Calibration Statement

Issue Date: **21.09.2026** **Expiry Date:** **2032-07-26**

Device Identification

Product	Surfact EMMA Smart Cold Chain Tracker
Sensor Type	Sensirion SHT43
Temp Sensor Serial	295283281
Visual Serial	ff3-a95-d36
PCB Serial	25435316
Dashboard Serial	26c62d47-2d5e-4f19-9ec7-68738459f0e9
QR Serial	d776ba97-78bc-4ff3-a951-d36a8881b6ac

Calibration Specification

This device incorporates a fully digital Sensirion SHT43 temperature sensor calibrated to **ISO/IEC 17025:2017** standards at three reference points: **-30°C, 5°C, and 70°C** at a calibration laboratory accredited by the Swiss Accreditation Service Swiss Calibration Service – Accreditation No: SCS 0158. The certified calibration is traceable to national and international standards, such as NIST and ISO17025.

Typical Accuracy	Measurement Range	Temperature Drift
$\pm 0.1^{\circ}C$	-40°C to +70°C	$< 0.01^{\circ}C$ per year

© Copyright Surfact AS | NO929 856 066

Extended Calibration Validity

The SHT43 sensor exhibits high certified accuracy and exceptionally low long-term drift ($< 0.01^\circ C/\text{year}$), as certified by the data sheet and manufacturers stress testing (THB-test JESD22-A101 standard). This accuracy is significantly within the established norm for ±0.5℃ in GxP applications. The long term stability ensures that the sensor remain within its calibrated specification for more than 10 years without a need for recalibration.

Technical Summary:

- Each sensor comes with a fully traceable and ISO17025 accredited 3-point factory calibration which certifies each individual sensor's accuracy.
- Annual drift ($< 0.01^\circ C$) ensures each sensor remain within ±0.5℃ for the entire life cycle of a Surfact Emma Smart Cold Chain Tracker.
- Surfact employs a yearly review process with an accredited 3rd party ISO17025 test laboratorium to test and verify that Emma Smart Cold Chain Trackers remain within specification.

Calibration Certificate and Technical Documentation

Attached documentation includes:

- Individual sensor ISO 17025 calibration certificate from Sensirion AG Calibration Laboratory (SCS 0158)
- Sensirion Calibration Certification - Digital Humidity- and Temperature Sensors
- Sensirion Certified Smart Tracking - regarding traceability, standards and drift
- Sensirion Data Sheet SHT43

> *This calibration statement applies only to the device identified by the serial numbers listed above. It documents compliance with EU GDP requirements for temperature monitoring equipment used in pharmaceutical applications.*

Oslo, man. 21. sep. 2026

Per Magne Helseth

Per Magne Helseth - Chief Executive Officer | Surfact AS

SENSIRION
Sensirion AG Calibration Laboratory
Laubisrütistrasse 26
8712 Stäfa
Switzerland

Certificate of Calibration

Certificate number:	0638062354174649357
Customer:	Sensirion AG Laubisrütistrasse 50 8712 Stäfa
Object (devices under test):	[SHT43, Digital Temperature Sensor, Reel ID: 22000009003142000023]
Comment:	The calibration data relates only to the items tested, uniquely identifiable by their serial numbers.
Date of calibration:	25.Jul.2022 – 26.Jul.2022

This certificate of calibration documents the traceability to national standards of the SI units. Measurement results, measurement uncertainties, and the measurement procedure are documented on the following pages and are part of the certificate.

10.Dec.2022 Sensirion AG Calibration Laboratory Laubisrütistrasse 26 8712 Stäfa	MKL	(Head of the calibration laboratory)

This certificate is released electronically and therefore unsigned. It applies to only the items identified and shall not be reproduced other than in full, without the specific written approval of Sensirion AG.

Calibration Laboratory accredited by the Swiss Accreditation Service
Swiss Calibration Service – Accreditation No: SCS 0158

© Copyright Sensirion AG, Switzerland

SENSIRION
Sensirion AG Calibration Laboratory
Laubisrütistrasse 26
8712 Stäfa
Switzerland

Calibration
The calibration was performed in accordance with internal guidelines using the method “in-situ surface temperature measurement by comparison (document WT010)”.
The measured temperature is based on the digital output of the sensors.
The calibration was performed in a controlled environment. The temperature outside the calibration equipment was between 21°C and 27°C and the relative humidity was between 35% RH and 60% RH.

Calibration Equipment

Equipment	Identification number
Calibration tool	K-103864
Reference standard and read-out equipment	K-149037, K-149510

The calibration is traceable to national and international standards.

Measurement Uncertainty
Measurement uncertainties represent a confidence level of 95% using a coverage factor of k=2.
The measurement uncertainties are determined in accordance with the ISO17025:2017 guidelines. The measured value (y) and the associated measurement uncertainty (U) define the Range (y ± U), that includes the measured quantity with a probability of 95%.

Conformity Rule
Calibration is conforming to specified tolerances if $|T_{DUT} - T_{ref}| \leq |\text{allowed tolerance}|$.
The decision rule shared risk (JCGM 106:2010, 8.2) is applied.

Calibration Results

Setpoint T = -30°C

Serial number	T_{ref} [°C]	T_{DUT} [°C]	$T_{DUT} - T_{ref}$ [°C]	Allowed tolerance [°C]	Measurement uncertainty U (k=2) [°C]	Conformity
295283281	-30.98	-31.00	-0.02	±0.48	0.40	Conform

Setpoint T = 5°C

Serial number	T_{ref} [°C]	T_{DUT} [°C]	$T_{DUT} - T_{ref}$ [°C]	Allowed tolerance [°C]	Measurement uncertainty U (k=2) [°C]	Conformity
295283281	4.78	4.75	-0.03	±0.48	0.20	Conform

Setpoint T = 70°C

Serial number	T_{ref} [°C]	T_{DUT} [°C]	$T_{DUT} - T_{ref}$ [°C]	Allowed tolerance [°C]	Measurement uncertainty U (k=2) [°C]	Conformity
295283281	69.78	69.89	0.11	±0.48	0.20	Conform

End of the calibration certificate

© Copyright Sensirion AG, Switzerland

Calibration Certification

Name and address of the manufacturer: Sensirion AG
Laubisruetistrasse 50
CH-8712 Switzerland

Description: Digital Humidity- and Temperature Sensors

- SHT2x
- SHT3x
- SHT4x
- SHT4xI-Digital
- SHT8x
- SHTC1
- SHTC3
- SHTW2
- STS21
- STS3x
- STS4x

The above mentioned products are calibrated to meet the specifications according to the corresponding Sensirion data sheet. Each device is individually tested after its calibration.

Sensirion uses transfer standards for the calibration. These transfer standards are themselves subject to a scheduled calibration procedure. The calibration of the reference itself used for the calibration of the transfer standards is performed by an ISO/IEC 17025 accredited laboratory.

The accreditation body is full member of the International Laboratory Accreditation Cooperation (www.ilac.org). Calibration certificates issued by facilities accredited by a signatory to the ILAC Mutual Recognition Arrangement (MRA) are accepted by all signatories to the ILAC MRA.

