

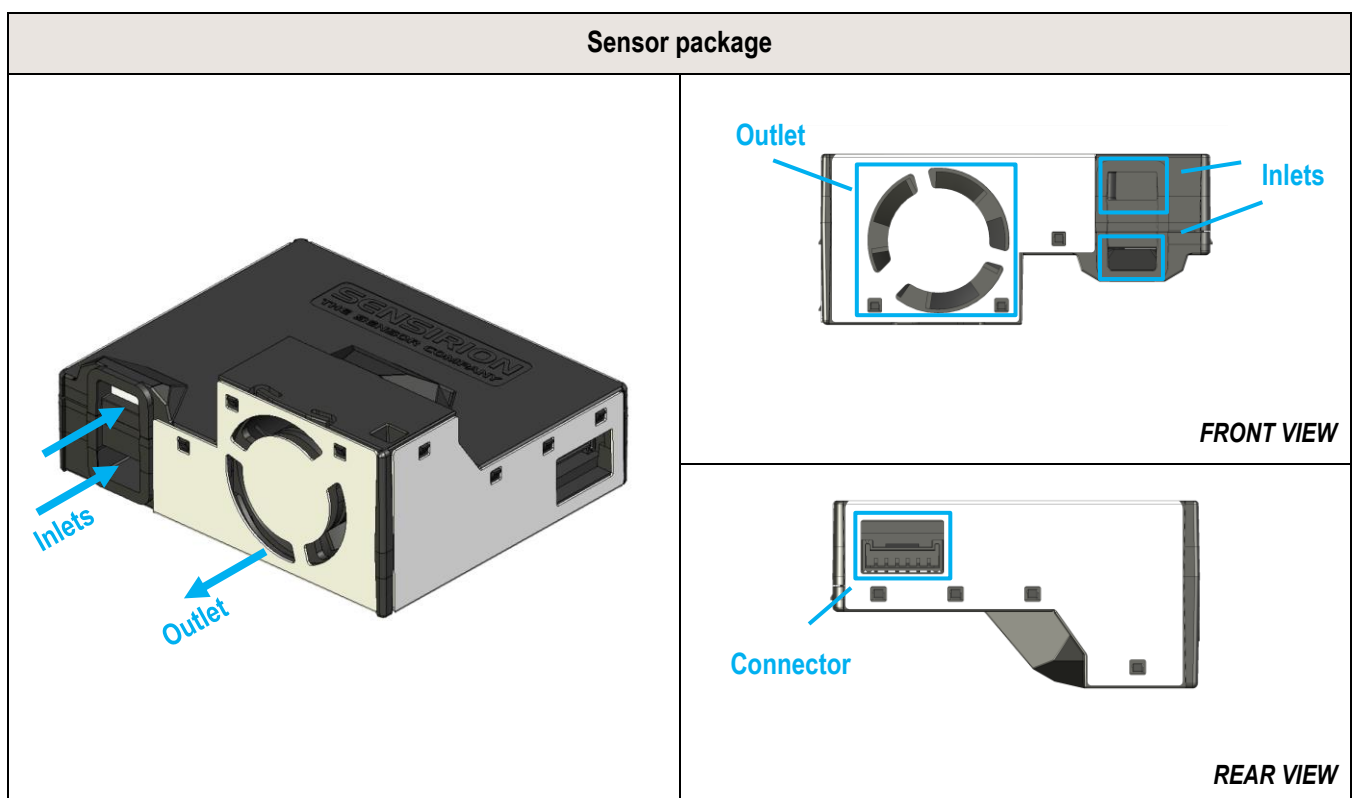
# Mechanical Design and Assembly Guidelines for SEN5x Particulate Matter Sensor

## 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 SEN5x. This application note will present the main design-in and assembly guidelines for the best sensor performance.

## 1 Package

SEN5x 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. The metal casing of the SEN5x is covered in a plastic foil to protect it during shipping. The foil has no impact on the sensor performance and thus does not need to be removed for mechanical assembly.



