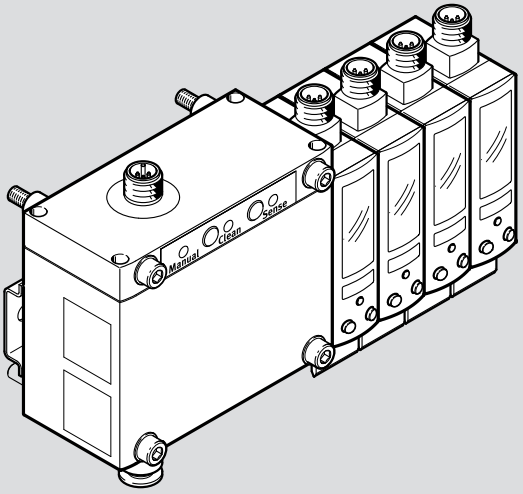
SOPA
Air gap sensor



FESTO

Manual

8163022
8163022
2021-08a
[8163024]

Translation of the original instructions

Table of contents

1 About this document

1.1 Applicable documents

All available documents for the product ➔ www.festo.com/sp.

2 Safety

2.1 General safety instructions

- Only use the product in its original condition without unauthorised modifications.
- Only use the product if it is in perfect technical condition.
- Only use media in accordance with the specifications ➔ Technical data.
- Observe labelling on the product.
- Note that changes to the switching status (EDIT mode) become effective immediately.

2.2 Intended Use

The air gap sensor SOPA is intended for distance monitoring in a range of 20 ... 200 µm. The distance measurement is performed using a non-contact pneumatic measuring process. This enables it to be used in harsh ambient conditions.

2.3 Training of qualified personnel

Work on the product may only be carried out by qualified personnel who can evaluate the work and detect dangers. The qualified personnel have skills and experience in dealing with electrical (open-loop) control technology.

2.4 UL/CSA certification

In combination with the UL inspection mark on the product, the information in this section must also be observed in order to comply with the certification conditions of Underwriters Laboratories Inc. (UL) for USA and Canada.

UL/CSA certification information	
Product category code	NRNT2/NRNT8
File number	E253738
Considered standards	UL 508 CSA22.2 No. 14
UL mark	c UL us

Tab. 1: UL/CSA certification information

This device is intended to be used with a Class 2 power source or Class 2 transformer in accordance with UL1310 or UL1585.
As an alternative a LV/C (Limited Voltage/Current) power source with one of the following properties can be used:

- This device shall be used with a suitable isolating source such that the maximum open circuit voltage potential available to the product is not more than 30 V DC and the current is limited to a value not exceeding 8 amperes measured after 1 minute of operation.
- This device shall be used with a suitable isolating source in conjunction with a fuse in accordance with UL248. The fuse shall be rated max. 3.3 A and be installed in the 30 V DC power supply to the device in order to limit the available current.

3 Additional information

- Contact the regional Festo contact if you have technical problems ➔ www.festo.com.
- Accessories and spare parts ➔ www.festo.com/catalogue.
- Device description file IODD ➔ www.festo.com/sp.

4 Product overview

4.1 Structure

4.1.1 Product design

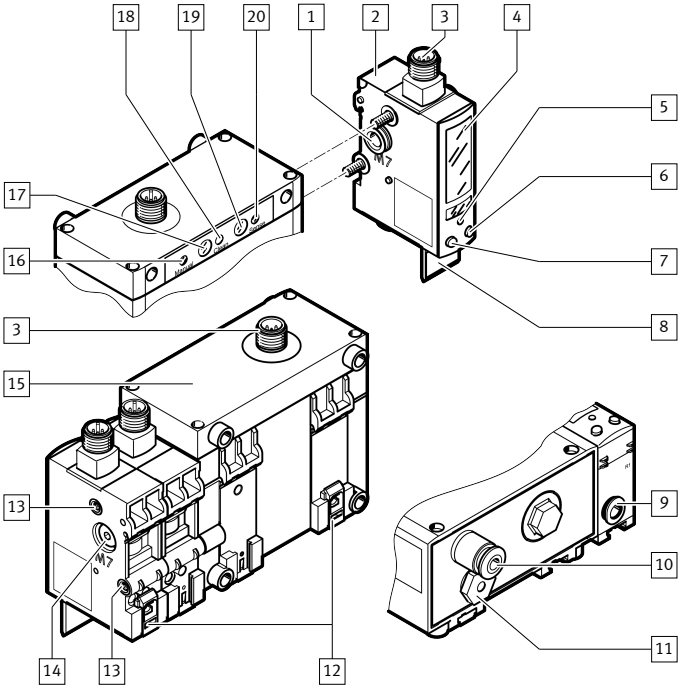
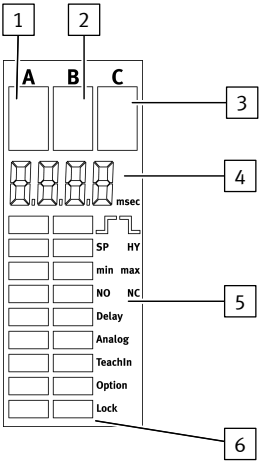


Fig. 1: Product design

1 Supply port for supply pressure
2 Sensor module (max. 4 modules permitted in combination with control module)
3 Plug for electrical connection
4 Display
5 Edit button
6 B pushbutton
7 A pushbutton
8 Label holder
9 Pneumatic port for measuring nozzle (outlet)
10 Supply port for operating pressure
11 Vent screw (width across flats 14)
12 Mounting slides
13 Threaded sleeve (M4)
14 Blanking plug (M7)
15 Control module (optional)
16 Manual LED (green) – ready indication for manual override (SOPA-C..-H only)
17 Clean pushbutton (blow-out air) (SOPA-C..-H only)
18 Status LED (yellow) – clean (blow-out air)
19 Sense pushbutton (measuring air) (SOPA-C..-H only)
20 Status LED (yellow) – sense (measuring air)

4.1.2 Display components



1 Display of binary output OutA
2 Display of binary output OutB
3 Display of binary output OutC
4 4-digit alphanumeric display
5 Toolbar for functions
6 Bar graph

Fig. 2: LCD display

4.1.2.1 Symbols on the display

Symbol	Description
	Display for binary signals set/not set (in the example A, B: set - C: not set)[1)]
	Threshold value comparator
	Window comparator
[SP]	Switching point
[SP][min]	lower switching point
[SP][max]	upper switching point
[HY]	Hysteresis
[NO]	Switching characteristic of N/O contact (normally open)
[NC]	Switching characteristic of N/C contact (normally closed)
[min]/[max]	minimum/maximum input value (in A/B/C)
[Delay]	Switch-off delay for the numerical display
[Analogue]	Settings for analogue output
[TeachIn]	Teach mode active
[Option]	Options for spurious pulse suppression (Off, 1, 2)
[Lock]	Security code active (block to prevent unauthorised parameterisation)
[Spec]	Special menu (SPEC) active
[di.]	Activation/deactivation of the numerical display Switching off the display backlight

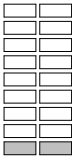
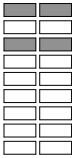
Symbol	Description
[PnP]/[nPn]	Switching the switching output
[P2-]	Allocation of the switching output for Pin 2 with the binary signal OutB or OutC
[P4-]	Allocation of the switching output Pin 4 with the binary signal OutA or OutC
[rP.]	Replicate settings to another device
[F.]	Set Analog output filter time τ for analogue output
[0..10]/[1.. 5]	Switching the voltage output
[H.]	Scaling the analogue output end value
[L.]	Scaling the analogue output start value
[----]	Numerical display is switched off
[IOL]	Flashes 3x when Edit mode is blocked by IO-Link
[SUP.P]	Error message: supply pressure is outside the set limits (SP_{min}/SP_{max})
[CLER]	Device has been reset to factory settings
	Graphic display of the current distance-correlated value for InA and InB in relation to the set switching point – The bar graph for InA is always active. – The bar graph for InB is only active if the binary signal OutB is assigned to the switching output at Pin 2.

1) "A" flashes when IO-Link communication is active

Tab. 2: Symbols on the display

4.1.2.2 Bar graph on the display

Display		Description
	Segment at the bottom left and [A] flash	– INFO mode active. – 7-segment display shows the input value InA.
	Segment at the bottom left and [A] light, [min] or [max] flash.	– SHOW mode active. – 7-segment display shows the minimum or maximum value InA.
	Segment at the bottom right and [B] flash.	– INFO mode active. – 7-segment display shows the input value InB.
	Segment at the bottom right and [B] light, [min] or [max] flash.	– SHOW mode active. – 7-segment display shows the minimum or maximum value InB.

Display		Description
	Segments at the bottom right and left and [C] flash.	– INFO mode active. – 7-segment display shows the input value InC.
	Segments at the bottom left and right and [C] light, [min] or [max] flash.	– SHOW mode active. – 7-segment display shows the minimum or maximum value InC.
	Marked segments light and [Option] flashes.	– EDIT mode active. – Special menu opens. – 7-segment display shows the set option.
	Marked segments light and [Lock] flashes.	– EDIT mode active. – Special menu opens. – 7-segment display shows the security code.

Tab. 3: Special bar graphs on the display

4.2 Function

4.2.1 Operating statuses

Operating status	Function
RUN mode	– Basic status after the operating voltage is applied – Numerical and graphic display of distance-correlated values (bar graph) – Display of measured values for supply pressure (in bar) – Display of the signal statuses of the binary signals OutA, OutB, OutC
INFO mode	– Display of input variables in the display – Switch the display by pressing the A-pushbutton, B-pushbutton or A and B-pushbuttons simultaneously.
SHOW mode	– Display of current settings for the binary signals, – Display and reset of the min/max values for the correlating distance value and the supply pressure
EDIT mode	– Setting or alteration of the parameters for the air gap sensor (switching outputs, display)
TEACH mode	– Teaching of the switching points for the correlating distance values (transfer of the current value as switching threshold)

Tab. 4: Operating statuses

4.2.2 Switching outputs

4.2.2.1 Switching signals

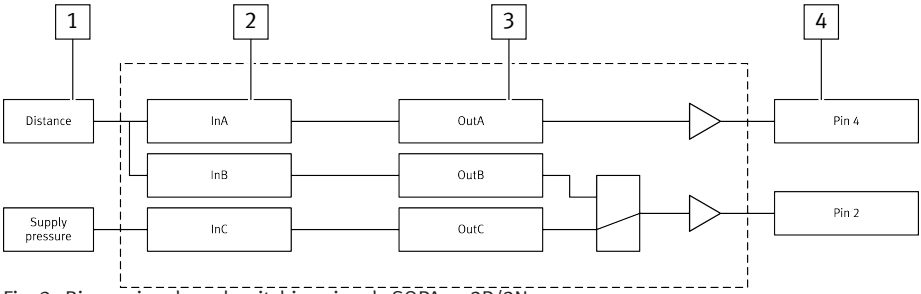


Fig. 3: Binary signals and switching signals SOPA-...-2P/2N-...

