Air gap sensor

SOPA-...
Identification of hazards and instructions on how to prevent them:

- **Danger**
  Immediate dangers which can lead to death or serious injuries

- **Warning**
  Hazards that can cause death or serious injuries

- **Caution**
  Hazards that can cause minor injuries

Other symbols:

- **Note**
  Material damage or loss of function

- **Recommndations, tips, references to other documentation**

- **Essential or useful accessories**

- **Information on environmentally sound usage**

Text designations:

- Activities that may be carried out in any order
- Activities that should be carried out in the order stated
  - General lists
  - Result of an action/References to more detailed information
# English – Air gap sensor SOPA-...

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1 Product description

For all available product documentation ➔ www.festo.com/pk

1.1 Overview

Fig. 1 Mechanical and electrical connections

- Control module (optional)
- Sensor module (max. 4 modules permitted in combination with control module)
- Plug for electrical connection
- Display
- Fastening slides
- Threaded sleeve (M4)
- Blanking plug (M7)
- Label holder
- Adapter plate for wall mounting
- Plug for electrical connection
1 Manual LED (green) – Ready indication for manual override
2 Pushbutton – Clean (exhaust air)
3 Pushbutton – Sense (instrument air)
4 EDIT button
5 B pushbutton
6 A pushbutton
7 Pneumatic connection for measuring nozzle (output)
8 Supply port for operating pressure
9 Vent screw (width across flats 14)
10 Supply port for supply pressure
11 Status LED (yellow) – Sense (instrument air)
12 Status LED (yellow) – Clean (exhaust air)

1) Only for product variants with manual override (SOPA-C-...-H)

Fig. 2 Operating elements and pneumatic connections
### 1.2 Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Order code</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air gap sensor</td>
<td>SOPA</td>
<td>Air gap sensor for contact and distance monitoring with LCD</td>
</tr>
<tr>
<td>Modules</td>
<td>CM1-</td>
<td>Control module with one sensor module</td>
</tr>
<tr>
<td></td>
<td>CM2-</td>
<td>Control module with two sensor modules, pneumatically interlinked</td>
</tr>
<tr>
<td></td>
<td>CM3-</td>
<td>Control module with three sensor modules, pneumatically interlinked</td>
</tr>
<tr>
<td></td>
<td>CM4-</td>
<td>Control module with four sensor modules, pneumatically interlinked</td>
</tr>
<tr>
<td></td>
<td>M1-</td>
<td>Single sensor module 1)</td>
</tr>
<tr>
<td>Manual override of control module</td>
<td>H-</td>
<td>Control module with electrically activatable manual override</td>
</tr>
<tr>
<td>Sensing range</td>
<td>R1-</td>
<td>20...200 μm</td>
</tr>
<tr>
<td>Type of mounting</td>
<td>H</td>
<td>H-rail mounting/through-hole</td>
</tr>
<tr>
<td></td>
<td>W</td>
<td>Additional wall mounting</td>
</tr>
<tr>
<td>Pneumatic connection</td>
<td>Q6-</td>
<td>Push-in connector 6 mm</td>
</tr>
<tr>
<td>Electrical inputs/outputs</td>
<td>2P-</td>
<td>2x PNP</td>
</tr>
<tr>
<td></td>
<td>2N-</td>
<td>2x NPN</td>
</tr>
<tr>
<td>Electrical connection</td>
<td>M12-</td>
<td>Plug connector; M12x1, 4-pin; A-coded</td>
</tr>
<tr>
<td>Electrical accessories</td>
<td>E1</td>
<td>Connecting cable with straight socket, cable length 2.5 m 2)</td>
</tr>
<tr>
<td></td>
<td>E2</td>
<td>Connecting cable with straight socket, cable length 5 m 2)</td>
</tr>
<tr>
<td></td>
<td>E3</td>
<td>Connecting cable with angled socket, cable length 2.5 m 2)</td>
</tr>
<tr>
<td></td>
<td>E4</td>
<td>Connecting cable with angled socket, cable length 5 m 2)</td>
</tr>
</tbody>
</table>

1) Optional manual override not selectable
2) Number of connecting cables dependent on the number of modules

Tab. 1 Overview of variants
### 1.3 Factory settings

<table>
<thead>
<tr>
<th>Settings</th>
<th>Menu option</th>
<th>Value/function</th>
</tr>
</thead>
<tbody>
<tr>
<td>[SPEC]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spurious pulse suppression</td>
<td>[Option]</td>
<td>Off</td>
</tr>
<tr>
<td>Signal assignment Out x to Pin 2</td>
<td>[P 2]</td>
<td>c</td>
</tr>
<tr>
<td>Display timeout</td>
<td>[di.]</td>
<td>ON</td>
</tr>
<tr>
<td>Security code</td>
<td>[lock]</td>
<td>OFF</td>
</tr>
<tr>
<td>[OutA]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switching point</td>
<td>[SP]</td>
<td>100</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>[Hy]</td>
<td>5</td>
</tr>
<tr>
<td>Switching characteristic</td>
<td></td>
<td>NO (normally open contact)</td>
</tr>
<tr>
<td>[OutB]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switching point</td>
<td>[SP]</td>
<td>150</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>[Hy]</td>
<td>5</td>
</tr>
<tr>
<td>Switching characteristic</td>
<td></td>
<td>NO (normally open contact)</td>
</tr>
<tr>
<td>[OutC]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower switching point</td>
<td>[SP min]</td>
<td>0.6 bar (60 kPa)</td>
</tr>
<tr>
<td>Upper switching point</td>
<td>[SP max]</td>
<td>1.8 bar (180 kPa)</td>
</tr>
<tr>
<td>Switching characteristic</td>
<td></td>
<td>NO (normally open contact)</td>
</tr>
</tbody>
</table>

Tab. 2


2 Function and application

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.

2.1 Design

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.