## 2 Placement of the Sensor

### 2.1 Coupling to Ambient

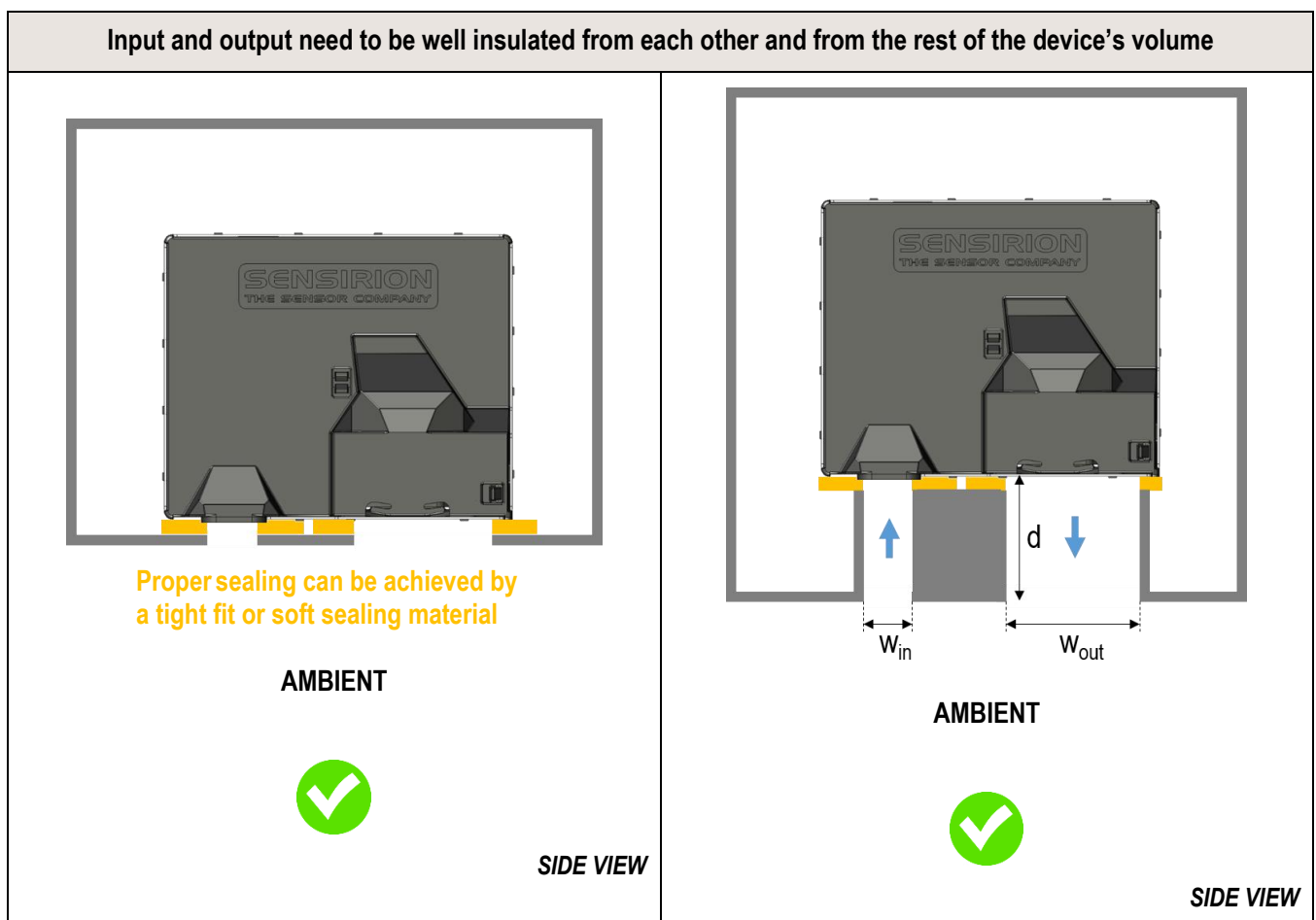
A good coupling of the inlets and outlet of the SEN5x to the ambient air via the device openings and a suitable device design is essential to accurately measure ambient air quality.

Ideally, the sensor is mounted such that the inlet as well as outlet are connected directly to ambient air.

