

SEN6x – Mechanical Design and Assembly Guidelines

3rd Generation Environmental Sensor Node for Air Quality Applications



Preface

To ensure the best performance of the sensor in the end user device, it is important to consider a few recommendations when designing a product using SEN6x. This application note will present the main design-in and assembly guidelines for the best sensor performance.



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1 Package

SEN6x features two air inlets and one air outlet that should not be obstructed and should be properly coupled to ambient air. The ambient particulate matter will flow through the sensor thanks to an integrated fan, active during sensor operation.

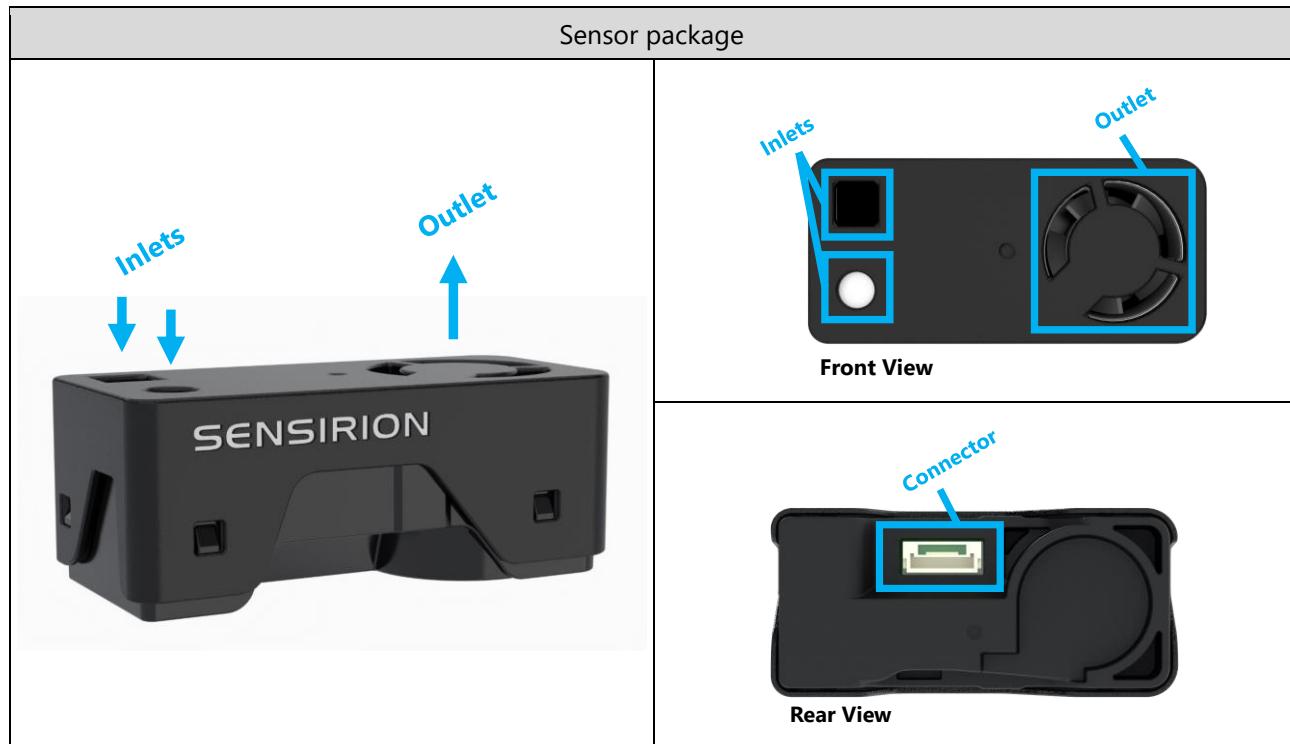


Figure 1. SEN6x package overview

2 Placement of the Sensor

2.1 Coupling to Ambient

A good coupling of inlets and outlet of the SEN6x to ambient air via the device openings, and a suitable device design are essential to accurately measure ambient air quality.

Ideally, the sensor is mounted such that the inlet, as well as the outlet, are connected directly to the ambient air, without channel.

If a channel is required, a short channel length d is preferred. The width of input w_{in} and output w_{out} channel should never restrict the airflow. The total opening area should not be smaller than the sensor openings:

$A_{in} >= 56\text{mm}^2$ & $A_{out} >= 148\text{mm}^2$ (If there is a fine mesh, the outlet area must be increased to compensate for the additional resistance in the flow path.)

It is essential for any design that inlet and outlet are well insulated from each other by proper sealing. The inlet and outlet need to be sealed tightly from the rest of the device's volume to avoid sucking air through any parasitic channels e.g. from the inside of the device.

The SEN6x module is not airtight, parasitic flows entering in the device can affect the normal flow and influence the reliability of data. Therefore, avoid having under- or over-pressure between the inlet/outlet areas (coupled to ambient) and the other parts of the sensor (internal in the design), $P_{INT} = P_{AMB}$ as seen in Figure 3.

Any restriction of the airflow through the Sensor module will proportionally affect the count rate of particulate matter and therefore the sensor readings.