1 Sensing variable
2 Input signal
3 Binary signal
4 Switching signal at sensor module plug

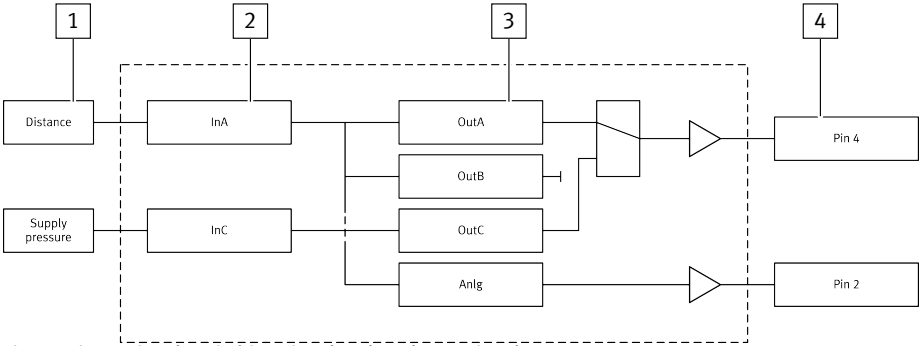


Fig. 4: Binary signal, switching signal and analogue signal SOPA -...- PNLK -...

1 Sensing variable
2 Input signal
3 Binary signal
4 Switching signal at sensor module plug

Switching output for OutA or OutB, analogue output

The switching outputs OutA and OutB and the analogue output are permanently assigned to the distance input variable. The setting is made via teach-in, display and buttons or via IO-Link (SOPA-...-PNLK-...).

Switching output for OutC

The switching output OutC is permanently assigned to monitoring the supply pressure. The setting is made via the display and buttons or via IO-Link (SOPA-...-PNLK-...). The binary signal at OutC acts as an enable signal for OutA and OutB.

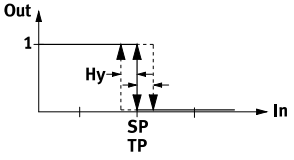
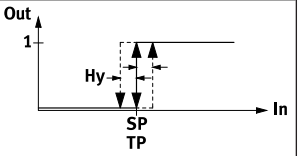
If the supply pressure is outside the switching window of OutC, [SUP.P] appears in the display. The sensor module is then unable to conduct a correct distance monitoring procedure. It is not possible to teach the binary signals in this case.

4.2.2.2 Switching functions

The binary signals OutA and OutB can be configured independently of one another. The threshold value switching function is assigned to the binary signal OutA and OutB (distance input variable). The window comparator switching function is assigned to the binary signal OutC (supply pressure input variable).

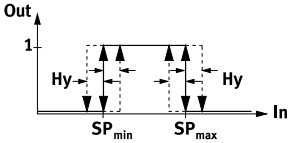
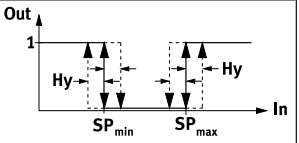
- The switching element function 'normally closed contact' (N/C) or 'normally open contact' (N/O) can be assigned to each binary signal.
- The switching point (SP) and hysteresis (HY) can be set for the binary signals OutA and OutB. Only the switching points can be adjusted for OutC.

Threshold value comparator for distance monitoring (OutA and OutB)

Function	N/O (normally open)	N/C (normally closed)
In: Distance		
Switching function: – 1 switching point (SP)		
TEACH mode: – 1 teach-in point (TP = SP)		

Tab. 5: Threshold value comparator with switching point (SP) and hysteresis (HY)

Window comparator for supply pressure monitoring (OutC)

Function	N/O (normally open)	N/C (normally closed)
In: supply pressure		
Switching function: – 2 switching points (SP_{min}, SP_{max}) – IO-Link: – SP1 = SP_{min} – SP2 = SP_{max}		
no TEACH mode		

Tab. 6: Window comparator with switching point (SP) and hysteresis (HY)

Hysteresis

Hysteresis serves to suppress switching signals in the event of fluctuations around the switching point (both sides in this case). The reset points function as long as the value is within the hysteresis range.

- Upper reset point = switching point (SP) + hysteresis (HY)
- Lower reset point = switching point (SP) - hysteresis (HY)

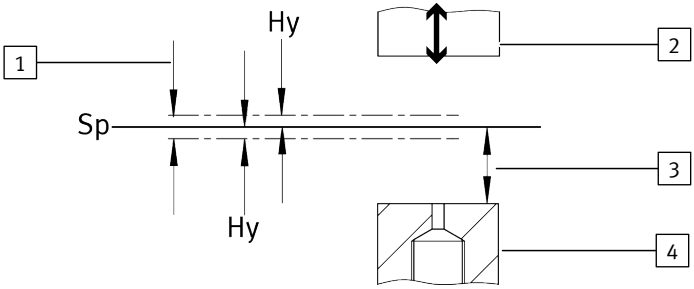


Fig. 5: Sensing range with switching points

1 Range in which the switching signals are suppressed in the event of fluctuations around the switching point (SP)

2 Object

3 Sensing distance

4 Measuring nozzle

4.2.3 Functional Principle

The system consists of two sub-components. The control module provides a compressed air preparation that is adapted to the supply pressure of the sensor module, as well as the functionality for switching measuring and exhaust air. Up to 4 sensor modules contain the sensory functions. The sensor modules can be operated both individually and in combination with the control module.

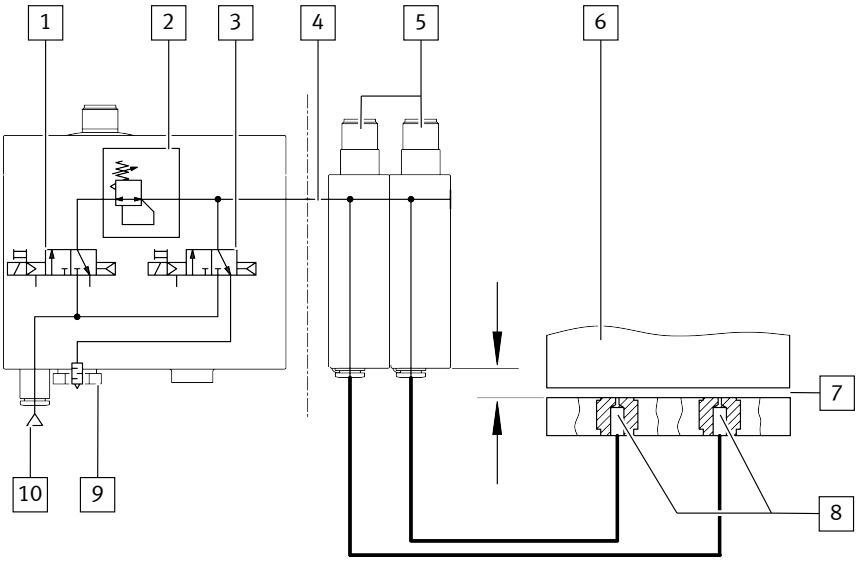


Fig. 6: Configuration with a control module and two sensor modules

1 3/2-way valve (instrument air)	6 Object (example)
2 Pressure regulator	7 Air gap
3 3/2-way valve (exhaust air)	8 Measuring nozzles (1 per sensor module)
4 Supply pressure	9 Vent screw
5 Sensor modules (pneumatically linked)	10 Supply port for operating pressure

The compressed air flows from the sensor modules to the measuring nozzles. If the object is very close to a measuring nozzle, the air gap is very small and only a small amount of air flows through. As the object gets further away, the air gap becomes larger and more air flows through. The change in flow rate is detected by the sensor modules, converted into a distance-correlated value and displayed (speed measuring method with ejector).

4.2.4 Analogue output

Analogue output

The analogue output (distance monitoring) is available as voltage output 0 ... 10 V or 1 ... 5 V or as current output 4 ... 20 mA.

Scaling of the analogue output

The analogue output at pin 2 of the electrical connection can be scaled. In the delivery status the output characteristic curve at its end points (0 ... 10 V or 1 ... 5 V or 4 ... 20 mA) is allocated to the value 0 ... 300 displayed correlated to the distance.

To scale the output characteristic curve, the effective range can be adapted for the distance input variable ➔ Tab. 7 . The scaling of the analogue signal means that only a limited sensing range affects the entire stroke of the analogue output (zoom function). This zoom function can be used to improve the resolution of the analogue output.

Function	Parameter	Value range
Scaling of the analogue output to an upper end value of the display range	[H.]	50 ... 400
Scaling of the analogue output to a lower start value of the display range	[L.]	0 ... 200
Minimum distance between [H.] and [L.]		50

Tab. 7

4.2.5 Filter

The analogue signal can be smoothed with the low-pass filter. Smoothing also changes the rise and fall time. Filtering only affects the analogue output. The filter time corresponds to the time constant τ of a low-pass filter. If there is a sudden change in flow, the system reacts with a delay. According to the set time constant τ the signal at the output of the filter has risen to 63.2% of the end value.

4.2.6 Replicating parameters

This function enables all settings that have been carried out on one sensor (master) to be transferred to other identical sensors (device).
Parameters are transferred with the IO-Link functions. The previously configured sensor (master) is set to a master mode, which enables it to transfer its parameters to an identical device (same device ID).

4.2.7 Minimum/maximum value

The minimum values and the maximum values for the flow measurement are displayed and reset in the SHOW mode.

i

Switching off the operating voltage resets the minimum and maximum values.

4.2.8 Security code

The settings can be protected from unauthorised access by setting a numerical code of up to 4 digits ➔ 7.14 Setting security code (EDIT mode). The security code must be entered every time a setting is changed (EDIT mode and TEACH mode).

