

Handling Instructions For SHTxx Humidity and Temperature Sensors

Abstract

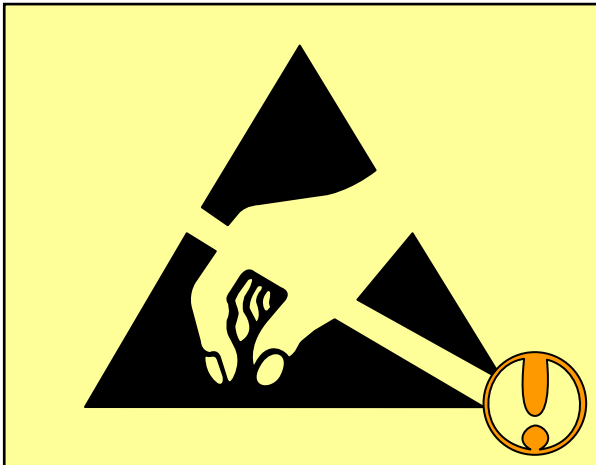
Sensirion SHTxx are relative humidity and temperature sensors of high quality. For taking advantage of their outstanding performance some precautions must be taken during storage, assembly and packaging. Therefore, please read the following instructions carefully - preferably during design-in phase and before production release of the respective device. Special attention is required regarding the exposure to volatile organic compounds, i.e. high concentration and long exposure time to respective gases shall be avoided. Such conditions are known to occur in manufacturing environment and/or during storage. Therefore, proper handling and choice of materials are crucial. Applying sensors in the field in ambient environment is not critical.

Applicability

This document is applicable to all Sensirion SHTxx humidity and temperature sensors.

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.

Exposure to chemicals

Humidity and Temperature sensors are highly accurate environmental sensors and as such they are not ordinary electronic components. The opening in the package exposes the sensor to the environment and makes it susceptible to pollutants. While applying sensors in the field in ambient environment is not critical, pollutants are

known to occur in manufacturing environments and during storage. Please carefully follow the guidelines in this application note to ensure that you can benefit of the sensor's outstanding performance.

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.

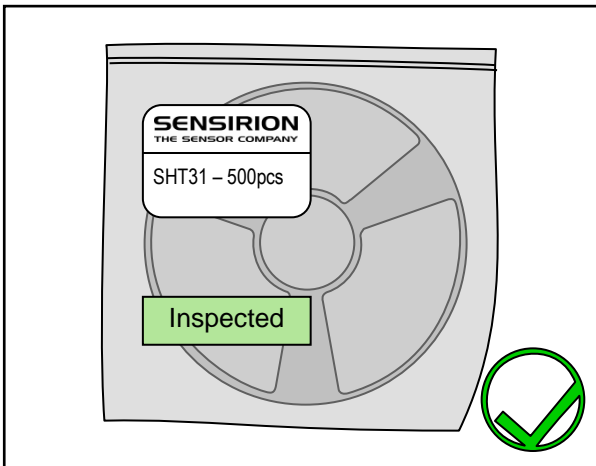
Acids and bases may affect the sensor irreversibly and shall be avoided: HCl, H₂SO₄, HNO₃, NH₃ etc. Also Ozone in high concentration or H₂O₂ have the same effect and therefore shall be avoided. Please note, that above examples represent no complete list of harmful substances.

The sensor shall not get in contact with cleaning agents (e.g. PCB board wash after soldering) or strong air blasts from an air-pistol (not oil-free air). 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...).

Packaging and storage

Prior to assembly or use of the sensors it is strongly recommended to store the sensors in the original sealed ESD bag at following conditions: Temperature shall be in the range of 10°C – 50°C (0 – 125°C for limited time) and humidity at 20 – 60%RH (sensors that are not stored in ESD bags).