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).
### 2.2 Operating statuses

![Diagram of SOPA operating statuses](image)

<table>
<thead>
<tr>
<th>Operating status</th>
<th>Function</th>
</tr>
</thead>
</table>
| RUN mode         | – Basic status after the operating voltage is applied  
                              – Numerical and graphical display of distance-correlated values (bar graph)  
                              – Display of measured values for supply pressure (in bar)  
                              – Display of signal statuses for binary signals Out A, Out B, Out C |
| INFO mode        | – Display of input variables in the display.  
                              – Switching of the display by pressing the A and/or B pushbutton. |
| SHOW mode        | – Display of current settings for the binary signals,  
                              – Display and reset of the min/max values for the distance-correlated value  
                              and supply pressure. |
| EDIT mode        | – Setting or alteration of the parameters for the air gap sensor  
                              (switching outputs, display). |
| TEACH mode       | – Teaching-in of the switching points for the distance-correlated values  
                              (transfer of the current value as the trigger level). |

Tab. 3 SOPA operating statuses
2.3 Function range

2.3.1 Binary signals and switching signals

Switching output at Pin 4 (Out A):
The switching output at Pin 4 is assigned to the binary signal OUT A and the distance input variable.

Switching output at Pin 2 (Out B or Out C):
The switching output at Pin 2 can be assigned alternatively to one of the following input variables via the special SPEC menu (Edit mode):
- to binary signal Out C for monitoring the correct supply pressure input variable (delivery status),
- to binary signal Out B for monitoring an additional distance threshold value.
The allocation of Pin 2 to Out B makes it possible to set two independent binary signals for distance monitoring over the entire measuring range.
The binary signal Out C for monitoring the supply pressure always acts as an enable signal for the binary signals Out A and Out B. If the supply pressure is outside the switching window of Out C, 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.

Binary signals and switching function
The binary signals Out A and Out B can be configured independently of one another. The threshold value switching function is assigned to the binary signal OUT A and OUT B (distance input variable).
The window comparator switching function is assigned to the binary signal OUT C (supply pressure input variable).
- The switching element function normally closed contact (NC) or normally open contact (NO) can be assigned to each binary signal.
- The switching point (SP) and hysteresis (HY) can be set for the binary signals Out A and Out B. Only the switching points can be adjusted for Out C.
Tab. 4  Switching point (SP) and hysteresis (HY) of the binary signals

Hysteresis serves to suppress switching signals in the event of fluctuations around the switching point. The reset points function as long as the value is within the hysteresis range.
- Upper reset point = switching point + hysteresis
- Lower reset point = switching point – hysteresis

Fig. 6  Sensing range with switching points
2.3.2 Graphic distance monitoring

Function of the bar graph in RUN mode

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

- Object outside the measuring range: All segments illuminate (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 illuminated.
- Object approaches the measuring nozzle: The green segments switch off one after the other.

Note
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 Out A and Out B have the same switching point. If different switching points have been set, the bars are asynchronous to one another.

<table>
<thead>
<tr>
<th>No.</th>
<th>Bar graph</th>
<th>In A</th>
<th>In B</th>
<th>Switches off if</th>
<th>Position of the object</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Display red</td>
<td></td>
<td></td>
<td>Distance &lt; 1.6 x switching point</td>
<td>Object outside the specified switching range¹</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td>Distance &lt; 1.4 x switching point</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td>Distance &lt; 1.2 x switching point</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>Distance &lt; 1.0 x switching point</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Display green</td>
<td></td>
<td></td>
<td>Distance &lt; 0.8 x switching point</td>
<td>Object within the specified switching range¹</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>Distance &lt; 0.6 x switching point</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>Distance &lt; 0.4 x switching point</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>Distance &lt; 0.2 x switching point</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Is always lit up</td>
<td>Status indicator</td>
</tr>
</tbody>
</table>

¹ The switching point of Out A and Out B is between segment 5 and 6

Tab. 5 Bar graph in the RUN mode
2.3.3 Spurious pulse suppression – parameter options
If measuring or exhaust air is switched on and off during operation, spurious pulses are generated (excessive fluctuations in supply pressure). Normally, such spurious pulses must be suppressed by programming the higher-order controller.
Spurious pulses can be suppressed in the air gap sensor SOPA by adjusting the parameters [Options].

<table>
<thead>
<tr>
<th>Option</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>Spurious pulse suppression switched off (factory setting). Setting optimised for short response times (spurious pulse suppression can be implemented using a higher-order controller).</td>
</tr>
<tr>
<td>1</td>
<td>Spurious pulse suppression when using the instrument air on/off function with deactivated exhaust air.</td>
</tr>
<tr>
<td>2</td>
<td>Spurious pulse suppression with use of the function exhaust air on/off and with instrument air switched off.</td>
</tr>
</tbody>
</table>

Tab. 6 Options for spurious pulse suppression

2.3.4 Switching off the display
The numerical (7-segment) display for the distance-correlated value can be switched off permanently or for a defined time delay. Both switch-off modes allow the usage of the INFO mode and the SHOW mode for a limited time.

2.3.5 Security code
The settings can be protected from unauthorised access by setting a numerical code which is up to 4 digits in length. The security code must be entered each time a setting is changed (EDIT mode and TEACH mode).

2.3.6 Min/max values
The min/max values for supply pressure monitoring and distance monitoring can be displayed and reset in the SHOW mode ➔ Chapter 5.5.

Note
Switching off the supply voltage resets the min/max values.
3 Requirements for product use

Warning
Depending on the functioning of the machine/system, manipulation of signal statuses may cause serious personal injury.
- Note that if the switching characteristics of the outputs are modified in Edit mode, the new characteristics will become effective immediately.
- Enable the password protection option (security code) to prevent accidental alteration by an unauthorised third party ➔ Chapter 5.6.3, section “Setting the security code”.

Note
Improper handling can result in malfunctions.
- Make sure that the specifications shown below are always observed.

- Observe the limit values (e.g. operating medium, pressures, forces, torques, temperatures, loads, speeds, operating voltages, flow rates).
- Take the ambient conditions at the location of use into consideration.
- Comply with the regulations of the workers’ compensation trade association, the German Technical Control Board (TÜV), of the VDE or relevant national regulations.
- Remove all transport packing, such as protective wax, foils (polyamide), caps (polyethylene), cardboard boxes (except for the sealing elements of the pneumatic connections).
  The material used in the packaging has been specifically chosen for its recyclability (exception: oiled paper = residual waste).
- Use the product in its original status. Unauthorised modification is not permitted.

