SENSIRION

SEN6x – Mechanical Design and Assembly Guidelines

3rd Generation Environmental Sensor Node for Air Quality Applications



Preface

To ensure optimal sensor performance in the end-user device, it is important to consider certain recommendations when designing a product using the SEN6x. This application note presents the key design-in and assembly guidelines to achieve the best sensor performance.

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1 Package

SEN6x features two air inlets and one air outlet, which must remain unobstructed and properly coupled to ambient air. During operation, an integrated fan actively draws ambient air through the sensor.

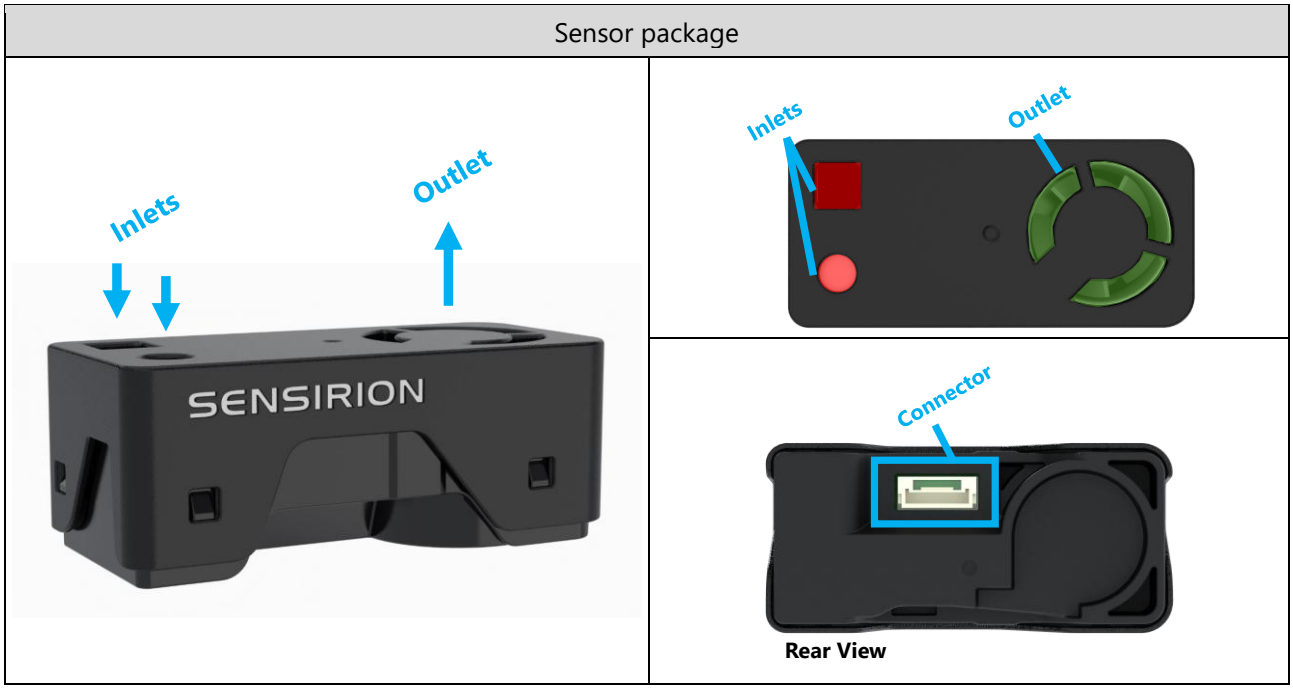


Figure 1. SEN6x package overview. Top right: Inlets (red, 56mm^2), outlet (green, 148 mm^2)

2 Placement of the Sensor

2.1 Coupling to Ambient

Proper coupling of the SEN6x inlets and outlet to the ambient air through the device openings, together with a suitable device design, is essential for accurate air quality measurement.
Ideally, the sensor should be mounted so that both the inlets and the outlet are connected directly to the ambient air without channels.
If channels are required, a short channel length *d* is preferred. The widths of the input w_{in} and the output w_{out} channels should never restrict the airflow. More specifically, the total opening area of each channel should not be smaller than the sensor openings: A_{in} >= 56 mm^2 and A_{out} >= 148 mm^2 (these values correspond to the size of the SEN6x inlet and outlet slits, see top right in **Figure 1**). If a fine mesh is used in either channel, the area must be increased to compensate for additional flow resistance.

It is essential for any design that inlets and outlet are well insulated from each other by proper sealing. In addition, both must be tightly sealed from the rest of the device volume to prevent air being drawn through parasitic channels, such as from inside the device (see Figure 2).

Since the SEN6x module is not airtight itself, parasitic flows entering the device can disturb the intended airflow and compromise data reliability. Therefore, also avoid having under- or over-pressure between the inlets/outlet areas (coupled to ambient) and the other parts of the sensor (internal in the design), $P_{INT} = P_{AMB}$, as shown in **Figure 3**.
Finally, any restriction of airflow through the sensor module will proportionally reduce the particulate matter count rate and, consequently, affect the accuracy of the sensor readings.