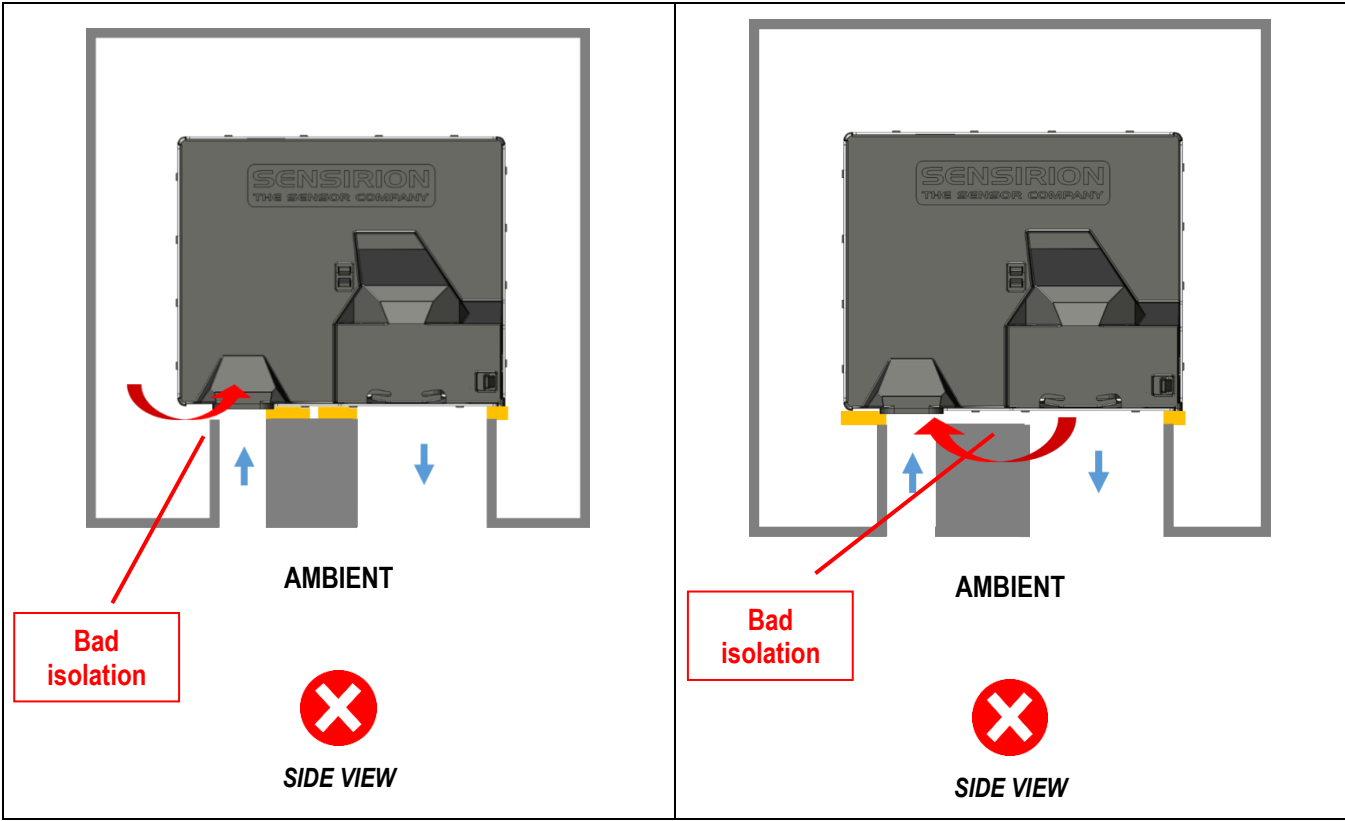
If a channel is required a shorter channel length  $d$  is preferred. The width of input  $w_{in}$  and output  $w_{out}$  channel should never restrict the airflow; the width of the output channel  $w_{out}$  can be made arbitrarily wide.

It is essential for any design that inlet and outlet are well insulated from each other by proper sealing<sup>1</sup>. 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.

In the application note "Mechanical design-in example for SEN5x" we provide a tested design-in proposal that shows how to mount SEN5x in the end product without the need for additional sealing material.