Measuring nozzle geometry

Caution
Damage from ingress of foreign matter!
In the event of an inappropriate measuring nozzle configuration or inappropriate routing of the compressed air lines, foreign matter can enter the sensor modules and cause a malfunction or damage to the device.
- Take the ambient conditions at the location of use into consideration by means of suitable design measures – for example a suitable arrangement of the measuring nozzles.
Take into consideration the necessary measuring nozzle geometry.

- Execute the outlet of the nozzle with sharp edges. Angled edges at the outlet opening are not permissible.

**Measuring nozzle configuration**

- Safeguard air discharge.
  
  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 (Fig. 8).

- Observe the permissible tube lengths between the sensor module and measuring nozzle (Technical Data, Chapter 11).

**Recessed measuring nozzle**

- Exhaust
- Invalid

Fig. 8  Measuring nozzle configuration
**Range of application and certifications**

In combination with the UL mark on the product, the information included in this section is also applicable for compliance with the certification requirements of Underwriters Laboratories Inc. (UL) for USA and Canada. Observe the following English-language remarks from UL:

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.

Note that, when more than one power supply or isolating device is used, connection in parallel is not permitted.

<table>
<thead>
<tr>
<th><strong>UL approval information</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product category code</strong></td>
</tr>
<tr>
<td><strong>File number</strong></td>
</tr>
<tr>
<td><strong>Considered standards</strong></td>
</tr>
<tr>
<td><strong>UL mark</strong></td>
</tr>
</tbody>
</table>

Tab. 7  UL approval information
4 Installation

4.1 Mechanical system

Fitting sensor modules (a maximum of 4 with a control block)

1. Remove the blanking plug \[1\] by using an internal hexagon socket spanner size AF 3 mm.
2. Make sure the sealing ring on the sensor module to be mounted is seated properly.
3. Press on the sensor module lightly and tighten the threaded sleeves \[2\] by using an internal hexagon socket spanner size AF 2.5 mm; max. tightening torque 0.7 Nm.
4. Tighten the blanking plug \[1\] on the last sensor module (max. 4) so it is hand-tight – spanner size AF 3 mm. Make sure the seal is seated properly.

Fig. 9 Mounting the sensor module

Attaching the sensor module

Caution
Material damage caused by fluid in the sensor module.
If the sensor module is located below the measuring nozzles, condensed water or other fluids can enter the module via the nozzles.
- Always position the sensor module so it is above the measuring nozzles.

Placing the sensor module
- Above the measuring nozzles ➔ Fig. 3.
- According to the specified tube lengths (0.5 ... 8 m).

H-rail mounting:
- Hang the SOPA on the H-rail and press it until the mounting tabs engage in place.
Plate mounting:
1. Create 4 x M5 threaded holes. 
   Hole patterns and dimensions ➔ Fig. 23.
2. Tighten the screws with a tightening torque of \( \leq 0.8 \text{ Nm} \). Use washers.

Wall mounting:
1. Mount 2 adapter plates (e.g. 2 x M3). 
   Hole patterns and dimensions ➔ Fig. 23.
2. Hang the SOPA on the mounting plates and press it until the mounting tabs engage in place.

Attaching the sensor module without a control module
Use a suitable pressure regulator to guarantee the required supply pressure for all pneumatically linked sensor modules (➔ Technical Data, Chapter 11).

The supply pressure can be fed from the left and/or right-hand side.
1. Mount the threaded M7 fitting onto the supply pressure connection \[1\] or \[2\].
   Max. thread length: 5.5 mm.
2. Seal the opposite connection with the M7 blanking plug.
   Spanner size AF 3 mm, tighten by hand.
4.2 Pneumatic system

1. Insert the tube (outside diameter: 6 mm) into the push-in fittings.
2. Connect the supply port for the measuring nozzle to the corresponding measuring nozzle (Fig. 3).
3. For operation with a control module: Connect the supply port for the operating pressure 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 (Fig. 2) (via vent screw or differential pressure regulator (LRLL-1/8-QS-6)).

Avoiding contamination of the measuring nozzles during downtimes
The vent screw (Fig. 2) can be removed and this connection used with a deactivated main air supply and power supply, if necessary, to feed purge air.
4.3 Electrical connection

Warning
Only use power sources which guarantee reliable electrical isolation of the operating voltage according to IEC/DIN EN 60204-1. Also observe the general requirements for PELV power circuits according to IEC/DIN EN 60204-1.
Switched-mode power supplies are permitted, provided that they ensure reliable separation in accordance with EN 60950/VDE 0805.

Note
Long signal lines pick up more interference.
• Make sure that the signal lines are always shorter than 10 m.

The max. tightening torque of the plugs is max. 0.3 Nm.

PIN allocation and control module circuit diagrams

<table>
<thead>
<tr>
<th>Pin</th>
<th>Allocation</th>
<th>Core colours</th>
<th>Plug connector</th>
</tr>
</thead>
</table>
| 1   | Operating voltage +24 V DC  
  – SOPA-...-H: Supply voltage for manual override  
  – SOPA-...-2N: Supply voltage for NPN inputs | Brown (BN) | 5-pin M12 |
| 2   | Switch on signal input exhaust air (Clean) | White (WH) | |
| 3   | Operating voltage 0 V  
  – SOPA-...-H: Supply voltage for manual override  
  – SOPA-...-2P: Supply voltage for PNP inputs | Blue (BU) | |
| 4   | Switch on signal input instrument air (Sense) | Black (BK) | |
| 5   | n.c = free (not connected) | Grey (GY) | |

1) Using the connecting cable from the electrical accessories ➔ Chapter 1.2 Features

Tab. 8 Pin allocation for control module
### Manual override of control module

**SOPA-C...-H-....-2P-M12...**

[Diagram showing manual override circuit]

**SOPA-C...-H-....-2N-M12...**

[Diagram showing non-manual override circuit]

### No manual override of control module

**SOPA-C...-....-2P-M12...**

[Diagram showing manual override circuit]

**SOPA-C...-....-2N-M12...**

[Diagram showing non-manual override circuit]