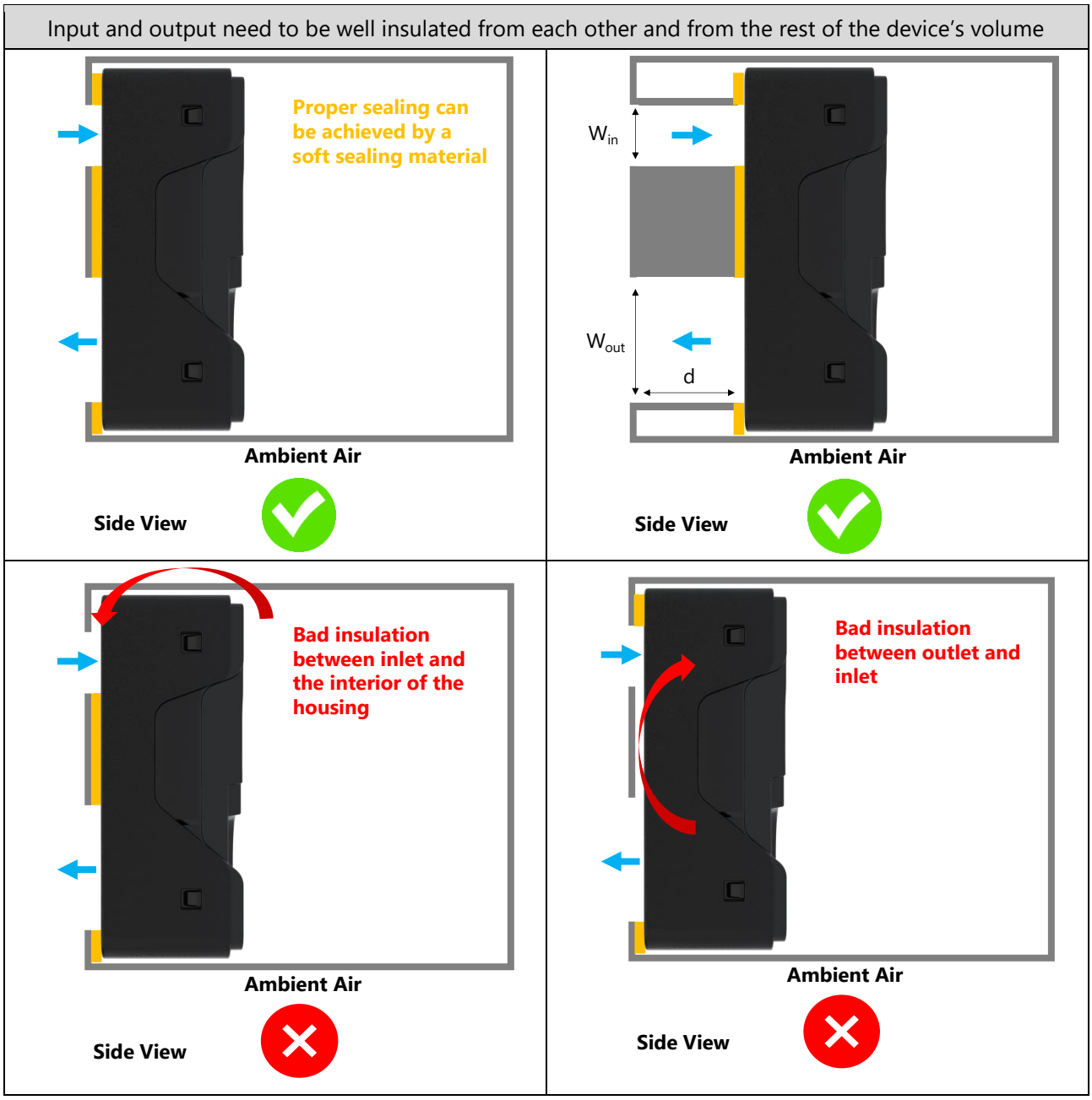


Figure 2. Insulation and air channel design of the device with SEN6x inside

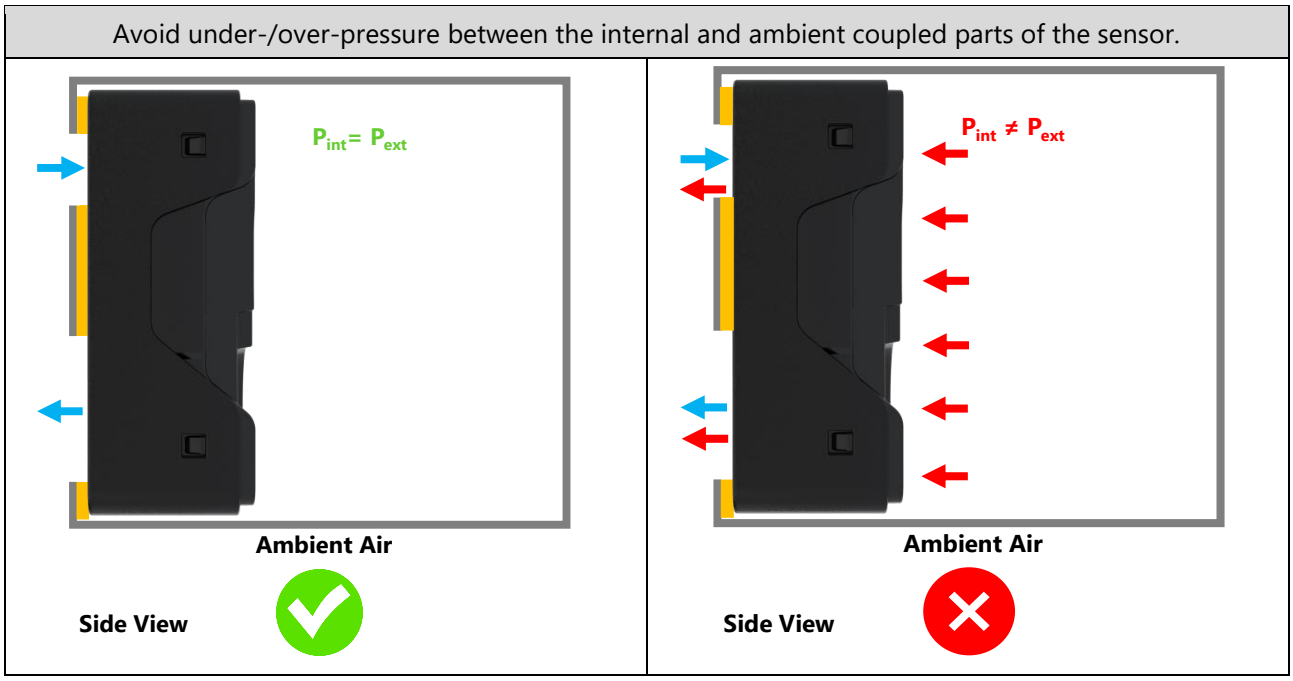


Figure 3. Pressure conditions for SEN6x design-in location

2.2 Orientation

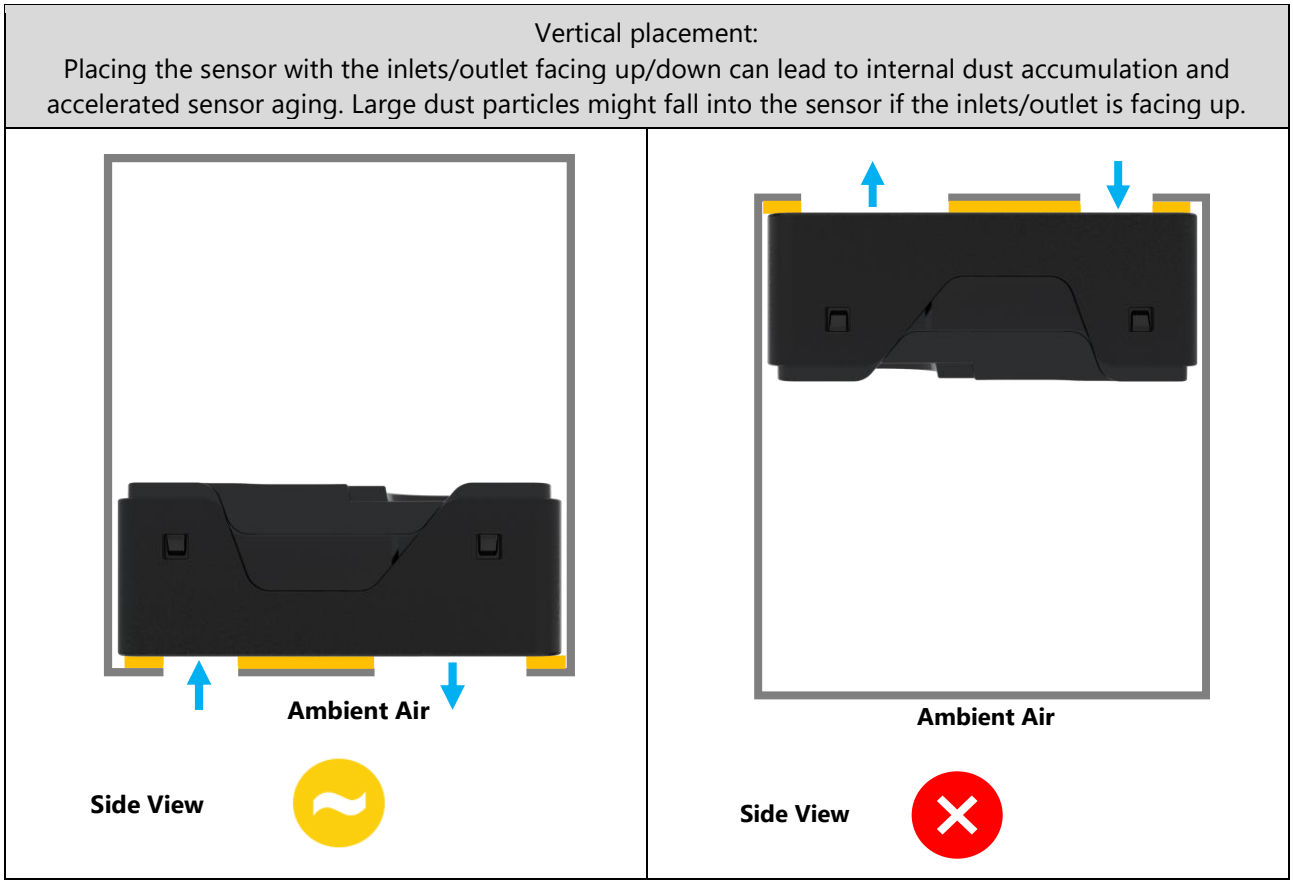


