Handling Instructions

For SCD4x CO_2 Sensors

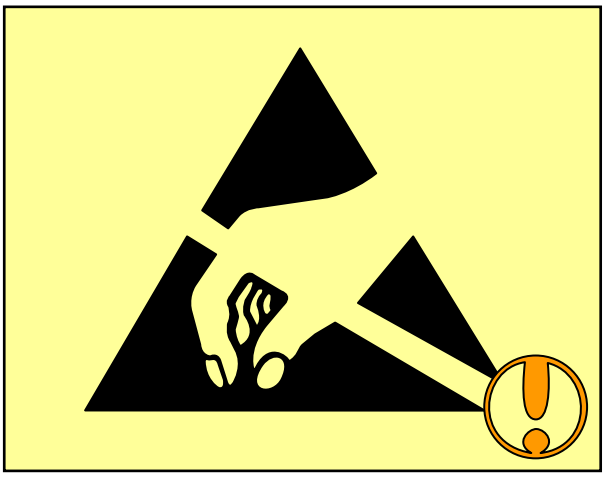
Preface

For taking advantage of the SCD4x outstanding performance, some precautions must be taken during storage, assembly and packaging. Please read the following instructions carefully - preferably during design-in phase and before production release of the respective device.

- The protection membrane on top of the metal cap must not be removed or damaged.
- No excessive shear force must be applied to the metal cap.
- The sensors in SMD packages are classified as Moisture Sensitivity Level 3.
- Prolonged exposure to high concentrations of volatile organic compounds such as solvents should be avoided.

1 ESD protection

The sensor shall be protected from ESD (Electrostatic Discharge) and only be handled in ESD protected areas (EPA) under protected and controlled conditions (ground all personnel with wrist-straps, ground all non-insulating and conductive objects, exclude insulating materials from the EPA, operate only in grounded conductive floor, etc.). Protect sensor outside the EPA using ESD protective packaging.



Protection against ESD is mandatory.

2 Mechanical handling

As the SCD4x is an optical system, it must not be exposed to extreme mechanical forces at any time. Wear clean gloves or finger cots while handling the sensor and avoid touching the white protection membrane.

Furthermore, no excessive force must be applied to the protection membrane on top of the metal cap. Damage to the protection membrane such as partial removal or a minor cut will make the sensor irreversibly defective. Finally, the sensor must not be exposed to strong air blasts from an air-pistol.

3 Exposure to Chemicals

Some solvents might cause the protection membrane to peel off the metal cap which results in an irreversible defect of the SCD4x sensor. Furthermore, the SCD4x comprises a best-in-class Sensirion relative humidity (RH) and temperature (T) sensor that must be protected from pollutants. While ambient environments are usually not critical for the sensor, pollutants are known to occur in manufacturing environments and may occur during storage and by packaging materials. Please carefully follow the guidelines in this application note to ensure that the performance of the built-in RH/T sensor is not compromised. Note that preserved accuracy of the RH/T sensor is required to ensure precise CO_2 readings over the entire relative humidity and temperature range – even if the RH and T output is not used in the application.

The sensor shall not get in close contact with volatile chemicals such as solvents or other organic compounds. Especially high concentration and long exposure must be avoided. Ketenes, acetone, ethanol, isopropyl alcohol, toluene, etc. are known to cause drift of the humidity reading – irreversibly in most of the cases. Please note that such chemicals are integral part of epoxies, glues, adhesives, etc. and outgas during baking and curing. These chemicals are also added as plasticisers into plastics, used for packaging materials, and do out-gas for some period.

Acids and bases may affect the sensor irreversibly and shall be avoided: HCl, H_2SO_4, HNO_3, NH_3 etc. Also ozone in high concentration or H_2O_2 have the same effect and therefore shall be avoided. Please note that above examples represent not a complete list of harmful substances.

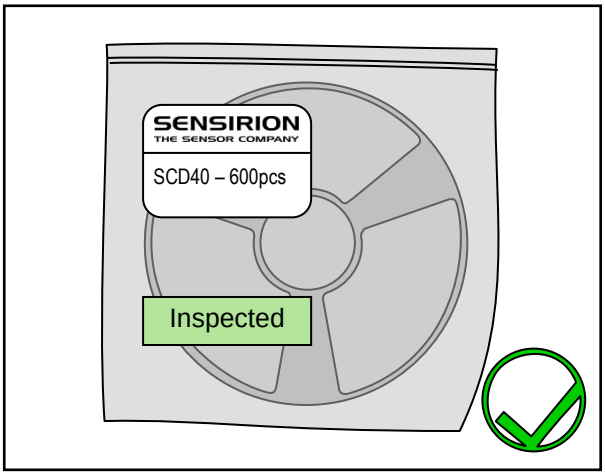
The sensor shall not get in contact with cleaning agents (e.g., PCB board wash after soldering). Applying cleaning agents to the sensor may lead to drift of the reading or complete breakdown of the sensor.