Tab. 9   Circuit diagrams for control module with/without manual override

### PIN allocation and sensor module circuit diagrams

<table>
<thead>
<tr>
<th>Pin</th>
<th>Allocation</th>
<th>Core colours(^1)</th>
<th>Plug connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Operating voltage +24 V DC</td>
<td>Brown (BN)</td>
<td>5-pin M12</td>
</tr>
<tr>
<td>2</td>
<td>Switching output for Out B or Out C (factory setting),</td>
<td>White (WH)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Operating voltage 0 V</td>
<td>Blue (BU)</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Switching output for Out A</td>
<td>Black (BK)</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>n.c = free (not connected)</td>
<td>Grey (GY)</td>
<td>3</td>
</tr>
</tbody>
</table>

\(^1\) Using the connecting cable from the electrical accessories  
Chapter 1.2 Features

Tab. 10   Pin allocation for sensor module

### Sensor module

**SOPA-....-.2P-M12-...**

[Diagram showing sensor module circuit]

**SOPA-....-.2N-M12-...**

[Diagram showing sensor module circuit]

Tab. 11   Circuit diagrams for sensor module
5 Commissioning

5.1 Symbols on the display

<table>
<thead>
<tr>
<th>Display</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A B C</td>
<td>Display for binary signals set/not set (in the example A, B: set – C: not set)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>∫</td>
<td>Threshold value comparator</td>
</tr>
<tr>
<td></td>
<td>∫∫</td>
<td>Window comparator</td>
</tr>
<tr>
<td>[SP]</td>
<td>Switching point</td>
<td></td>
</tr>
<tr>
<td>[SP][min]</td>
<td>Lower switching point</td>
<td></td>
</tr>
<tr>
<td>[SP][max]</td>
<td>Upper switching point</td>
<td></td>
</tr>
<tr>
<td>[HY]</td>
<td>Hysteresis</td>
<td></td>
</tr>
<tr>
<td>[NO]</td>
<td>Switching characteristic of normally open contact</td>
<td></td>
</tr>
<tr>
<td>[NC]</td>
<td>Switching characteristic of normally closed contact</td>
<td></td>
</tr>
<tr>
<td>[min]/[max]</td>
<td>Minimum/maximum input value (In A/B/C)</td>
<td></td>
</tr>
<tr>
<td>[TeachIn]</td>
<td>TeachIn mode active</td>
<td></td>
</tr>
<tr>
<td>[Option]</td>
<td>Options for spurious pulse suppression (Off, 1, 2)</td>
<td></td>
</tr>
<tr>
<td>[LOCK]</td>
<td>Security code active (block to prevent unauthorised parameterisation)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Special menu (SPEC) is active</td>
<td></td>
</tr>
<tr>
<td>[P2-]</td>
<td>Allocation of the switching output for Pin 2 with the binary signal In B or In C</td>
<td></td>
</tr>
<tr>
<td>[di.]</td>
<td>Activation/deactivation of the numerical display</td>
<td></td>
</tr>
<tr>
<td>[Delay]</td>
<td>Switch-off delay for the numerical display</td>
<td></td>
</tr>
<tr>
<td>[- – – –]</td>
<td>Numerical display is switched off</td>
<td></td>
</tr>
<tr>
<td>[SUP.P]</td>
<td>Error message: Supply pressure is outside the range of values</td>
<td></td>
</tr>
</tbody>
</table>

Graphical display of the current distance-correlated value for In A and In B in relation to the set switching point (Chapter 5.2).

- The bar graph for In A is always active.
- The bar graph for In B is only active if the binary signal Out B is assigned to the switching output at Pin 2.

Tab. 12 Symbols on the display
### 5.2 Bar graph on the display

<table>
<thead>
<tr>
<th>Display</th>
<th>Meaning</th>
</tr>
</thead>
</table>
| ![Segment at the bottom left and [A] flash](image) | INFO mode active.  
7-segment display shows the input value In A. |
| ![Segment at the bottom left and [A] illuminate, [min] or [max] flash.](image) | SHOW mode active.  
7-segment display shows the minimum or maximum value In A. |
| ![Segment at the bottom right and [B] flash](image) | INFO mode active.  
7-segment display shows the input value In B. |
| ![Segment at the bottom right and [B] illuminate, [min] or [max] flash.](image) | SHOW mode active.  
7-segment display shows the minimum or maximum value In B. |
| ![Both of the bottom segments and [C] flash.](image) | INFO mode active.  
7-segment display shows the input value In C. |
| ![Segment at the bottom left and right and [C] illuminate, [min] or [max] flash.](image) | SHOW mode active.  
7-segment display shows the minimum or maximum value In C. |
| ![Marked segments illuminate and [Option] flashes:](image) | EDIT mode active.  
Special menu opens.  
7-segment display shows the set option. |
| ![Marked segments illuminate and [Lock] flashes:](image) | EDIT mode active.  
Special menu opens.  
7-segment display shows the security code. |

Tab. 13 Special bar graphs on the display
5.3 Symbols for representing the menu structure

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Symbol" /> → 80s</td>
<td>Automatic return to the basic status (RUN mode) when the monitoring time has expired (here 80 seconds).</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /> → 3s</td>
<td>In order to return manually to the basic status (RUN mode), press the EDIT button for 3 seconds.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Establish distance (for teaching the value TP).</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Symbol on the display flashes (here Out A).</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Establish distance (for teaching the value TP).</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Symbol on the display flashes (here Out A).</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Security code active (lock – blocked against unauthorised programming).</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Security code inactive.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Press pushbutton (A pushbutton here). Advance/switch to the menu.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /> / <img src="image" alt="Symbol" /></td>
<td>Press the A pushbutton or B pushbutton. The SOPA then switches to the setting indicated by the arrow.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /> + <img src="image" alt="Symbol" /></td>
<td>C pushbutton: Press A pushbutton and B pushbutton simultaneously (= C pushbutton).</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /> + <img src="image" alt="Symbol" /></td>
<td>Press pushbutton (here A pushbutton) and the EDIT button simultaneously.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /> / <img src="image" alt="Symbol" /></td>
<td>Press the A pushbutton or B pushbutton. Set the value.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Press the Edit button.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /> if</td>
<td>Branch in the menu. The setting last selected in the EDIT mode is indicated in the SHOW mode.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /> Er...</td>
<td>Display of current errors.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /> Clear</td>
<td>Delete minimum/maximum value.</td>
</tr>
</tbody>
</table>

Tab. 14 Symbols for representing the menu structure

5.4 RUN mode

In the basic status, the product is in RUN mode. The current distance-correlated values are displayed. The basic status can be reached from other modes by:
- pressing Edit button for 3 seconds or
- expiration of a monitoring time, timeout.