Figure 4. Vertical placement options of SEN6x

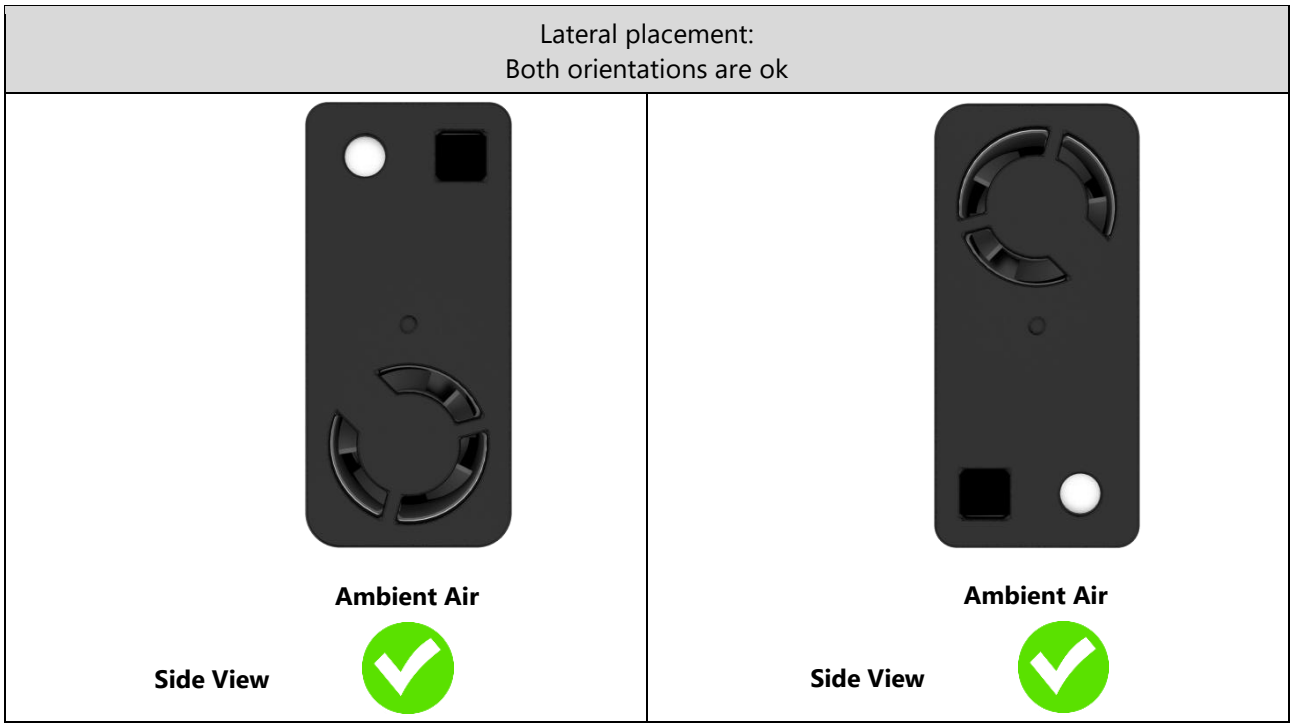


Figure 5. Lateral placement options of SEN6x

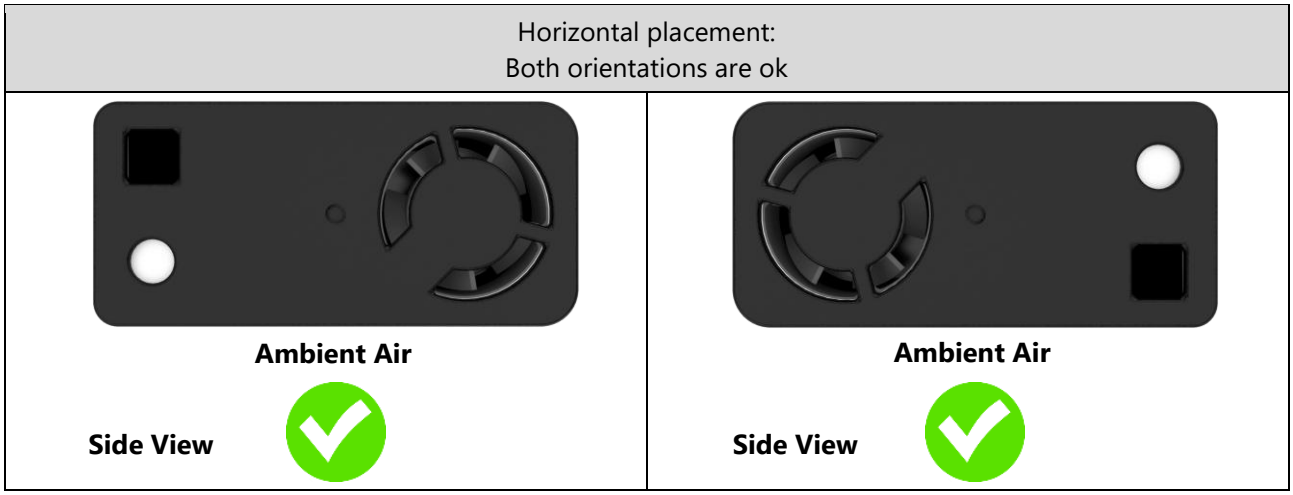


Figure 6. Horizontal placement option of SEN6x

2.3 Isolation from Airflow

External airflows can create a pressure drop between the inlets and the outlet and alter the sensor readings. 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, a duct-air mount is recommended, as it helps reduce the turbulence at the sensor openings.