4.2.9 Graphic distance monitoring

Function of the bar graph in RUN mode

The “distance” input variable is assigned to the two bar graphs. The bar graphs show the current position of the object proportional to the value of the relevant switching point.

- Object outside the sensing range: all segments lit (maximum distance).
- Object approaches the switching point: the red segments switch off one after the other.
- Object has reached the switching point: all red segments are switched off, all green segments are on.
- Object approaches the measuring nozzle: the green segments switch off one after the other.

i

Both sets of bars are only active if the switching output at Pin 2 is assigned to the binary signal Out B.
The bars run synchronously if OutA and OutB have the same switching point.
If different switching points have been set, the bars are asynchronous to one another.

No.[1])	Bar graph	Switches off if	Description
9	Display red	Distance ≤ 1.6 x switching point	Object outside the specified switching range[2])
8		Distance ≤ 1.4 x switching point	
7		Distance ≤ 1.2 x switching point	
6		Distance ≤ 1.0 x switching point	
5	Display green	Distance ≤ 0.8 x switching point	Object within the specified switching range[2])
4		Distance ≤ 0.6 x switching point	
3		Distance ≤ 0.4 x switching point	
2		Distance ≤ 0.2 x switching point	
1		always on	Sensor ready for operation

1) Segment number
2) The switching point of OutA and OutB is between segments 5 and 6

Tab. 8: Bar graph in the RUN mode

5 Assembly

5.1 Measuring Nozzles

Measuring Nozzle Geometry

NOTICE

Damage due to Ingress of Foreign Matter or Liquids

In the event of an inappropriate measuring nozzle configuration or inappropriate routing of the compressed air lines, foreign matter or liquids (e.g. condensation) can enter the product and cause a malfunction or damage the product.

- Prevent the entry of foreign matter and liquids through design measures, for example through a suitable configuration of the measuring nozzles.

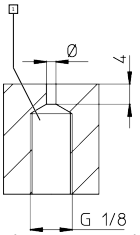


Fig. 7: Measuring Nozzle Geometry

1 Measuring nozzle

1. Take the measuring nozzle geometry into account.
   – Diameter: 1.5 mm / 2.0 mm (nominal diameter) / 2.5 mm
2. Execute the outlet of the nozzle with sharp edges. Sharp edges at the outlet opening are permissible.

Measuring Nozzle Configuration

1. Ensure air outlet.
   In the event of gap distance queries of < 30 µm, it may be necessary to reset the outlet openings of the nozzles by 30 ... 60 µm after the bearing surface in order to permit air discharge. The bearing surface, in which the measuring nozzles are mounted, must be provided with ducts that permit exhaust to the outside.
2. Comply with permissible tube lengths between the sensor module and measuring nozzle .

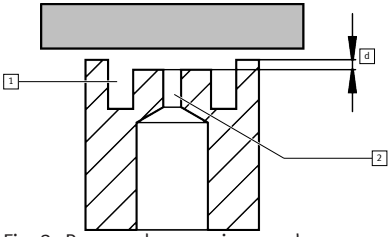


Fig. 8: Recessed measuring nozzle

d Distance 30... 60 µm

2 Measuring nozzle

1 Air duct (example)

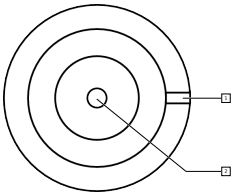


Fig. 9: Exhausting

1 Air duct (example)

2 Measuring nozzle

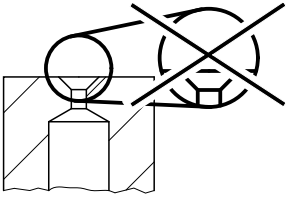
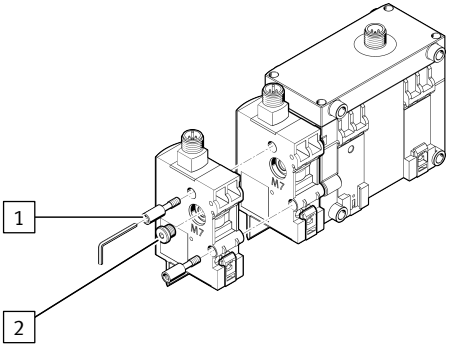


Fig. 10: Impermissible measuring nozzle configuration

5.2 Assembling sensor module with control module

One control module can be connected to a maximum of 4 sensor modules.



1 Blanking plug

2 Threaded sleeve

Fig. 11: Mounting the sensor module

1. Loosen the blanking plugs with an internal hexagon key.
   - Spanner size (A/F): 3 mm
2. Make sure the sealing ring on the sensor module is seated properly.
3. Press the sensor module lightly and tighten the threaded sleeve with an internal hexagon key.
   - A/F: 2.5 mm
   - Tightening torque: 0.5 Nm
4. Tighten the blanking plugs on the last sensor module by hand.
   - A/F: 3 mm

5.3 Mounting the sensor module

NOTICE

Damage due to Ingress of Foreign Matter or Liquids

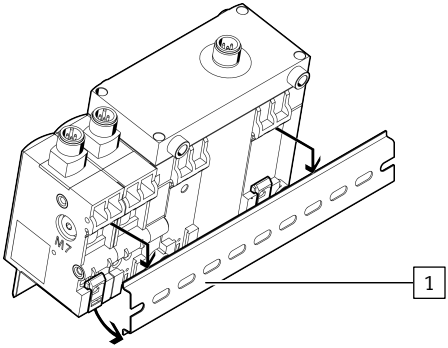
In the event of an inappropriate measuring nozzle configuration or inappropriate routing of the compressed air lines, foreign matter or liquids (e.g. condensation) can enter the product and cause a malfunction or damage the product.

- Prevent the entry of foreign matter and liquids through design measures, for example through a suitable configuration of the measuring nozzles.

Arrange the measuring nozzles

1. Place sensor module above the measuring nozzles ➔ Fig. 6.
2. Use suitable tubing length: 0.5 ... 8 m

5.3.1 H-rail mounting



1 H-rail

Fig. 12: H-rail mounting

1. Attach H-rail mounting to the H-rail.
2. Press the H-rail mounting in the direction of the arrow until the mounting slide catches.

5.3.2 Plate mounting

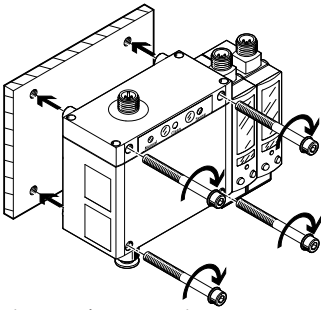
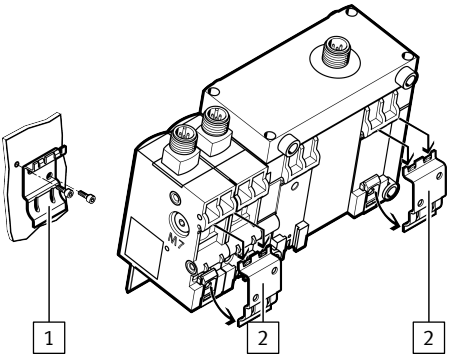


Fig. 13: Plate mounting

1. Prepare threaded holes M5 ➔ 13.3 Hole patterns.
2. Guide screws through the sensor and tighten. Use washers.
   – Tightening torque: 0.8 Nm

5.3.3 Wall mounting



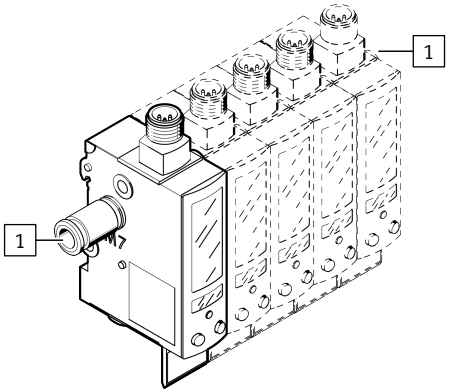
1 Adapter plate for wall mounting
2 Adapter plate

Fig.14

1. Mount the adapter plates on the wall.
   – Hole patterns and dimensions ➔ 13.3 Hole patterns.
2. Attach the sensor to the adapter plates and press until the fastening slide locks.

5.4 Using sensor module without control module

The supply pressure can be fed from the left and the right-hand side.



1 Connection for supply pressure

Fig. 15: Attach the sensor modules

1. Mount the fitting on the supply pressure port.
   – Thread M7, thread length: max. 5.5 mm
2. Seal the exposed port with a blanking plug.
   – A/F: 3 mm

5.5 Accessories

Identifier		Type
Connecting cable	Straight socket	NEBU-M12G5-K-...
	Angled socket	NEBU-M12W5-K-...
Differential pressure regulator		LRLL-1/8-QS-6
Adapter plate for wall mounting[1)]		SXE3-...-W...
Blanking plug		B-M7
Push-in fitting		QSM-M7-6-I

1) Included in the scope of delivery for SOPA-...-W-...

Tab. 9: SOPA accessories

6 Installation

6.1 Pneumatic Installation

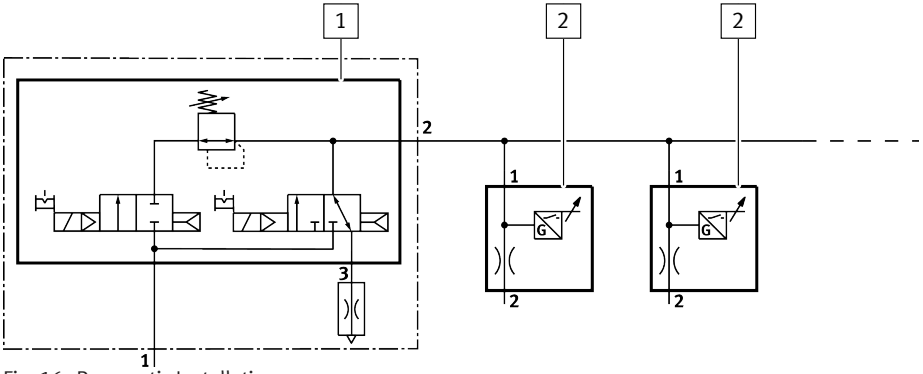


Fig. 16: Pneumatic Installation

1 Control module

2 Sensor module

1. Insert tubing into push-in fitting.
   – Outside diameter: 6 mm
2. Connect the supply port for the measuring nozzle to the corresponding measuring nozzle ➔ Fig. 6.
3. For operation with a control module: connect supply port for operating medium to the compressed air source.
   For operation without a control module: connect the supply port for the supply pressure to the precision pressure regulator.
4. Ensure adequate exhaust at the vent screw connection (via vent screw or differential pressure regulator (LRLL-1/8-QS-6) ➔ Fig. 1.