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 to store the individual sensors as well as devices with assembled sensors in metal-in antistatic shielded ESD bags. In particular, it is recommended not to use any adhesive or adhesive tapes to reseal the sensor bag after opening. Following ESD Bags can be recommended (no polluting effect on humidity sensor):

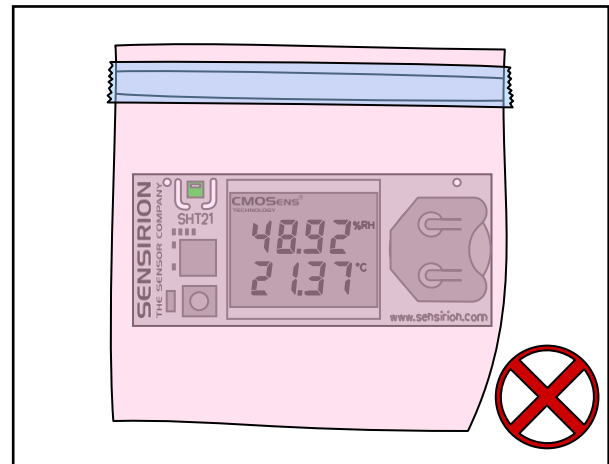
ESD Bag	
Manufacturer	Product
Stroebe	"Topshield" Bags

Sensors as a component or mounted into the final product shall not be packaged in outgassing plastic materials which could cause sensor pollution. 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 color); be very careful with bubble foils and foams.

Be careful about stickers present inside the packing (e.g. on the housing of the device). Sticker size should be kept to a minimum, and the sticky side shall fully adhere onto a surface.

Please note that many packaging materials may be provided with 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. Additives may also be added to materials which are listed for recommended use. For high safety, device housing and shipment packaging must be qualified. Such a qualification test may contain exposure of the final device with sensor in its shipment packaging to temperature $\geq 65^{\circ}\text{C}$ for at least 168 hours. (If shipping or storage conditions are expected to be harsh, the qualification test conditions for the packing material have to be customized.) The sensor reading then shall show

no changed deviation against a reference compared to same measurements before the exposure.



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

For guidance on simple and straight-forward testing of humidity sensors please consult the Testing Guide for humidity sensors.

Assembly - Soldering

For soldering, standard reflow soldering ovens may be used. The sensors are designed to withstand soldering profile according to IPC/JEDEC J-STD-020 with peak temperatures at 260°C during up to 30sec for Pb-free assembly in IR/Convection reflow ovens (see **Error! Reference source not found.**).

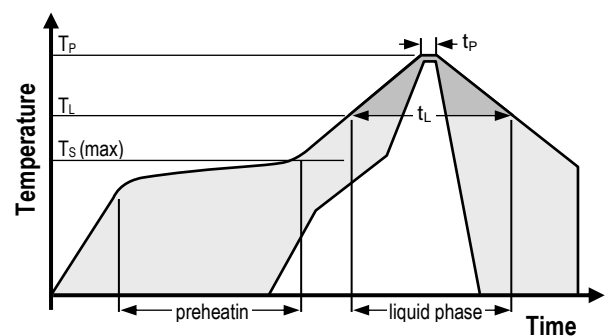


Figure 1 Soldering profile according to JEDEC standard. $T_P \leq 260^{\circ}\text{C}$ and $t_P \leq 30\text{sec}$ above 255°C for Pb-free assembly. $T_L < 220^{\circ}\text{C}$ and $t_L < 150\text{sec}$. Ramp-up rate $< 3^{\circ}\text{C}$ and ramp-down rate $< 6^{\circ}\text{C}/\text{sec}$ for temperatures $> T_L$.

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. PCB that are assembled on top and bottom side), it is recommended to assemble the SHTxx only in the last solder cycle. This is to reduce risks of sensor pollution.

The use of “no clean” type ≥ 3 solder paste¹ is strongly recommended as no board wash can be applied to SHTxx humidity sensors. An appropriate amount of solder paste shall be used, to result in a stand-off height (clearance between the package body and any part of the substrate) of 50 μ m to 75 μ m. Please consult the appropriate sensor data sheet for device specific information on the metal land pattern and recommendations on solder paste printing stencils.

