Testing Guide

For SHTxx Relative Humidity & Temperature Sensor Series

Introduction

This Qualification Guide defines how Sensirion is testing the various performance parameters of humidity and temperature sensors. Furthermore, it shall help to test and qualify the sensors reliably in due time. It is of great importance that all applicable documents (Datasheet, Users Guide and Handling Instructions) are carefully studied before integration, testing and qualification of the sensor.

Sensor Testing and Qualification

For calibration and end testing of RH sensors Sensirion is using expert calibration equipment and procedures to guarantee highest precision and reliability. In order to ensure consistent testing of Sensirion's SHTxx relative humidity & temperature sensors the following preparing items should be carefully considered:

a) *Test Objects:* The test series should consist of at least 5-10 sensors, which should be taken out of the original packaging.

b) *Conditioning:* Make sure that sensors have not been contaminated prior to the testing. Original packaging should not have been fixed with scotch tape, packaging should not have been stored in plastic bags. If you are unsure whether sensors might have been contaminated or not, follow re-conditioning procedure (80-90°C [176-194°F] at < 5%RH for 24h (baking) followed by 20-30°C [70-90°F] at > 74 %RH for 48h (re-hydration).

c) *Re-hydration after soldering:* In case sensors have been soldered to a PCB board please make sure that re-hydration procedure (20-30°C [70-90°F] at >74%RH for 48 hours) has been applied after soldering.

d) *Test set-up:* Make sure that test and reference sensor experience equal humidity and temperature conditions. If possible apply a professional humidity chamber. If such a chamber is not available put the reference and test sensor into a closed box and give the set up time to homogenize. Please make also sure that in the humidity housing there are no humidity absorbing materials present near the sensors - materials like silicone sealing, rubber, etc., and that there are no contaminating materials present. More information on contamination can be found in the infosheet "Handling Instructions".

e) *Reference sensor:* The reference sensor should be of high reliability. If possible, apply a dew point mirror or recently calibrated RH probes.

Testing RH Accuracy

It is recommended to run the following test profile: Set temperature to 25°C (77°F) and run a low – medium – high RH profile (e.g. 15% – 50% – 90%) and check hysteresis with a high – medium – low RH profile (e.g. 90% – 50% – 15%). See Figure 1. Allow at least 45 minutes settling time at each relative humidity set-point, before starting a measurement. For the first set point, a longer waiting time might be required to allow the temperature to stabilize (~3 hours for temperature changes <30°).

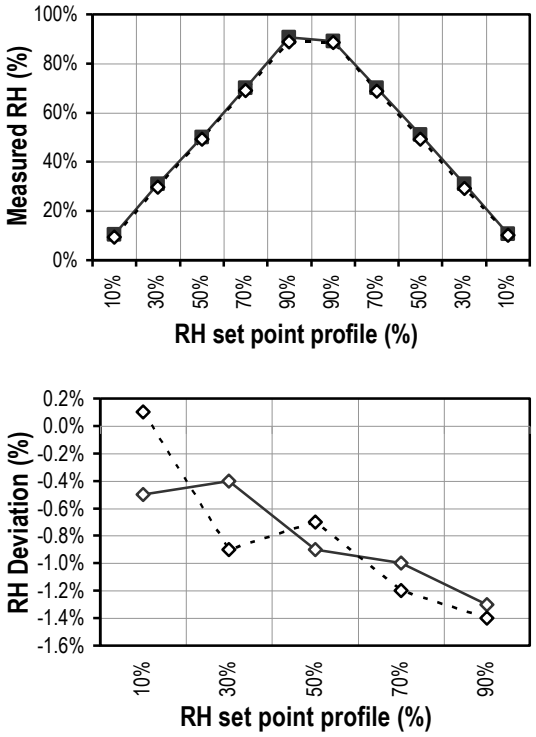

Figure 1 Top Panel: Measurement profile for accuracy testing (full squares: reference, open diamonds: test sensor). Lower Panel: RH deviation profile, full line: ascending order, hatched line: descending order.

It is also recommended to operate the SHTxx sensors with the Sensirion SEK Evaluation Kit in order to avoid communication or conversion errors.

IMPORTANT: Relative humidity is highly temperature dependent. During the measurement the temperature of reference and test sensor must show the same value to make RH values comparable. For your test records it is highly recommended to note RH and T for each set-point and sensor.

Testing T Accuracy

For testing temperature accuracy, the same general procedures apply as for RH. Due to the very high temperature accuracy of SHTxx sensors, additional improvements to the measurement set-up need to be applied. Consider especially point e) of the general guidelines: best practice is using a reference which is much more accurate than the sensor (ideally a factor 10). To make sure that the sensors measures the same temperature as the reference, and therefore to make the measurements valid, consider the following best practices:

a) *Thermal coupling*: Attach the sensors and the reference to a highly temperature conducting material. This can be achieved easily by attaching them to a piece of metal, e.g. copper. More thermal mass is advantageous.

b) *Homogeneity*: Place the sensors and the reference in close proximity to each other to limit the influence of air flows or heating/cooling effects inside the test chamber. Additionally, use a measurement chamber which is as small possible. This can be achieved by putting a small measurement box in a bigger climate chamber.

c) Settling time: Same as for testing RH accuracy, long settling time is required before measurement to let the temperature stabilize. (~3 hours for temperature changes <30°).