This provides traceability of measurement to recognized national standards and to units of measurement realized at the “National Physical Laboratory” (NPL) or other recognized national standards laboratories like “Physikalisch-Technische Bundesanstalt” (PTB) or “National Institute of Standards and Technology” (NIST).

Staefa, Thursday, August 26, 2021

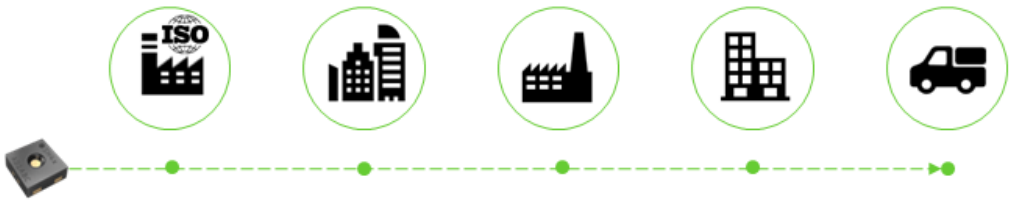
Stephan Weber,
Director,
Head of Quality Management, Sensirion AG

Volker Born
Manager,
Head of Quality Engineering, Sensirion AG

© Copyright Sensirion AG, Switzerland

Certified Smart Tracking

Less complexity for the benefit of all -- Enabled by Sensirion



Highlights

- End to end monitoring
- ISO17025 certified | NIST traceable
- Efficient recertification
- Economical, time-saving & scalable
- Cloud access throughout the value chain
- Design-in guidelines

Sensirion is the first ISO17025-accredited Semiconductor company in the world, allowing Sensirion to issue certified sensors independently, which in turn enables customers to build a certified smart tracker without having to certify the entire device. This document showcases novel aspects of this approach and what design-in considerations should be considered to achieve the best results.

Sensors with ISO17025 certificate

Product	Details
STS33-DIS	3-point calibrated, ISO17025 certified temperature sensor
SHT33-DIS	3-point calibrated, ISO17025 certified, 0x44 & 0x45 I2C addr.
SHT43-ADCB	3-point calibrated, ISO17025 certified, 0x44 I2C addr.
SHT43-BDCB	3-point calibrated, ISO17025 certified, 0x45 I2C addr.

Scan me to provide feedback

Contents

1 Novel Approaches for the Design of Calibrated and Certified Devices 3
1.1 Device versus Sensor Certification – Analog versus Digital 3
1.2 Signal Stability and Transmission 4
1.3 Design-in Guidelines 4
1.4 Difference between NIST traceability and ISO17025 certification 5
2 Sensirion Certification Insights 6
2.1 Recertification 6
2.2 Drift Estimation for Determining Re-certification Needs 7
2.3 Sustainability 7
3 Glossary 8
4 Bibliography 9
5 Revision History 9

1 Novel Approaches for the Design of Calibrated and Certified Devices

The core innovation of Sensirion's Certified Smart Tracking is the redundancy of calibration of a device by certifying the sensor component itself. This approach allows for a leaner way of achieving reliable monitoring of environmental conditions. Traditional monitoring devices require calibration of the entire system, which can be very time-consuming and costly. With Sensirion Certified Smart Tracking solutions, the sensor components are calibrated and certified, eliminating the need for calibration of the assembled devices. This new approach to calibration and monitoring changes the classical value chain of End-to-end monitoring devices, enabling more efficient and accurate monitoring of environmental conditions.

1.1 Device versus Sensor Certification – Analog versus Digital

When calibrating an analog measurement device, all components that might affect the measurement must be considered for calibration, in particular the sensing element *(e.g.* a Pt100), its corresponding read-out equipment, and the signal path in-between. This is traditional approach is necessary due to the analog nature of signal transport and processing, which can be affected when temperatures, strain, or resistances change ever so slightly. Today, many manufacturers and institutions still stick to this approach for traditional reasons. However, new approaches would be enabled by the switch from an analog to a digital system (see Figure 1).

Digital sensors, such as the the SHT43, consist of an analog sensing element and on-chip read-out electronics which entails that calibration and certification of the digital sensor comprises the same elements also considered in the traditional approach. Since the signal processing happens in the digital sensor itself, it is not subject to change due to other electronics in the device, provided correct design-in of the sensor to avoid a bias by dissipative heat from other electronics in the sensors (see section 1.2). In addition, Sensirion's calibration and certification process is accredited in a way to account for the soldered state, so that manufacturing processes don't affect the validity of the certificate.

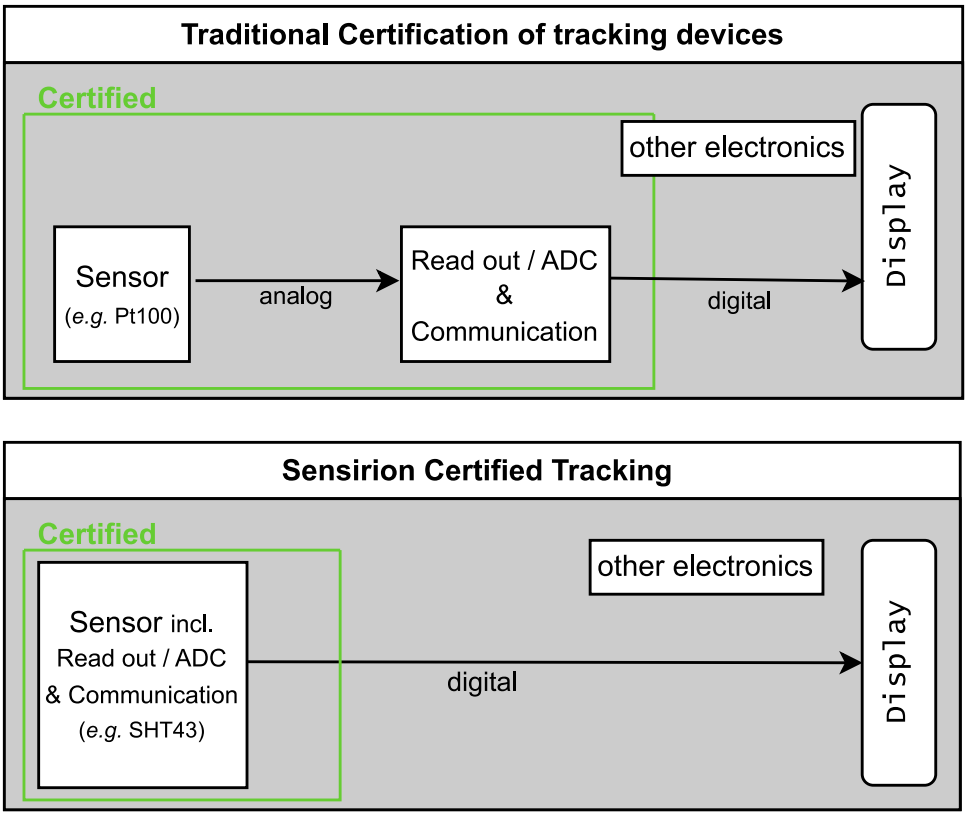


Figure 1. Comparison between traditional analog and digital sensor based (Sensirion) smart tracking devices.