Tubing at Standstill

- To avoid contamination of the measuring nozzles, remove the vent screw and use this connection to supply purge air.

6.2 Electrical installation

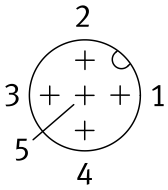
⚠ WARNING

Risk of injury due to electric shock.

- For the electrical power supply, use only PELV circuits in accordance with IEC 60204-1/EN 60204-1 (Protective Extra-Low Voltage, PELV).
- Observe the general requirements of IEC 60204-1/EN 60204-1 for PELV circuits.
- Only use voltage sources that ensure a reliable electric separation from the mains network in accordance with IEC 60204-1/EN 60204-1.

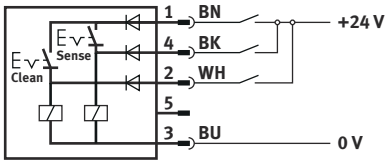
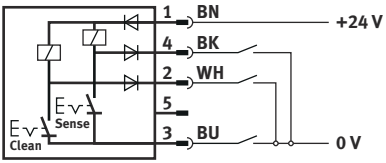
1. Use signal lines that are shorter than 30 m.
2. Configure binary outputs according to the wiring (only with PNLK sensor modules).
   – Tightening torque for the union nut at the plug connector: 0.3 Nm

6.2.1 PIN allocation and control module circuit diagrams

Pin	Wire colour[1)]	Allocation	Plug
1	Brown (BN)	Operating voltage +24 V DC	M12, 5-pin 
2	White (WH)	Switch on signal input exhaust air (Clean)	
3	Blue (BU)	Operating voltage 0 V	
4	Black (BK)	Switch on measuring air signal input (Sense)	
5	Grey (GY)	n.c = free (not connected)	

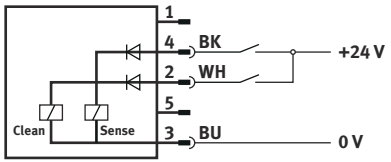
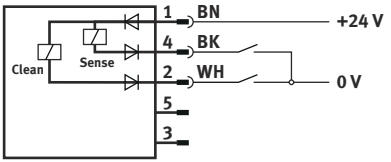
1) When using the connecting cable from the accessories.

Tab. 10: Pin allocation for control module

SOPA-C..-H-...-2P-...[1)]	SOPA-C..-H-...-2N-...
	
PNP	NPN

1) in combination with PNLK sensor modules

Tab. 11: Circuit diagrams for control module with manual override

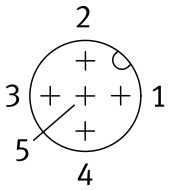
SOPA-C-...-2P-...[1)]	SOPA-C-...-2N-...
	

1) in combination with PNLK sensor modules

Tab. 12: Circuit diagrams for control module without manual override

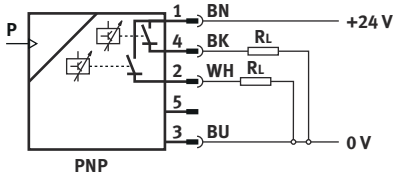
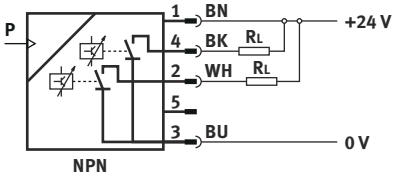
6.2.2 PIN allocation and sensor module circuit diagrams

SOPA-...-2P/-2N

Pin	Wire colour[1)]	Allocation	Plug
1	Brown (BN)	Operating voltage +24 V DC	M12, 5-pin 
2	White (WH)	Switching output for OutB or OutC (factory setting)	
3	Blue (BU)	Operating voltage 0 V	
4	Black (BK)	Switching output for OutA	
5	Grey (GY)	n.c = free (not connected)	

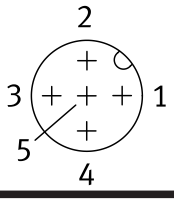
1) When using the connecting cable from the accessories.

Tab. 13: Pin allocation for sensor module

SOPA-...-2P-M12-...	SOPA-...-2N-M12-...
	

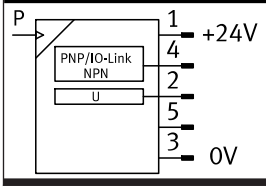
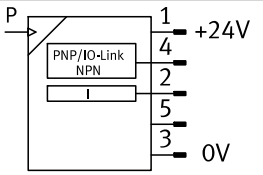
Tab. 14: Circuit diagrams for sensor module

SOPA-...-PNLK

Pin	Wire colour[1)]	Allocation	Plug
1	Brown (BN)	Operating voltage +24 V DC	M12, 5-pin 
2	White (WH)	Analogue output	
3	Blue (BU)	Operating voltage 0 V	
4	Black (BK)	Switching output for OutA or OutC (C/Q line with IO-Link)	
5	Grey (GY)	n.c = free (not connected)	

1) When using the connecting cable from the accessories.

Tab. 15: Pin allocation for sensor module

SOPA-...-PNLK-VB-...	SOPA-...-PNLK-A-...
	

Tab. 16: Circuit diagrams for sensor module

7 Commissioning

7.1 Switching on the Sensor (RUN mode)

- Switch on the operating voltage.
  - ↳ Current measured value is displayed. The sensor is in the basic status (RUN mode).

The basic static can be established using the following actions:

– Pressing Edit button for 3 seconds
– Expiration of monitoring time (timeout)

7.2 Menu structure (EDIT mode)

Some menu options or setting values are not applicable depending on the product variant and the selected switching function.

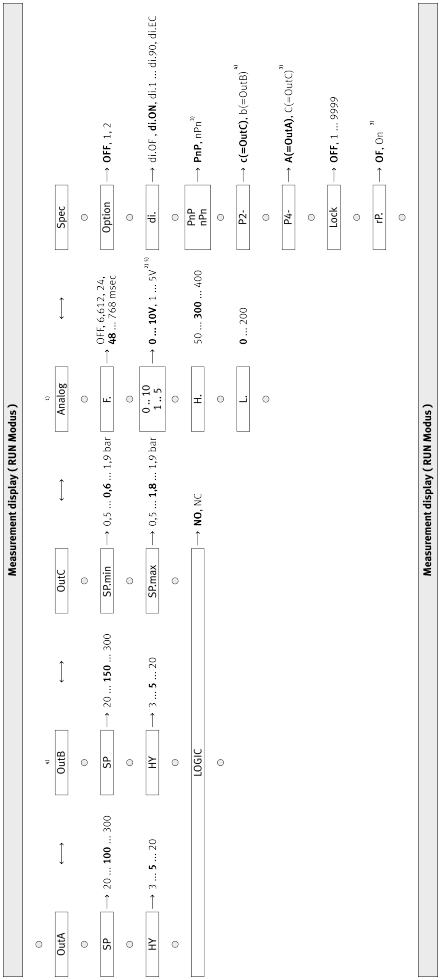


Fig. 17: EDIT mode menu structure

Key	Meaning
○	Edit button
↓	A or B pushbutton
bold	Factory setting
1)	Menu column only for PNLK-VB/A
2)	Menu item only with PNLK-VB

Key	Meaning
3)	Menu item only for PNLK-VB/A
4)	Menu column and menu item only for 2P/2N

Tab. 17: Legend for menu structure EDIT mode

7.3 Displaying parameters (INFO/SHOW mode)

Requirement: the sensor is ready for operation (RUN mode).

1. Press A button, B button or A and B button.
   - ↳ Display shows the relevant input value or an error number.
2. To display each of the following parameters, press the A button, B button or A and B button .
3. At the end of the SHOW mode, the relevant minimum and maximum values are displayed. To reset the display of the minimum and maximum values, press the Edit button.
   - ↳ RUN mode is active.

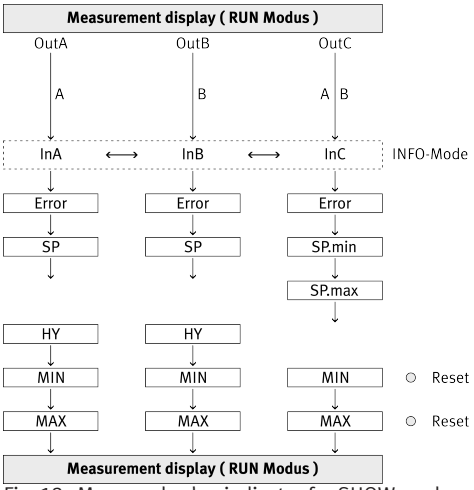


Fig. 18: Measured value indicator for SHOW mode

Key	Meaning
○	Edit button
↓	A button, B button or A and B button

Tab. 18: Legend for measured value indicator (RUN mode)

7.4 Starting EDIT Mode

Requirement: The sensor is ready for operation (RUN mode).

1. Press the Edit button.
   - ↳ EDIT mode is active. [Out A] flashes. With active security blocking, [Lock] flashes.
2. Enter security code with A or B pushbutton.

3. Press the Edit button.
   ↳ EDIT mode is active and [Out A] flashes.

7.5 Setting the switching characteristics of the binary signals (EDIT mode)

– The distance monitoring function can be set for the binary signals OutA and OutB.
– The supply pressure monitoring function can be set for binary signal OutC ➔ 4.2.2.1 Switching signals.

Setting distance monitoring for OutA

i

The procedure for setting the distance monitoring for OutA and OutB is basically identical. The procedure is described below based on the binary signal OutA.

Requirement: EDIT mode is active.

1. Select [OutA] with the A or B pushbutton.
2. Press the Edit button to confirm the selection.
   ↳ [SP] flashes.
3. Set switching point with the A or B pushbutton.
4. Press the Edit button to confirm the set value.
   ↳ [HY] flashes.
5. Set value for hysteresis with A or B pushbutton.
6. Press the Edit button to confirm the set value.
   ↳ [NO] or [NC] flashes.
7. Select the switching element function with the A or B pushbutton.
8. Press the Edit button to confirm the selection.
   ↳ RUN mode is active.
9. Use a test run to check that the sensor switches as desired (switching point and hysteresis).