Standard pick & place equipment and vacuum nozzles for standard QFN packages may be used for assembly of SHTxx and STSxx sensors.

Manual soldering is not recommended. For rework soldering, contact time must be limited to 5 seconds at up to 350°C.

Immediately after the exposure to high temperatures SHTxx humidity sensors may temporarily read a negative humidity offset (typ. -1 to -2 %RH after reflow soldering). This offset slowly disappears again by itself when the sensor is exposed to ambient conditions (typ. within 1-3 days). If RH testing is performed immediately after reflow soldering, this offset should be considered when defining the test limits.

It is important to note that the diced edge or side faces of the I/O pads may oxidise over time, therefore a solder fillet may or may not form. Hence there is no guarantee for solder joint fillet heights of any kind.

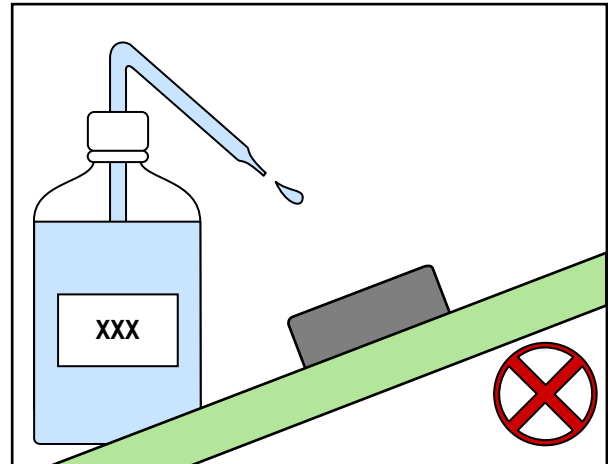
Assembly – Others

Sensors in SMT packages are classified as Moisture Sensitivity Level 1 (IPC/JEDEC J-STD-020). It is recommended to process the sensors within 1 year after date of delivery.

Before developing the assembly process, please read the User’s Guide and the Datasheets carefully. In the following, crucial items are underlined plus additional items are given:

No mechanical force shall be applied to any part of the sensor during assembly or usage.

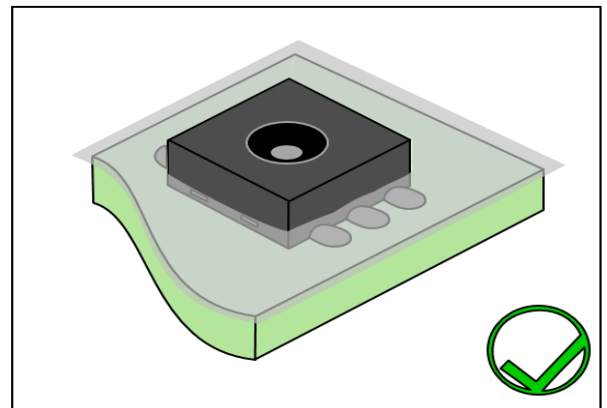
No board wash shall be applied to SHTxx humidity sensors. Therefore, and as mentioned in the previous section, it is strongly recommended to use “no-clean” solder paste.



Do not apply board wash.

For application in corrosive environment – such as condensed water or corrosive gases – it may be necessary to protect the electronic assembly including the soldered contacts of the sensor with a passivation. Such passivation may be achieved by conformal coating or by applying adhesive.

Low viscose conformal coatings or potting materials may flow into the inside the sensor cap, cover the sensor element and thus make the humidity sensor inoperative. Use only high viscose conformal coatings or potting materials, or seal the interface between sensor cap and sensor PCB before applying conformal coating. In any case, covering the humidity sensor opening with any kind of coating must be avoided. Therefore, the top surface of the sensor should remain free of coating.



If conformal coating is applied, the top surface of the sensor must remain free of coating.