The following are displayed in the RUN mode (depending on the setting of the switching output at Pin 2):
- the numerical distance-correlated value or the values for supply pressure (in bar) and
- a graphical display (bar graph) of the distance-correlated values in relation to the respective switching points for binary signals Out A and/or Out B and
- the signal statuses of the switching outputs Out A, Out B, Out C (set, not set).

A flashing value indicates that the measuring range has been exceeded.
Note
The supply pressure display is temporally limited to 80 seconds. After this time has lapsed the numerical distance-correlated value is displayed again.

Calling RUN mode:
1. Pressurise the SOPA with the required operating pressure and/or supply pressure (→ Technical Data, Chapter 11).
2. Switch on the operating voltage.
The SOPA is in the RUN mode.
3. Check the SOPA settings (→ Chapter 5.5).

5.5 INFO/SHOW mode

Fig. 15 Menu structure for the INFO mode/SHOW mode
The following are displayed in the INFO mode:
- the input values In A, In B (distance) and In C (supply pressure).

The following are displayed in the SHOW mode:
- the setting values for the switching signals (switching point, hysteresis, switching characteristic) and
- the extreme values of the input values (minimum distance, maximum distance) or
- in the event of an error: display of the error number.

The following pushbutton allocations are applicable here:
- A pushbutton: input values In A and the settings for the binary signal Out A.
- B pushbutton: input values In B and the settings for the binary signal Out B.
- A pushbutton + B pushbutton (C pushbutton): input values In C and the settings for the binary signal Out C.

Note
The supply pressure display is temporally limited to 80 seconds. After this time has lapsed the numerical distance-correlated value is displayed again.

Calling the INFO mode and SHOW mode:
Requirement: SOPA is in RUN mode.
1. Press the A, B or C pushbutton.
   ➔ SOPA displays the respective input value (or an error number).
2. Press the A, B or C pushbutton again.
   ➔ SOPA displays the settings for the respective switching output one after the other.

Note
At the end of the SHOW mode, the respective minimum and maximum values are displayed. If no other pushbuttons are pressed, this remains permanently on display (no timeout).
The display of the minimum and maximum values can be reset by pressing the Edit button.

3. Press the A, B or C pushbutton again.
   ➔ SOPA switches to RUN mode.
5.6 Edit mode

The following can be configured in the EDIT mode:

- the settings for the binary signals Out A, Out B, Out C and
- the special menu [SPEC].

Warning
Manipulation of signal statuses may cause serious personal injury, depending on the functioning of the machine/system.

- Note that if the switching characteristics of the outputs are modified in EDIT mode, the new characteristics will be effective immediately.
5.6.2 Setting the switching characteristic of binary signals
The distance monitoring function can be set for the binary signals Out A and Out B. The supply pressure monitoring function can be set for binary signal Out C (Chapter 2.3.1).

Setting distance monitoring for Out A:
1. Press the Edit button.
   → The EDIT mode is active and [Out A] flashes or, if there is an active security lock, [Lock] flashes.
2. If there is an active security lock, it must be released:
   • Press the A/B pushbuttons until the chosen security code is set.
   • Press the Edit button.
   → The EDIT mode is active and [Out A] flashes.
3. Press the A/B pushbutton if you want to switch to a different setting menu (Out B, Out C, SPEC).
4. Press the Edit button to confirm the selection.
   → [SP] flashes.
5. Set the switching point by using the A/B pushbuttons.
6. Press the Edit button to confirm the value.
   → [HY] flashes.
7. Set the value for the hysteresis by using the A/B pushbuttons.
8. Press the Edit button to confirm the value.
   → [NO] or [NC] flashes.
9. Select the switching element function using the A/B pushbuttons.
10. Press the Edit button to confirm the value.
    → SOPA switches to RUN mode.

Conduct a test run and vary the distance to check whether the SOPA switches as desired.

Note
To set the distance monitoring function for Out B, select [Out B] at point 3 and then continue the setting procedure as described above.
Setting supply pressure monitoring for Out C:

Note
The binary signal Out C is pre-configured for monitoring the supply pressure with the control module SOPA-C. When using the control module SOPA-C, we recommend you keep these factory settings. Changing the switching points for the binary signal Out C is only expedient if you are using a precision controller to operate the sensor modules instead of the control module.

1. Press the Edit button.
   The EDIT mode is active and [Out A] flashes or, if there is an active security lock, [Lock] flashes.
2. If there is an active security lock, it must be released:
   • Press the A/B pushbuttons until the chosen security code is set.
   • Press the Edit button.
     The EDIT mode is active and [Out A] flashes.
4. Press the Edit button to confirm the selection.
   [SP min] flashes.
5. Set the switching point by using the A/B pushbutton.
6. Press the Edit button to confirm the value.
   [SP max] flashes.
7. Set the value for the switching point by using the A/B pushbuttons.
8. Press the Edit button to confirm the value.
   [NO] or [NC] flashes.
9. Select the switching element function using the A/B pushbuttons.
10. Press the Edit button to confirm the value.
    SOPA switches to RUN mode.

Conduct a test run and vary the supply pressure to check whether the SOPA switches as desired. Recommendation: Teach-in the value for Out A again after changing the switching points for Out C.
5.6.3 Setting special menu [SPEC]

1. Press the Edit button.
   ➔ The EDIT mode is active and [Out A] flashes or, if there is an active security lock, [Lock] flashes.

2. If there is an active security lock, it must be released:
   • Press the A/B pushbuttons until the chosen security code is set.
   • Press the Edit button.
   ➔ The EDIT mode is active and [Out A] flashes.