Ensure good ventilation (fresh air supply) to avoid high concentrations of volatile chemicals (solvents, e.g. ethanol, isopropanol, methanol, acetone, cleaning solutions, detergents…).

4 Packing and Storage

The SCD4x is classified as Moisture Sensitivity Level 3 (IPC/JEDEC J-STD-020). Therefore, the sensor should be mounted and reflowed within 1 week of exposure to ambient room conditions (30° C / 60% RH maximum).

Prior to assembly or use of the sensors it is strongly recommended to store the sensors in the original sealed bag with temperatures in the range of 10°C – 50°C.

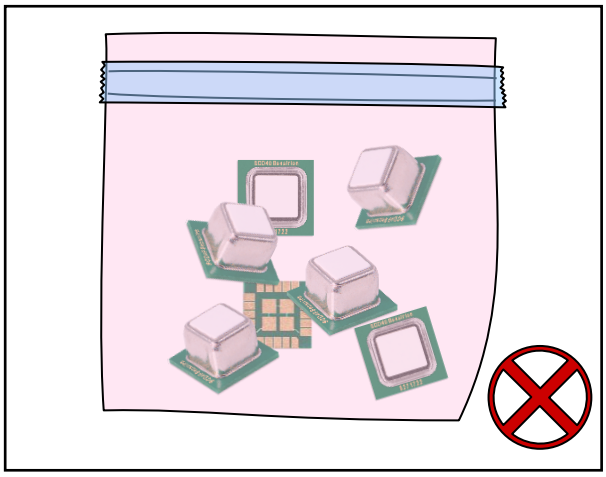


Store sensors in original, unopened ESD bag. Place additional stickers only on the outside of the ESD bag.

Once sensors have been removed from the original ESD bag we recommend storing the individual sensors as well as devices with assembled sensors in antistatic shielded ESD bags at normal pressure (i.e. bag should not be evacuated). In particular, it is recommended not to use any adhesive or adhesive tapes to reseal the sensor bag after opening. The following ESD bags can be recommended (no polluting effect on humidity sensor):

ESD Bag	
Manufacturer	Product
Stroebel	"Topshield" Bags

Sensors as a component or mounted into the final product shall not be packaged in outgassing plastic materials. Please note that many packaging materials may be contain additives (plasticizers) which may have a polluting effect on the sensor. Generally speaking, if a material emits a strong odour you should not use it. Besides metal-in antistatic shielded ESD bags, paper or cardboards based packaging, deep drawn plastic trays (PE, PET, PP) may be considered. Do not use antistatic polyethylene bags (light blue, pink or rose colour); be very careful with bubble foils and foams. Be careful about stickers present inside the packaging (e.g., on the housing of the device).



Do not use polyethylene antistatic bags (light blue, pink or rose colour). Do not use adhesive tapes inside packaging.

For guidance on simple and straight-forward testing of SCD4x CO_2 sensors please consult the corresponding "Testing Guide". Furthermore, the humidity sensor handling instruction lists some encapsulants and adhesives that do not contaminate the integrated humidity sensor[1].

5 Assembly

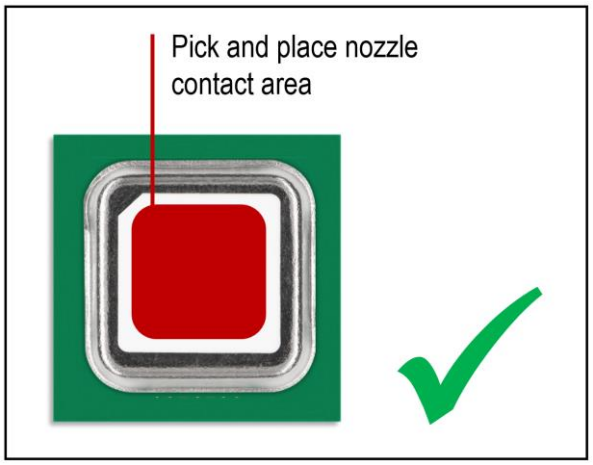
Before fixing the assembly process parameters, please read the datasheet carefully.