1.2 Signal Stability and Transmission

When contrasting digital sensors and conventional analog sensors, one of the most prominent advantages of digital sensors lies in the simplification of signal transmission. Digital sensors convert the measured data into discrete digital values, which significantly reduces susceptibility to signal distortions during transmission. This inherent stability ensures data integrity and enables more accurate and reliable measurements. This is also the underlying reason why Sensirion can certify the sensors without the need of knowing their final application, provided the sensors are designed-in properly, which of course would also apply to analog sensors.

1.3 Design-in Guidelines

The SHT43 digital sensor has a compact design, which facilitates seamless integration into various applications. Unlike conventional analog sensors that require separate readout and analog-to-digital conversion components, our digital sensor seamlessly incorporates these functions into a single unit. As a result, customers can develop smaller and lighter tracking devices without compromising overall performance. The integration of readout and ADC functionality eliminates the need for extra circuitry, streamlining the design process and reducing the overall space requirements.

As the certified SHT43 makes a certification of the whole tracking device redundant, it is even more important to follow the guidelines, given in the design in guide [1], during the design phase of your device. Below you can find a summary of the most important recommendations from the Design Guide for Humidity and Temperature Sensors that can be found on our website.

Decouple the Sensor from other electronics and possible heat sources.

To ensure that the sensor is not affected by potential heat sources through conduction or radiation, it is necessary to thermally decouple the sensor from other electronics. There are various measures that need to be taken to achieve thermal decoupling. For instance, thin metal connections and sufficient distances between the sensor and heat sources are recommended. Furthermore, mill slits around the sensor on the PCB are advised. Additionally, thermal conduction can be mitigated by removing as much metal as possible from the PCB in proximity of the sensor. Another solution, and at the same time well-suited for recertification of a smart tracking device, is to mount the sensor on a separate removable flex-PCB.

Furthermore, since the housing of a device can influence any measurement taken, special care should be taken to reduce the influence from enclosed air by sealing the sensor compartment from the remaining housing. This avoids heat transport and ensures more representative sampling.

Design with a possible airflow

To ensure accurate values of the sensor, it is also important to consider the airflow and air exchange of the local air surrounding the sensor with the environment. The best solution is to ensure an airflow directly over the sensor. If this is not possible, we recommend reducing the dead volume around the sensor and have the largest possible aperture towards the environment of the device.

1.4 Difference between NIST traceability and ISO17025 certification

A NIST traceable calibration is when a manufacturer or laboratory can certify that the standards used to calibrate a device, and therefore the device itself, are traceable to standards used at NIST. This traceability can be established by a chain of intermediate transfer calibrations and transfer standards, each step increasing the overall measurement uncertainty. Even though the traceability of the reference standard is given by certification, this does not include any information on the calibration measurement itself (see **Figure 2** left).

- Each step increases the overall measurement uncertainty.
- No information on level of competence of staff and equipment.
- Reference standard traceable, the calibration itself however is not.

An ISO 17025 accreditation is a statement to the competence of the calibration laboratory. Given that the body performing the calibration is ISO 17025 accredited, the results are trustworthy, certified and are traceable to national and international standards (see **Figure 2** right).

- Accreditation by an official body member of ILAC MRA
- Highest standards with known measurement uncertainty
- Calibration performed by a certified body.

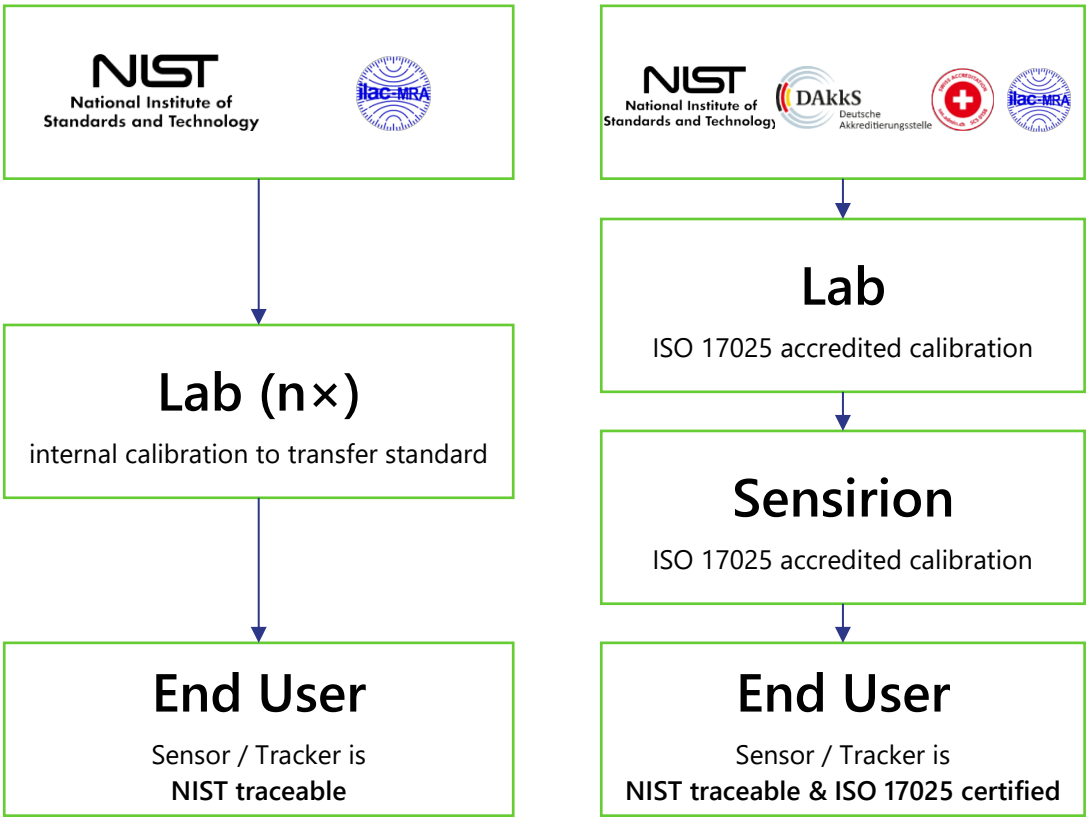


Figure 2. Schematic overview of steps taken to get a NIST traceable sensor (left) and an ISO17025 certified sensor (right).

Where 'NIST Traceable' meets the Metrological Traceability requirement, ISO17025 also requires a complete and sophisticated quality system ranging from process requirements to management system requirements including quality assurance of the calibration data, validity of the calibration method, maintenance of the

equipment and competence of the staff. Hereunder the differences shown between the requirements of NIST traceability vs. ISO17025.