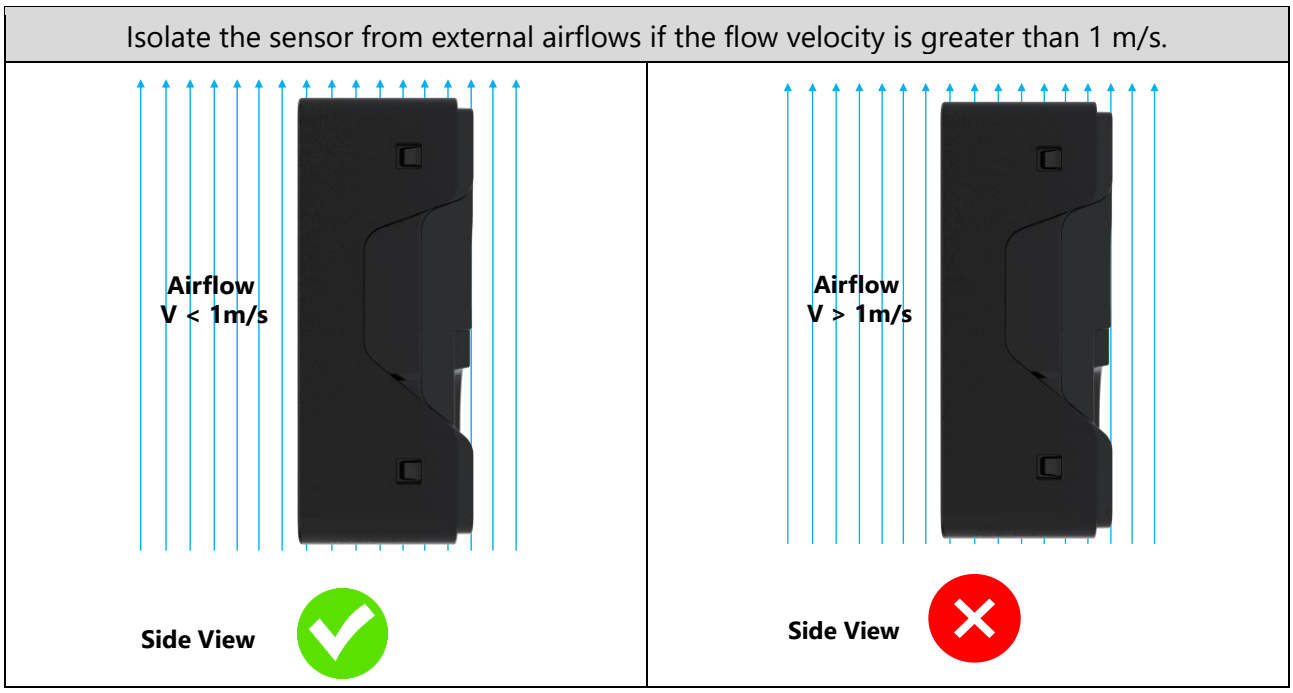


Figure 7. Isolation of external airflows

2.4 Decoupling from External Heat Sources

The output of the Sensirion SEN6x sensor is internally compensated for self-heating of the module. However, when the sensor is integrated into a system, additional heat sources, such as microcontrollers, batteries, Wi-Fi modules, or displays, can introduce further temperature offsets.

While the SEN6x internal temperature compensation algorithm[1] can be adapted to account for some additional heating, externally induced temperature offsets remain subject to uncertainty. Heat sources will not behave identically across devices, and the greater the over-temperature, the larger the absolute error resulting from this uncertainty. We therefore recommend minimizing the exposure of the SEN6x to other heat sources as much as possible by design. An over-temperature of less than 5 °K is recommended.

Accordingly, it is beneficial to position the SEN6x as far away from heat sources as possible. Furthermore, the sensor should be placed below heat sources, since air convection arising from them will otherwise warm the sensor.

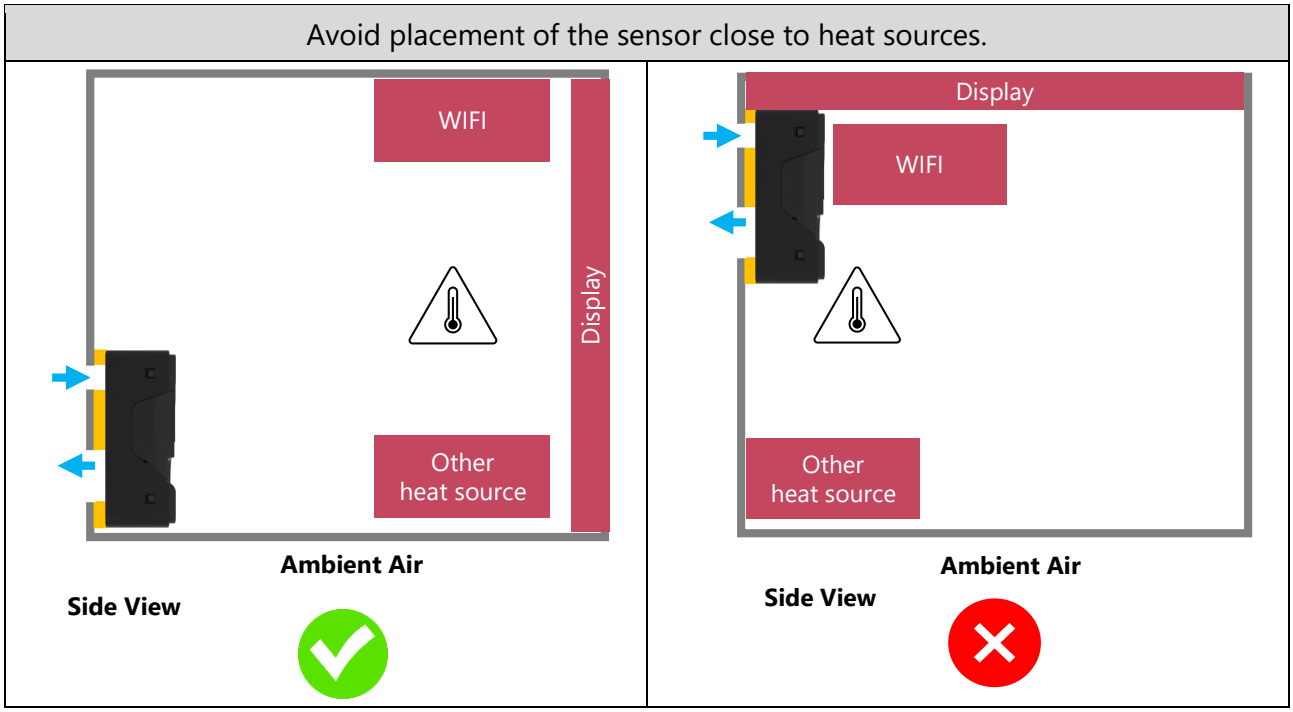


Figure 8. SEN6x placement relative to heat sources

[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

Exposure of the SEN6x to direct sunlight can introduce temperature offsets and gradients and may accelerate the aging of the SEN6x. In addition, direct sunlight entering the inlets or outlet can affect particulate matter measurements. It is therefore recommended to protect the sensor from direct sunlight, either through an appropriate design-in or by using a light shade.