Testing RH Response Time

For properly measuring RH response times a test set-up shall guarantee a step function from dry air to humid air at the very same temperature, or vice versa. Therefore, the following test set-up is recommended – compare with Figure 2. The sensor is placed into a small box. Across a rotary valve this test chamber shall be fed with dry air – taken from compressed, oil-free air – and humid air – taken from a humidity chamber. As the compressed air cools down with expansion, the temperature shall be brought to room temperature by a heater. The heater alternatively can be placed between air bottle and rotary valve or between rotary valve and test chamber. The tubing between the valve and the test chamber shall be kept as short as possible. This allows for an abrupt change from dry to humid air. A flow rate of the dry air and humid air of at least 1 m/s is recommended to avoid that the setup is limiting the response time.

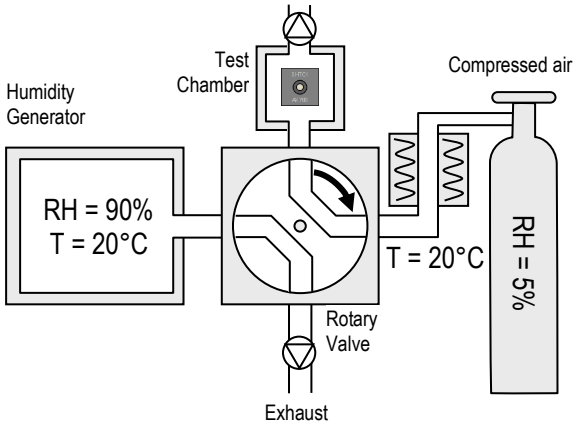

Figure 2 Response time test set up. Dry air from compressed air is blown into test chamber with sensor – a heater makes sure the air is at room temperature. With a rotary valve the relative humidity is taken from a humidity chamber and therefore abruptly changed from low to high.

To start the measurement, blow dry air into the sensor box and give the sensor time to display a constant value. It should be in the range of 5 - 10% RH. Control the temperature carefully as well. Then change the air source abruptly and make sure the temperature remains constant. In order to avoid any temperature changes it is recommended to run the measurement at ambient temperature.

The data should behave roughly inverse exponential – see Figure 3. The SHTxx sensors readings shall change 63% of the full RH step within less than 8 seconds. For example, if the RH step is between 10% and 90% then the RH value shall read >60% within 8 seconds. Please note that the last percentage points of the response curve to complete the full step will develop with a lower time constant.

There is an alternative option to measure response time in a very simple and effective way – which, however, may not fulfill scientific standards: Put the sensor into a humidity chamber with high humidity (90% for example) or if no humidity chamber is available, put the sensor into a closed box with an

open glass of water. Make sure that the temperature inside the chamber or box is equal to the outside temperature. Start measuring (for example with the Sensirion SEK Evaluation Kit) and when the values are high and stable remove the sensor from the box or chamber and expose it to the outside conditions. Give the sensor enough time to stabilize the RH value and in this way define the full RH step. The response time can then be derived from the data.

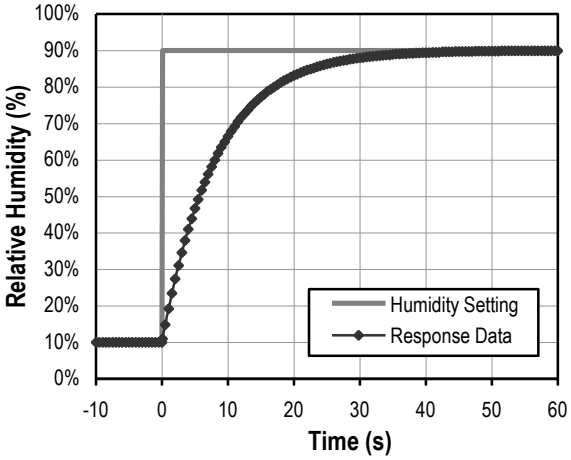

Figure 3 Measurement profile of response time testing

Revision History

Date	Revision	Changes
10 March 2008	1.0	First Release
04 September 2008	1.1	Add Section 1.1
5 May 2010	1.2	Complete rework: New title (former title was “Qualification Guide” and more information how Sensirion does the out going quality test. No changes to the existing contents.
21 December 2018	1.3	Additional information concerning contamination, initial waiting time and recommended flow rate. Changed from EK-Hx to SEK. Add “Testing T Accuracy”

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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