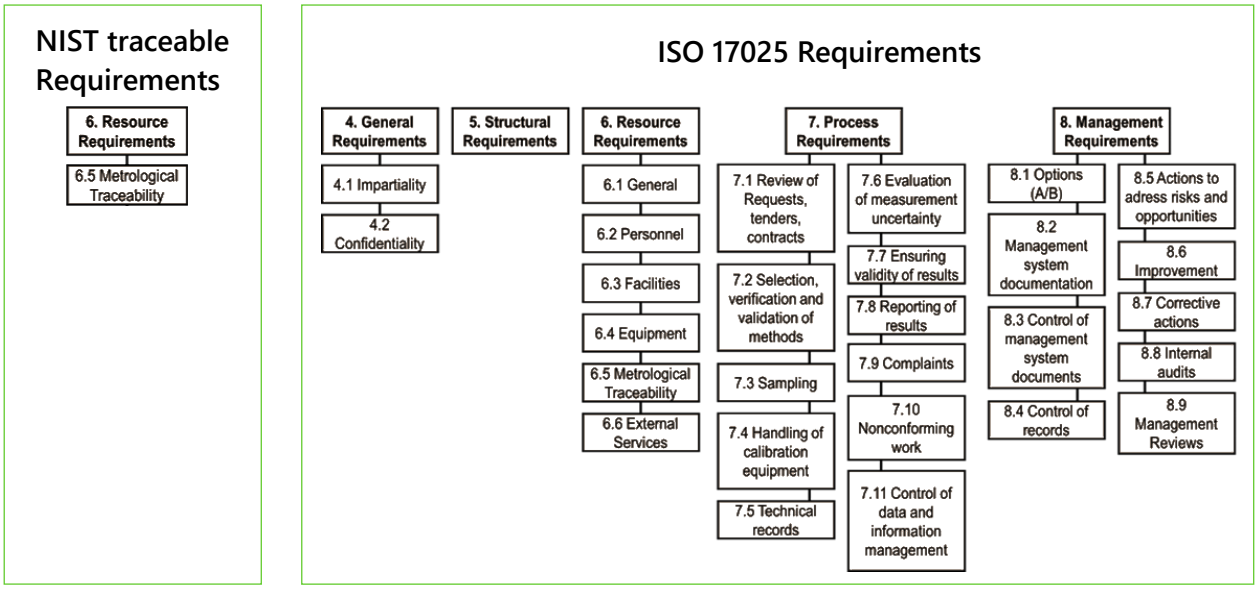


Figure 3. Comparison of the requirements for "NIST traceable" (left) and ISO 17025 (right).

2 Sensirion Certification Insights

2.1 Recertification

Any calibration certificate generally is valid only at the time of calibration due to the device under test leaving the controlled environment to the field, where damages cannot be fully excluded. The commonly used term "certificate validity" therefore does, in contrast to public perception, not indicate if the certificate is still valid, but instead refers to the often arbitrary time-period in which the device should be re-certified. To estimate this time-period, issuing companies and regulation bodies need to find a reasonable compromise between frequent calibration and lifetime in the field. To this end, a good strategy is to determine a typical application profile and estimate the drift of the measurement device to assess how long it remains within customer specifications. (Example: GDP Guidelines require ±0.5°C accuracy, SHT33 and SHT43 have max accuracy of 0.48 °C and <0.01 °C drift per year, which results in >2 years lifetime in the field.)

The second, more established, yet less pragmatic method is to arbitrarily demand re-certification every calendar year. This is often recommended in industry guidelines.

At Sensirion, the first ISO17025-certified semiconductor company in the world, sensors are certified in an in-house accredited calibration lab, which is optimized for efficiency and in line processes. Customer devices, which would require manual operations therefore cannot be re-certified as full devices at Sensirion. Instead, Sensirion recommends mounting the sensor on a removable board or better even a flex-PCB in the device, so that the sensor can easily be exchanged with a new certified sensor. This is not only time and cost-efficient but also has a lower impact on the environment.

2.2 Drift Estimation for Determining Re-certification Needs

Sensor drift is a phenomenon inherent to any measurement device due to material aging or any influence from the environment. Therefore, all reliable sensor manufacturers determine a drift that might be expected in the field. However, since the type of influence can only be estimated, worst case scenarios always consider drift in two directions. Sensirion therefore defines the drift specified in the datasheets as a widening of specs. Next to binding specification, Sensirion believes in transparency and performs accelerated aging tests to a simulated lifetime of 15 years in the field. This is achieved by THB tests, following the JESD22-A101 standard. While some companies assume THB to simulate 30 years, Sensirion takes a more strict and conservative approach assuming THB to simulate 15 years.

Example SHT33:

The drift specified in the datasheet (<0.01 °C per year) implies a widening of the specs from originally $S_{Original}$(-30°C to +70°C) = 0.48°C to 0.49°C after one year. Following this example, the maximum SHT33 accuracy specification after 15 years lifetime (S_{15y}) would therefore be:

$$S_{15y} = S_{Original} + 15 \times 0.01\,°C \quad \rightarrow \quad S_{15y}(\text{STS33 @25, 50°C}) = 0.63\,°C$$

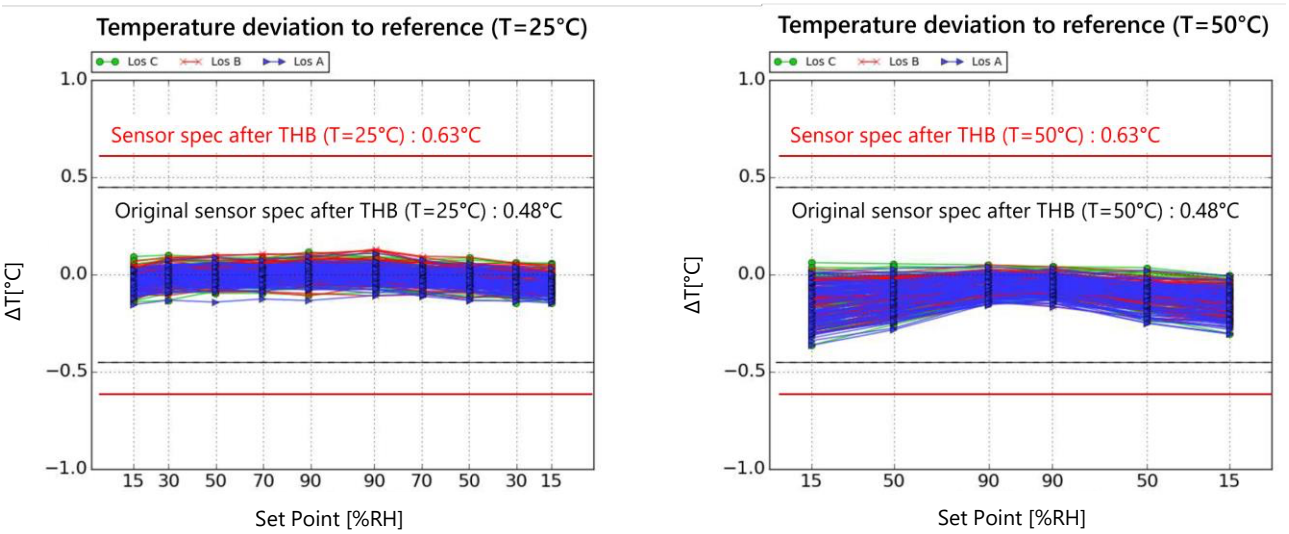


Figure 4. Steady-State Temperature-Humidity Bias Life Test (THB) test results according to JEDEC standard, with THB: 85 %RH, 85°C, 1000h; Standard JESD22-A101; 77 Sensors from 3 independent lots, total 231 Sensors.

This entails that even after 15 years simulated lifetime, the T performance is well within specs after THB (drift 0.01°C/y). Specifically, even within the original specs, which entails a yearly drift of <<0.01 °C.