4. Press the Edit button to confirm the selection.
   ➔ [Option] flashes. The signal processing option can now be set.

Setting the signal processing option:

5. Select the desired setting (OFF, 1 or 2) using the A/B pushbuttons.

6. Press the Edit button to confirm the selection.
   ➔ [P2-] flashes. The allocation of the switching output at Pin 2 can now be set.

Setting the allocation of the switching output at Pin 2:

7. Set the desired binary signal by using the A/B pushbuttons.
   – c = Out C = supply pressure monitoring at Pin 2,
   – b = Out B = additional switching point for distance monitoring at Pin 2.

8. Press the Edit button to confirm the selection.
   ➔ [di.] flashes. The mode for deactivating the numerical display can be set.

Setting the mode for deactivating the numerical display:

9. Select the mode using the A/B pushbuttons.
   – on = numerical display is always on,
   – off = numerical display is always off,
   – 1...90 = duration for which the display remains active after the last pushbutton is pressed (in min).
   The numerical display is deactivated after this time expires.
   [----] appears on the display.

10. Press the Edit button to confirm the selection.
    ➔ [Lock] flashes. The security code can be set.

Setting the security code

Note

If you forget the security code, the SOPA must be reset to its factory settings (➔ Chapter 6).

11. Use the A/B pushbuttons to select between an inactive security code (OFF) or a maximum 4-digit security code.

12. Press the Edit button to confirm the selection.
    ➔ SOPA switches to RUN mode.
5.7 TEACH mode

The TEACH mode can be used to teach-in the switching points of the distance monitoring function for the threshold value comparator switching function. The binary signals Out A and Out B can be provided with two values that are independent of one another.

Note

The procedure for teaching the binary signals Out A (A pushbutton) and Out B (B pushbutton) is the same. The procedure is described below based on the binary signal Out A.

1. Set the desired sensing distance between the object and measuring nozzle.
2. First press the A pushbutton and then the Edit button as well.
   - [Out A] and [TeachIn] flash. The value is transferred as the switching point.
   - If [Lock] flashes (security lock active): The value is stored in the buffer.
If the security lock is active [Lock]:
3. Set the security code by using the A/B pushbuttons.
4. Press the Edit button.
   - [Out A] and [TeachIn] flash. The value that is stored in the buffer in step 2 is transferred as the switching point.
   - SOPA switches to RUN mode.
6 Operation

Type SOPA-C...
You can generally switch the instrument air on continuously to prevent the contamination of the sensor modules and the measuring nozzles. 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.

6.1 Resetting the sensor module to its factory settings

Note
By resetting to factory settings, the current settings are lost. If required, make a note of these settings before resetting.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Factory setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Out A</td>
<td>Switching point = 100; hysteresis = 5, switching characteristic = NO</td>
</tr>
<tr>
<td>Out B</td>
<td>Switching point = 150; hysteresis = 5, switching characteristic = NO</td>
</tr>
<tr>
<td>OUT C</td>
<td>Switching point lower limit = 0.6 bar (60 kPa); switching point upper limit = 1.8 bar (180 kPa); switching characteristic = NO</td>
</tr>
<tr>
<td>Option</td>
<td>Option for spurious pulse suppression = off</td>
</tr>
<tr>
<td>P2-di</td>
<td>Allocation of the switching output for Pin 2 with the binary signal Out C</td>
</tr>
<tr>
<td>Lock</td>
<td>Lock = off (security code inactive)</td>
</tr>
</tbody>
</table>

Tab. 15 Sensor module factory settings

To reset the sensor module to its factory settings:
1. Switch off the operating voltage.
2. Press and hold all three setting elements (A pushbutton + B pushbutton + the Edit button).
3. Switch the operating voltage off and then on again.
   ➔ The sensor module switches to RUN mode.
6.2 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 the differential pressure regulator
1. Remove the vent screw (spanner size AF 14) and mount the differential pressure regulator (LRLL-1/8-QS-6) to this port (Fig. 2).
2. Press the CLEAN pushbutton (CLEAN = OFF) and then the SENSE pushbutton (SENSE = ON) on the control module.
3. Make sure that no workpiece is inserted.
4. Turn the adjusting screw on the differential pressure regulator clockwise (towards LOW) until no air flows from the differential pressure regulator.
5. Turn the adjusting screw on the differential pressure regulator counter-clockwise (towards HIGH) until air starts to flow from the differential pressure regulator.

Checking the settings of the differential pressure regulator
1. Seal the measuring nozzles (e.g. clamp workpiece).
2. Press the CLEAN pushbutton (CLEAN = OFF) and then the SENSE pushbutton (SENSE = ON) on the control module.
   - The “ready for operation” signal switches on after a short delay.
   - If the delay is too long: reduce the time by turning the adjusting screw on the differential pressure regulator towards HIGH.

7 Maintenance and care

Cleaning the SOPA from the outside
1. Switch off the operating voltage.
2. Switch off the compressed air.
3. Clean the SOPA from the outside.
   - Soap suds (max. +60 °C), petroleum ether and all non-abrasive cleaning agents may be used.
8  Disassembly

1. Switch off the operating voltage.

2. Switch off the compressed air.

3. Disconnect the connections for the control module and the sensor modules.

4. Disassemble the device (Fig. 18).

<table>
<thead>
<tr>
<th>Wall mounting/H-rail mounting</th>
<th>Plate mounting</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Wall mounting/H-rail mounting" /></td>
<td><img src="image2" alt="Plate mounting" /></td>
</tr>
<tr>
<td><img src="image3" alt="Wall mounting/H-rail mounting diagram" /></td>
<td><img src="image4" alt="Plate mounting diagram" /></td>
</tr>
<tr>
<td><img src="image5" alt="Wall mounting/H-rail mounting diagram" /></td>
<td><img src="image6" alt="Plate mounting diagram" /></td>
</tr>
<tr>
<td><img src="image7" alt="Wall mounting/H-rail mounting diagram" /></td>
<td><img src="image8" alt="Plate mounting diagram" /></td>
</tr>
</tbody>
</table>