5.1 Pick and place process

The SCD4x footprint, landing pads and the tape & reel dimension are illustrated in the SCD4x datasheet. Note that pins are numbered according to IPC standard with pin 1 having a rounded edge. Subsequent pins are counted upwards counter-clockwise (top view). On the front side of the SCD4x, an edge of the membrane serves as the polarity mark, indicating pin 1.
To avoid damage, the SCD4x should be picked in the centre of protection membrane with a nozzle that has a plastic contact area (see schematic below). The touch down force of the nozzle should be tuned to a value such that the nozzle leaves no permanent mark on the

[1] Humidity sensor handling instructions:
www.sensirion.com/file/handling_instructions_rht

membrane (typically < 5 N). Finally, the outer diameter of the nozzle should be smaller than 4.4 mm.



SCD4x P&P nozzle contact area. The edge in the protection membrane serves as a polarity mark indicating the pin 1 mark on the backside of the PCB.

5.2 Sensor reflow soldering (SMT)

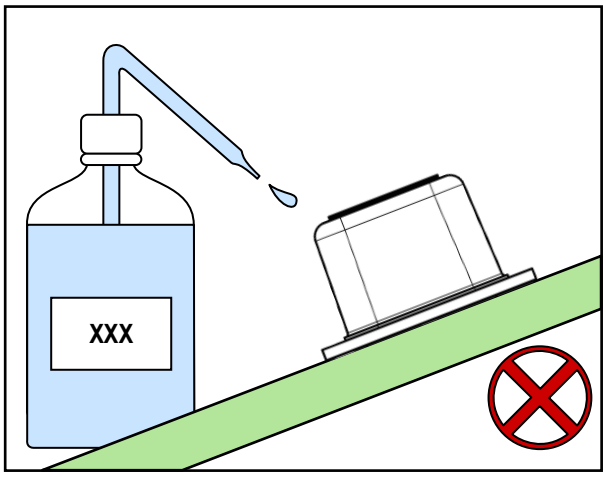
Standard reflow soldering ovens are recommended for the soldering process. A soldering profile is illustrated in the SCD4x datasheet. Make sure that maximum temperatures and exposure times are respected. In case the PCB passes through multiple solder cycles (as is the case for e.g. PCBs that are assembled on top and bottom side), the SCD4x must be assembled in the last solder cycle. Subsequent manual soldering of other PCB components (e.g. through-hole soldering) has no impact as long as the SCD4x is not exposed to temperatures higher than 200 °C. The sensor shall be mounted into the device, if possible, after all materials that are used in the assembly process have completely cured or dried out. Otherwise ensure good ventilation (fresh air supply) in curing ovens and assembly lines. Not respecting these guidelines can result in non-reversible and / or reversible change of calibration (i.e. offset of the CO_2 signal, which can be corrected by applying a FRC). See SCD4x Datasheet [2] and Testing Guide Application Note [3] for more information on recalibration procedure).

The SCD4s is not compatible with vapour phase reflow soldering.

5.3 Rework process

Manual hand soldering / de-soldering of the SCD4x must only be done with solder equipment that allows precise temperature control. Temperatures higher than the specified peak temperature in the SCD4x datasheet can result in a sensor defect or can compromise SCD4x sensor performance, even if heat exposure is very local and limited in time. Furthermore, no force must be applied to the metal cap or the protection membrane during rework process.

Do not apply board wash after the sensor is assembled onto the PCB. Furthermore, be particularly careful when using strong cleaning agents (e.g. detergents, alcohols, brominated or fluorinated solvents) during rework processes as they might compromise the membrane adherence.

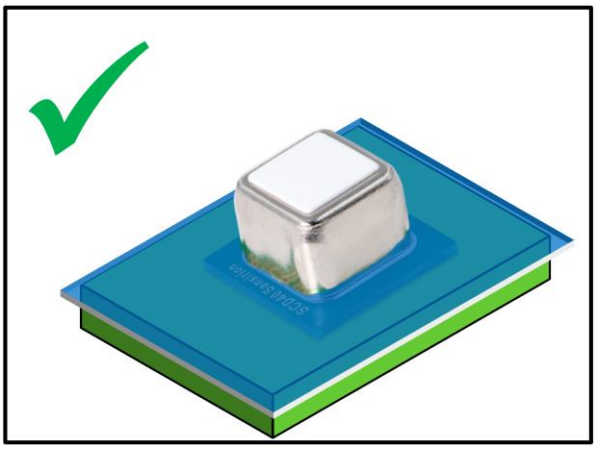


Do not apply board wash.