2.3 Sustainability

Production and certification of an SHT43 at Sensirion is estimated to produce 6 g of CO_2 and consumes almost negligible amounts of resources. In contrast, transporting a batch of devices (about 20 kpcs) to a calibration lab could produce up to 12 g of CO_2. Knowing that this is rough estimation, it illustrates how a replacement of the certified sensor might be the most economical and ecological solution.

3 Glossary

Typical Accuracy

When plotting the accuracy (accuracy=device deviation from reference) distribution of a statistically significant number of sensors, the number of sensors in the µ±2σ range shows the typical accuracy. This equals 95.45% of all sensors.

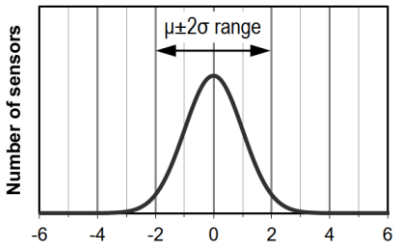


Figure 5. Visual representation of the µ±2σ range.

Maximum Accuracy

When plotting the accuracy distribution of a statistically significant number of sensors, the number of sensors in the µ±4σ range shows the typical accuracy. This equals 99.99% of all sensors. [2]

Allowed Tolerance

Allowed device deviation from a reference including maximum measurement uncertainty. In contrast to typical and maximum accuracy, not a statistical fraction, but every tested device, *i.e.,* 100% must fulfill the allowed tolerance. This is of particular interest for ISO17025-certified sensors.

Measurement Uncertainty

All measurements are subject to uncertainty determined through error propagation of all involved steps. Nevertheless, it is often neither estimated, nor reported, in contrast to ISO17025 measurements, where it is mandatory to add the measurement uncertainty to the measured value before evaluation of pass criteria.

ISO 17025

ISO17025 is an international standard that specifies the general requirements for the competence of testing and calibration laboratories. This standard was first published in 1999 by the International Organization for Standardization (ISO) and is now widely recognized as the highest level of accreditation that a laboratory can achieve. The purpose of ISO17025 is to ensure that laboratories perform tests and calibrations to a consistently high standard, producing accurate and reliable results. The standard covers all aspects of laboratory management, including the quality of the equipment and materials used, the qualifications and training of staff, and the procedures used to perform tests and calibrations. To achieve ISO17025 accreditation, laboratories must undergo a rigorous assessment process, which includes a thorough evaluation of their technical competence, quality management systems, and overall operational efficiency. This assessment is carried out by independent accreditation bodies, which are recognized by the International Laboratory Accreditation Cooperation (ILAC). Once a laboratory has achieved ISO17025 accreditation, it is required to undergo regular surveillance and re-assessment to ensure that it continues to meet the standard's requirements. This helps to ensure that the laboratory maintains its high level of competence and continues to produce accurate and reliable results.

4 Bibliography

5 Revision History

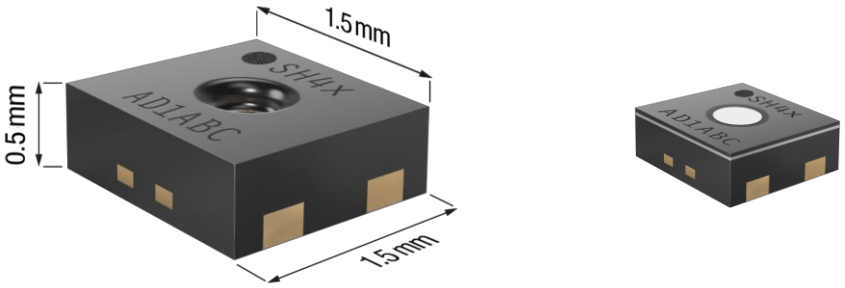
Date	Version	Pages	Changes
August 2023	1	all	Initial release
October 2023	1.1	1 7	Added SHT33-DIS to Sensor list Corrected typo

.

SENSIRION

Datasheet – SHT4x

4th Gen. Relative Humidity and Temperature Sensor



Highlights

- Accuracies Δ*RH* = ±1.0 %RH, Δ*T* = ±0.1 °C
- VDD = 1.08 V … 3.6 V
- Avg. current: 0.4 µA, Idle current: 80 nA
- I2C FM+, CRC checksum, multip. I2C addr.
- Patented protection options [1], PTFE membrane and removable protective cover
- Operating range: 0 … 100 %RH, −40…125 °C
- Fully functional in a condensing environment
- Power heater, true NIST-traceability
- JEDEC JESD47 qualification
- Sensor-specific calibration certificate acc. to ISO 17025: 2017, 3-point temp. calibration

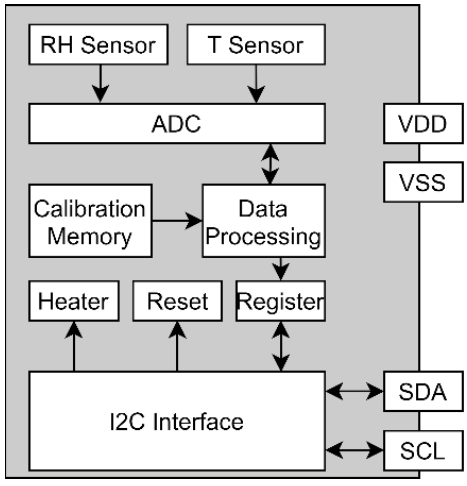
SHT4x is a digital sensor platform for measuring relative humidity and temperature at different accuracy classes. Its I2C interface provides several preconfigured I2C addresses while maintaining an ultra-low power budget (0.4 µW). The power-trimmed internal heater can be used at three heating levels thus enabling sensor operation in demanding environments. The four-pin dual-flat-no-leads package is suitable for surface mount technology (SMT) processing and comprises an optional on-package patented PTFE [1] membrane or a removable protective cover. Sensor specific calibration certificates according to ISO17025, identifiable through unique serial numbers, are available.

Device Overview

Product	Details
SHT40-xD1B	base RH&T accur., possible I2C addr.: 0x44, 0x45, 0x46
SHT40-AD1F	SHT40-AD1B with PTFE membrane
SHT40-AD1P	SHT40-AD1B with protective cover
SHT41-AD1B	intermed. RH&T accur., 0x44 I2C addr.
SHT43-ADCB	ISO17025 3-point calibration certificate
SHT45-AD1B	±1.0 %RH, ±0.1 °C accur., 0x44 I2C addr.

See full product list on page 21.

Functional Block Diagram



Scan me to provide feedback

2 Sensor Specifications

Every SHT4x is individually tested and calibrated and is identifiable by its unique serial number (see section 4.7 for details on the serial number). For the calibration, Sensirion uses transfer standards, which are subject to a scheduled calibration procedure. The calibration of the reference, used for the calibration of the transfer standards, is NIST traceable through an ISO/IEC 17025 accredited laboratory.

