SENSIRION

Design-In Guidelines

For STCC4 CO_2 Sensors

Sensirion's STCC4 CO_2 sensors offer optimized CO_2 accuracy for indoor air quality applications. To maximize the sensor performance, several design-in rules must be considered. Please carefully read these guidelines in combination with the STCC4 datasheet during the design-in phase.

Key Instructions

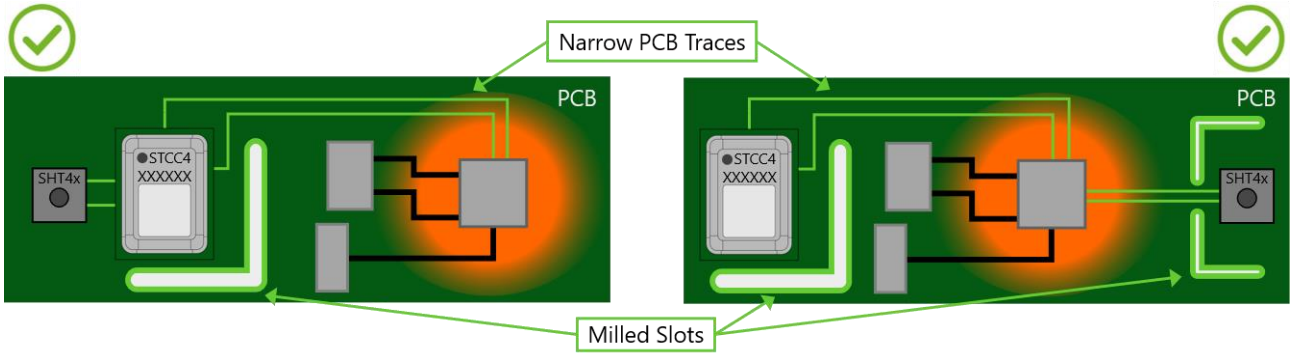
- Place the STCC4 and SHT4x in the same local environmental conditions
- Minimize heat conduction exposure by isolating STCC4 from heat-generating components
- Minimize heat convection exposure by insulating STCC4 from hot or cold air flows
- Minimize sensor heat-up by shielding STCC4 from sunlight exposure
- Maximize ambient air coupling with a sufficiently large aperture

Contents

1 Thermal Decoupling

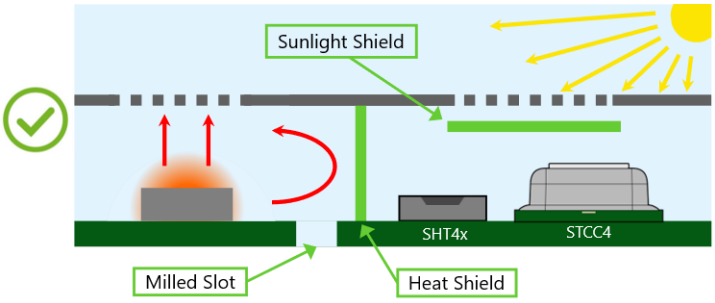
The STCC4 CO_2 sensor uses the thermal conductivity measurement principle and is therefore sensitive to local temperature deviations from the default condition of 25 °C (see Section 1.1 of the STCC4 datasheet) as well as rapid temperature transients. Heat conduction and convection to the sensor must be minimized.

To minimize heat conduction, place the sensor in the most thermally stable region of the device. This can be achieved by maximizing the distance between the sensor and heat-generating components (*e.g.*, power electronics, microprocessors, display, *etc.*). Heat conduction through the PCB should be minimized with milled slots and narrow PCB traces.



Guideline 1: Maximize the distance between the sensor and heat-generating components.
Guideline 2: Use milled slots and narrow PCB traces to minimize heat conduction through the PCB.

To minimize heat convection, shield the sensor from heated air generated by nearby heat-generating components with heat shields or pockets. Ensure a good air exchange near heating-generating elements to avoid heat-up of the whole device. Place the sensor in the lower part of the device to avoid convective heat flow generated by heat-generating components. Avoid direct sunlight exposure to minimize sensor heat-up.