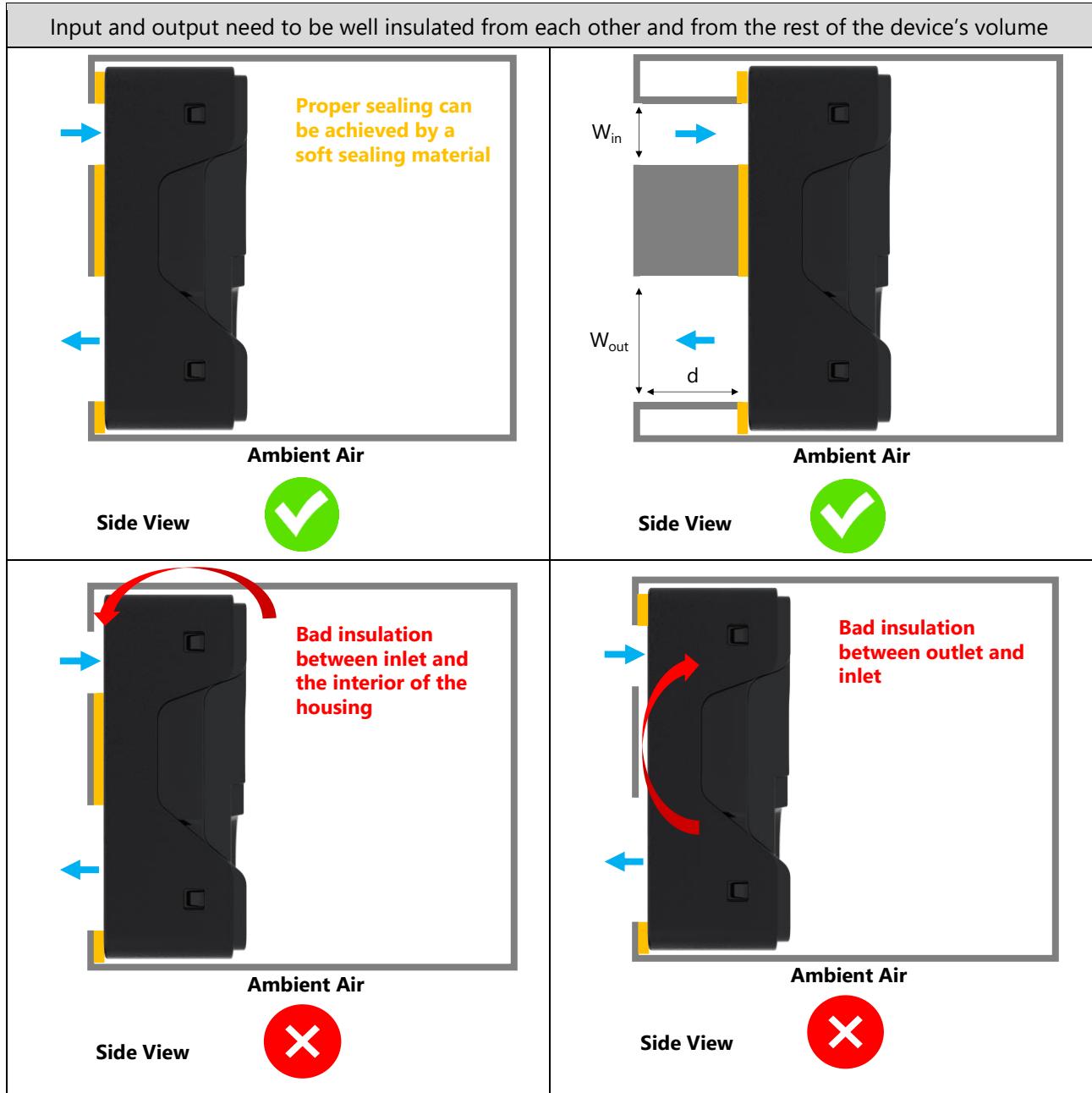


Figure 2. Insulation and air channel design of the device with SEN6x inside

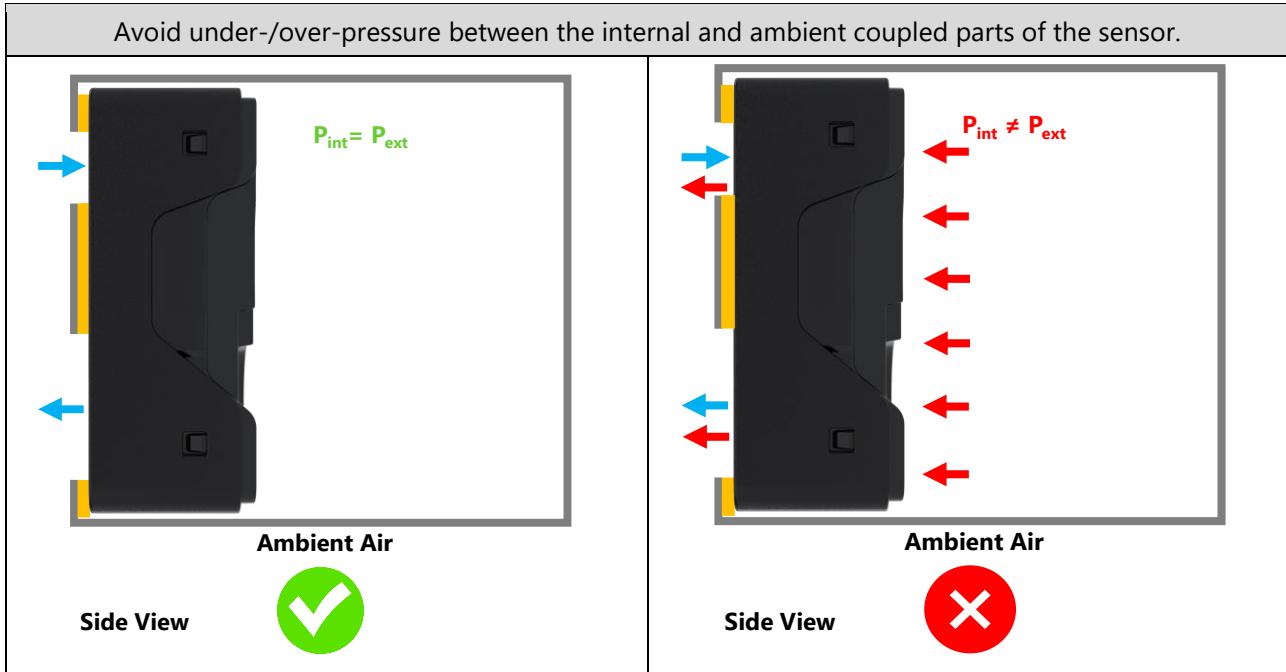


Figure 3. Pressure conditions for SEN6x design in location

2.2 Orientation

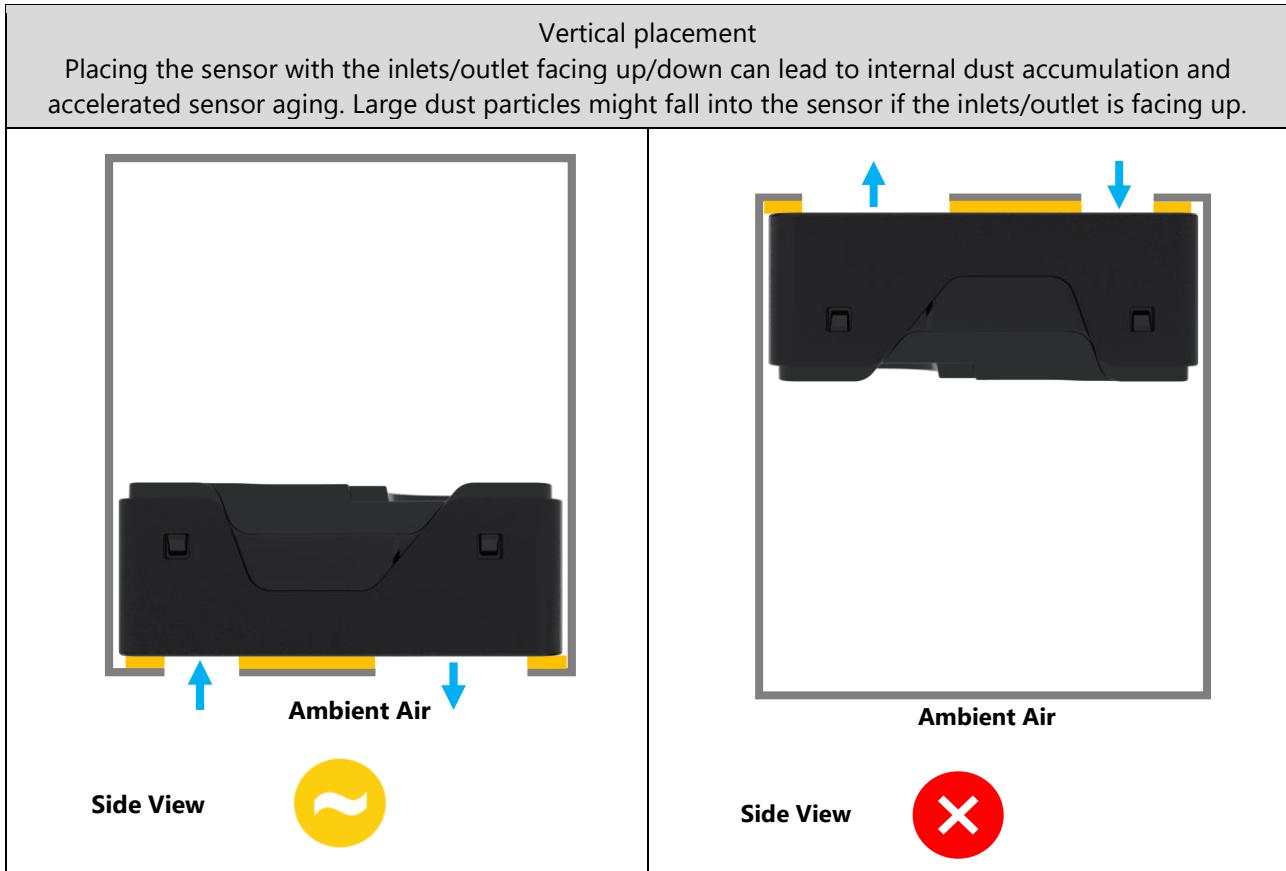


Figure 4. Vertical placement options of SEN6x