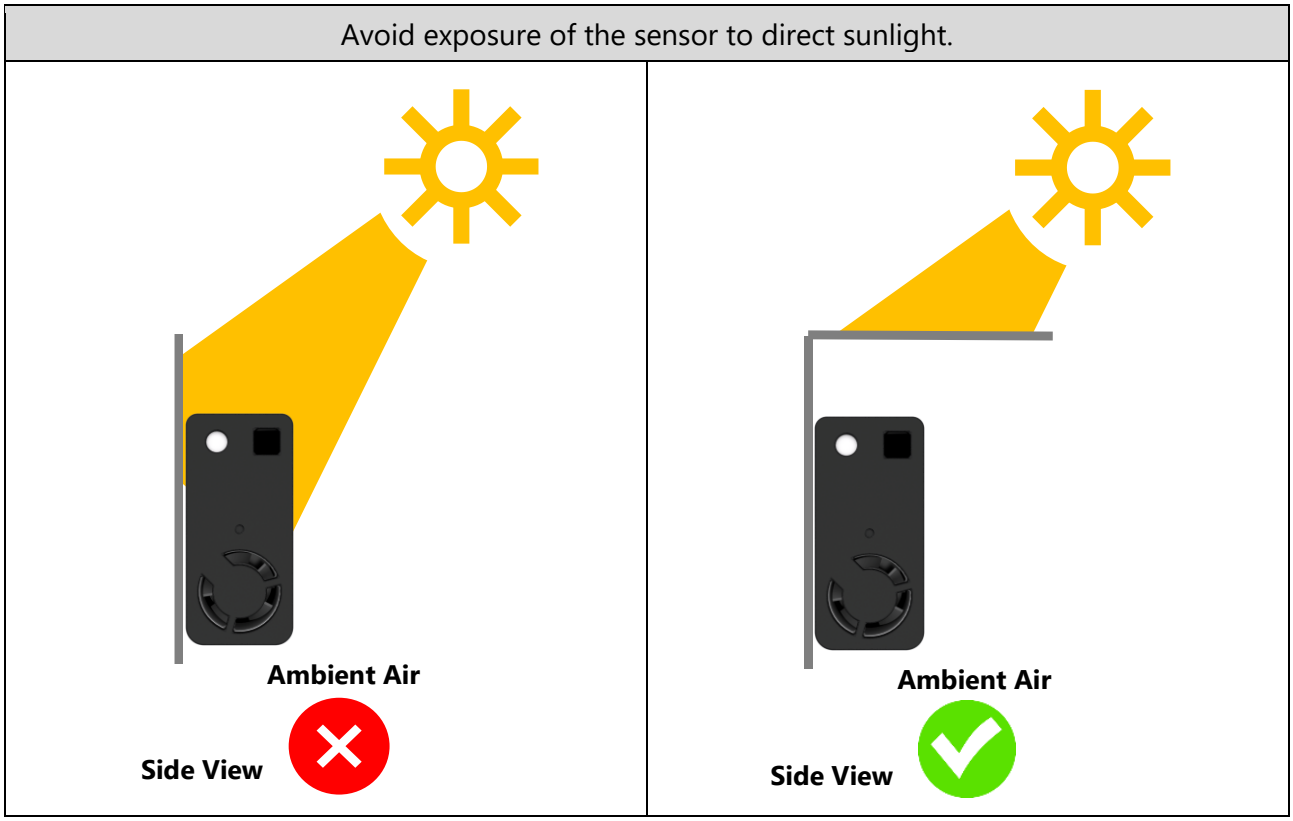


Figure 9. Design consideration for sunlight

3 Mechanical Assembly Guidelines

The following indications should be followed when assembling the SEN6x:

- Do not obstruct the inlets or the outlet.
- Ensure that the inlets and outlet are separated by tightly sealed channels to ambient air to avoid parasitic air flow.
- To avoid resonances in the housing structure, use a firm mechanical fixture combined with flexible foam decoupling to avoid any structure-borne sound.
- Acoustic foam or thin rubber can be used to further reduce noise[2].
- The sensor should not be thermally insulated to avoid overheating and large temperature offset.

An example mounting, using a snap in fixture is shown **Figure 10**. This 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.