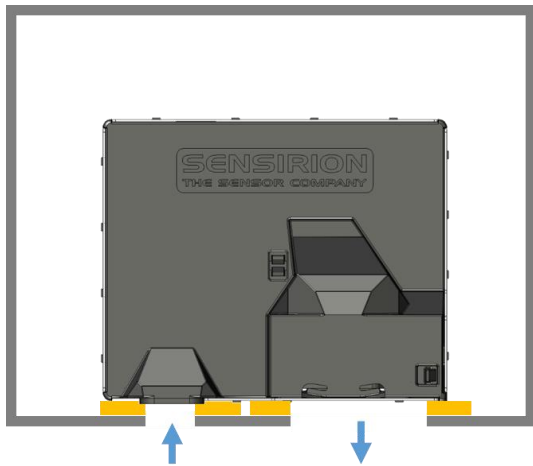
<sup>1</sup> Selection of appropriate material for insulation is essential to avoid contamination of the sensor. For more information about material selection see "SEN5x Handling Instructions"



## 2.2 Orientation

### Vertical placement

Placing the sensor with the inlets/outlet facing down avoids dust accumulation and accelerated sensor aging.

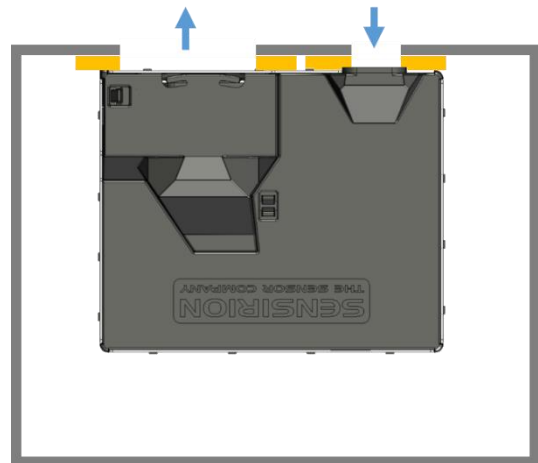


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SIDE VIEW

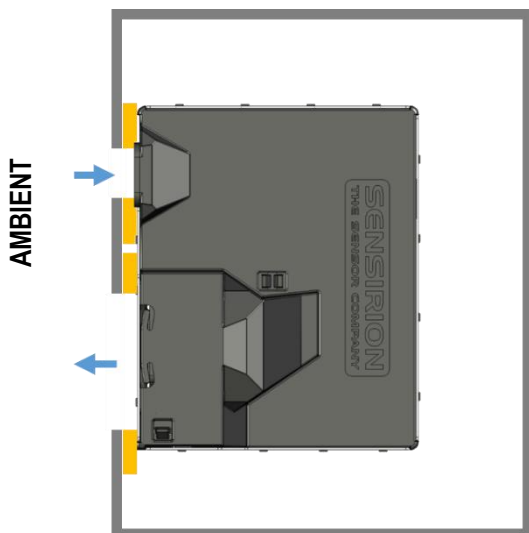
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SIDE VIEW

### Lateral placement

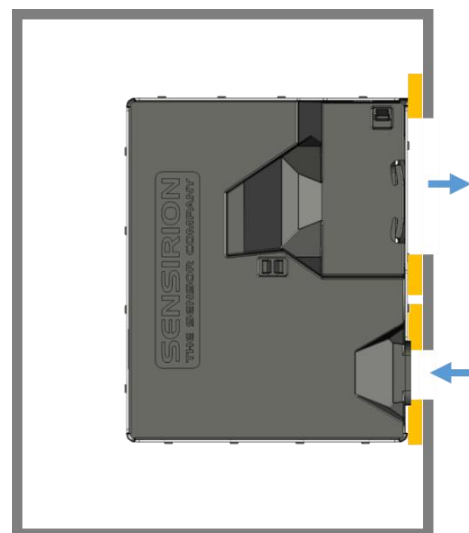
Inlets should always be above outlet to avoid particles getting back from the outlet to the inlets due to gravity.



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SIDE VIEW

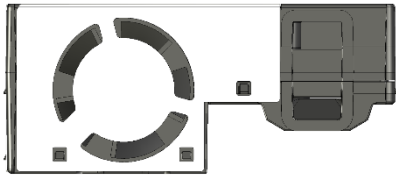


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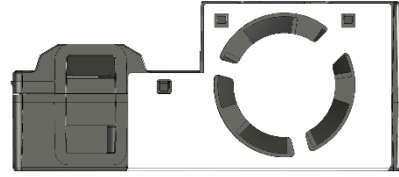