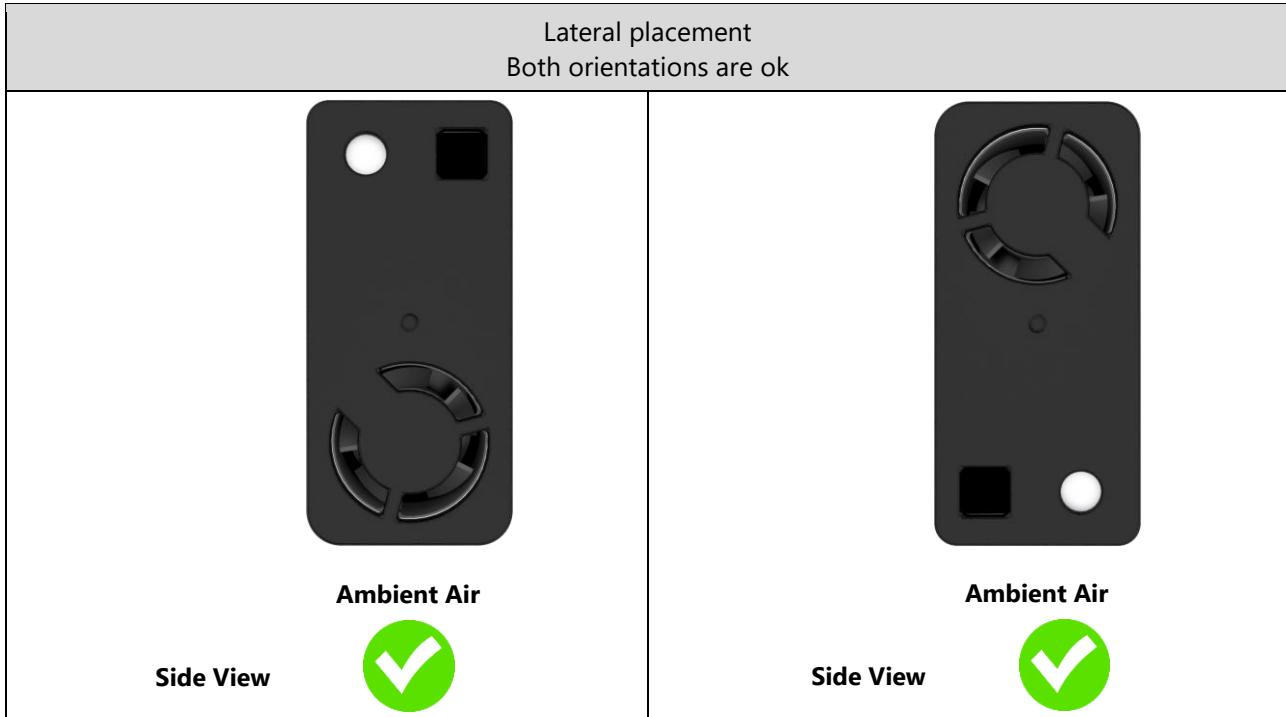


Figure 5. Lateral placement options of SEN6x

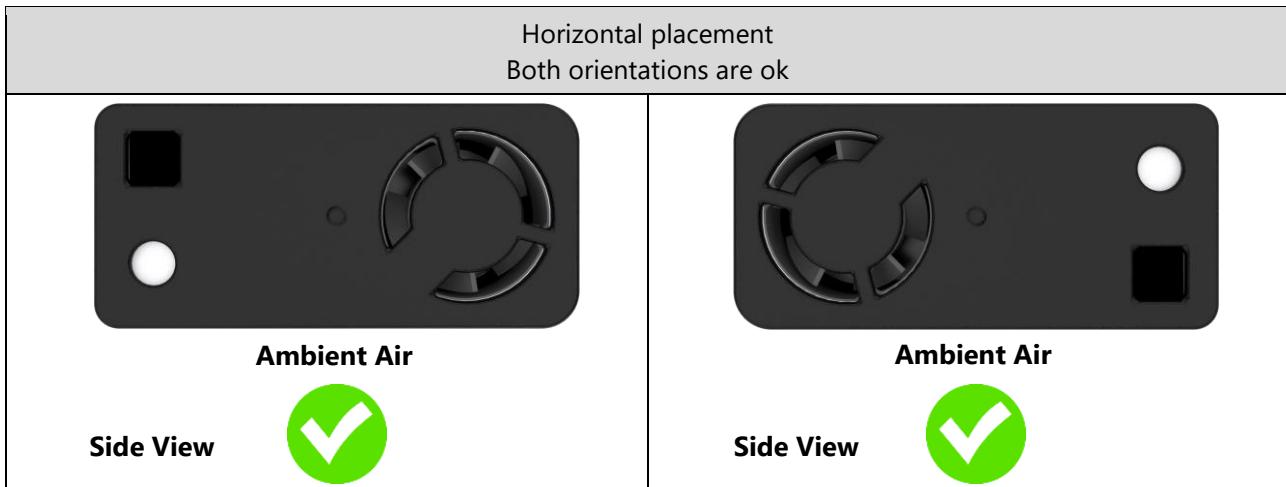


Figure 6. Horizontal placement option of SEN6x

2.3 Isolation from Airflow

External airflows can generate a pressure drop between the inlets and the outlet and alter the sensor reading. Very strong flows can also physically prevent particles from entering the sensor inlet channels. The sensor should be isolated from the airflow of the final device (e.g., air purifier) if the velocity of this flow is greater than 1 m/s. For a design-in where the external flow velocity is greater than 1 m/s, consider a duct air mount (reducing the turbulences on the sensor openings).