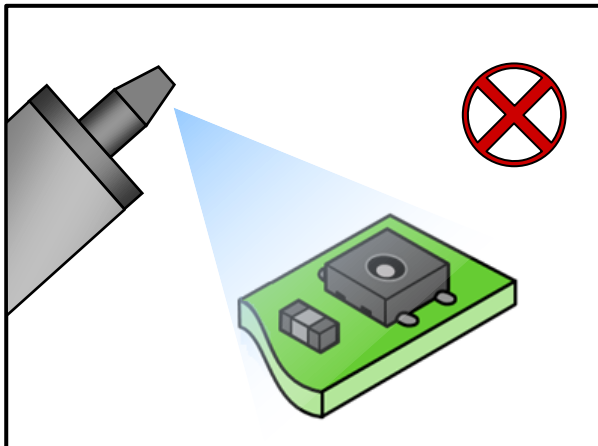
Solvent vapors are produced during curing and processing of the coating. Ensure good ventilation throughout the application, staging and curing to prevent pollution of the sensor. Ventilation shall be established in such a way that the concentration of these gaseous substances remains low, e.g. by using ovens with fresh air supply.

¹ Solder types are related to the solder particle size in the paste: Type 3 covers the size range of 25 – 45 μ m as specified in IPC J-STD-005A.

Coating thickness and curing times shall be chosen according to respective datasheets and application notes of the manufacturer. If a time frame for curing is provided it is recommended to apply the upper time limit. This is especially true if the PCB design features large components with undercuts where high layer thicknesses on/under components or drain-off edges can form. Please note that the tack-free state of the coating is no indication of full curing. For full curing refer to application notes of the manufacturer. Ensure process stability for coating thickness and apply corresponding safety margins for curing times.

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 and according to respective datasheet.

Conformal Coatings	
Manufacturer	Product
Peters	Elpeguard SL 1301 ECO-FLZ
Electrolube	AFA (Aromatic Free Acrylic) Coating
Chase	HumiSeal 1B51NSLU
Dow Corning	Dow corning 1-2620



Do not apply spray to unprotected sensor.

Whenever using spray coating techniques (e.g. to apply varnish or conformal coating, etc.) the SHT3x with protective cover option can be used or the SHTxx sensor has to be covered by the adhesive tape to prevent coating of the humidity sensor opening. The following table lists adhesive tapes which have been tested regarding pollution of the humidity sensor and are known to be suitable.

Adhesive Tapes	
Manufacturer	Product
3M	Electrical Tape 92

Do not apply any other adhesive tapes such as Scotch Tape, Sello Tape, Tesa Film, etc.



In conjunction with the sensor, use only recommended Kapton® tape Electrical Tape 92 by 3M™.

Regarding adhesives and encapsulants the material in the following tables may be used – according to respective datasheets, applied and fully cured in well ventilated environment (fresh air supply). Materials and brands not listed in the following tables may be harmful and shall be tested carefully before applying.

Epoxy Adhesives	
Manufacturer	Product
EPO-TEK	H70E/S
EPO-TEK	T6067
EPO-TEK	93-86
Lord	MD-130
Eccobond	E3503-1
Ablebond	84-3

Epoxy Glob Top Encapsulants	
Manufacturer	Product
Stycast	50300 / 50400 series
Hysol	EO1061/EO1062