6 Conformal Coating

Active components of the SCD4x are shielded from environmental influences by the metal cap and the protection membrane. Therefore, conformal coating of the SCD4x is not necessary for most applications.

If a conformal coating is applied anyways, there are some important aspects that must be respected to prevent sensor failure or diminished performance.



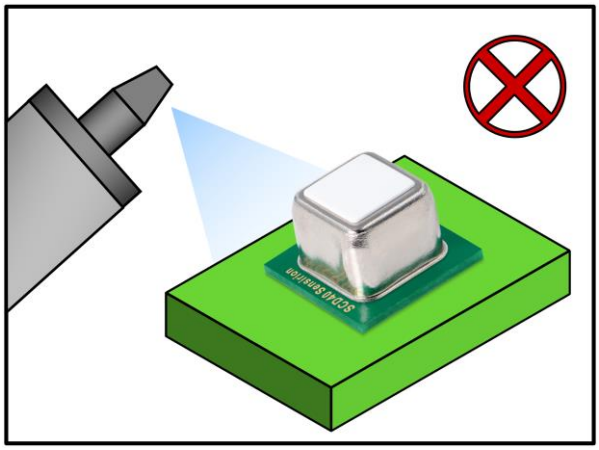
If conformal coating is applied, the top surface of the sensor (protection membrane) must remain free of coating.

[2] www.sensirion.com/file/datasheet_scd4x

[3] www.sensirion.com/file/scd4x_testing_guide

Most importantly, covering the protection membrane (top of the sensor) with any kind of coating must be avoided. This is because the membrane must remain permeable to air molecules to ensure coupling to ambient. Note that a thin layer of conformal coating is already enough to fully block the sensors opening and thus destroying the sensor. Furthermore, the membrane must not be removed after the coating process.

The SCD4x is not compatible with spray coating and dip coating. Manual coating with a brush, dispensing and jetting can be used to apply conformal coating on the PCB while ensuring that no coating is applied to the membrane.



Do not apply spray to unprotected sensor.

Finally, a suitable coating should be selected that does not contaminate the built-in humidity sensor. The following table lists conformal coatings which have been tested regarding pollution of the humidity sensor and are known to be suitable if applied and fully cured under good ventilation (fresh air supply) and according to the respective datasheet.

Conformal Coatings	
Manufacturer	Product
Peters	Elpeguard SL 1301 ECO-FLZ
Dow Corning	1-2577 Low Voc Conformal Coating
Electrolube	AFA (Aromatic Free Acrylic Conformal Coating)

7 Application in extreme environment

Some applications require the exposure to harsh environments. Even though the sensor is uncritical to be used in most cases, some precautions must be taken.

Regarding limits of exposure to extreme humidity and temperature conditions please consult the SCD4x datasheet.

If the SCD4x is used in condensing environments, it is recommended to operate the sensor continuously in the high performance mode. The induced temperature offset reduces risk of condensation inside the optical cavity.

Exposure to volatile organic compounds at high concentration and long exposure time is critical as this could result in pollution of the built-in humidity sensor resulting in offset of RH readings. Inaccurate RH readings can compromise the CO_2 output accuracy due to the built-in RH-compensation algorithm.

Exposure to acids or bases may be critical too. Etching substances such as H_2O_2, NH_3, etc. at high concentrations are critical to the sensor as well. Such application needs to be carefully tested and qualified.

Disclaimer

The above given restrictions, recommendations, materials, etc. do not cover all possible cases and items.

The material recommendations are given regarding to pollution of the built-in humidity sensor and assume optimal processing for avoiding VOCs. The materials were not tested regarding other properties like reliability, performance, usability or mechanical properties. The material recommendations have been compiled with our best knowledge at the time of writing. Manufacturers may change the compounds without notice, which can lead to reduced Sensor performance due to outgassing.

This document is not to be considered complete and is subjected to changes without prior notice.

Revision History

Date	Version	Page(s)	Changes
January 2021	1	All	Initial version

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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