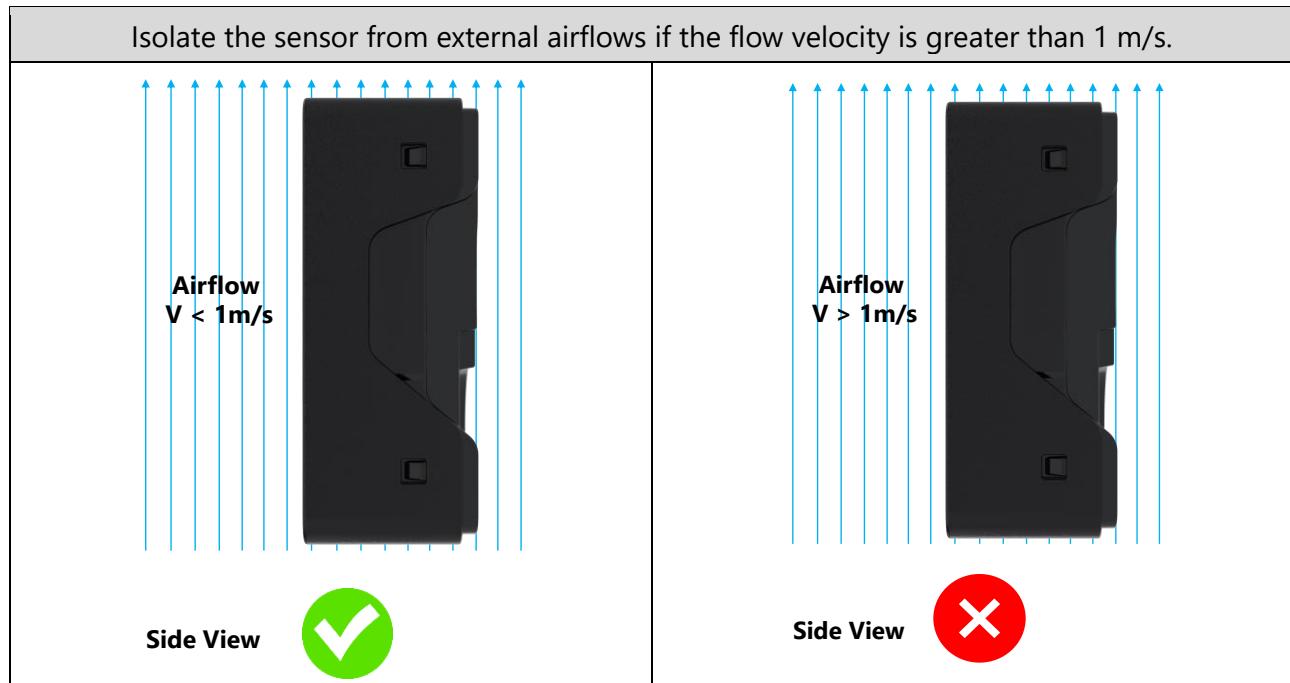


Figure 7. Isolation of external airflows

2.4 Decoupling from External Heat Sources

The Sensirion SEN6x sensor output is compensated for self-heating of the module itself. If the sensor is built into a system, other heat sources such as microcontrollers, battery, Wi-Fi module, display, etc. add an additional temperature offset.

While SEN6x internal temperature compensation algorithm¹ can be adapted to deal with some additional heating, an external induced temperature is also subject to uncertainty. The heat sources will not perform exactly the same in every device and the larger the over-temperature, the larger the absolute error from the uncertainty. We therefore recommend minimizing the exposure of the SEN6x to other heat sources as much as possible by design. An over-temperature of $<5^{\circ}\text{K}$ is recommended.

Thus, it is beneficial to design the SEN6x as far apart from any heat sources as possible.

It is further recommended to place the SEN6x below heat sources, as air convection arising from heat sources will heat up the sensor.