2.1 Relative Humidity

Parameter	Conditions	Value	Units
SHT40 *RH* accuracy[1]	typ.	±1.8	%RH
	max.	See **Figure 2**	-
SHT41 *RH* accuracy[1]	typ.	±1.8	%RH
	max.	See **Figure 3**	-
SHT43 *RH* accuracy[1]		±1.8	%RH
		See **Figure 4**	
SHT45 *RH* accuracy[1]	typ.	±1.0	%RH
	max.	See **Figure 5**	-
Repeatability[2, 3]	high	0.08	%RH
	medium	0.15	%RH
	low	0.25	%RH
Resolution[4]	-	0.01	%RH
Hysteresis	At 25 °C	±0.8	%RH
Specified range[5]	extended[6]	0 to 100	%RH
Response time[7]	$\tau_{63\%}$	4	s
Long-term drift[8]	typ.	<0.2	%RH/y

Table 1. General relative humidity sensor specifications.

[1] For definition of typ. and max. accuracy, please refer to the document "Sensirion Humidity Sensor Specification Statement".
[2] The stated repeatability is three times the standard deviation (3σ) of multiple consecutive measurement values at constant conditions and is a measure for the noise on the physical sensor output. Different repeatability commands are listed in **Table 8**
[3] Valid for 25 °C and 50 %RH.
[4] Resolution of A/D converter.
[5] Specified range refers to the range for which the humidity or temperature sensor specification is guaranteed.
[6] For details about recommended humidity and temperature operating range, please refer to section 2.3.
[7] Time for achieving 63% of a humidity step function, measured at 25 °C and 1 m/s airflow. Humidity response time in the application depends on the design-in of the sensor.
[8] Typical value for operation in normal RH/T operating range. Value may be higher in environments with vaporized solvents, out-gassing tapes, adhesives, packaging materials, etc. For more details please refer to Handling Instructions.

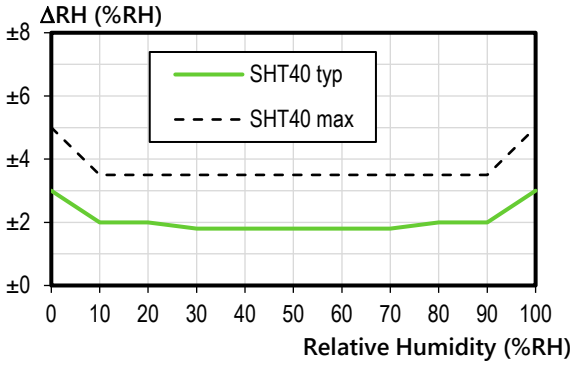


Figure 2. SHT40 typical and maximal relative humidity accuracy at 25 °C.

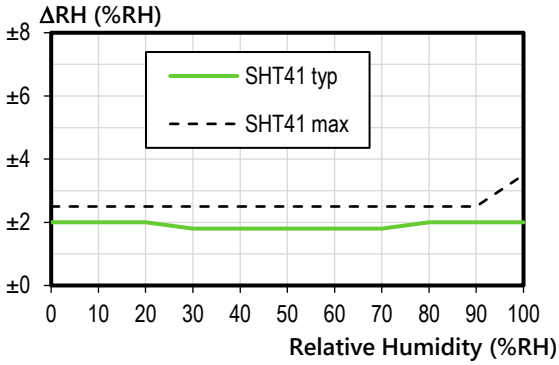


Figure 3. SHT41 typical and maximal relative humidity accuracy at 25 °C.

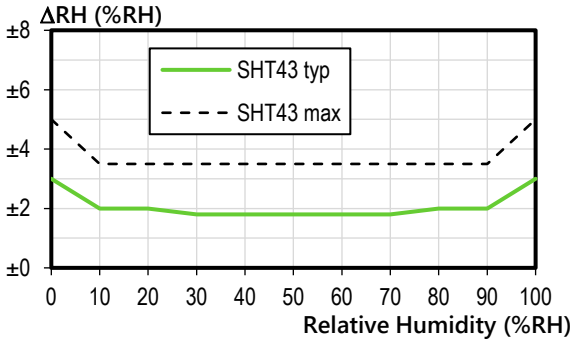


Figure 4. SHT43 typical and maximal relative humidity accuracy at 25 °C.

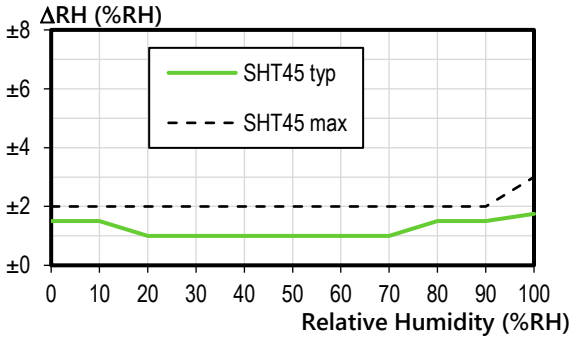


Figure 5. SHT45 typical and maximal relative humidity accuracy at 25 °C.

2.1.1 Relative Humidity Accuracy at the Extended Temperature Range

The typical RH accuracy tolerances in the range of T = 0 °C … 80 °C are given in **Figure 6**, **Figure 7**, **Figure 8**, and **Figure 9**.**Figure 10**

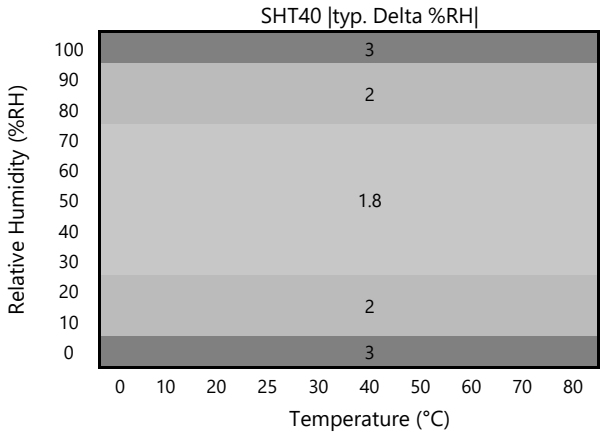


Figure 6. Typical RH accuracy tolerance over humidity and temperature for SHT40.

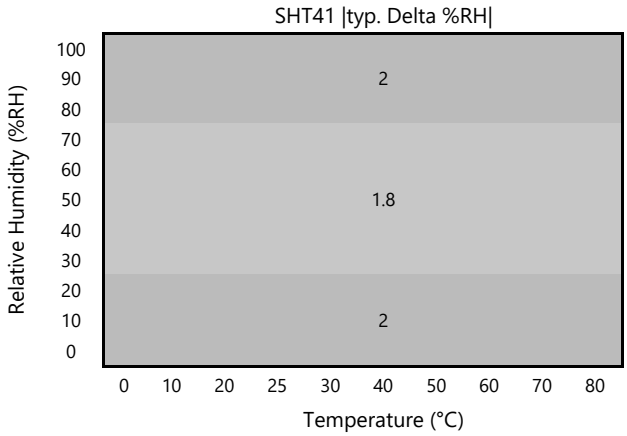


Figure 7. Typical RH accuracy tolerance over humidity and temperature for SHT41.

