 6.10.3 Complete reset

*Tab. 46: Complete reset*

| | |
|---|---|
| 1 Select “12. Memory” | Toggle to sheet “Memory”.. |
| 2 Select “Copy from” | Ignore this setting |
| 3 Select “(Copy) to” | Select “Complete reset” |
| 4 Select “Execute” | Selects “Yes” |
| 5 Press SET/RUN | The initialization starts. |

**Note** When choosing “Complete Reset” for “Copy to ... “ the setting “Copy from” becomes inactive.

## 6.11 Setting display and keys

### 6.11.1 Set internal decimal places visible in RUN mode

*Tab. 47: Set decimal places visible in RUN mode*

| | |
|---|---|
| **1 Select “13. Display/Key”** | Toggle to sheet “Display/Key”. |
| **2 Select Display Digit** | |
| **3 Change the setting** | “All” : displays up to 5 places of decimals<br>“-1” : displays up to 4 places of decimals<br>“-2” : displays up to 3 places of decimals<br>“-3” : displays up to 2 places of decimals |
| **4 Press** SET/RUN | |

**Note** This setting only changes the displayed digit number, it does not influence the output value or even the output quality.

Default: “–2”

### 6.11.2 Set brightness

*Tab. 48: Set brightness*

| | |
|---|---|
| **1 Select “13. Display/Key”** | Toggle to sheet “Display/Key”. |
| **2 Select LCD Backlight** | |
| **3 Change the setting** | “100 percent” : Maximum brightness<br>“20 percent” : 20% brightness<br>“2 percent” : 2% brightness |
| **4 Press** SET/RUN | |

**Note** Default: “100 percent”

### 6.11.3 Set key lighting

*Tab. 49: Set key lighting*

| | |
|---|---|
| **1 Select “13. Display/Key”** | Toggle to sheet “Display/Key”. |
| **2 Select “Key Lighting”** | |
| **3 Change the setting** | “On” : key lighting ON<br>“Off” : key lighting OFF |
| **4 Press** SET/RUN | |

**Note** Setting to “On” lights the buttons which are available.

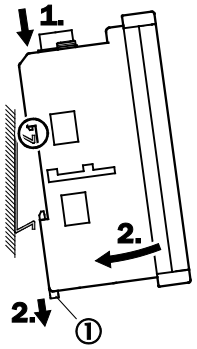
Default: “On”

# 7 Mounting

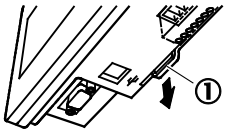
## 7.1 Installing controller

### 7.1.1 Install to DIN rail

*Tab. 50: Mount controller to DIN rail*

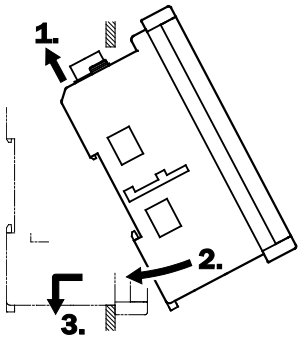
| | |
|---|---|
| **1** Insert the upper claw on rear of the DIN rail, and push the bottom of controller into the rail, with the knob pulled down. |  <br>① Knob |
| **2** Ensure the controller fits perfectly on the DIN rail. | |

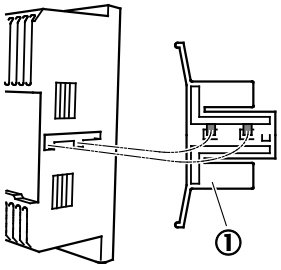
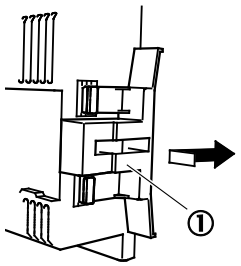
**Note** To remove the controller from DIN rail, pull the bottom of controller to the front, with the knob pulled down using a flathead screwdriver.




### 7.1.2 Install to panel

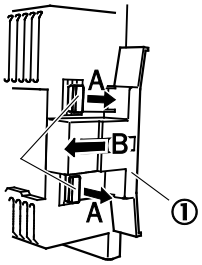
*Tab. 51: Mount controller topanel*

| | |
|---|---|
| **1** Drill hole of specified size on the panel. (“Dimensional outline”). | |
| **2** Remove any terminal board and connectors from the controller. | |
| **3** Insert the upper of controller to the opening, and push the bottom into the opening.<br>When the whole controller is in the opening, align the position. |  |

| | |
|---|---|
| **4** Insert the protruded part of fixture to the slit at the lateral side of controller (panel mounting mechanism). |  ① Fixture |
| **5** By pressing fixture to the controller, slide the fixture to the direction indicated by the arrow, to secure the controller.<br>**Note**<br>Set the fixture to the opposite side also. |  ① Fixture |

**Note** To install/remove the controller to/from the panel, remove all the terminals and connectors connected to the controller.

To remove fixture from the controller, pull claws (two places) up to the direction of arrow A, and slide the fixture to the front (direction of arrow B).



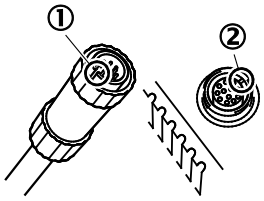
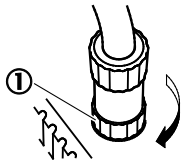

① Fixture

## 7.2 Connecting connectors for sensor head

WARNING

Ensure the cutout of connector smoothly fits the protruded part of controller. Forced connector insertion can damage the connector pin seriously.