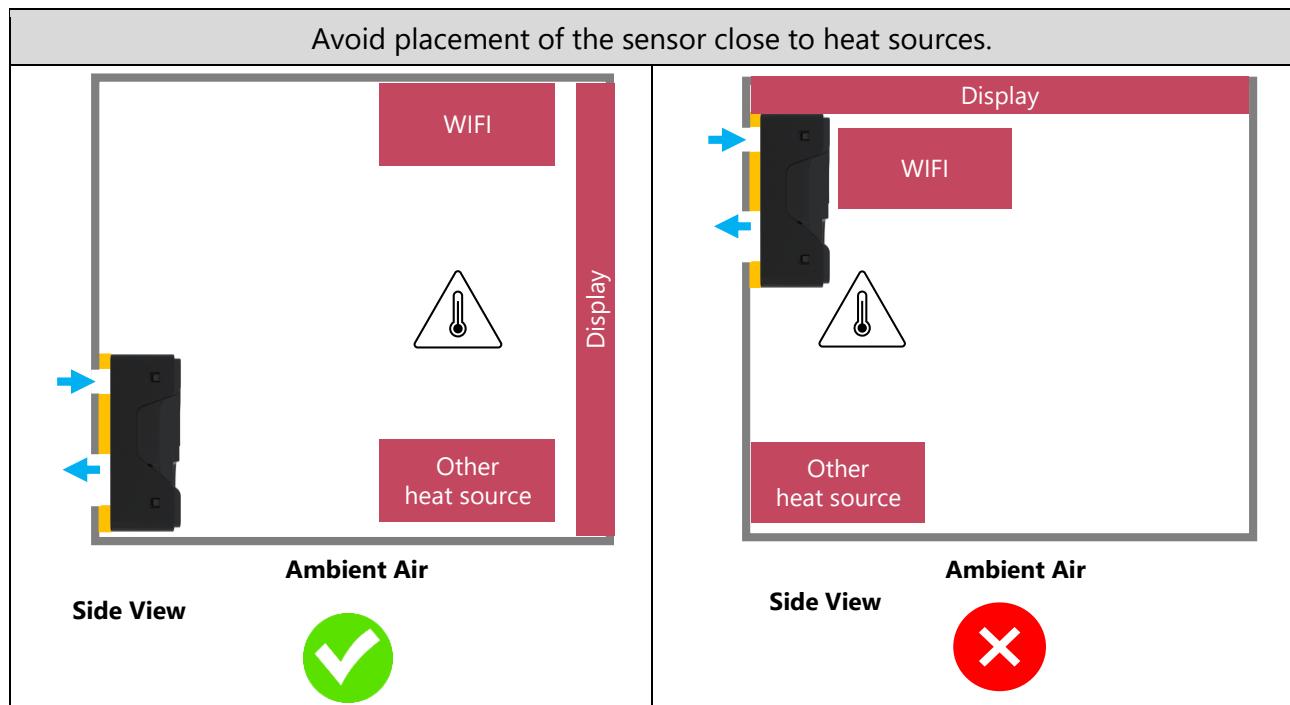


Figure 8. SEN6x placement relative to heat sources

¹ Self-heating of the module is compensated according to the application note "SEN6x – Temperature Acceleration and Compensation Instructions" [1]

2.5 Protection from Sunlight

Exposing the SEN6x to direct sunlight might introduce temperature offset, temperature gradients and accelerate the aging of the SEN6x. Direct sunlight into the inlets/outlets might influence the particulate matter performance. Thus, it is recommended to protect the sensor from direct sunlight. This can be achieved by a suitable design-in or by using a light shade.

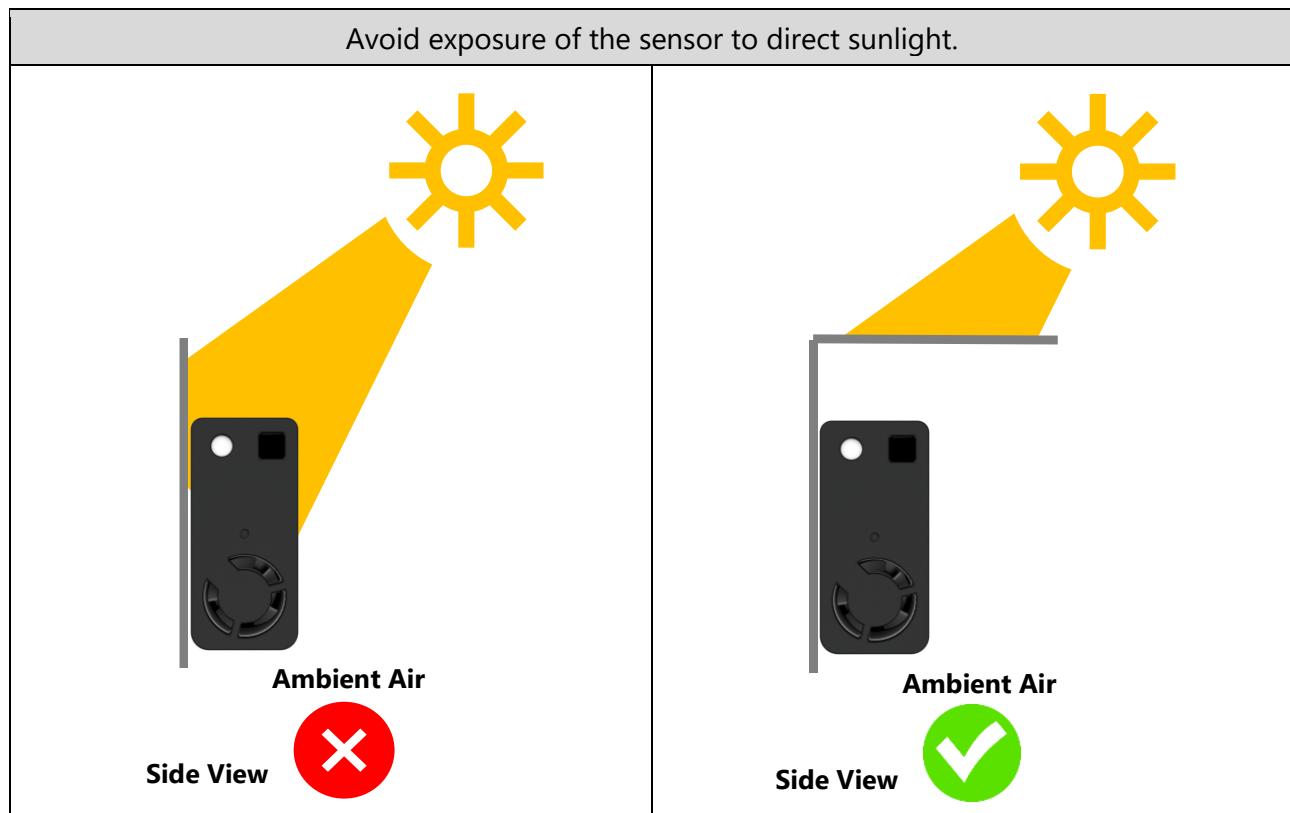


Figure 9. Design consideration for sunlight

3 Mechanical Assembly Guidelines

The following indications should be followed when assembling the SEN6x:

- Do not obstruct inlets and outlet.
- Make sure that the inlet and outlet are separated via tightly sealed channels to ambient to avoid parasitic air flow.
- To avoid any resonances building up in the housing structure, we recommend a firm mechanical fixture with a flexible foam decoupling to avoid any structural borne sound.
- Acoustic foam or thin rubber can be used to further reduce noise².
- The sensor should not be thermally insulated to avoid overheating and large temperature offset.