Setting supply pressure monitoring for OutC

i

The binary signal OutC is pre-configured for monitoring the supply pressure with the control module SOPA-C.
A change in the switching points only makes sense if a precision controller is used to operate the sensor modules.

Requirement: EDIT mode is active.

1. Select [OutC] with the A or B pushbutton.
2. Press the Edit button to confirm the selection.
   ↳ [SP min] flashes.
3. Set switching point (SP_{min}) with the A or B pushbutton.
4. Press the Edit button to confirm the set value.
   ↳ [SP max] flashes.
5. Set switching point (SP_{max}) with the A or B pushbutton.

6. Press the Edit button to confirm the set value.
   ↳ [NO] or [NC] flashes.
7. Select the switching element function with the A or B pushbutton.
8. Press the Edit button to confirm the selection.
   ↳ RUN mode is active.
9. Use a test run to check that the sensor switches as desired (switching point and hysteresis).
10. Recommendation: after changing the switching points for OutC, re-teach the value for OutA.

7.6 Setting analogue output with ... -PNLK-A (EDIT mode)

Requirement: EDIT mode is active.

1. Select [Analogue] with the A or B pushbutton.
2. Press the Edit button to confirm the selection of the output.
   ↳ [F.] flashes.
3. Set end value of the display range of the scaling.
4. Press the Edit button to confirm the set value.
   ↳ [H.] flashes.
5. Press the Edit button to confirm the set value.
   ↳ [L.] flashes.
6. Set start value of the display range of the scaling.
7. Press the Edit button to confirm the set value.
   ↳ RUN mode is active.

7.7 Setting analogue output with ... -PNLK-VB (EDIT mode)

Requirement: EDIT mode is active.

1. Select [Analogue] with the A or B pushbutton.
2. Press the Edit button to confirm the selection of the output.
   ↳ [F.] flashes.
3. Set time constant for low-pass filter with the A or B pushbutton.
4. Press the Edit button to confirm the set value.
   ↳ – [0..10] or [1.. 5] flashes.
5. Set the voltage range of the analogue output.
6. Press the Edit button to confirm the set value.
   ↳ [H.] flashes.
7. Set end value of the display range of the scaling.
8. Press the Edit button to confirm the set value.
   ↳ [L.] flashes.
9. Set start value of the display range of the scaling.
10. Press the Edit button to confirm the set value.
    ↳ RUN mode is active.

7.8 Teaching the switching points (TEACH mode)

i

The process for teaching the switching outputs OutA (A pushbutton) and OutB (B pushbutton) is basically identical. The procedure is described below based on the binary signal OutA.

1. Establish the desired switching distance between the object and the measuring nozzle.
2. Press and hold the A pushbutton.
3. Also press the Edit button.
   - [OutA] and [TeachIn] flash. The value is adopted as the switching point.
   - [Lock] flashes: security lock active. The value is buffered.
4. Enter the set security code using the A or B pushbutton.
5. Press the Edit button.
   - [OutA] and [TeachIn] flash. The cached value is accepted as the switching point.
   - RUN mode is active.

7.9 Setting the spurious pulse suppression (EDIT mode)

If measuring or exhaust air is switched on and off during operation, spurious pulses are generated (excessive fluctuations in supply pressure). Spurious pulses can be suppressed in the air gap sensor SOPA by adjusting the parameters [Options].

Requirement: EDIT mode is active.

1. Select the Special menu [Spec] with the A or B pushbutton.
   - [SPEC] flashes.
2. Press the Edit button repeatedly until [Option] is displayed.
3. Select parameters with A or B key ➔ Tab. 19 Options for spurious pulse suppression.
4. Press the Edit button to confirm the set value.
   - The next adjustable parameter is shown.

Option	Meaning
Off	Spurious pulse suppression switched off (factory setting). Setting optimised for short response times (spurious pulse suppression can be implemented using a higher-order controller).
1	Spurious pulse suppression when using the measuring air on/off function with deactivated exhaust air
2	Spurious pulse suppression with use of the exhaust air on/off function and with measuring air continuously on

Tab. 19: Options for spurious pulse suppression

7.10 Switch off display (EDIT mode)

The numerical display (7-segments) for the distance-correlated value and the backlighting of the display can be switched off permanently or with an adjustable delay time. Both settings allow time-limited use of the INFO mode and the SHOW mode.

Switch off 7-segment display/backlighting

Requirement: EDIT mode is active.

1. Select the Special menu [Spec] with the A or B pushbutton.
   ↳ [Spec] flashes.
2. Press the Edit button repeatedly until [di.] flashes.
3. Select parameter with A or B pushbutton.
   – [di.OF]: 7-segment display is off.
   – [di.ON]: 7-segment display is permanently on.
   – [di.1] ... [di.90]: 7-segment display switches off automatically after the set duration (in minutes).
   – [di.EC]: backlighting of the display switches off automatically after 60 seconds.
4. Press the Edit button to confirm the set value.
   ↳ The next adjustable parameter is shown.

7.11 Changeover of binary output OutA (EDIT mode)

Requirement: EDIT mode is active.

1. Select the Special menu [Spec] with the A or B pushbutton.
   ↳ [Spec] flashes.
2. Press the Edit button repeatedly until [PnP] or [nPn] flashes.
3. Select function of the binary output with A or B pushbutton.
4. Press the Edit button to confirm the set value.
   ↳ The next adjustable parameter is shown.

7.12 Setting the allocation of the switching output at Pin 2 (EDIT mode)

Requirement: EDIT mode is active.

1. Select the Special menu [Spec] with the A or B pushbutton.
   ↳ [Spec] flashes.
2. Press the Edit button repeatedly until [P2-] flashes.
3. Select parameter with A or B pushbutton.
   – b = OutB = additional switching point for distance monitoring
   – c = OutC = supply pressure monitoring
4. Press the Edit button to confirm the set value.
   ↳ The next adjustable parameter is shown.

7.13 Setting the allocation of the switching output at Pin 4 (EDIT mode)

Requirement: EDIT mode is active.

1. Select the Special menu [Spec] with the A or B pushbutton.
   ↳ [Spec] flashes.
2. Press the Edit button repeatedly until [P4-] flashes.
3. Select parameter with A or B pushbutton.
   – A = OutA = additional switching point for distance monitoring
   – c = OutC = supply pressure monitoring
4. Press the Edit button to confirm the set value.
   ↳ The next adjustable parameter is shown.

7.14 Setting security code (EDIT mode)

i

If you forget the security code, the SOPA must be reset to its factory settings ➔ 9.2 Restoring Factory Settings (Restore).

Requirement: EDIT mode is active.

1. Select the Special menu [Spec] with the A or B pushbutton.
2. Press the Edit button repeatedly until [Lock] flashes.
3. Select with the A or B pushbutton between inactive security code (OFF) or maximum 4-digit security code.
4. Press the Edit button to confirm the set value.
   ↳ RUN mode is active.

7.15 Replicating parameters (EDIT mode)

Requirements: EDIT mode is active.

1. Select the Special menu [Spec] with the A or B pushbutton.
   ↳ [Spec] flashes.
2. Press the Edit button repeatedly until [rP.] flashes.
3. Select parameter [rP.On] with the A or B pushbutton.
4. Press the Edit button.
   ↳ [rP.rd] is displayed.
5. Press the A or B pushbutton to activate the transfer.
   ↳ – [rP.rn] is displayed.
   – All parameters are transferred from the master sensor to the device sensor.
   – [rP.rn] is displayed on completion of the transfer. [rP.Co] or [rP.Id] is displayed in case of error ➔ 11.1 Error messages.
6. To end the replication function, press the Edit button.
   ↳ RUN mode is active.

8 IO-Link interface description

8.1 General information, IO-Link

Characteristic	Specification
Protocol version	Device V1.1
Profile	Smart Sensor Profile (0x0001) Identification and Diagnosis (0x4000)
Function classes	Device Identification (0x8000) Switching Sensor Channel (0x8001) Process Data Variable (0x8002) Device Diagnosis (0x8003) Teach Channel (0x8004) Extended Identification (0x8100)
Communication mode	COM2 (38.4 kbaud)
SIO-Mode support	yes
Port class	A
Process data length OUT	0 byte
Process data length IN	2 byte
Process data content IN	Distance monitoring SSC1 (Switching Signal Channel 1) Distance monitoring SSC2 (Switching Signal Channel 2) Supply pressure monitoring SSC3 (Switching Signal Channel 3) Distance 10 bit PDV (Process Data Variable)
Service data IN	supply pressure 14 bit
Min. cycle time	3 ms
Data storage required	0.5 KB
Vendor ID	333
Device ID	➔ Tab. 21 Device ID values

Tab. 20: General IO-Link specification

Device ID	Order code
192	SOPA-PNLK-VB
193	SOPA-PNLK-A

Tab. 21: Device ID values

8.2 Identification parameters

Index	Sub Index	Name	Value	Access[1]	Length [Byte]	Format
0x0010	0	Vendor Name	Festo	R	5	String
0x0011	0	Vendor Text	http://www.festo.com	R	20	
0x0012	0	Product Name	Order code, e.g. SOPA-M1-R1-H-PNLK-VB-M12	R	max. 64	
0x0013	0	Product ID	Part Number, e.g. 8093816	R	7	
0x0014	0	Product Text	Air gap sensor	R	15	
0x0015	0	Serial Number	Product Key, e.g. 3S7PL9V6HHM	R	11	
0x0016	0	Hardware Revision	e.g. REV01	R	5	
0x0017	0	Firmware Revision	e.g. V26.4.17	R	12	
0x0018	0	Application Specific Tag[2]	***	R/W	32	
0x0019	0	Function Tag[2]	***	R/W	32	
0x001A	0	Location Tag[2]	***	R/W	32	
0x2101	0	Part Number	e.g. 8093816	R	7	

1) R = read, R/W = read and write
2) Value defined by user

Tab. 22: Identification parameters

8.3 IO-Link default parameters

Index	Sub Index	Name	Value	Access[1)]	Length [Byte]	Format
0x0002	0	System Command	➔ 8.4 IO-Link default commands	W	1	UInterger8
0x000C	0	Device Access Locks ➔ Tab. 24 Device access blocking	bit-wise: 0 = unblocked 1 = blocked	R/W	2	Record
0x0020	0	Error Count	0	R	2	UInterger16
0x0024	0	Device Status	0	R	1	UInterger8
0x0025	0	Detailed Device Status	➔ Tab. 35 Status messages	R	24	Array of 3-byte data records
0x0028	0	Process Data Input	➔ 8.9 Process data IN	R	2	Record

1) R = read, R/W = read and write

Tab. 23: IO-Link default parameters

Bit no.	Description
0	Block parameter write access (no effect)
1	Block data storage (no effect)
2	Block local parameterisation (EDIT and TEACH mode)
3	Block local user interface (SHOW, EDIT and TEACH mode)

Tab. 24: Device access blocking

8.4 IO-Link default commands

Value [dec]	Value [hex]	Access[1])	Command	Description
65	0x41	W	SP1 Single Value Teach	Determines the teach-in point for switching point SP1.
128	0x80	W	Device reset	Warm start of the device.
129	0x81	W	Application reset	Application-specific parameters are reset.
130	0x82	W	Restore factory settings	Reset the configuration and the parameters to the original condition (default)
160	0xA0	W	Reset min. distance PDV (InA)	Minimum InA-measurement value is reset.
161	0xA1	W	Reset max. distance PDV (InA)	Maximum InA-measurement value is reset.
164	0xA4	W	Reset min. supply pressure PDV (InC)	Minimum InC measured value is reset.
165	0xA5	W	Reset max. supply pressure PDV (InC)	Maximum InC measured value is reset.