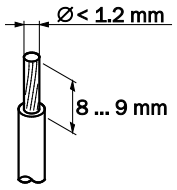
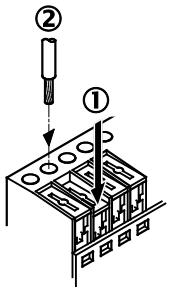
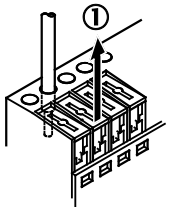
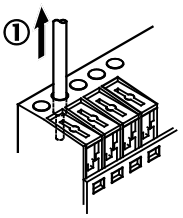
*Tab. 52: Connecting connectors for sensor head*

| | |
|---|---|
| **1** Insert the connector cutout to the protruded part of controller. |  <br>① Cutout<br>② Protruded part |
| **2** Turn the connector lock to the direction of arrow (clockwise direction) until it clicks. |  <br>① Lock |

**Note** To remove connector from the controller, turn the lock in counterclockwise direction before removing.

## 7.3 Connecting cable to 12-pin terminal board

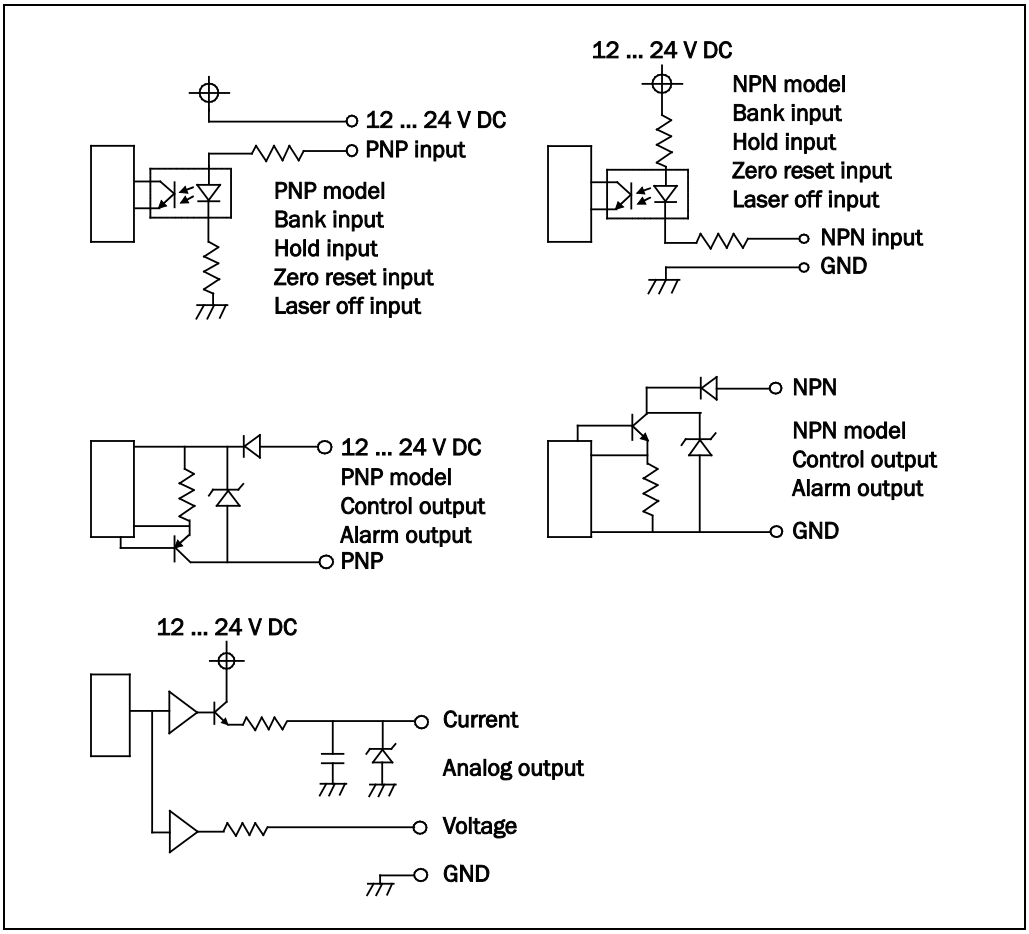
*Tab. 53: Connecting cable to 12-pin terminal board*

| | |
|---|---|
| **1** Strip the insulation of the cable coating to expose the cable core by 8 to 9 mm. When using shield cable, twist so that the core diameter is less than Ø1.2 mm. |  <br>① Peel the cable coating |
| **2** Insert the cable until exposed cable is fully inserted into terminal boad. |  <br>① Press down using a flathead screwdriver<br>② Insert cable |
| **3** Pull lever up until it clicks |  <br>① Pull up |
| **4** Pull the cable softly to ensure that the lever is locked and the cable is not pulled out. Ensure that the cable core is not exposed. |  <br>① Ensure the cable is not easily pull out |

# 8 Appendix

## 8.1 Input/output diagram

*Fig. 38: Input/output diagram*



## 8.2 Communication

### 8.2.1 Communication specification

**RS 232 (In the Default setting, the following values are set)**

*Tab. 54: RS232 communication parameters*

| | |
|---|---|
| Baud rate | 9600/19200/**38400**/115200 bps |
| Transmission code | ASCII |
| Data length | 7/**8** bit |
| Stop bit length | 1 bit |
| Parity check | **None**/Even/Odd |
| Data classification | STX · ETX |

Adjust the settings of the computer and this product within the above range.

**USB**

This product uses FT245M manufactured by Future Technology Devices International Ltd. (FTDI) for the USB device. (USB1.1 and USB2.0 compatible)

This product can be accessed from the computer using the virtual COM port (VCP) driver or DLL USB driver D2XXX.

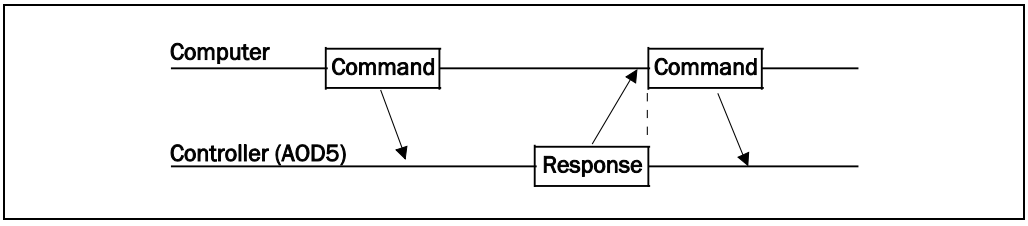
Please use the FTDI driver that was supplied with your current SOPAS software. You can find this driver in a folder (FTDI Driver) under the SOPAS program.