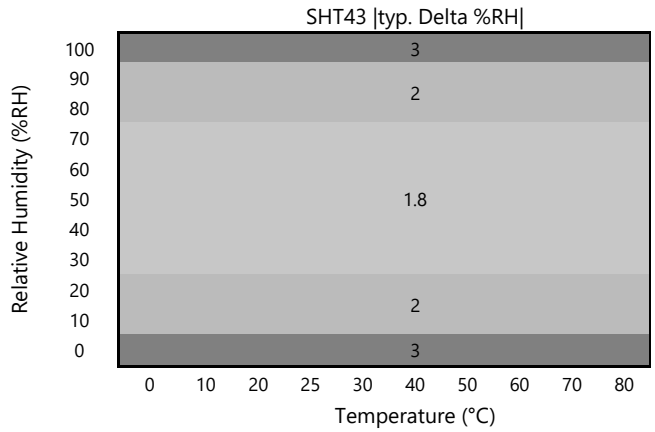


Figure 8. Typical RH accuracy tolerance over humidity and temperature for SHT43.

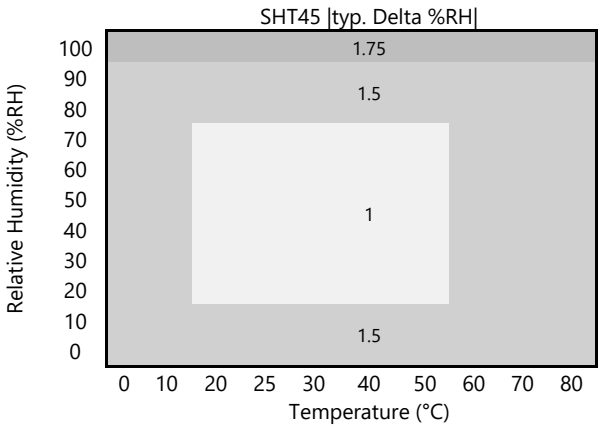


Figure 9. Typical RH accuracy tolerance over humidity and temperature for SHT45.

2.2 Temperature

Parameter	Conditions	Value	Units
SHT40 *T* Accuracy[1]	typ.	±0.2	°C
	max.	see **Figure 10**	-
SHT41 *T* Accuracy[1]	typ.	±0.2	°C
	max.	see **Figure 11**	-
SHT43 *T* Accuracy[1]	max.	see **Figure 12**	-
SHT45 *T* Accuracy[1]	typ.	±0.1	°C
	max.	see **Figure 13**	-
Repeatability[2]	high	0.04	°C
	medium	0.07	°C
	low	0.1	°C
Resolution[4]	-	0.01	°C
Specified range[5]	-	–40 to +125	°C
Response time[9]	$\tau_{63\%}$	2	s
Long-term drift[10]	typ.	<0.03	°C/y
Long-term drift for SHT43	typ.	<0.01	°C/y

Table 2. General Temperature Sensor specifications.

[9] Temperature response time depends on heat conductivity of sensor substrate and design-in of sensor in application.
[10] Max. value is <0.04 °C/y. And please note that it is different for the SHT43.

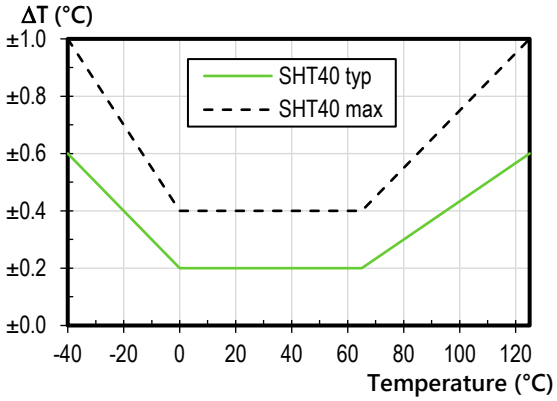


Figure 10. SHT40 typical and maximal temperature accuracy.

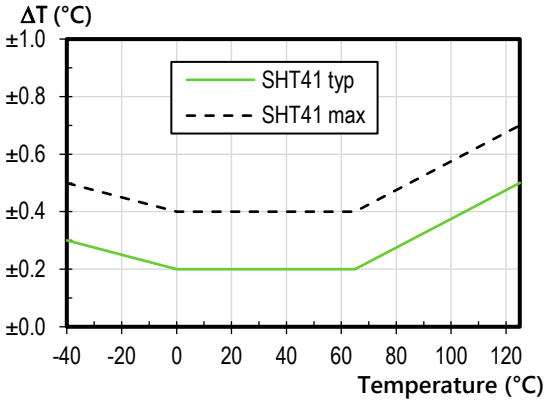


Figure 11. SHT41 typical and maximal temperature accuracy.

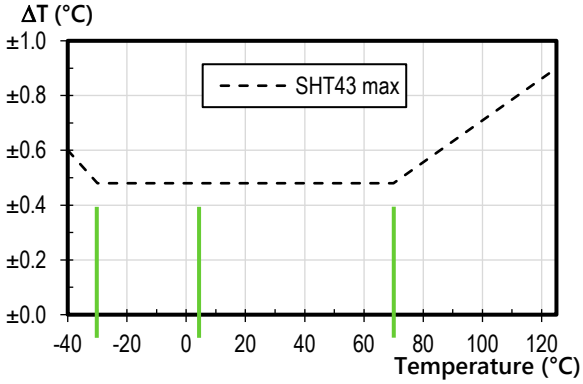


Figure 12. SHT43 maximal temperature accuracy. The green lines represent the calibration points for ISO-17025 certification.

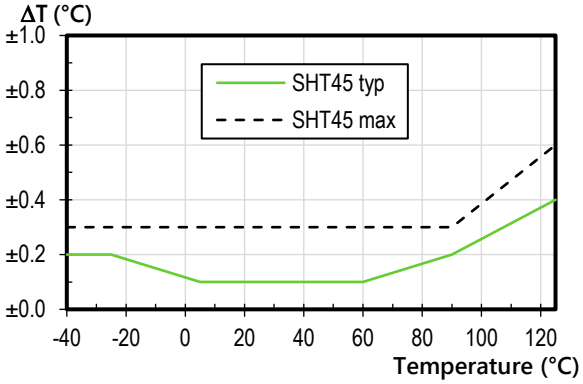


Figure 13. SHT45 typical and maximal temperature accuracy.

2.3 Recommended Operating Conditions

The sensor shows best performance when operated within the recommended normal temperature and humidity range of 5 °C … 60 °C and 20 %RH … 80 %RH, respectively. Long term exposure to conditions outside recommended normal range, especially at high relative humidity, may temporarily offset the RH signal (*e.g.* +3 %RH after 60 h at >80 %RH). After returning into the recommended normal temperature and humidity range the sensor will recover to within specifications by itself. Prolonged exposure to extreme conditions may accelerate ageing.

The Sensors from Sensirions SHT4x Family show exceptional resistance to volatile organic compounds and ageing. To avoid contamination the conditions described in the document "Handling Instructions for humidity Sensors" [2] must be met. Please note that this does apply not only to transportation and manufacturing, but also to operation of the SHT4x.