An example mounting, using the snap in fixture is shown Figure 10. The example retainer and the sealing can be downloaded as a STEP-file from the SEN6x product page.

Disclaimer: the mounting example is meant for prototyping only! The design must be adjusted according to sealing ductility & thickness, material and manufacturing process of the retainer itself.

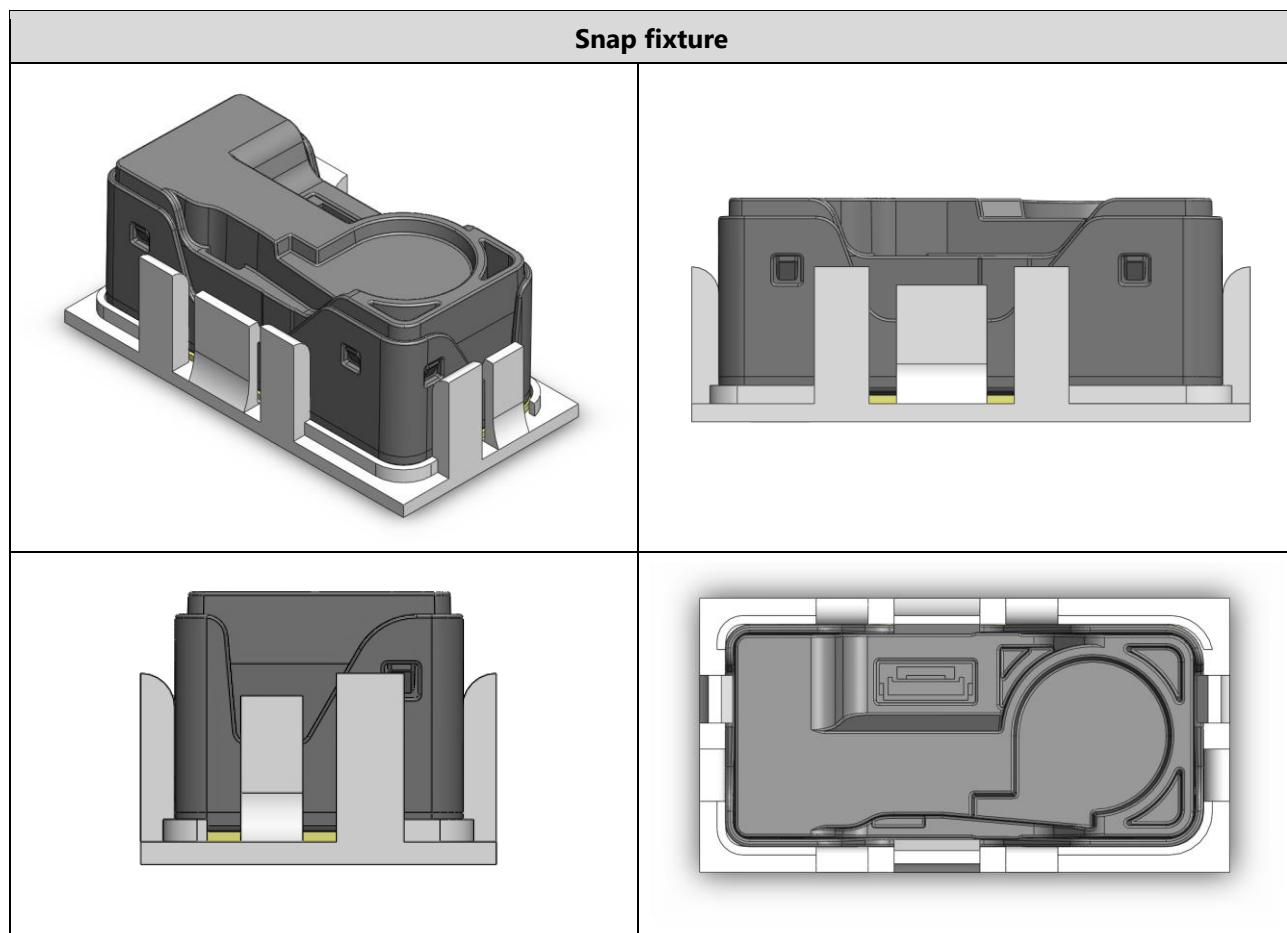


Figure 10. Example snap fixture mounting of SEN6x

² Note that sensor acoustic emission level is always according to datasheet specifications. Acoustic foam helps to reduce unwanted noise generated by the mechanical coupling between the sensor and the housing.