### 8.2.2 Communication procedure

When a command is sent from computer to the controller, the controller sends a response back to the computer.

Basically, one response is sent to one command.
When a command is sent, be sure to send it after receiving the response to the previous command. (A stop command can be sent while measurement values are being read continuously.)

*Fig. 39: USB communication procedure*

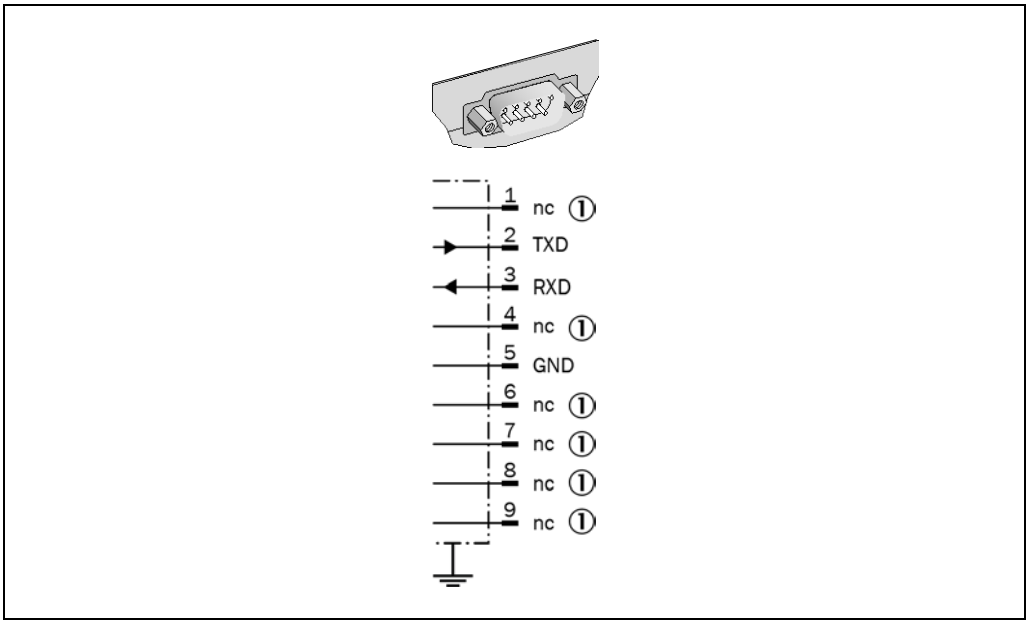


### 8.2.3 Connection with computer

**RS 232**

Use a shielded RS232C cable (straight).

*Fig. 40: RS232C communication pinnig*




① Not connected

**Note** The shield must be applied when using the RS232 interface.

To connect the sensor with an RS232 compatible interface to a computer (D-sub, 9 pin):

- Connect pin 2 (TXD) of the sensor to pin 2 (RXD) on the computer.
- Connect pin 3 (RXD) of the sensor to pin 3 (TXD) on the computer.
- Connect pin 5 (GND) of the sensor to pin 5 (GND) on the computer.
- Connect the shielded cable with shielding of the D-sub male connector to the sensor and to the computer.

**USB**

Use a USB 2.0 cable (A-B type).

### 8.2.4 Send data format (command)

There three types of data (command 1, 2 and 3) being sent. Parameters are indicated by the combination of commands 1 and 2, and command 3 indicates the setting value.

When only commands 1 and 2 are sent, the setting value for the parameter is returned as response. (Readout)

To write (change) the setting item, add command 3 which then becomes the new setting value of the according parameter.

When data was written correctly, “>” (3EH) is returned as the response.

When the command was wrong, “?” (3FH) is returned as the response.

*Tab. 55: Command format for read out of data*

**For the readout of settings or measurement values, and control commands (such as zero reset)**

| 02H | | 20H | | 03H |
|---|---|---|---|---|
| STX | Command 1 | SPACE 1 | Command 2 | ETX |
| 1 | 2 | 3 | 4 | 5 |

| | | |
|---|---|---|
| 1 | STX | Code which indicates the beginning of the data to be sent. (02H) |
| 2 | Command 1 | Select and set from the command 1 column in the command table. Refer to chapter 8.2.6 “Communication command table” on page 68 onwards. |
| 3 | SPACE 1 | Indicates the separation of command 1 and command 2. (20H) |
| 4 | Command 2 | Select and set from the command 2 column in the command table. Refer to chapter 8.2.6 “Communication command table” on page 68 onwards. |
| 5 | ETX | Code which indicates the end of send data. (03H) |

*Tab. 56: Command format for writing data*

**For writing settings**

| 02H | | 20H | | 20H | | 03H |
|---|---|---|---|---|---|---|
| STX | Command 1 | SPACE 1 | Command 2 | SPACE 2 | Command 3 | ETX |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

| | | |
|---|---|---|
| 1 | STX | Code which indicates the beginning of the data to be send (02H) |
| 2 | Command 1 | Select and set from the command 1 column in the command table. Refer to chapter 8.2.6 “Communication command table” on page 68 onwards. |
| 3 | SPACE 1 | Indicates the separation of command 1 and command 2. (20H) |
| 4 | Command 2 | Select and set from the command 2 column in the command table. Refer to chapter 8.2.6 “Communication command table” on page 68 onwards. |
| 5 | SPACE 2 | Indicates the separation of command 2 and command 3. (20H) |
| 6 | Command 3 | Select and set from the command 3 column in the command table. Refer to chapter 8.2.6 “Communication command table” on page 68 onwards. |
| 7 | ETX | Code which indicates the end of send data. (03H) |

### 8.2.5 Received data format (response)

*Tab. 57: Data format of response*

| 02H | | 03H |
|---|---|---|
| STX | Response | ETX |
| 1 | 2 | 3 |

| | | |
|---|---|---|
| 1 | STX | Code which indicates the beginning of the receive data. (02H) |
| 2 | Response | Response data for the sent command is set. |
| 3 | ETX | Code which indicates the end of the received data. (03H) |

As the response to the readout command, the character string shown in command 3 of the command table is sent.