1) W = write, - = no access

Tab. 25: Additional IO-Link default commands

8.5 Smart sensor profile parameters

Index	Sub Index	Name	Value	Access[1)]	Length [Byte]	Format
0x000D	0	Profile Characteristics		R	12	Array of UInteger16
	1	Device Profile ID	0x0001: Smart Sensor Profile	R	2	UInteger16
	2		0x4000: Identification and Diagnosis	R	2	
	3	Function Class ID	0x8001: Switching Sensor Channel	R	2	
	4	Function Class ID	0x8004: Teach Channel	R	2	

Index	Sub Index	Name	Value	Access[1)]	Length [Byte]	Format
0x000E	0	PDInput Descriptor		R	6	Array of Octet-String3
	1	SSC1, SSC2, SSC3	0x01, 0x03, 0x00	R	3	Octet-String3
	2	PDV	0x02, 0x0A, 0x06	R	3	Octet-String3
0x003A	0	Teach-In Channel	0 - SSC1 (OutA), default	R/W	1	UInteger8
			1 - SSC1 (OutA)			
			2 - SSC2 (OutB)			
0x003B	0	Teach-In Status	0	R	1	Record
	1	Teach Flag TP2 for SP2	not used	R	1	BooleanT
	2	Teach Flag TP1 for SP2		R	1	
	3	Teach Flag TP2 for SP1		R	1	
	4	Teach Flag TP1 for SP1		R	1	
	5	Teach State	0	R	1	UInteger4
SSC1, distance monitoring (OutA)						
0x003C	1	Set point SP1 (SP)	20 ... 300, default: 100	R/W	2	UInteger16
	2	Set point SP2	Not used, default: 0		2	
0x003D	1	Switch point logic	0 - normally open (NO), standard		1	UInteger8
			1 - normally closed contact (NC)			
	2	Switch point mode	Not used, default: 132		1	
	3	Hysteresis (HY)	3 ... 20, default: 5		2	UInteger16

Index	Sub Index	Name	Value	Access[1)]	Length [Byte]	Format
SSC2, distance monitoring (OutB)						
0x003E	1	Set point SP1 (SP)	20 ... 300, default: 150	R/W	2	UInteger16
	2	Set point SP2	Not used		2	
0x003F	1	Switch point logic	0 - normally open (NO), default		1	UInteger8
			1 – normally closed contact (NC)			
	2	Switch point mode	Not used, default: 132		1	
	3	Hysteresis (HY)	3 ... 20, default: 5		2	UInteger16
SSC3, supply pressure monitoring (OutC)						
0x4000	1	Set point SP1 (SP.min)	4096 ... 15563, default: 4915	R/W	2	UInteger16
	2	Set point SP2 (SP.max)	4096 ... 15563, default: 14745		2	
0x4001	1	Switch point logic	0 - normally open (NO), default		1	UInteger8
			1 – normally closed contact (NC)			
	2	Switch point mode	Not used, default: 133		1	
	3	Hysteresis (HY)	Not used, default: 410		2	UInteger16

1) R = read, R/W = read and write, –= no access

Tab. 26: Smart sensor profile parameters

8.6 Device-specific parameters

Index	Sub Index	Name	Value	Access[1)]	Length [Byte]	Format
0x016A	0	Analog output scaling start distance value	0 ... 200, default: 0	R/W	2	UInteger16
0x016B	0	Analog output scaling final distance value	50 ... 400, default: 300	R/W		
0x016C	0	Analog output type[2)]	0 = 0 ... 10 V, default	R/W		
			1 = 1 ... 5 V			
0x01BE	0	Analog output filter time τ	0 = filter off	R/W		
			1 = 6 ms			
			2 = 12 ms			
			3 = 24 ms			
			4 = 48 ms, default			
			5 = 96 ms			
			6 = 192 ms			
			7 = 384 ms			
			8 = 768 ms			
0x01E0	0	Spurious pulse suppression (Option)	0 = option off, default	R/W		
			1 = option 1			
			2 = option 2			
0x01E3	0	Pin 4 selection	0 = OutA Distance monitoring, (default)	R/W		
			2 = OutC Supply pressure monitoring			
0x01E8	0	Backlight (Eco-Mode) or numerical display (always on/off or time to switch off after last key actuation)	0 = Eco mode	R/W		
			1 = always off			
			2 = always on, default			
			3 = 1 min			
			4 = 5 min			
			5 = 15 min			

Index	Sub Index	Name	Value	Access[1]	Length [Byte]	Format
0x01E8	0	Backlight (Eco-Mode) or numerical display (always on/off or time to switch off after last key actuation)	6 = 30 min 7 = 60 min 8 = 90 min	R/W	2	UInteger16
0x01EA	0	Lock code	0 - not blocked, default ≥ 1 (blocked for local parameter access)	R/W		
0x2001	0	PDV (InA) process value distance[3]	0 ... 2^{10} - 1	R		
0x2003	0	PDV (InC) process value, supply pressure monitoring[3]	0 ... 2^{14} - 1	R		
0x2005	0	InA Minimum detection value distance (MIN)[3]	0 ... 2^{10} - 1	R		
0x2006	0	InA Maximum detection value distance (MAX)[3]	0 ... 2^{10} - 1	R		
0x2009	0	InC minimal measured supply pressure value (MIN)[3]	0 ... 2^{14} - 1	R		
0x200A	0	InC maximal measured supply pressure value (MAX)[3]	0 ... 2^{14} - 1	R		

1) R = read, R/W = read and write, –= no access
2) only for SOPA-PNLK-VB
3) volatile (non-permanent) parameter

Tab. 27

8.7 IO-Link teach-in

Overview

IO-Link teach-in is only available for OutA and OutB on this device, each with one value for the threshold value comparator.

i

The IO-Link teach-in is only available for the monitoring channels SSC1 and SSC2

Only one teach point is required for the switching point function threshold value comparator.

i

Avoid excess pressure at the sensor

There must be no excess pressure at the sensor during the teach-in procedure. If there is excess pressure at the sensor, the teach-in procedure stops with the ISDU error message “Function currently not available” (0x8036). The sensor remains in Run mode.

Sequence

1. Set teach value for distance.
2. Select SSC channel via IO-Link.
3. Send teach-in command.
   - As soon as the teach-in command is sent successfully, the teach-in process starts. The display flashes alternately [t-IN], and [IOL]. Keys A, B and EDIT are blocked.

     i

     The teach point can be set several times with the command 0x41. The current measured process value is always used here. If the sent command is invalid for the current switching/ teach-in mode, the ISDU error message “Function currently not available” (0x8036) is output.
4. The device returns the teach-in status at the end of the teach procedure.

Data type for teach commands

All teach commands are in the format UInterger8. They must be sent with the index 0x0002 (Standard Command) subindex 0.

For more information see IO-Link Smart Sensor Profile ➔ 8.5 Smart sensor profile parameters.

No.	Action	OUT	Index	Sub-index	Data	Remarks
1	Set first teach value (distance)					
2	Select SSC channel	A	0x003A	0x00	0x01	Select teach-in channel 1 - OutA
		B	0x003A	0x00	0x02	Select Teach-In channel 2 - OutB
3	Send teach-in commands (teach-in value)		0x0002	0x00	0x41	Default command (0x0002 - 0x00) - Activate SP1individual value teach-in (0x41)
info	Teach-In status		0x003B	0x04	1 - taught-in, 0 -not taught	TP1 for SP1
			0x003B	0x02	1 - taught-in, 0 - not taught-in	TP1 for SP2

Tab. 28: IO-Link teach-in for _I¯¯ mode, single-point mode, threshold value comparator

8.8 Block parameterisation

Block parameterisation can be used to prevent individual parameter values from being incompatible with the values stored in the device. All parameters transmitted as a block will be simultaneously accepted and activated.