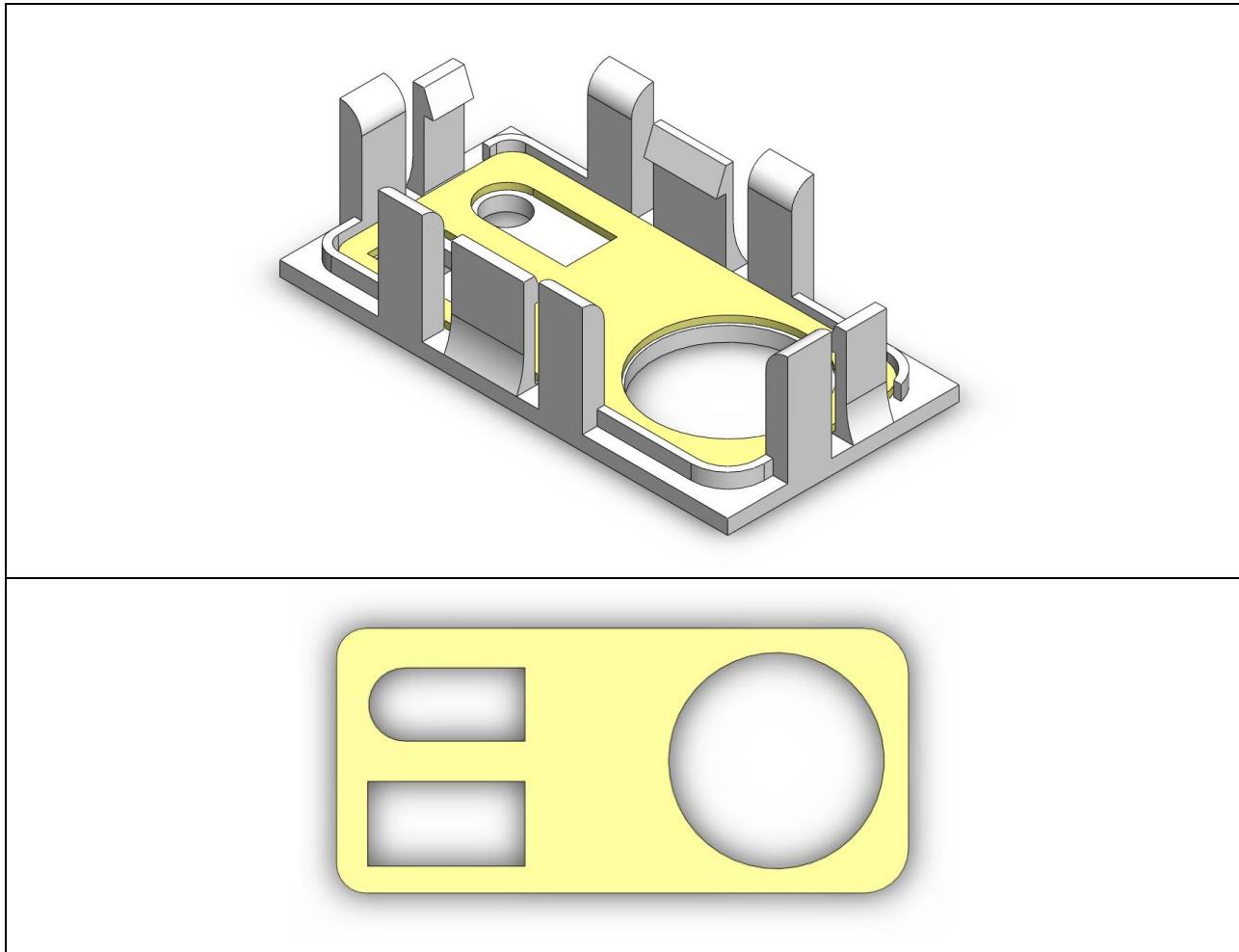


Figure 11. Snap fixture for SEN6x

4 Bibliography

- [1] Sensirion, "SEN6x - Temperature Acceleration and Compensation Instructions," April 2025. [Online]. Available: www.sensirion.com.

5 Revision History

Date	Version	Page(s)	Changes
December 2024	0.9	All	Initial public release
May 2025	0.91	All	Add required area in Coupling to Ambient , Improve description in Decoupling from External Heat Sources , Add reference in Mechanical Assembly Guidelines to STEP file of example retainer

Important Notices

Warning, Personal Injury

Do not use this product as safety or emergency stop devices or in any other application where failure of the product could result in personal injury. Do not use this product for applications other than its intended and authorized use. Before installing, handling, using or servicing this product, please consult the data sheet and application notes. Failure to comply with these instructions could result in death or serious injury.

If the Buyer shall purchase or use SENSIRION products for any unintended or unauthorized application, Buyer shall defend, indemnify and hold harmless SENSIRION and its officers, employees, subsidiaries, affiliates and distributors against all claims, costs, damages and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if SENSIRION shall be allegedly negligent with respect to the design or the manufacture of the product.

ESD Precautions

The inherent design of this component causes it to be sensitive to electrostatic discharge (ESD). To prevent ESD-induced damage and/or degradation, take customary and statutory ESD precautions when handling this product. See application note "ESD, Latchup and EMC" for more information.

Warranty

SENSIRION warrants solely to the original purchaser of this product for a period of 12 months (one year) from the date of delivery that this product shall be of the quality, material and workmanship defined in SENSIRION's published specifications of the product. Within such period, if proven to be defective, SENSIRION shall repair and/or replace this product, in SENSIRION's discretion, free of charge to the Buyer, provided that:

- notice in writing describing the defects shall be given to SENSIRION within fourteen (14) days after their appearance;
- such defects shall be found, to SENSIRION's reasonable satisfaction, to have arisen from SENSIRION's faulty design, material, or workmanship;
- the defective product shall be returned to SENSIRION's factory at the Buyer's expense; and
- the warranty period for any repaired or replaced product shall be limited to the unexpired portion of the original period.

This warranty does not apply to any equipment which has not been installed and used within the specifications recommended by SENSIRION for the intended and proper use of the equipment. EXCEPT FOR THE WARRANTIES EXPRESSLY SET FORTH HEREIN, SENSIRION MAKES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE PRODUCT. ANY AND ALL WARRANTIES, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY EXCLUDED AND DECLINED.

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SENSIRION reserves the right, without further notice, (i) to change the product specifications and/or the information in this document and (ii) to improve reliability, functions and design of this product.

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