There are the following 2 responses for the writing command and control command:

> (3EH) Indicates that data was written correctly.

? (3FH) Indicates that data was not accepted because the command was wrong, etc.

### 8.2.6 Communication command table

When any Command is sent to unsupported controller unit or sensor head “?” is returned.

*Tab. 58: Communication command table*

| **Sensor head setting** | | | |
|---|---|---|---|
| Command 1 | Command 2 | Command 3 | Set contents |
| HEAD | MEASURE_A<br>MEASURE_B<br>MEASURE_C | FRONT, REAR, THICKNESS, GAP | Measurement target |
| | SHIFT_A<br>SHIFT_B<br>SHIFT_C | –0.1000 to +0.1000 | Calibration (shift) |
| | SPAN_A<br>SPAN_B<br>SPAN_C | 0 to 3.9999 | Calibration (span) |
| | LASER_A<br>LASER_B<br>LASER_C | 5 to 0 | Laser power |
| | SENS_A<br>SENS_B<br>SENS_C | MIN, 1 to 9, MAX , AUTO | Sensitivity |
| | THRESH_A<br>THRESH_B<br>THRESH_C | 0 to 14, AUTO | Light receiving waveform threshold |
| | AVE_A<br>AVE_B<br>AVE_C | 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096 | Number of values taken for moving average |
| | BAUD_A<br>BAUD_B<br>BAUD_C | 9.6 K, 19.2 K,<br>38.4 K, 57.6 K,<br>115.2 K, 230.4 K,<br>460.8 K, 921.6 K,<br>1843.2 K, 312.5 K,<br>625.0 K, 1250.0 K | Baud rate |
| | ALARM_A<br>ALARM_B<br>ALARM_C | CLAMP , HOLD | Output during alarm (when no measurement can be taken) |
| | SAMP_A<br>SAMP_B<br>SAMP_C | 100, 200, 400, 800, 1600, 3200, AUTO | Sampling period (comparable to aperture time) |
| HEAD | INTER | OFF, ON | Mutual interference prevention (Only available for sensor head A & B. |
| HEAD | INSTALL_A<br>INSTALL_B<br>INSTALL_C | DIFFUSE<br>SPECULAR | Chose target surface remission type.<br>Available for OD5-85x20 and OD5-30x05 type. |

*Tab. 59: Communication command table, control output*

| **Control output setting** | | | |
|---|---|---|---|
| Command 1 | Command 2 | Command 3 | Set contents |
| CONTROL | Q1_HI<br>Q1_LO<br>Q2_HI<br>Q2_LO<br>Q3_HI<br>Q3_LO<br>Q4_HI<br>Q4_LO<br>Q5_HI<br>Q5_LO | –2999.99999 to +2999.99999 | Upper/Lower limit value for the different switching outputs. |
| | HYSTE | 0 to +2999.99999 | Hysteresis |
| | MODE | OFF, OFF_DELAY, ON_DELAY, 1SHOT | Delay functions |
| | TIMER | 0 to 60000 | Delay time of delay functions |
| | Q1_SOURCE<br>Q2_SOURCE<br>Q3_SOURCE<br>Q4_SOURCE<br>Q5_SOURCE | A, B, C, CAL | Output source |

*Tab. 60: Communication command table, analog output*

| **Analog output setting** | | | |
|---|---|---|---|
| Command 1 | Command 2 | Command 3 | Set contents |
| ANALOG | P1_UP<br>P1_LO<br>P2_UP<br>P2_LO<br>P3_UP<br>P3_LO | –2999.99999 to +2999.99999 | Upper/Lower limit value of the different analog outputs |
| | P1_SOURCE<br>P2_SOURCE<br>P3_SOURCE | A, B, C, CAL | Source for each analog output. |

*Tab. 61: Communication command table, calculation settings*

| **Calculation setting** | | | |
|---|---|---|---|
| Command 1 | Command 2 | Command 3 | Set contents |
| CAL | VAL_W<br>VAL_X<br>VAL_Y<br>VAL_Z | 0, A, B, C, K | W, X, Y, Z variables for caluclation |
| | OPE_1<br>OPE_2<br>OPE_3 | +, – | Operator 1/2/3 for calculation |
| | SIGN_A<br>SIGN_B<br>SIGN_C | FARSIDE+<br>NEARSIDE+ | Measurement value increase/decrease direction, changes the algebraic sign of the measurement value |
| | K | –2999.99999 to +2999.99999 | Value of K, as constant for caluclation |
| | SHIFT_A<br>SHIFT_B<br>SHIFT_C<br>SHIFT_CAL | –2999.99999 to +2999.99999 | Shift |

*Tab. 62: Communication command table, hold settings*

| **Hold setting** | | | |
|---|---|---|---|
| Command 1 | Command 2 | Command 3 | Set contents |
| HOLD | A<br>B<br>C<br>CAL | OFF<br>SAMPLE<br>PEAK<br>BOTTOM<br>P-P<br>AUTOPEAK<br>AUTOBOTOM | Hold functions |

*Tab. 63: Communication command table, filter setting*

| **Filter setting** | | | |
|---|---|---|---|
| Command 1 | Command 2 | Command 3 | Set contents |
| FILTER | FILTER | OFF<br>HIPASS<br>LOPASS | Filter functions |
| | FREQ | 10/10<br>15/20<br>25/50<br>50/100<br>100/200<br>200/400<br>350/800<br>650/2000 | Cut-off frequency for filter functions |

*Tab. 64: Communication command table, bank setting*

| **Bank setting** | | | |
|---|---|---|---|
| Command 1 | Command 2 | Command 3 | Set contents |
| BANK | BANK | 0 to 15 | Bank |