8.8.1 Block parameterisation for Distance monitoring SSC1 (OutA)

Index	Subindex	Name
0x003C	1	Set point SP1(SP)
	2	Set point SP2
0x003D	2	Switch point mode
	3	Hysteresis (HY)

Tab. 29: Block of coherent OutA parameters

8.8.2 Block parameterisation for Distance monitoring SSC2 (OutB)

Index	Subindex	Name
0x003E	1	Set point SP1(SP)
	2	Set point SP2
0x003F	2	Switch point mode
	3	Hysteresis (HY)

Tab. 30: Block of coherent OutB parameters

8.8.3 Block parameterisation for Supply pressure monitoringSSC3 (OutC)

Index	Subindex	Name
0x4000	1	Set point SP1 (SP.Min)
	2	Set point SP2(SP.Max)
0x4001	2	Switch point mode
	3	Hysteresis (HY)

Tab. 31: Block of coherent OutC parameters

8.8.4 Block parameterisation for analogue output

Index	Subindex	Name
0x016A	0	Analog output scaling start distance value
0x016B	0	Analog output scaling final distance value

Tab. 32: Block of coherent parameters for the analogue output

8.9 Process data IN

Bit	15	14 ...6	5 ... 3	2	1	0
Significance	MSB	–				LSB
Process data	Process Data Variable(PDV)			SSC3	SSC2	SSC1
Data content	Distance 10 bit PDV (InA/ InB)			OutC	OutB	OutA
Index	0x0028			0x0028		
Sub-Index	1			2	3	4
Data type	UInteger10			Boolean		

Tab. 33: Process data IN

8.10 Correction factors

Unit	Range [0 ... 2 bar]	
	Gain	Offset
mbar	0.122077763535	0
bar	0.000122077764	0
kPa	0.012207776354	0
MPa	0.000012207776	0
psi	0.001770591467	0
mmHg	0.091565891473	0
inch HG	0.003604956357	0
inch H_2O	0.049010559727	0
kgf/cm²	0.000124482695	0

Tab. 34: Conversion factors for InC PDV, InC PDV Min, InC PDV Max and OutC switching point SP1, SP2

8.11 Diagnostics IO-Link

8.11.1 Status messages

Status	Type	Definition
0	Reserved	Device is OK
1	Notification	Service required
2	Warning	Outside the specification
3	Error	Functional check
4	–	Failure

Tab. 35: Status messages

8.11.2 Diagnostic levels

Diagnostic level	Effect on display	Effect on keys and outputs	Description
0	–	–	Device is OK
1	Shows error no. in show mode	–	No restriction in function yet but operating parameters are deteriorating
2	Shows error no. in run mode	–	Errors in the sensor environment, no critical effect on basic sensor functions, can be corrected by the user

Diagnostic level	Effect on display	Effect on keys and outputs	Description
3	Shows error no. in run mode	Switching outputs and, if applicable, analogue outputs are set inactive	Errors in the sensor environment, no critical effect on basic sensor functions, can be corrected by the user
4	Display flashes with error no.	Switching outputs and, if applicable, analogue outputs set inactive, keys blocked	Hardware error on the device, e.g. defective EEPROM

Tab. 36: Diagnostic levels

9 Operation and use

9.1 Notes on operation

Type SOPA-C..

- To prevent contamination of the sensor modules and the measuring nozzles, switch on the measuring air.
- Activate the exhaust air to clean contaminated measuring nozzles.

The switching status of the valves, which are integrated in the control module and used for activating the measuring and exhaust air, is indicated by the status LED [Sense] and [Clean].

Type SOPA-C..-H

- The electric manual override function for the measuring and exhaust air on the control module can be deactivated by switching off the supply voltage for the manual override.
  - The LED which indicates the ready status of the manual override is then switched off.

9.2 Restoring Factory Settings (Restore)

i

By resetting to the factory settings, the current settings are lost. Note down current settings before resetting.

1. Switch off operating voltage.
2. Press and hold the A pushbutton, B pushbutton and Edit button.
3. Switch on the operating voltage.
   - [CLER] is displayed.
   - The factory settings are restored . RUN mode is active.

9.3 Using the differential pressure regulator

In order to enable faster response times with low measuring distances or completely sealed measuring nozzles, a differential pressure regulator (LRLL-1/8-QS-6) can be used instead of the vent screw. The valve function enables the pressure to be exhausted significantly quicker than via the vent screw.

Connecting and checking the differential pressure regulator

1. Remove the vent screw (SW 14).

2. Mount the differential pressure regulator (LRLL-1/8-QS-6) n the connection for the vent screw (➔ Fig. 6).
3. Press the CLEAN pushbutton (CLEAN = OFF) and then the SENSE pushbutton (SENSE = ON) on the control module.
4. Make sure that there is not an object in the area of the measuring nozzles .
5. Turn the adjusting screw on the differential pressure regulator clockwise (towards LOW) until air stops flowing from the differential pressure regulator.
6. Turn the adjusting screw on the differential pressure regulator anticlockwise (towards HIGH) until air starts to flow from the differential pressure regulator.

Checking the settings of the differential pressure regulator

1. Seal the measuring nozzle (e.g. workpiece inserted).
2. Press the CLEAN key (CLEAN = OFF) on the control module.
   ↳ Sensor module is supplied with operating pressure. [SUP.P] is displayed.
3. Press and hold the SENSE pushbutton (SENSE = ON) on the control module until [SUP.P] is no longer displayed.
4. If the delay ([SUP.P] in the display) is too great, reduce the time by turning the control valve (towards HIGH).

10 Maintenance and Care

1. Switch off the energy sources (operating voltage, compressed air).
2. Clean sensor with non-abrasive cleaning agents.

11 Malfunctions

11.1 Error messages

Indication on display	Event code [hex]	G[1)]	E[2)]	S[3)]	Error	Remedy
[Er01]	0x5000	4	3	4	Sensor module defective	Replace sensor module
[Er14]	0x180E	2	2	1	Supply pressure (InC) outside the measuring range (> 2 bar, > 0.2 MPa); signal cannot be evaluated	Observe the measuring range ➔ 13.1 Technical data, general.
[Er17]	0x5111	4	3	3	Undervoltage in supply voltage	Observe the voltage range ➔ 13.1 Technical data, general.
[Er21]	0x1815	4	3	4	Short circuit/overload at switching output OutA (only for SOPA-...-PNLK)	Rectify short circuit/overload.
[SUP.P]	0x1815	2	2	1	Supply pressure switched off	Apply supply pressure ➔ 13.1 Technical data, general.

Indication on display	Event code [hex]	G[1)]	E[2)]	S[3)]	Error	Remedy
[SUP.P]	0x1815	2	2	1	Exhaust air in the system	Wait until the exhaust air has completely dissipated from the system.
						Use/set differential pressure regulator.
[Er.Co]					IO-Link communication errors	Check line OutA. Check settings of the device sensor.
[Er.Id]					IO-Link device ID error, devices are not identical	When replicating, use sensors with the same pressure range/type (same device ID).

1) device status
2) IO-Link event type
3) diagnostic level

Tab. 37: Error messages, error codes, diagnostic levels and error description

11.2 Fault clearance

Fault description	Cause	Remedy
No indication on display	Supply voltage not applied or permitted operating voltage not present	Switch on the supply voltage; maintain the voltage range.
	Electrical connections swapped (incorrect polarity)	Connect the sensor module in accordance with the plug pattern.
	Sensor module defective	Replace sensor module.
Incomplete display	Display faulty	Replace sensor module.
Incorrect pressure indicator for supply pressure (InC)	Sensor module contaminated	Replace the sensor module and operate the sensor only with filtered compressed air ➔ 13.1 Technical data, general.
Measured value indicator (7-segment) flashes	Value InC (supply pressure) outside the measuring range (> 2 bar)	Maintain pressure range ➔ 13.1 Technical data, general.
	Overpressure above permitted overload pressure (device damaged)	Replace sensor module.
Outputs do not switch in accordance with the settings	Short circuit or overload at output	Correct short circuit or overload.

Fault description	Cause	Remedy
Outputs do not switch in accordance with the settings	Sensor module defective	Replace sensor module.
Settings cannot be edited (Lock)	Access protection active	Enter security code or reset device to factory setting.
Long response times after the CLEAN function with virtually closed or completely closed measuring nozzles	Pressure reduction for the measuring nozzle too slow	Replace the vent screw with a differential pressure regulator ➔ 9.3 Using the differential pressure regulator.
"Sensor ready for operation" display not showing when using a differential pressure regulator.	No pressure reduction for the measuring nozzle	Adjust the differential pressure regulator ➔ 9.3 Using the differential pressure regulator.

Tab. 38

12 Disassembly

1. Switch off the energy sources (operating voltage, compressed air).
2. Disconnect the connections for the control module and the sensor modules.
3. Remove device.

Wall mounting/H-rail mounting

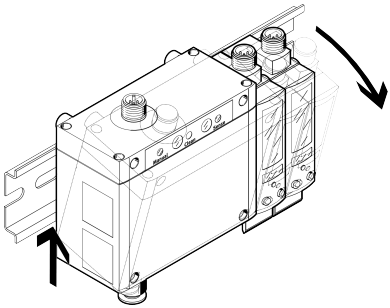


Fig. 19: Disassembly from the H-rail

- Lift the sensor and tilt it forward.

Plate mounting

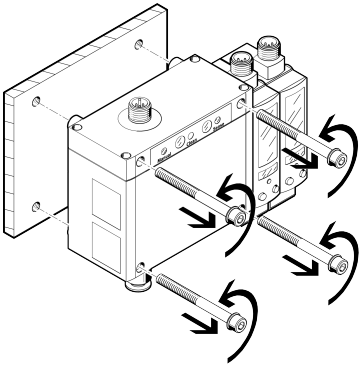


Fig. 20: Disassembly from the wall

- Loosen the screws and remove the sensor.

13 Technical data

13.1 Technical data, general

SOPA-...		-M-...-2P	-M-...-2N	-M-...-PNLK	-C
General					
Certification		RCM Mark, c UL us - Recognized (OL) 1)[1)]			
CE marking		Declaration of Conformity ➔ www.festo.com/sp			
Input signal/measuring element					
Detected variable		Distance			–
Measurement principle		pneumatic			–
Sensing range	[µm]	20 ... 200[2)]			
Operating pressure	[MPa]	–			0.4 ... 0.7
	[psi]	–			58 ... 101.5
	[bar]	–			4 ... 7
Supply pressure	[MPa]	0.08 ... 0.16			–
	[psi]	11.6 ... 23.2			–
	[bar]	0.8 ... 1.6			–
Nominal pressure	[MPa]	0.12			0.5
	[psi]	17.4			72.5
	[bar]	1.2			5
Operating medium		Compressed air in accordance with ISO 8573-1:2010 [7:4:4]			