Snap fixture

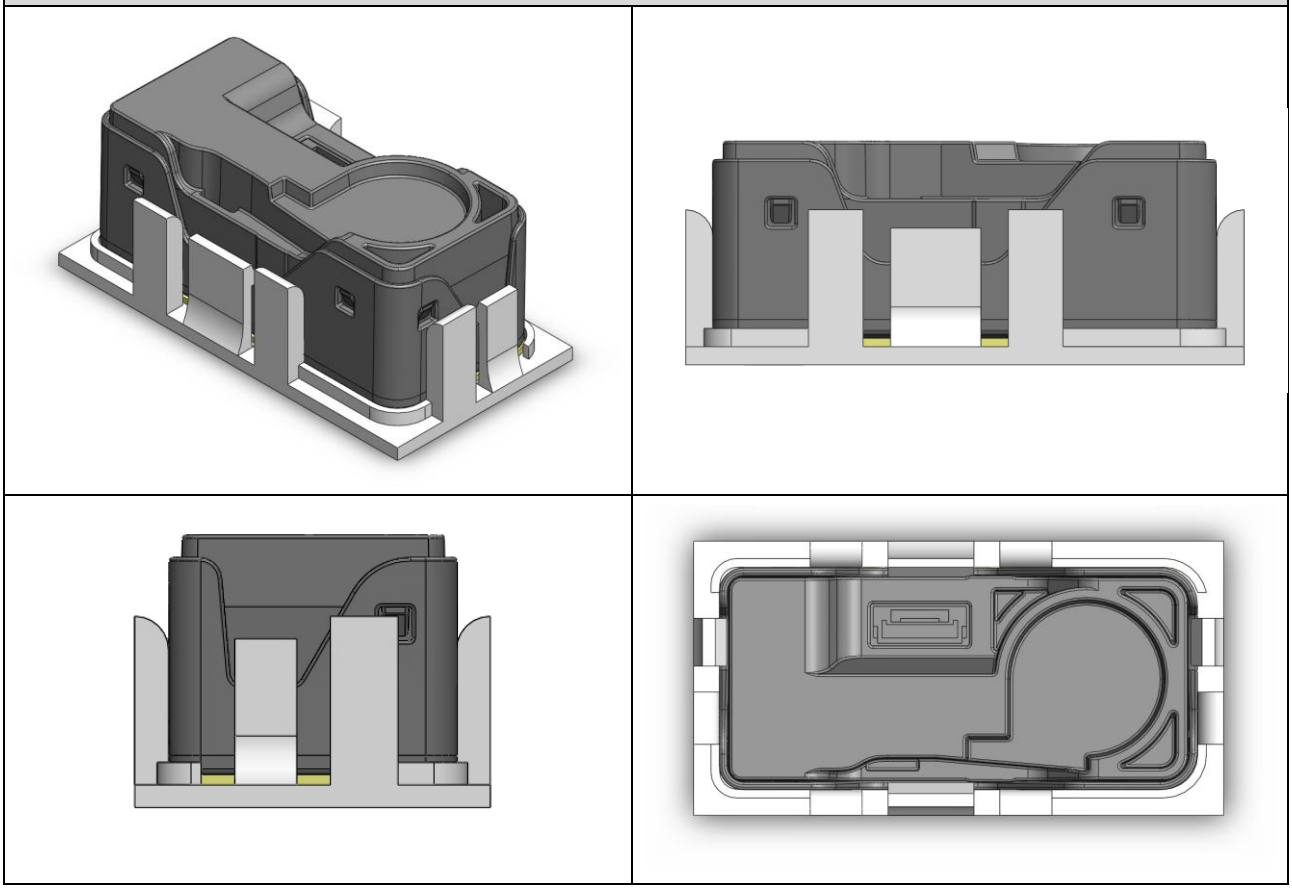


Figure 10. Example snap fixture mounting for the SEN6x

[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.

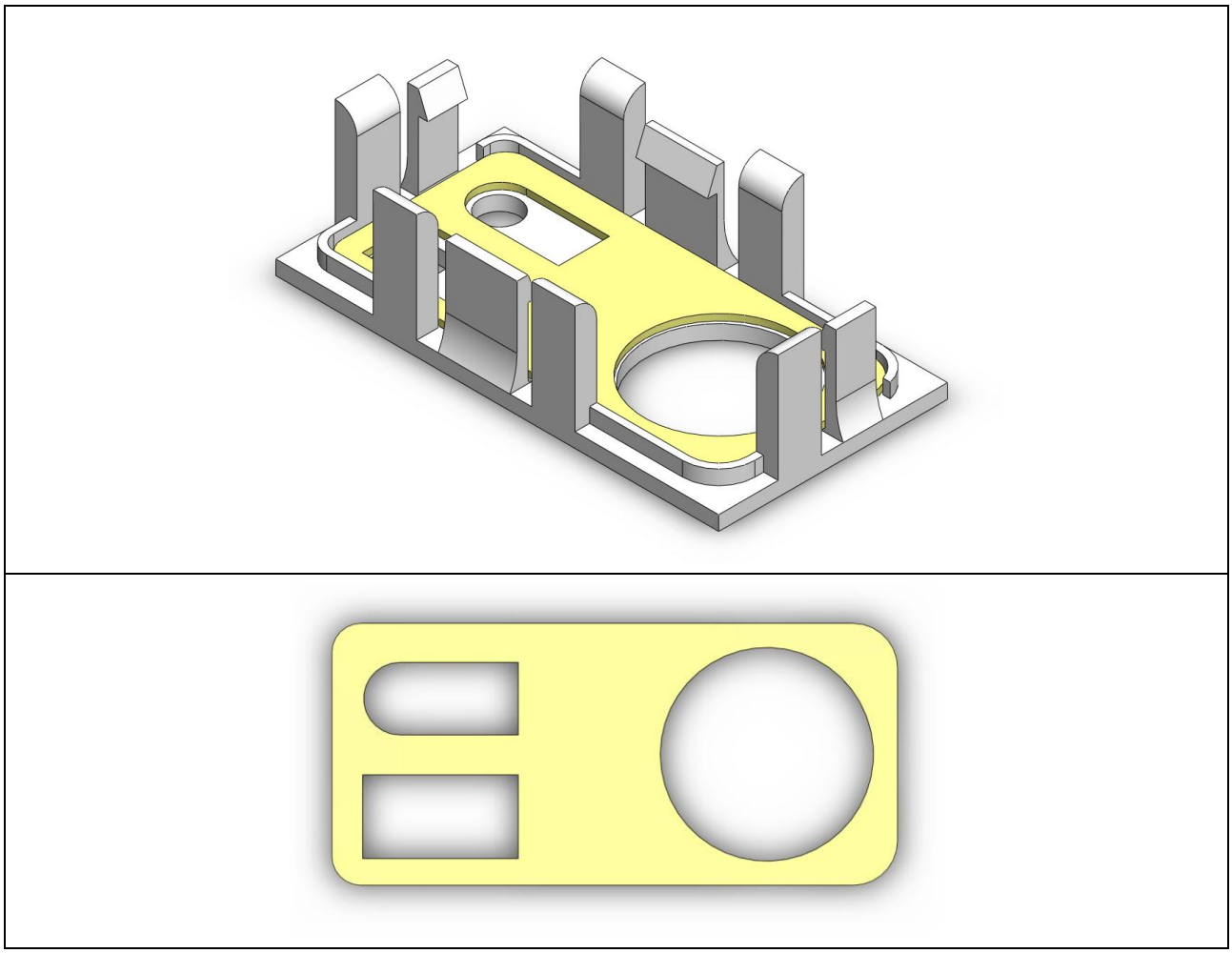


Figure 11. Snap fixture for the SEN6x

4 Consideration for highly noise sensitive applications

The SEN6x requires an active airflow, this is realized with an internal fan. Despite careful selection and quality control, the fan is still a moving part that will produce some acoustical emissions. Larger rigid surfaces may amplify the acoustic footprint.
For noise sensitive applications such as installation in bedrooms or devices with internal microphones, we recommend decoupling the sensor from the housing to reduce structure born sound and test for resonances that may appear in the prototype design. For decoupling we recommend using thick and soft foam and/or very soft rubber/silicone retainer constructions.