SIDE VIEW

**Horizontal placement**  
**Both orientations are ok**



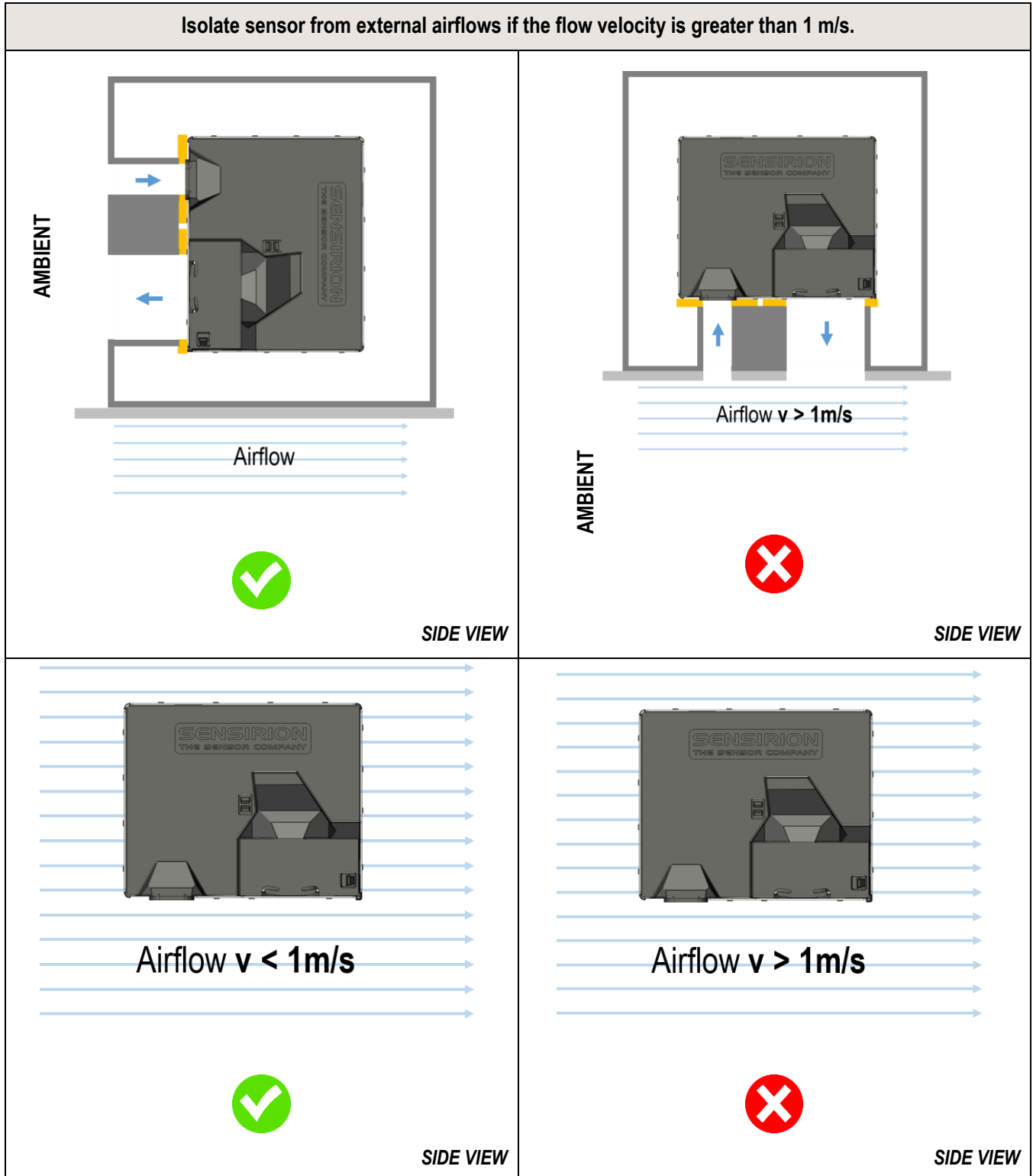
*FRONT VIEW*



*FRONT VIEW*

### 2.3 Isolation from Airflow

External airflows can generate a pressure drop between inlets and 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 contact Sensirion for more information.