Silicone Adhesives	
Manufacturer	Product
RTV	6424 (Momentive)
Dow Corning	732

Silicone Glob Top Encapsulants	
Manufacturer	Product
Stycast	S 7503

Instant Adhesives	
Manufacturer	Product
Loctite	401

PUR (Polyetherane) Casting Compounds	
Manufacturer	Product
Peters	VU 4457-61

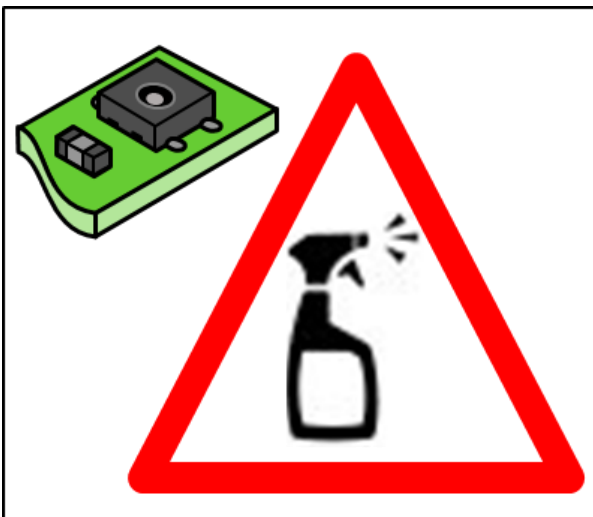
Hot melts may absorb water and thus may have an impact on the response time of the sensor in the device. Therefore, hot melt shall be applied sparingly.

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.

Prevent any dust or particles from entering the sensor opening (sensor performance may be affected). Wear clean gloves or finger cots while handling the sensor and avoid touching the sensor opening.

Ensure recommendations in this application note are equally considered during repair and rework of assemblies containing sensors. During repair and rework, it may be recommendable to cover the sensor with Kapton tape (specific recommendation see above).

Be particularly careful when using strong cleaning agents (e.g. detergents, alcohols, brominated or fluorinated solvents). Cleaning any part of a product might lead to high concentration of cleaning agents on the sensor. Please remove any sensors or devices containing sensors before cleaning the production area and tools. Ensure good ventilation (fresh air supply) and that any solvents have evaporated before resuming production.



Prevent sensor from exposure to cleaning agents.

Application in extreme environment

Some applications require the exposure of humidity and temperature sensors to harsh environments. In many of the cases the sensor is uncritical to be used. However, some precautions must be taken.

For exposure to extreme conditions with regards to humidity and temperature please consult the datasheet

of respective product. Please make sure that exposure time of the sensor to maximum range of operating conditions is limited as given in datasheet. Exposure to volatile organic compounds at high concentration and long exposure time is critical not only in assembly but also in the field. Such application needs to be carefully tested and qualified.

Exposure to acids or bases may be critical, too. In order to be critical, the concentration must be such that polymers are attacked. For bases there is a rule of thumb that $\text{pH} < 9$ are uncritical. Etching substances such as H_2O_2 , NH_3 , etc. at high concentrations are critical to the sensor, too.

Corrosive substances at very low concentrations are not critical to the sensor itself. However, they may attack the solder contacts. Therefore, the contacts must be well protected (passivated) in case of an application to such environment – compare also Section “Assembly”.

Application of Sensirion humidity and temperature sensors to harsh environment must be carefully tested and qualified. Sensirion qualifies its humidity and temperature sensors to work properly within ambient clean air – qualification for use in harsh environment is duty of the user of the sensor.

Reconditioning procedure

As stated above extreme conditions or exposure to solvent vapors may offset the sensor. The following reconditioning procedure may bring the sensor back to calibration state:

Baking: 100 – 105°C at < 5%RH for 10h
 Re-Hydration: 20 – 30°C at ~ 75%RH for 12h².

Disclaimer

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

The material recommendations are given with regard to pollution of SHTxx sensors and assume optimal processing for avoiding VOC in process – 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 subject to change without prior notice.

² 75%RH can conveniently be generated with saturated NaCl solution.

Revision history

Date	Revision	Changes
29 June 2007	0.1 (Preliminary)	Initial revision
7 January 2009	1.0	Complete rework.
18 March 2010	1.1	New format, implementation of pictograms.
28 June 2012	2.0	Moisture Sensitivity Level adapted.
18 November 2013	3	Document partially restructured and clarifications added.
22. May 2014	4	ESD bag recommendation changed, reconditioning procedure added
12. March 2018	5	ESD bag recommendation changed, Pictograms updated, conformal coating added
7. May 2020	6	Conformal coating recommendation changed; coating information added
30. June 2021	7	Soldering information added; new suitable conformal coatings added

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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