SOPA-...		-M-...-2P	-M-...-2N	-M-...-PNLK	-C
Temperature of medium	[°C]	0 ... +50			
Ambient temperature	[°C]	0 ... +50			
Output, general					
Repetition accuracy of switching point					
– Sensing range 30 µm ... 150 µm	[µm]	± 2.5			–
– Sensing range 20 µm ... 200 µm	[µm]	± 5			–
Switching output					
Switching output		2 x PNP	2 x NPN	PNP/NPN, switchable	–
Switching function					
– OutA		Threshold value comparator with variable hysteresis			–
– OutB		Threshold value comparator with variable hysteresis		–	–
– OutC		Window comparator			–
Switching element function		N/C contact or N/O contact, switchable			–
Temperature coefficient of the switching point per 10 K	[%]	typ. 2			–
Switch-on time		➔ Fig. 21 and ➔ Fig. 22			–
Output current	[mA]	≤ 100			–
Voltage drop	[V]	≤ 1.5			–
Analogue output					
Analogue output					
– SOPA-...-V		–	–	0 ... 10 V	–
– SOPA-...-B		–	–	1 ... 5 V	–
– SOPA-...-A		–	–	4 ... 20 mA	–
Distance characteristic curve start value		–	–	0	–
Distance characteristic curve end value		–	–	300	–

SOPA-...		-M-...-2P	-M-...-2N	-M-...-PNLK	-C
Rise time	[ms]	–	–	≤ 22	–
Load resistance of current output					
– SOPA-...-A	[Ω]	–	–	≤ 500	–
Min. load resistance of voltage output					
– SOPA-...-V	[kΩ]			≥ 20	–
Output, additional data					
Short circuit current rating		yes			
Overload protection		present			
Electronic					
Rated operating voltage	[V DC]	24			
Operating voltage	[V DC]	15.0 ... 30.0		20.0 ... 30.0	22.8 ... 26.4
No-load supply current	[mA]	≤ 50			≤ 10
Reverse-polarity protection		for all electrical connections			
Electromechanics					
Connection type		Plug			
Connection technology		M12x1 A-coded			
Number of pins/wires		5			
Tightening torque	[Nm]	0.3			
Cable length	[m]	≤ 30			
	[m]	≤ 20 (for IO-Link)			
Mechanical system					
Mounting position		any[3)]			
Nominal diameter of measuring nozzle	[mm]	2			
Specified measuring nozzle diameter	[mm]	1.5/2/2.5			
Pneumatic port		QS-6			
Tube length	[m]	0.5 ... 8			

SOPA-...		-M-...-2P	-M-...-2N	-M-...-PNLK	-C
Materials					
Housing		Reinforced PA			Reinforced PA/ anodised aluminium
Keypad		PA6			PET
Inspection window		PA			–
Sealing ring		HNBR, FPM, NBR			HNBR, NBR
Adapter plate SXE3-W		–	–	–	Chromated steel
Display, operation					
Display range InA/InB (distance)		0 ... 500, dimensionless			
Display range InC (supply pressure)[4)]	[bar]	0 ... 2			
Setting range threshold value OutA/OutB (distance)		20 ... 300, dimensionless			
Setting range threshold value OutC (supply pressure)[4)]	[bar]	0.5 ... 1.9			
Setting range hysteresis OutA/OutB (distance)		3 ... 20, dimensionless			
Hysteresis OutC (supply pressure)[4)]	[bar]	0.05			
Immission, emission					
Storage temperature	[°C]	–20 ... +80			
Degree of protection		IP65 (in accordance with EN 60529)			
Internal air consumption	[Nl/min]	–	–	–	typ. 4.5
Measuring air consumption (sense)	[Nl/min]	typ. 15 (per measuring module)			–
Exhaust air consumption (clean)	[Nl/min]	typ. 35 (per measuring module)			–
Protection class		III (in accordance with DIN VDE 0106-1)			

SOPA-...	-M-...-2P	-M-...-2N	-M-...-PNLK	-C
Shock resistance	30 g acceleration with 11 ms duration (half-sine) (in accordance with DIN EN 60068 Part 2-27)			
Vibration resistance	5 g acceleration at 10 ... 150 Hz / 35 mm (in accordance with DIN EN 60068 Part 2-6)			

1) type-specific ➔ Identification on the product
2) When using a single sensor module with precision pressure regulator (0.12MPa/18psi/1.2bar), a sensing range of up to 400 µm is possible.
3) Condensate must not accumulate in the sensor module.
4) Value is only shown in bar in the display.

Tab. 39: Technical data, general

13.2 Diagrams

Response times for different tube lengths

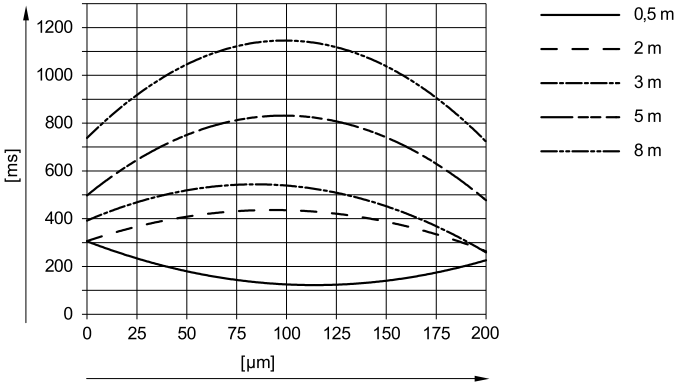


Fig. 21: Typical response time t as a function of distance x after switching on the instrument air (measuring nozzle: 2 mm)

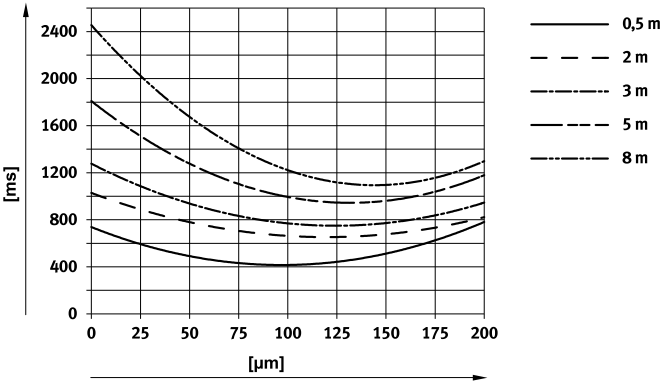


Fig. 22: Typical response time t as a function of distance x after switching off the exhaust air (measuring nozzle: 2 mm)

Displays for different tube lengths

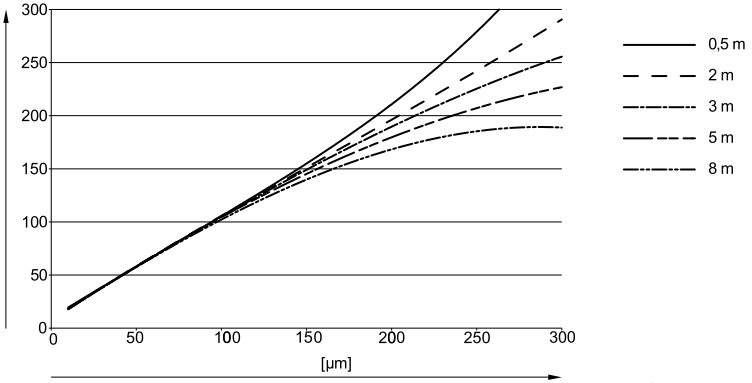


Fig. 23: Influence of the tube length on the dimensionless display value (measuring nozzle 2 mm)

Repetition accuracy of the switching point

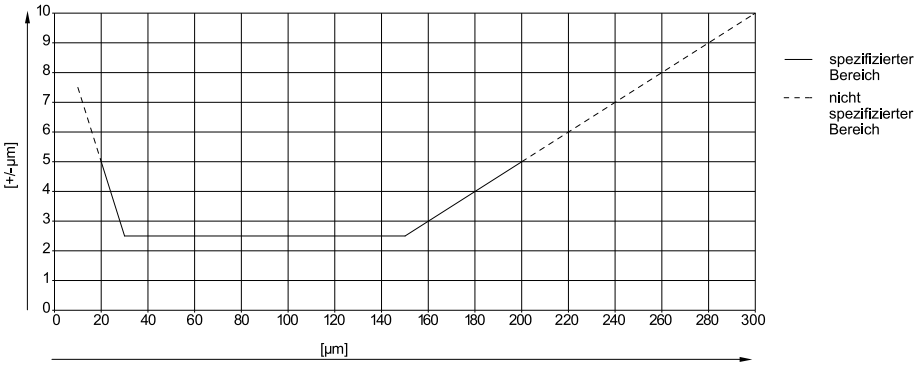
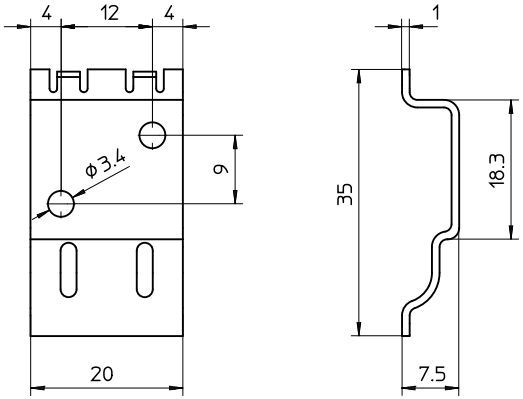


Fig. 24: Repetition accuracy of the switching point [±µm] as a function of the switching point distance x (measuring nozzle: 2 mm)

13.3 Hole patterns



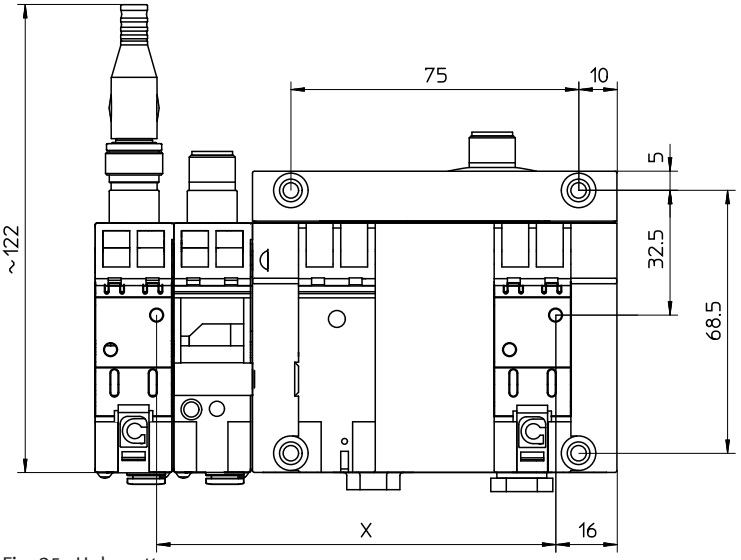


Fig. 25: Hole patterns

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