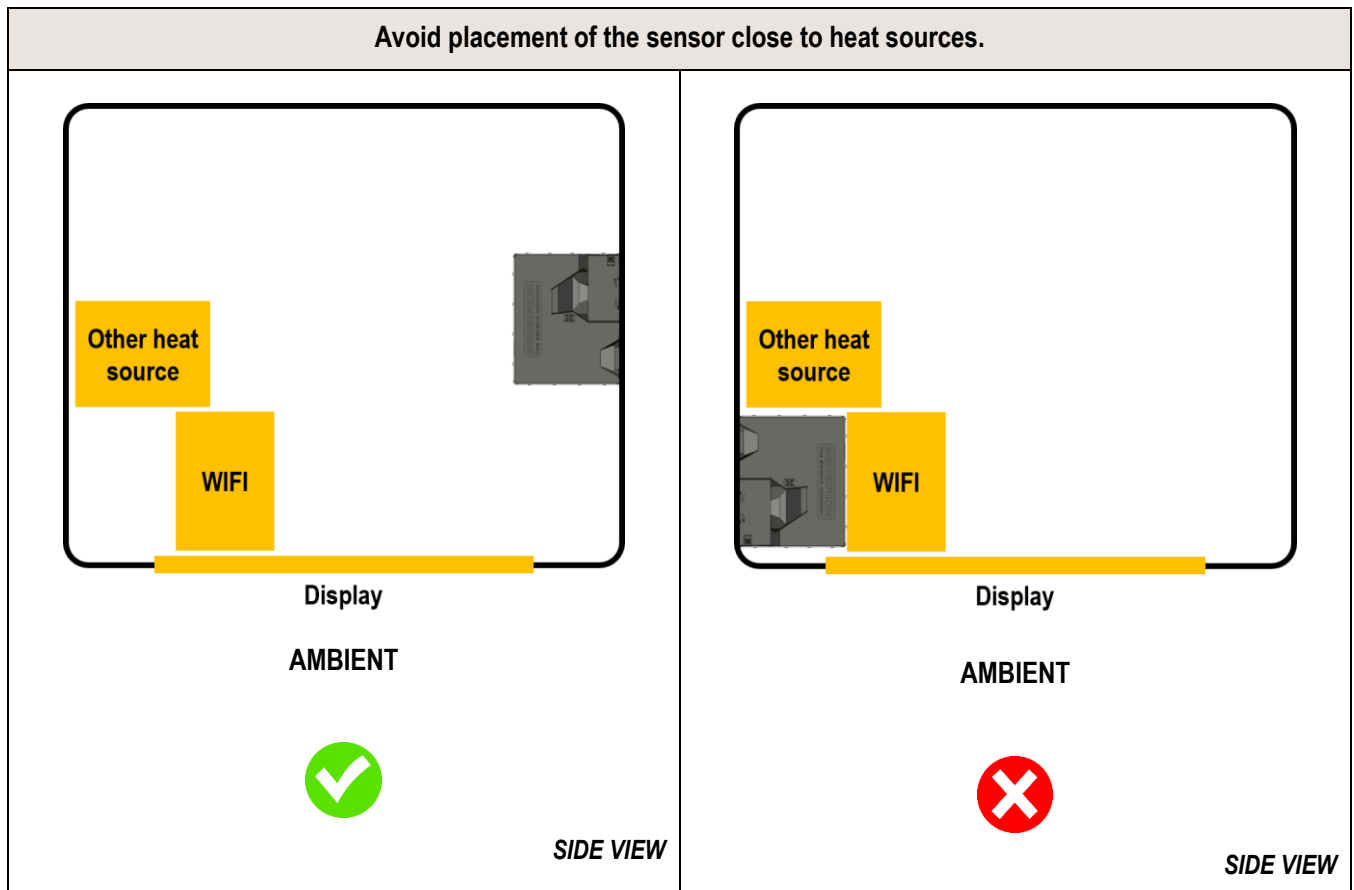
## 2.4 Decoupling from External Heat Sources

Sensirion SEN5x 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 SEN5x internal temperature compensation algorithm<sup>2</sup> can be adapted to deal with some additional heating, a degradation of performance is expected for excessive temperature offsets.

Thus it is beneficial to design the SEN5x as far apart from internal heat sources.