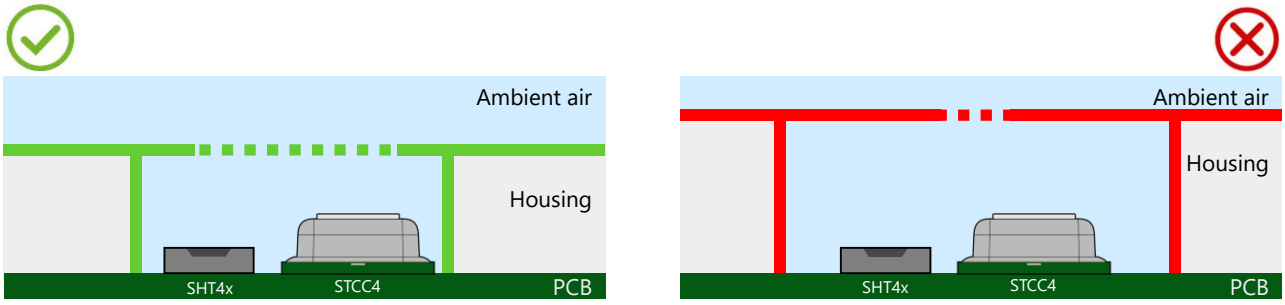
Guideline 3: Shield the sensor with heat shields or pockets from heated air.
Guideline 4: Protect the sensor from direct sunlight exposure.

The SHT4x temperature and humidity sensor should be placed either close to the STCC4 or at a more distant location, depending on the SHT4x performance requirements. In both cases, the sensors should experience the same local environmental conditions. See **Section 3** for more information.

Verify the temperature near the sensor in different device use cases (*e.g.*, charging, standard operation, display intensity settings, *etc.*) to confirm that the sensor is in the most thermally stable region of the device.

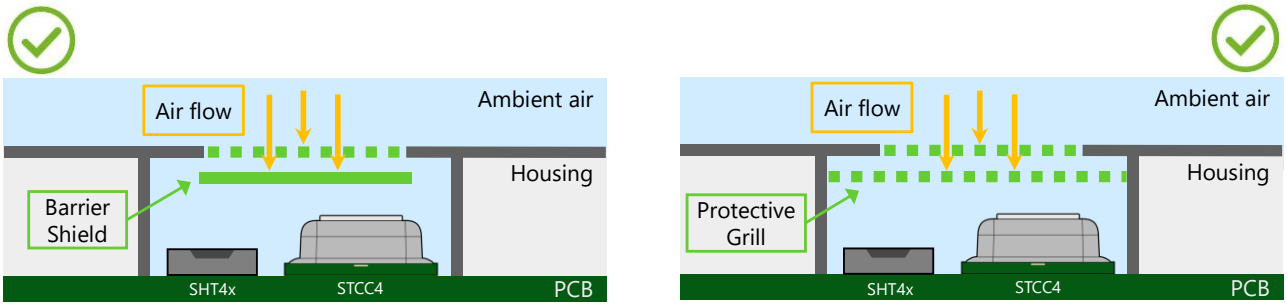
2 Ambient Air Coupling

To minimize the impact of device design on the sensor response time, the sensor should have an adequate coupling to the ambient air. Design a sufficiently large aperture to ambient air and minimize the air volume around the sensor. Use a protective grill with several openings instead of a single large aperture to additionally reduce the risk of damage due to electrostatic discharge through human contact while providing sufficient ambient air coupling.



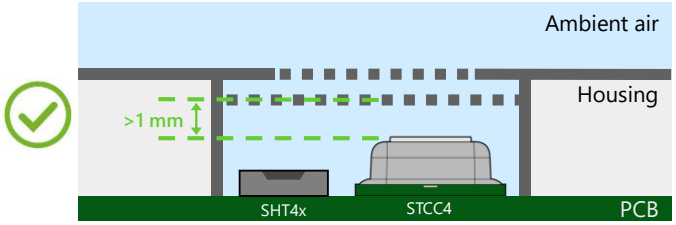
Guideline 1: Design a sufficiently large aperture to ambient air.
Guideline 2: Minimize the air volume around the sensor.
Guideline 3: Use a protective grill instead of a single large aperture.