2.4 ISO17025 certification with 3-point calibration data

All SHT43 can be uniquely identified by their serial number (read out command see paragraph 4.7). For each sensor an individual 3-point calibration is performed, accredited to ISO/IEC 17025:2017. The accreditation is performed and granted by the Swiss Accreditation Service (SAS), a public institution of the Swiss

Government. The accreditation is documented on the SAS website under the name SCS 0158 and can be downloaded from this link[11]. The three calibration temperatures are T = −30 °C, T = 5 °C, and T = 70 °C. Measurement uncertainties and decision rules according to the SAS are given in Table 3. Metrological traceability of the calibration is in accordance to ch. 6.5 of ISO/IEC 17025:2017, encompassing but not limited to NIST traceability or traceability to other national metrology institutes, according to the CIPM Mutual Recognition Arrangement (CIPM MRA). Reel-wise calibration certificates and data for each SHT43 can be downloaded from libellus.sensirion.com. This allows for efficient processing by automated systems.

Temperature	Expanded measurement uncertainty (k=2)*	Decision rule
−30 °C	0.40 °C	Shared risk (JCGM 106:2012, 8.2)
5 °C	0.20 °C	Shared risk (JCGM 106:2012, 8.2)
70 °C	0.20 °C	Shared risk (JCGM 106:2012, 8.2)

Table 3. Measurement uncertainty and decision rule for the accredited calibration according to Swiss Accreditation Service (SAS). *Measurement uncertainties represent a confidence level of 95% using a coverage factor of k = 2.

For more information on how Sensirion being the first ISO17025 certified Semiconductor company affects the design of certified tracking find the document Sensirion Certified Smart Tracking on our website www.sensirion.com.

2.5 Design In

The above-mentioned specifications hold for the stand-alone sensing element. To achieve the best performance please consult the document Design in Guide [1] on our website Sensirion.com.

[11] https://www.sas.admin.ch/sas/en/home/akkreditiertestellen/akkrstellensuchesas.exturl.html/aHR0cHM6Ly9zYXNkYi5jbGllbnRzLmxpaXAuY2gvc2VhcmNoLm/h0bWw=.html?csrfmiddlewaretoken=2le2f1aOTUge9YQ3nuaL0ILEYS980ZMdH60doLdY8Nh1sHC3wpw3YvLLVBezmDRn&lang=en&search_term=0158&accreditation_type=2&submit=Start+search

3 Electrical Specifications

Parameter	Symbol	Conditions	Min	Typ	Max	Unit	Comments
Supply voltage	V_{DD}		1.08	3.3	3.6	V	-
Power-up/down	V_{POR}	Static power supply	0.6	-	1.08	V	-
Slew rate of the supply voltage	$V_{DD, slew}$		-	-	20	V/m s	Voltage changes on the supply between $V_{DD, min}$ and $V_{DD, max.}$ Faster slew rates may lead to a reset
Supply current (heater **off**)	I_{DD}	Idle state	- -	0.08 -	1.0 3.4	µA	At 25 °C At 125 °C
		Power up	-	50	-	µA	-
		Measurement	-	320	500	µA	Current while sensor is measuring
		Avg., high repeatability Avg., med. repeatability Avg., low repeatability	- - -	2.2 1.2 0.4	- - -	µA	Avg. current consumption (continuous operation with 1 meas. per second)
Supply current (heater **on**)	I_{DD}	Nomin. heater "200 mW"	-	60	100	mA	see section 4.9
		Nomin. heater "110 mW"	-	33	55	mA	
		Nomin. heater "20 mW"	-	6	10	mA	
Power consumpt. at VDD=1.2 V (no heater)	-	Avg., high repeatability Avg., med. repeatability Avg., low repeatability	- - -	2.6 1.4 0.5	- - -	µW	Avg. power consumption (continuous operation with 1 meas. per second)
Low level input voltage	V_{IL}	-	0	-	0.3* V_{DD}	V	-
High level input voltage	V_{IH}	-	0.7* V_{DD}	-	V_{DD}	V	-
Pull up resistors	R_p	V_{DD} < 1.62 V	820	-	-	Ω	-
		V_{DD} ≥ 1.62 V	390	-	-	Ω	-
Low level output voltage	V_{OL}	V_{DD} < 1.62 V, R_{pullup} > 820 Ω	-	-	0.2* V_{DD}	V	-
		V_{DD} = 1.62 V … 2.0 V, R_{pullup} > 390 Ω	-	-	0.2* V_{DD}	V	-
		V_{DD} > 2.0 V, R_{pullup} > 390 Ω	-	-	0.4	V	-
Capacitive bus load	C_b	R_P ≤ 820 Ω: fast mode	-	-	400	pF	Capacitive bus load can be determined from $C_b < t_{rise}/(0.8473*R_p)$. Rise times are t_{rise} = 300 ns for fast mode & t_{rise} = 120 ns for fast mode plus
		R_p = 390 Ω, VDD > 1.62 V: fast mode plus	-	-	340	pF	

Table 4. Electrical specifications.

9 Nomenclature

Position	Value(s)	Explanation
1	S	Sensirion
2	H	Humidity Signal
3	T	Temperature Signal
4	4	Fourth product generation
5	0 1 5 3	Base accuracy Intermediate accuracy Best accuracy ISO17025 certified
6	-	delimiter
7	A B C	I2C interface with 0x44 address I2C interface with 0x45 address I2C interface with 0x46 address
8	D	DFN package
9	1 C	Reserved 3-point calibrated and certified
10	B F P	Blank package Package with integrated, patented PTFE membrane Package with removable protective cover for conformal coating (coming soon)
11	-	delimiter
12	R	Tape on reel packaging
13	2 3	Packaging article contains 2'500 pieces Packaging article contains 10'000 pieces

Table 11. SHT4x product nomenclature. For ordering information, kindly refer to **Table 12**.

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.

SENSIRION is only liable for defects of this product arising under the conditions of operation provided for in the data sheet and proper use of the goods. SENSIRION explicitly disclaims all warranties, express or implied, for any period during which the goods are operated or stored not in accordance with the technical specifications.

SENSIRION does not assume any liability arising out of any application or use of any product or circuit and specifically disclaims any and all liability, including without limitation consequential or incidental damages. All operating parameters, including without limitation recommended parameters, must be validated for each customer's applications by customer's technical experts. Recommended parameters can and do vary in different applications.

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.

Headquarters and Subsidiaries

Sensirion AG
Laubisruetistr. 50
CH-8712 Staefa ZH
Switzerland

phone: +41 44 306 40 00
fax: +41 44 306 40 30
info@sensirion.com
www.sensirion.com

Sensirion Inc., USA
phone: +1 312 690 5858
info-us@sensirion.com
www.sensirion.com

Sensirion Japan Co. Ltd.
phone: +81 45 270 4506
info-jp@sensirion.com
www.sensirion.com/jp

Sensirion Korea Co. Ltd.
phone: +82 31 337 7700~3
info-kr@sensirion.com
www.sensirion.com/kr

Sensirion China Co. Ltd.
phone: +86 755 8252 1501
info-cn@sensirion.com
www.sensirion.com/cn

Sensirion Taiwan Co. Ltd
phone: +886 2 2218-6779
info@sensirion.com
www.sensirion.com

To find your local representative, please visit
www.sensirion.com/distributors

Copyright © 2022, by SENSIRION. CMOSens® is a trademark of Sensirion. All rights reserved