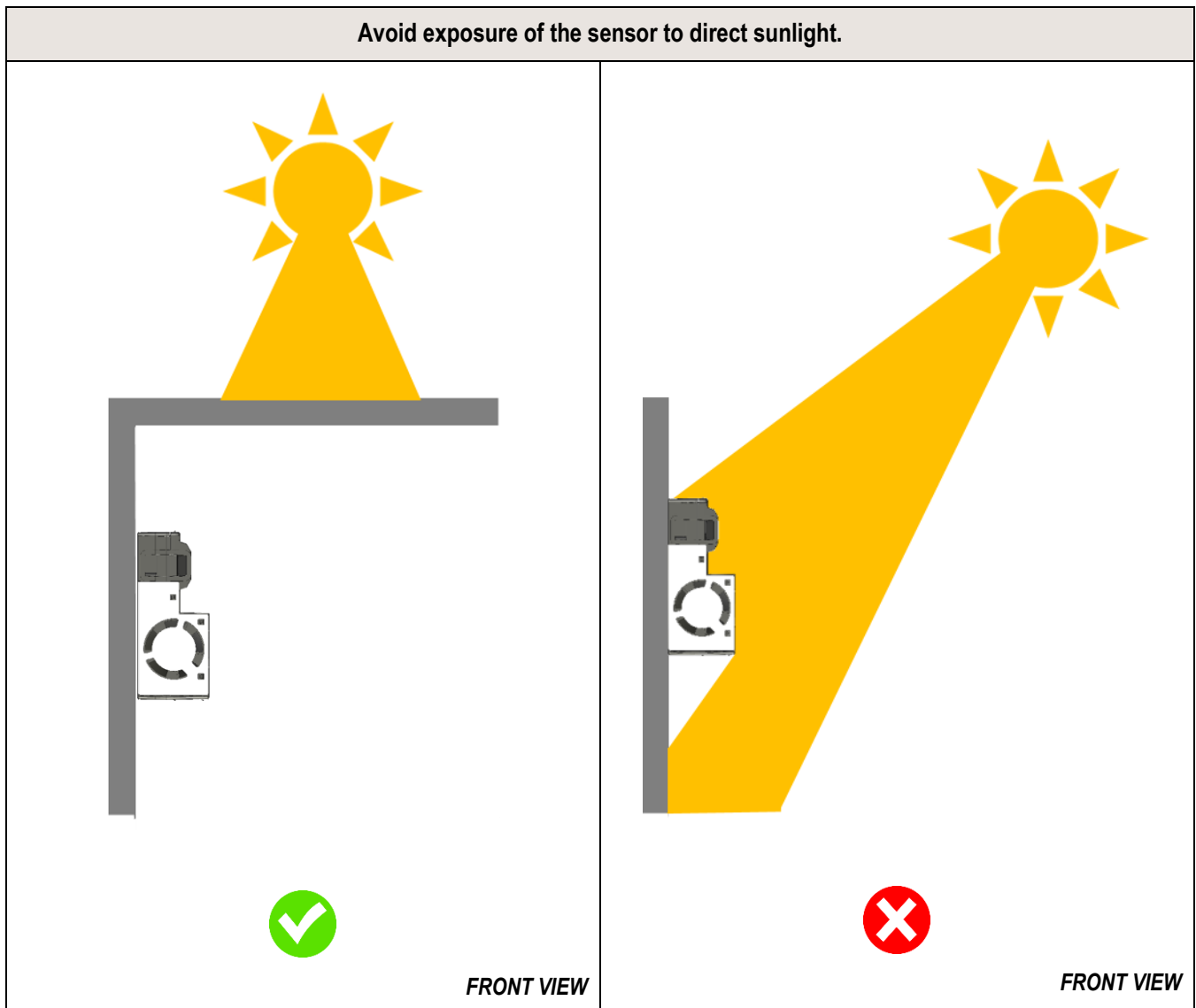
It is further recommended to place the SEN5x below heat sources as air convection arising from heat sources might heat up the sensor.



<sup>2</sup> For further details, please refer to the document "SEN5x –Temperature Compensation Instruction".

## 2.5 Protection from Sunlight

Exposing the SEN5x to direct sunlight might introduce temperature gradients and accelerate the aging of the SEN5x. 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.