*Tab. 65: Communication command table, memory setting*

| **Memory setting** | | | |
|---|---|---|---|
| Command 1 | Command 2 | Command 3 | Set contents |
| MEMORY | FROM | 0 to 15, INI | Copy source |
| | TO | 0 to 15, ALL, COMMON, RESET | Copy destination |
| | EXE | NO, YES | Copy execution |

*Tab. 66: Communication command table, measurement value read out*

| **Measurement value readout** | | | |
|---|---|---|---|
| Command 1 | Command 2 | Command 3 | Set contents |
| MEASURE | A<br>B<br>C<br>CAL<br>AB<br>ABC | – | Readout of measurement value or calculation value of sensor head, or several sensor heads (1 measurement value only) |
| | START_A<br>START_B<br>START_C<br>START_CAL<br>START_AB<br>START_ABC | – | Readout of measurement value or calculation value of sensor head, or several sensor heads (Start of continuous readout) |
| | STOP | – | Stop of continuous read-out |
| | SIZE | 0, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000 | Sets the number of measurement values to be sent for continuous readout.<br>When 0 (zero) is selected, data continues to be sent until the “stop” command is received.<br>Default: 10 |

| Measurement value readout | | | |
|---|---|---|---|
| Command 1 | Command 2 | Command 3 | Set contents |
| | RATE | 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768 | Slows down the output rate for continuous readout.<br>Measurement value is read out per 100 µs when 1 is selected, and per 6.4 ms when 64 is selected.<br>(The output rate for RS 232 is controlled by the chosen baud rate.<br>Default: 1 |
| MEASURE | ZEROSUP | YES, NO | Sets zero suppression to the measurement value to be read out.<br>Example:<br>+85.00000 (YES)<br>+0085.00000 (NO)<br>Default: YES |

Example:

PC -> AOD5 (STX)MEASURE A(ETX)
AOD5 -> PC (STX)+30.12345(ETX)
PC -> AOD5 (STX)MEASURE B(ETX)
AOD5 -> PC (STX)+85.54321(ETX)
PC -> AOD5 (STX)MEASURE AB(ETX)
AOD5 -> PC (STX)+30.12345+85.54321(ETX)
PC -> AOD5 (STX)MEASURE ABC(ETX)
AOD5 -> PC (STX)+30.12345+85.54321+350.12345(ETX)
PC -> AOD5 (STX)MEASURE START_A(ETX)
AOD5 -> PC +30.12345(CR)
+30.23456(CR)
+30.34567(CR)
+30.45678(CR)・
・
PC -> AOD5 (STX)MEASURE START_ABC(ETX)
AOD5 -> PC +30.12345+85.54321+350.12345(CR)
+30.23456+85.65432+351.23456(CR)
+31.34567+86.76543+361.34567(CR)
+32.45678+76.654321+391.12340(CR)

**Note**

*Tab. 67: Reading out period at different communication speeds.*

| RATE | Reading out period (Reference) | | |
|---|---|---|---|
| | USB | RS 232 (115.2 kbps) | RS 232 (38.4 kbps) |
| 1 | 100 µs | 1.1 ms | 2.6 ms |
| 2 | 200 µs | 1.2 ms | 2.6 ms |
| 4 | 400 µs | 1.4 ms | 2.7 ms |
| 8 | 800 µs | 1.8 ms | 3.1 ms |
| 16 | 1.6 ms | 2.6 ms | 3.9 ms |
| 32 | 3.2 ms | 4.2 ms | 5.5 ms |
| 64 | 6.4 ms | 7.4 ms | 8.7 ms |
| 128 | 12.8 ms | 13.8 ms | 15.1 ms |
| 256 | 25.6 ms | 26.6 ms | 27.9 ms |
| 512 | 51.2 ms | 52.2 ms | 53.4 ms |
| 1024 | 102.4 ms | 103.4 ms | 105 ms |
| 2048 | 204.8 ms | 205.8 ms | 207 ms |
| 4096 | 409.6 ms | 410.6 ms | 412 ms |
| 8192 | 819.2 ms | 820.2 ms | 820.2 ms |
| 16384 | 1.6384 s | 1.6394 s | 1.6394 s |
| 32768 | 3.2768 s | 3.2778 s | 3.2778 s |

RS 232 values are typical examples under the following condition. Reading out period varies from condition.

- data = 8 bit
- parity = None
- Reading value is “+85.00000” (10 letters including CR.)

*Tab. 68: Communication command table, Zero reset*

| Zero reset | | | |
|---|---|---|---|
| Command 1 | Command 2 | – | Set contents |
| ZERO | A<br>B<br>C<br>CAL | – | Zero reset of measurement value or calculation value of sensor head. This will automatically set the offset/shit value acordingly. |
| | CAN_A<br>CAN_B<br>CAN_C<br>CAN_CAL | – | Zero reset cancellation of measurement value or calcuation value of sensor head |

*Tab. 69: Communication command table, read firmware*

| **Read firmware command** | | | |
|---|---|---|---|
| Command 1 | Command 2 | – | Set contents |
| VERSION | AMP_HARD<br>AMP_SOFT<br>HEAD_A<br>HEAD_B<br>HEAD_C | - | Read out firmware of controller unit and sensor head. |

Example:

PC -> AOD5 (STX)VERSION HEAD_A(ETX)

AOD5 -> PC (STX)01.5(ETX)

PC -> AOD5 (STX)VERSION AMP_SOFT(ETX)

AOD5 -> PC (STX)10.0(ETX)

*Tab. 70: Communication command table, select operation*

| **Select Operation** | | | |
|---|---|---|---|
| Command 1 | Command 2 | Command 3 | Set contents |
| HEAD | OPERATION | MEASURE<br>LIGHT_A<br>LIGHT_B<br>LIGHT_C | Roud out measurement data or light distribution curve of sensor head A/B/C. |