A protective grill in combination with a barrier shield or second protective grill offset to the first protective grill is recommended to reduce sensor exposure to air bursts (*e.g.*, human breath, fan) as well as to conditioned air (*e.g.*, from radiators, air conditioners).



Guideline 4: Combine a protective grill with a barrier shield or additional, offset protective grill.

While designing a minimal air volume around the sensor, mitigate the risk of collision by designing at least 1 mm of distance between the sensor membrane and housing. The package outline is described in Section 4.2 of the STCC4 datasheet.



Guideline 5: Design at least 1 mm of distance between the sensor membrane and housing.

Measure the sensor response time during design-in to confirm that the device design does not significantly impact the sensor performance.

3 Environmental Compensation

The thermal conductivity of gases is impacted by environmental conditions such as temperature, humidity, and pressure. To maintain the sensor accuracy, the STCC4 requires continuous input from a temperature and humidity sensor from the SHT4x product family. Two options are available to provide continuous temperature and humidity input to the STCC4:

- Connect the SHT4x (only valid with I^2C address 0x44) to the STCC4 through the dedicated I^2C controller interface (See Section 2.5 of the STCC4 datasheet). The temperature and humidity values will be provided directly to the STCC4 with a 1 s sampling interval.
- Send the SHT4x temperature and humidity values with a 1 s sampling interval to the STCC4 through the dedicated I^2C command (see Section 3.4.4 of the STCC4 datasheet).

The STCC4 and SHT4x do not generate significant amounts of heat during operation and therefore do not impact each other's respective outputs when designed in close proximity. Furthermore, the SHT/STS and STCC4 design-in guides recommend similar thermal decoupling guidelines. However, in certain cases, the best ambient air coupling design for the SHT4x sensor may lead to a different design-in location relative to the STCC4 sensor. Ensure that the SHT4x and STCC4 are placed in the same local environmental conditions. Consult the SHT/STS design-in guide to maximize the performance of both the SHT4x and STCC4 sensors.

In applications with low ambient pressure or significant pressure fluctuations, it is recommended to provide continuous pressure values from an external pressure sensor to the STCC4 through the dedicated I^2C command (see Section 3.4.5 of the STCC4 datasheet). In applications at higher altitudes with small pressure fluctuations (*i.e.*, weather fluctuations), it is recommended to provide a one-time pressure value derived from the altitude to the STCC4 through the dedicated I^2C command (see Section 3.4.5 of the STCC4 datasheet).

4 Stable Power Supply

A stable power supply to the sensor ensures consistent operation and performance. To minimize the risk of voltage ripples or drops from other loads, it is recommended to design-in a low dropout (LDO) regulator. The sensor electrical specifications are described in Section 2.2 of the STCC4 datasheet.

5 ESD Protection

After the sensor is mounted into the device, the risk of damage due to electrostatic discharge is reduced, but should be further mitigated to minimize the risk of sensor failure. Before mounting, the sensor should be handled as described in the STCC4 handling instructions. It is recommended to design-in the sensor such that it cannot be reached by hand. When exposure to the sensor is necessary, it is then recommended to protect the sensor with a metallic wire enclosure or a metal grid underneath the aperture.

6 Disclaimer

This document must not be considered exhaustive and is subject to change without prior notice.

7 Revision History

Date	Version	Page(s)	Changes
October 2025	1.0	All	Initial release

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 (including death). 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 purchases or uses 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 is 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 solely warrants to the original purchaser of this product for a period of 12 months (one year) from the date of delivery that this product is 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 as sole and exclusive remedy, in SENSIRION's discretion, repair this product or send a replacement product, 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 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.

The Buyer shall at its own expense arrange for any dismantling and reassembly that is necessary to repair or replace the defective product. This warranty does not apply to any product which has not been installed or used within the specifications recommended by SENSIRION. 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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