5 FAQ Design-In SEN6x – Frequently Asked Questions

Below are several frequently asked questions about the design-in process, together with their answers.

1. What is the maximum cable length for connecting the SEN6x sensor?

The maximum specified cable length for I²C communication is 0.5 m. In most cases, the limiting factors are the power lines or crosstalk on the communication lines. By applying proper shielding, it may be possible to extend the cable length beyond this specification.

2. Which acoustic frequencies of the SEN6x fan can lead to resonance?

The base resonance frequency of the fan is approximately 66.67 Hz (with some variance), as it operates at 4000 RPM (4000 / 60). As it consists of five blades, this produces a blade-pass frequency of 333.34 Hz, along with harmonics at 666.67 Hz and 1000 Hz (corresponding to multiples of 5, 10, and 15 of the base frequency). In addition, the fan has three braces, which generate a brace-related resonance frequency near 200 Hz. Among all of these, the dominant resonance frequency is 1000 Hz.

3. Which design guidelines are recommended to reduce acoustic noise?

The following guidelines should be considered to minimize acoustic noise in SEN6x designs:
Avoid resonances at the fan's base frequency and blade-pass frequency by adjusting dimensions or structural design (see resonance frequencies **above**).

- Eliminate loose parts in the design to prevent rattling.
- Stiffen housing panels using materials such as alubutyl or structural bracing.
- Decouple the sensor mechanically with soft foam or PU rubber, with softness adjusted to the appropriate frequency.
- Use soft rubber feet to isolate the device from the surface to reduce resonance

4. What is the fan speed?

The fan operates at a constant speed of 4000 RPM, and this value cannot be adjusted.

5. What is the airflow through the SEN6x? [l/min]

The airflow is around 0.8-0.9 l/min.

6. What is creep? How can it be removed?

Prolonged exposure to high humidity levels (above approximately 90% RH) can cause a reversible positive offset, known as *creep*, as excess water becomes trapped in the polymer. To counteract this effect, the temperature and humidity sensor in the SEN6x is equipped with an internal heater. The thermal energy generated by the heater accelerates the removal of excess moisture, ensuring accurate and stable humidity and temperature measurements.
A dedicated command is available to activate the sensor's heater at 200 mW for 1 s (see the command "Activate SHT Heater" in the SEN6x datasheet [2]).

7. How does Sensirion's patented sheath-flow technology work, and is it included in the SEN6x?

Sensirion's sheath-flow technology ensures that particle-laden "dirty air" is always surrounded by a layer of filtered, clean air as it passes through the measurement channel of the SEN6x. This protective airflow prevents dust and particles from settling on the optical components, resulting in significantly reduced drift over time and ensuring a long sensor lifetime.
This technology is fully integrated into the SEN6x

8. Why does the SEN6x not include the automatic cleaning feature that was present in the SEN5x?

Field experience showed that automatic cleaning provided no significant additional benefit, as the SEN6x is already reliably protected by its patented sheath-flow design. In addition, customers reported negative effects, since the sensor became noticeably louder once a week for about 10 seconds when the fan speed was increased for cleaning.
To ensure a quieter and more consistent user experience, the automatic cleaning function was removed. If required, customers can still initiate fan cleaning manually using the command "Start Fan Cleaning SEN6x" (see the SEN6x datasheet for details [2]).

9. Breadboard – Why is it not recommended?
For reliable testing of the SEN6x, Sensirion recommends using the SEK-SEN6x evaluation kit together with the SensorBridge. Breadboard setups are generally not recommended for performance verification, as they can introduce additional contact and connection resistance and may result in an insufficient or unstable power supply. This may lead to incorrect sensor behavior, including zero readings or maximum output readings. Therefore, particular attention should be paid to a stable power supply, reliable electrical connections, and proper I^2C communication (according to the SEN6x datasheet [2]).

6 Bibliography

[1] Sensirion, "SEN6x - Temperature Acceleration and Compensation Instructions," December 2025. [Online]. Available: https://sensirion.com/resource/SEN6x-temp-compensation

[2] Sensiron, "SEN6x - Datasheet," December 2025. [Online]. Available: https://sensirion.com/resource/datasheet/SEN6x

7 Revision History

Date	Version	Page(s)	Changes
December 2024	0.9	All	Initial public release
May 2025	0.91	All	Added required area in **Coupling to Ambient,** Improved description in **Decoupling from External Heat Sources,** Added reference in **Mechanical Assembly Guidelines** to STEP file of example retainer
January 2026	0.92	All	General improvement in formulations, Added **FAQ Design-In SEN6x – Frequently Asked Questions**
June 2026	1.0	10	Add section **Consideration for highly noise sensitive applications**
November 2026	1.1	2, 12	Added FAQ question 9, Reformulated text & updated illustrations **Section 2.1**

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.

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Headquarters and Subsidiaries

Sensirion AG
Laubisruetistr. 50
CH-8712 Staefa ZH
Switzerland

phone: +41 44 306 40 00
fax: +41 44 306 40 30
info@sensirion.com
www.sensirion.com

Sensirion Inc., USA
phone: +1 312 690 5858
info-us@sensirion.com
www.sensirion.com

Sensirion Japan Co. Ltd.
phone: +81 45 270 4506
info-jp@sensirion.com
www.sensirion.com/jp

Sensirion Korea Co. Ltd.
phone: +82 31 337 7700~3
info-kr@sensirion.com
www.sensirion.com/kr

Sensirion China Co. Ltd.
phone: +86 755 8252 1501
info-cn@sensirion.com
www.sensirion.com/cn

Sensirion Taiwan Co. Ltd
phone: +886 2 2218-6779
info@sensirion.com
www.sensirion.com

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