*Tab. 71: Communication command table, get light distribution data*

| **Get light distribution data** | | | |
|---|---|---|---|
| Command 1 | Command 2 | Command 3 | Set contents |
| MEAURE | LIGHT | - | Light intensity data of each pixel (481 pixels) |
| | LIGHT_C0 | | Location of the barycenter of the first peak |
| | LIGHT_C1 | | Location of the barycenter of the second peak |
| | LIGHT_TH | | Location of the threshold level |

### 8.2.7 Specification of OD5 Light distribution data

Light intensity data of each pixel (481 pixels)

*Tab. 72: Data format light intensity of each pixel*

| | | | | | |
|---|---|---|---|---|---|
| STX | P1-C1 | P1-C2 | P1-C3 | CR | |
| | P2-C1 | P2-C2 | P2-C3 | | CR |
| | P480-C1 | P479-C2 | P479-C3 | CR | |
| | P481-C1 | P480-C2 | P480-C3 | CR | ETX |

P1-C1 Hundreds digit value (ASCII) in the first pixel intensity (0-255)
P1-C2 Tenths digit value (ASCII) in the first pixel intensity (0-255)
P1-C3 Once digit value (ASCII) in the first pixel intensity (0-255)
.
P481-C1 Hundreds digit value (ASCII) in the 481th pixel intensity (0-255)
P481-C2 Tenths digit value (ASCII) in the 481th pixel intensity (0-255)
P481-C3 Once digit value (ASCII) in the 481th pixel intensity (0-255)

Location of the barycenter of the first (second) light-peak

*Tab. 73: Data format location of barycenter of first (second) light-peak*

| | | | | |
|---|---|---|---|---|
| STX | C1 | C2 | C3 | ETX |

C1 Hundreds digit value (ASCII) in the x-coordinate (0-481)
C2 Tenths digit value (ASCII) in the x-coordinate (0-481)
C3 Once digit value (ASCII) in the x-coordinate (0-481)

Locaton of the threshold level

*Tab. 74: Data format location of the threshold level*

| | | | | |
|---|---|---|---|---|
| STX | C1 | C2 | C3 | ETX |

C1 Hundreds digit value (ASCII) in the Y-coordinate (0-255)
C2 Tenths digit value (ASCII) in the Y-coordinate (0-255)
C3 Once digit value (ASCII) in the Y-coordinate (0-255)