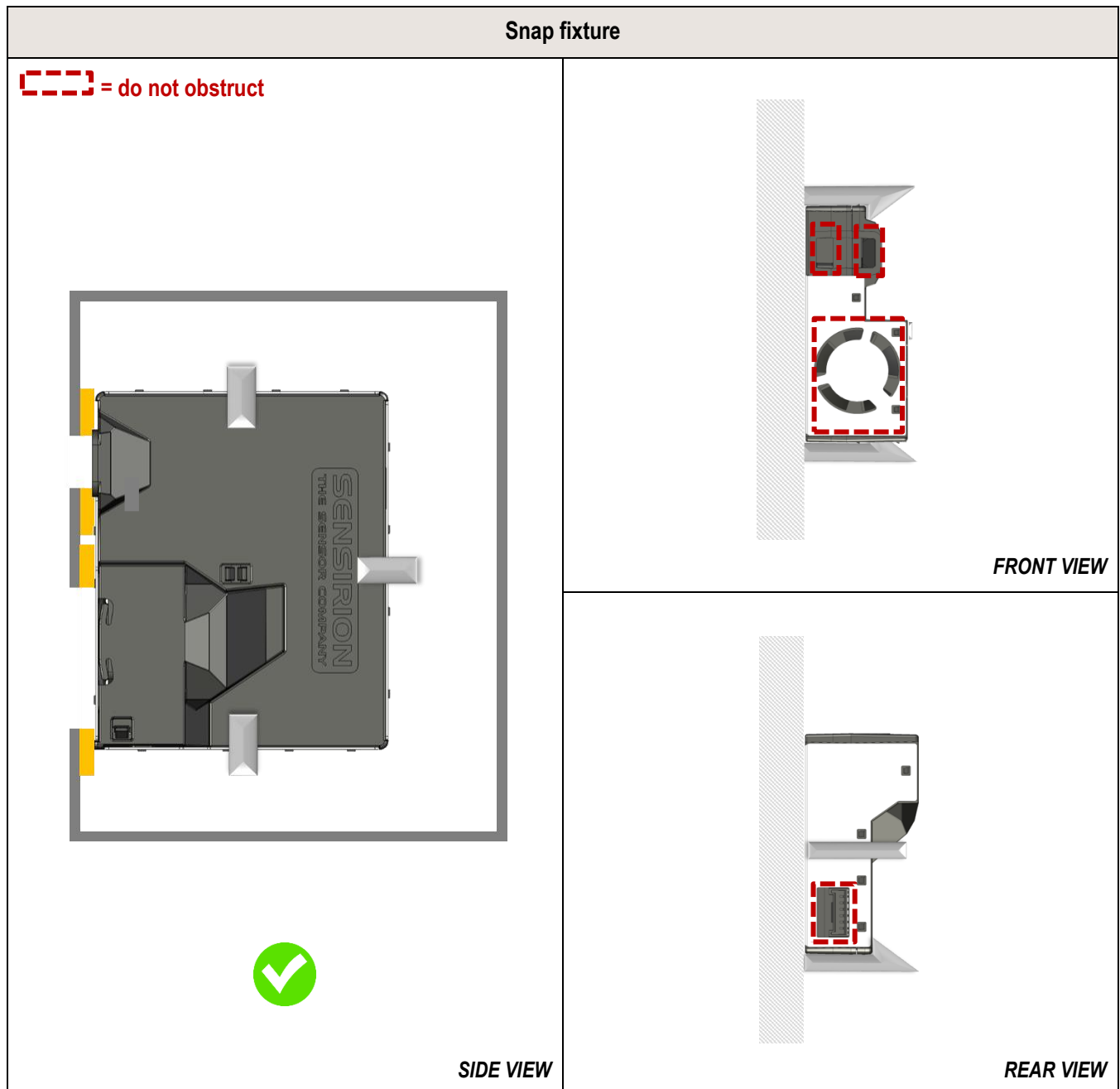


### 3 Mechanical Assembly Guidelines

The following indications should be followed when assembling the SEN5x:

- Do not obstruct inlets and outlet.
- Make sure that inlet and outlet connected via tightly sealed channels to ambient to avoid parasitic air flow
- Firm mechanical fixations should be used to reduce unwanted noise caused by loose mechanical coupling.
- Acoustic foam or thin rubber can be used to further reduce noise<sup>3</sup>.
- If an all-around casing is used, it is recommended to not cover the entire sensor surface to avoid overheating.

An example mounting is shown below. The red dashed-line regions show the non-obstructed inlets/outlet and connector areas.



<sup>3</sup> 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 fixations.

## Revision History

Date	Version	Page(s)	Changes
15. June 2021	1.0	All	Initial version

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