1. Lift the device
2. Tilt the device forwards

1. Loosen the screws
2. Remove the device

Fig. 18  Disassemble SOPA
## 9 Fault clearance

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No indication on display</td>
<td>No supply voltage or impermissible operating voltage</td>
<td>Switch on the supply voltage; observe the voltage range.</td>
</tr>
<tr>
<td></td>
<td>Electrical connections swapped (incorrect polarity)</td>
<td>Connect the sensor module in accordance with the plug pattern.</td>
</tr>
<tr>
<td></td>
<td>Sensor module defective</td>
<td>Replace sensor module.</td>
</tr>
<tr>
<td>Incomplete display</td>
<td>Display defective</td>
<td>Replace sensor module.</td>
</tr>
<tr>
<td>Incorrect pressure indicated for supply pressure (In C)</td>
<td>Sensor module fouled</td>
<td>Replace the sensor module and only operate the SOPA with filtered compressed air (Chapter 11)</td>
</tr>
<tr>
<td>Measured value indicator (7-segment) flashes</td>
<td>Value In C (supply pressure) outside the measuring range (&gt; 2 bar)</td>
<td>Observe the pressure range (Chapter 11)</td>
</tr>
<tr>
<td></td>
<td>Overpressure above permitted overload pressure (device damaged)</td>
<td>Replace sensor module.</td>
</tr>
<tr>
<td>Outputs do not switch in accordance with the settings</td>
<td>Short circuit or overload at the output</td>
<td>Eliminate short circuit/overload</td>
</tr>
<tr>
<td></td>
<td>Sensor module defective</td>
<td>Replace sensor module.</td>
</tr>
<tr>
<td>Settings cannot be edited (Lock)</td>
<td>Access protection active</td>
<td>Entering the security code Reset device to its factory settings&lt;sup&gt;1)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Long response times after the CLEAN function with virtually closed or completely closed measuring nozzles</td>
<td>Pressure reduction for the measuring nozzle too slow</td>
<td>Replace the vent screw with a differential pressure regulator (Chapter 6.2)</td>
</tr>
<tr>
<td>No “ready for operation” signal when using a differential pressure regulator</td>
<td>No pressure reduction for the measuring nozzle</td>
<td>Adjust the differential pressure regulator (Chapter 6.2)</td>
</tr>
</tbody>
</table>

<sup>1</sup) If the security code can no longer be found.

Tab. 16  Fault clearance
### 10 Accessories

<table>
<thead>
<tr>
<th>Designation</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecting cable</td>
<td>NEBU-M12G5-K-...</td>
</tr>
<tr>
<td>– Straight socket</td>
<td>NEBU-M12W5-K-...</td>
</tr>
<tr>
<td>– Angled socket</td>
<td></td>
</tr>
<tr>
<td>Differential pressure regulator</td>
<td>LRLL-1/8-QS-6</td>
</tr>
<tr>
<td>Adapter plate for wall mounting¹)</td>
<td>SXE3-...-W...</td>
</tr>
<tr>
<td>Blanking plug</td>
<td>B-M7</td>
</tr>
<tr>
<td>Push-in fitting</td>
<td>QSM-M7-6-I</td>
</tr>
</tbody>
</table>

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

### 11 Technical data

<table>
<thead>
<tr>
<th>Technical data</th>
<th>SOPA-C</th>
<th>SOPA-M</th>
</tr>
</thead>
<tbody>
<tr>
<td>General information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certification</td>
<td>RCM Mark, c UL us – Recognized (OL)</td>
<td></td>
</tr>
<tr>
<td>CE mark (Declaration of Conformity</td>
<td>According to EU EMC Directive</td>
<td></td>
</tr>
<tr>
<td>(<a href="http://www.festo.com/sp">www.festo.com/sp</a>)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Note on materials</td>
<td>RoHS-compliant</td>
<td></td>
</tr>
<tr>
<td>Input signal/measuring element</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured variable</td>
<td>Distance</td>
<td></td>
</tr>
<tr>
<td>Measuring principle</td>
<td>Pneumatic system</td>
<td></td>
</tr>
<tr>
<td>Sensing range [µm]</td>
<td>20...200</td>
<td></td>
</tr>
<tr>
<td>Operating pressure [bar]</td>
<td>4...7</td>
<td></td>
</tr>
<tr>
<td>Operating pressure [MPa]</td>
<td>0.4...0.7</td>
<td></td>
</tr>
<tr>
<td>Supply pressure [bar]</td>
<td>0.8...1.6</td>
<td></td>
</tr>
</tbody>
</table>
### Technical data

<table>
<thead>
<tr>
<th></th>
<th>SOPA-C</th>
<th>SOPA-M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply pressure</td>
<td>[MPa]</td>
<td>0.08...0.16</td>
</tr>
<tr>
<td>Max. overload pressure [bar]</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Max. overload pressure [MPa]</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Nominal pressure</td>
<td>[bar]</td>
<td>5</td>
</tr>
<tr>
<td>Nominal pressure</td>
<td>[MPa]</td>
<td>0.7</td>
</tr>
<tr>
<td>Operating medium</td>
<td></td>
<td>Compressed air according to ISO 8573-1:2010 [7:4:4]</td>
</tr>
<tr>
<td>Temperature of medium [°C]</td>
<td>0...+50</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>[°C]</td>
<td>0...+50</td>
</tr>
<tr>
<td>Nominal temperature</td>
<td>[°C]</td>
<td>20</td>
</tr>
</tbody>
</table>

#### Switching output

- **Switching output**
  - SOPA-...-2P
  - SOPA-...-2N
- **Switching function**
  - Distance monitoring (Out A/B):
  - Supply pressure monitoring (Out C):
- **Switching element function**
  - N/C or N/O contact, adjustable
- **Repetition accuracy of switching point**
  - Sensing range 30 μm ... 150 μm
  - Sensing range 20 μm ... 200 μm
  - +/-2.5
  - +/-5
- **Temperature coefficient of switching point/10 K** [%]
  - Typically 2

#### Measured value indicator

- **Display range In A/In B (distance)** 0 ... 400 (dimensionless)
- **Display range In C (supply pressure)** [bar] 0 ... 2
- **Display range In C (supply pressure)** [MPa] 0 ... 0.2

#### Output, additional data

- **Short circuit protection** Yes (pulsed)
- **Overload protection** Present

### Electronics

- **Rated operating voltage DC** [V] 24
- **Operating voltage DC** [V] 22.8 ... 26.4
  - 15.0 ... 30.0
- **Max. idle current** [mA] 10
  - 50
- **Reverse polarity protection** For all electrical connections