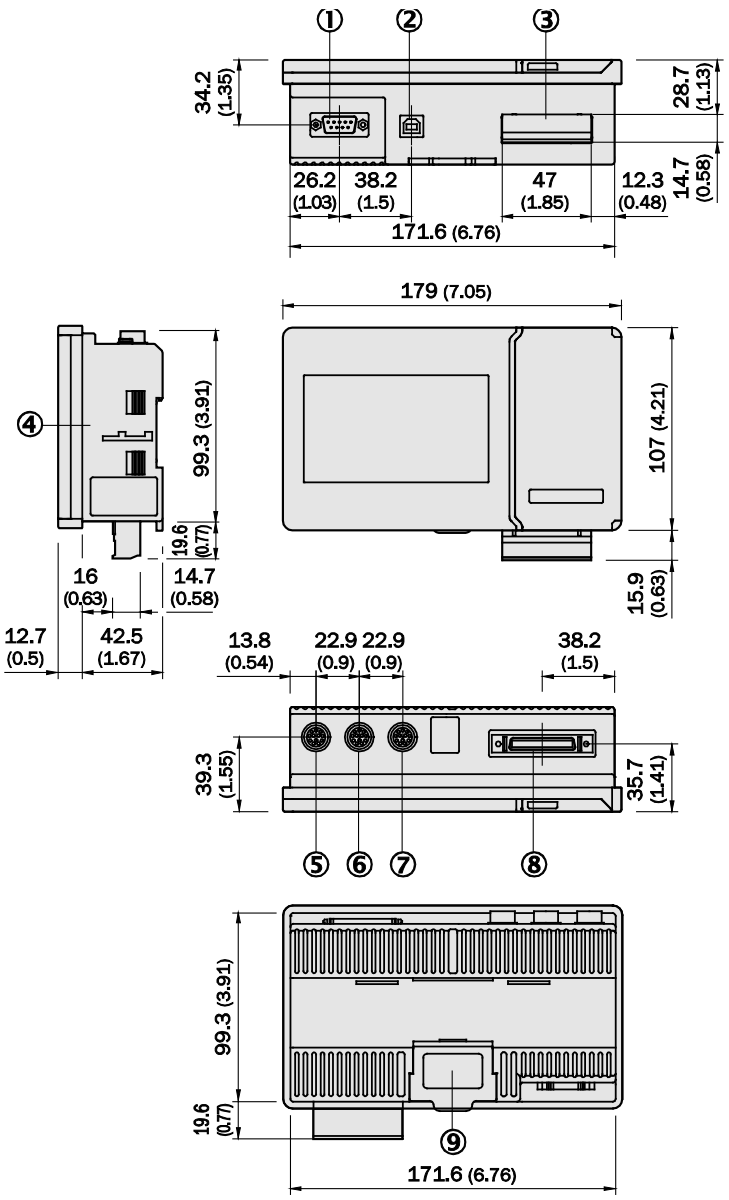
## 8.3 ASCII code table

*Tab. 75: ASCII code table*

| Character | Hexadecimal | Decimal | Character | Hexadecimal | Decimal | Character | Hexadecimal | Decimal |
|---|---|---|---|---|---|---|---|---|
| NUL | 0 | 0 | + | 2B | 43 | V | 56 | 86 |
| SOH | 1 | 1 | , | 2C | 44 | W | 57 | 87 |
| STX | 2 | 2 | - | 2D | 45 | X | 58 | 88 |
| ETX | 3 | 3 | . | 2E | 46 | Y | 59 | 89 |
| EOT | 4 | 4 | / | 2F | 47 | Z | 5A | 90 |
| ENQ | 5 | 5 | 0 | 30 | 48 | [ | 5B | 91 |
| ACK | 6 | 6 | 1 | 31 | 49 | \ | 5C | 92 |
| BEL | 7 | 7 | 2 | 32 | 50 | ] | 5D | 93 |
| BS | 8 | 8 | 3 | 33 | 51 | ^ | 5E | 94 |
| HT | 9 | 9 | 4 | 34 | 52 | _ | 5F | 95 |
| NL | A | 10 | 5 | 35 | 53 | ` | 60 | 96 |
| VT | B | 11 | 6 | 36 | 54 | a | 61 | 97 |
| NP | C | 12 | 7 | 37 | 55 | b | 62 | 98 |
| CR | D | 13 | 8 | 38 | 56 | c | 63 | 99 |
| SO | E | 14 | 9 | 39 | 57 | d | 64 | 100 |
| SI | F | 15 | : | 3A | 58 | e | 65 | 101 |
| DLE | 10 | 16 | ; | 3B | 59 | f | 66 | 102 |
| DC1 | 11 | 17 | < | 3C | 60 | g | 67 | 103 |
| DC2 | 12 | 18 | = | 3D | 61 | h | 68 | 104 |
| DC3 | 13 | 19 | > | 3E | 62 | i | 69 | 105 |
| DC4 | 14 | 20 | ? | 3F | 63 | j | 6A | 106 |
| NAK | 15 | 21 | @ | 40 | 64 | k | 6B | 107 |
| SYN | 16 | 22 | A | 41 | 65 | l | 6C | 108 |
| ETB | 17 | 23 | B | 42 | 66 | m | 6D | 109 |
| CAN | 18 | 24 | C | 43 | 67 | n | 6E | 110 |
| EM | 19 | 25 | D | 44 | 68 | o | 6F | 111 |
| SUB | 1A | 26 | E | 45 | 69 | p | 70 | 112 |
| ESC | 1B | 27 | F | 46 | 70 | q | 71 | 113 |
| FS | 1C | 28 | G | 47 | 71 | r | 72 | 114 |
| GS | 1D | 29 | H | 48 | 72 | s | 73 | 115 |
| RS | 1E | 30 | I | 49 | 73 | t | 74 | 116 |
| US | 1F | 31 | J | 4A | 74 | u | 75 | 117 |
| SPACE | 20 | 32 | K | 4B | 75 | v | 76 | 118 |
| ! | 21 | 33 | L | 4C | 76 | w | 77 | 119 |
| “ | 22 | 34 | M | 4D | 77 | x | 78 | 120 |
| # | 23 | 35 | N | 4E | 78 | y | 79 | 121 |
| $ | 24 | 36 | O | 4F | 79 | z | 7A | 122 |
| % | 25 | 37 | P | 50 | 80 | { | 7B | 123 |
| & | 26 | 38 | Q | 51 | 81 | \| | 7C | 124 |
| ‘ | 27 | 39 | R | 52 | 82 | } | 7D | 125 |
| ( | 28 | 40 | S | 53 | 83 | ~ | 7E | 126 |
| ) | 29 | 41 | T | 54 | 84 | DEL | 7F | 127 |
| * | 2A | 42 | U | 55 | 85 | | | |

## 8.4 Dimensional drawing

*Fig. 41: OD Precision Dimensional drawing*




① RS 232C interface

② USB interface

③ Terminal board (detachable)

④ For panel mounting bracket (recommended window size 173 x 102 mm)