### Electromechanics

- **Electrical connection** Plug connector M12x1, 4-pin
- **Max. cable length** [m] 30
## Technical data

### Mechanical system

<table>
<thead>
<tr>
<th></th>
<th>SOPA-C</th>
<th>SOPA-M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation position</td>
<td>Any(^1)</td>
<td></td>
</tr>
<tr>
<td>Nominal diameter of measuring nozzle [mm]</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Specified measuring nozzle diameter [mm]</td>
<td>1.5/2/2.5</td>
<td></td>
</tr>
<tr>
<td>Pneumatic connection</td>
<td>QS-6(^2)</td>
<td></td>
</tr>
<tr>
<td>Specified tube length [m]</td>
<td>0.5 ... 8</td>
<td></td>
</tr>
<tr>
<td>Product weight [g]</td>
<td>450</td>
<td>60</td>
</tr>
<tr>
<td>Information on housing materials</td>
<td>Reinforced PA/ anodised aluminium</td>
<td>PA reinforced</td>
</tr>
<tr>
<td>Keypad material information</td>
<td>PET</td>
<td>TPU</td>
</tr>
<tr>
<td>Inspection window material information</td>
<td></td>
<td>PC</td>
</tr>
<tr>
<td>Sealing ring material information</td>
<td>Nitrile rubber</td>
<td></td>
</tr>
<tr>
<td>Adapter plate material information</td>
<td>Chromated steel(^3)</td>
<td></td>
</tr>
</tbody>
</table>

### Display/operation

<table>
<thead>
<tr>
<th>Setting range</th>
<th>SOPA-C</th>
<th>SOPA-M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold value Out A/Out B (distance)</td>
<td>20 ... 300 (dimensionless)</td>
<td></td>
</tr>
<tr>
<td>Setting range</td>
<td>[bar]</td>
<td>0.5 ... 1.9</td>
</tr>
<tr>
<td>Threshold value Out C (supply pressure)</td>
<td>0.05 ... 0.19</td>
<td></td>
</tr>
<tr>
<td>Setting range</td>
<td>[MPa]</td>
<td>0.5 ... 1.9</td>
</tr>
<tr>
<td>Threshold value Out C (supply pressure)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Setting range</td>
<td>[mbar]</td>
<td>20(^4) (2 kPa)</td>
</tr>
<tr>
<td>Hysteresis Out A/Out B (distance)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hysteresis Out C (supply pressure)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Immissions/emissions

<table>
<thead>
<tr>
<th>Storage temperature [°C]</th>
<th>–20 ... +80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of protection</td>
<td>IP65 (according to EN 60529)</td>
</tr>
<tr>
<td>Internal air consumption [SLPM]</td>
<td>4 ... 5</td>
</tr>
<tr>
<td>Instrument air consumption (sense) [SLPM]</td>
<td>15</td>
</tr>
<tr>
<td>Blow out air consumption (clean) [SLPM]</td>
<td>35</td>
</tr>
<tr>
<td>Protection class according to DIN VDE 0106-1</td>
<td>III</td>
</tr>
<tr>
<td>Shock resistance according to DIN/IEC 68-EN 60068 Part 2-27</td>
<td>30 g acceleration with 11 ms duration (half-sine)</td>
</tr>
<tr>
<td>Vibration resistance according to DIN/IEC 68-EN 60068, Part 2-6</td>
<td>0.35 mm travel at 10 ... 60 Hz, 5 g acceleration at 60 ... 150 Hz</td>
</tr>
</tbody>
</table>

---

1) No condensed water should be able to accumulate in the sensor module
2) Plug-in connector for outer diameter of tubing 6 mm
3) When selecting feature ...-W-..
4) Not adjustable

Tab. 19
Response times for different tube lengths

**Fig. 19** Typical response time $t$ as a function of distance $x$ after switching on the instrument air (measuring nozzle: 2 mm)

**Fig. 20** 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

![Graph showing tube length vs. display value](image)

Fig. 21 Influence of the tubing length on the dimensionless display value (measuring nozzle 2 mm)

Repetition accuracy of the switching point

![Graph showing switching point accuracy vs. distance](image)

Fig. 22 Repetition accuracy of the switching point [±μm] as a function of the switching point distance x (measuring nozzle: 2 mm)
Adapter plate hole patterns SXE3-W

X  Distance dimension, dependent on the number of sensor modules used (➔ Tab. 20)

Fig. 23  Adapter plate hole patterns SXE3-W

<table>
<thead>
<tr>
<th>Number of sensor modules</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension X [mm]&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>83.5</td>
<td>104.0</td>
<td>124.5</td>
<td>145.0</td>
</tr>
</tbody>
</table>

<sup>1)</sup>  ➔ Fig. 23

Tab. 20  Dimensions X
12 Quick commissioning

- Switch on the operating voltage.
  ➔ The sensor modules are automatically set to RUN mode.

### Note
If you are unsure as to whether a sensor module is in RUN mode:
- Press and hold the Edit button for 3 seconds. The sensor module switches to RUN mode.

The switching output Out A is used for distance monitoring. In the event of a quick commissioning procedure, you will need to set or teach-in the switching point for Out A.

**Option 1: Manually setting the switching point for Out A**

1. Press the Edit button.
   ➔ The EDIT mode is active. [Out A] flashes or [Lock] flashes if there is an active security lock (release security lock ➔ Chapter 5.6.2).
2. Press the Edit button again to confirm the selection.
   ➔ [SP] flashes.
3. Set the switching point by using the A/B pushbuttons.
4. Press and hold the Edit button for 3 seconds.
   ➔ The sensor module switches to RUN mode.

**Option 2: Teaching-in the switching point for Out A**

1. Set the desired sensing distance between the object and measuring nozzle.
2. First press the A pushbutton and then the Edit button as well.
   [Out A] and [TeachIn] flash.
3. Release both pushbuttons.
   ➔ The value is transferred as the switching point or [Lock] flashes (release security lock ➔ Chapter 5.7).
   ➔ The sensor module switches to RUN mode.