⑤ Sensor head A connection port

⑥ Sensor head B connection port

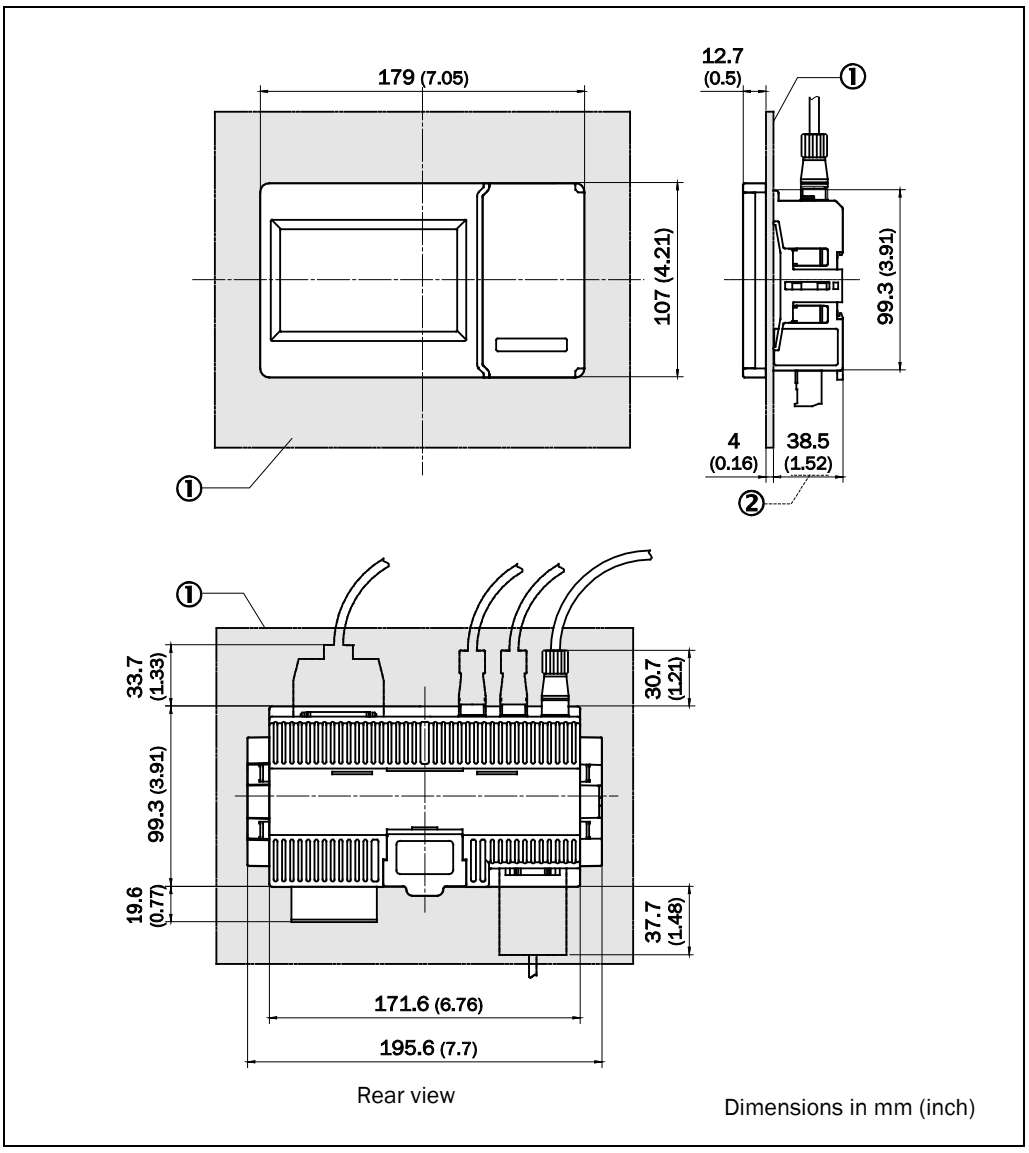
⑦ Sensor head C connection port

⑧ Terminal board 50-pin extern

⑨ DIN rail mounting mechanism

### 8.4.1 Panel mounting dimensions

*Fig. 42: Dimensional drawing Panel*

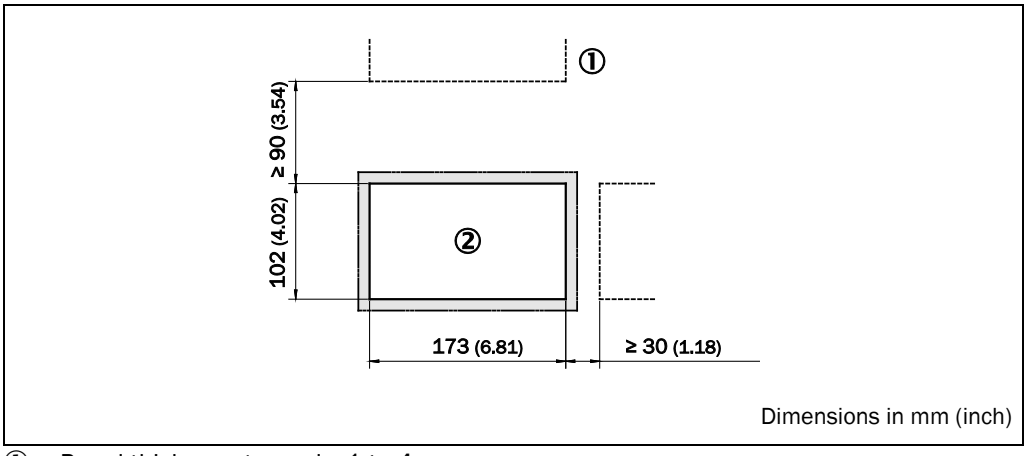



① Panel

② Size when the controller is mounted to a panel of 4.0 mm thickness

### 8.4.2 Panel opening dimensions

*Fig. 43: Panel opening dimensions*




① Panel thickness to apply: 1 to 4 mm

② Opening

## 8.5 Accessories

*Fig. 44: Extension cables sensor head – controller unit*

| **Extension cable between sensor head and controller** | | |
|---|---|---|
| **Type** | **Order no.** | **Length (L)** |
| DSL-1212-G02M | 6035986 | 2 m |
| DSL-1212-G05M | 6035987 | 5 m |
| DSL-1212-G10M | 6045158 | 10 m |
| DSL-1212-G20M | 6045159 | 20 m |

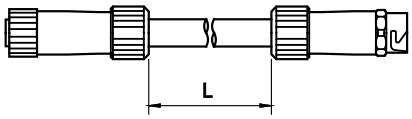



*Fig. 45: Cable for stand-alone use of sensor head*

| **Cable for sensor head (For stand-alone use of sensor head)** | | |
|---|---|---|
| **Type** | **Order no.** | **Length (L)** |
| DOL-1212-G05M | 6035988 | 5 m |
| DOL-1212-G10M | 6045214 | 10 m |
| DOL-1212-G20M | 6045215 | 20 m |

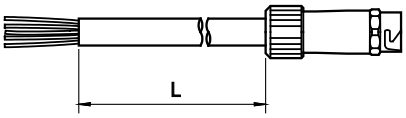
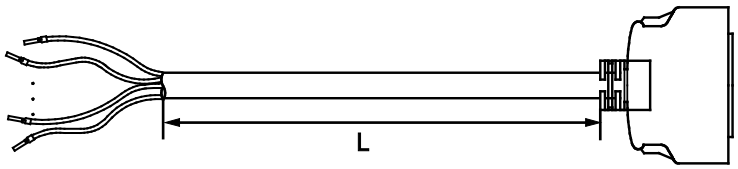



*Fig. 46: I/O Expansion cable*

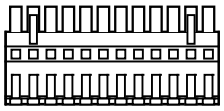
| **I/O Connector cable (Half pitch, 50-pin)** | | |
|---|---|---|
| **Type** | **Order no.** | **Length (L)** |
| IO-EXP-AOD5 | 6035990 | 3 m |




For pinning refer to chapter 2”Pin Assignment of 50-pin Input/Output Terminal” on page 8.

*Fig. 47:Terminal board connector*

| **12-pin terminal board** | | |
|---|---|---|
| **Type** | **Order no.** | |
| TERM.-AOD5 | 6035989 | Terminal Board Connector |



### 8.5.1 Package descriptions

Controller Main Unit

12-pin terminal board (1 pc)

User Manual

Fixture (1 set including 2 pcs) [For panel mounting]

## 8.6 List of tables



## 8.7 List of figures



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