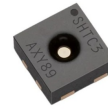


SENSIRION SHTC3 Digital Humidity and Temperature Sensor



# SENSIRION SHTC3 Digital Humidity and Temperature Sensor User Guide

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# SENSIRION

**SENSIRION SHTC3 Digital Humidity and Temperature Sensor**



## Specifications

- **Model:** SHTC3
- **Model:** SHT4x
- **Features:** Robustness, decades of sensor development

## Product Usage Instructions

### Purpose

This document provides a high-level guideline to replace the SHTC3 sensor with sensors from the SHT4x family. It outlines important differences to be considered in the design-in processes.

### Performance Comparison

The following table compares the relative humidity and temperature specifications of the SHTC3 and SHT4x sensors:

Parameter	SHTC3	SHT4x
Relative Humidity RH accuracy	Typ. – 63% RH	Typ. – 63% RH
High repeatability	Typ. 0.25% RH	Typ. 0.25% RH
Resolution	Typ. 0.08% RH	Typ. 0.01% RH
Hysteresis	Specified range: 1% RH	No signal drop
Response time	Typ. 1 s	Typ. 2 s
Long-term drift	Specified range: 0.01% RH/y	No signal drop
Condensation behavior	Droplet formation	No signal drop

### Electrical Characteristics

The following table compares the key electrical specifications of the SHTC3 and SHT4x sensors:

Parameter	SHTC3	SHT4x
Supply voltage	Min. 1.62 V, Typ. 3.3 V, Max. 3.6 V	Min. 1.08 V, Typ. 3.3 V, Max. 3.6 V
Power-up/down level	VPOR: Min. 1.28 V, Typ. 1.4 V, Max. 1.55 V	VPOR: Min. 0.6 V, Typ. 1.08 V, Max. 1.4 V
Supply current (heater not activated)	Min. 1.08 $\mu$ A, Typ. 430 $\mu$ A, Max. 900 $\mu$ A	Min. 0.3 $\mu$ A, Typ. 320 $\mu$ A, Max. 900 $\mu$ A
Power consumption	Average: Typ. 4.9 mW	Average: Typ. 16.2 mW
Low-level input voltage	Min. 0.4 V (low)	Min. 0.5 V (low)
High-level input voltage	Max. 2.2 V (high)	Max. 2.6 V (high)

## Timing Specifications

The following table compares the key timing specifications of the SHTC3 and SHT4x sensors:

Parameter	SHTC3	SHT4x
Power-up time after hard reset	Min. 0.18 ms, Typ. 0.24 ms	Min. 0.18 ms, Typ. 0.24 ms
Soft reset time after soft reset	Min. 0.18 ms, Typ. 0.24 ms	Min. 0.18 ms, Typ. 0.24 ms
Measurement duration (medium repeatability)	Typ. 10.8 ms, Max. 12.1 ms	Typ. 3.7 ms, Max. 4.5 ms
Heater-on duration	N/A	Min. 0.1 s, Max. 1.0 s

## Flagship SHT4x Feature: Built-In Heater

The SHT4x sensor has a built-in heater feature.

## FAQ

### Q: Where can I find more information about the SHTC3 and SHT4x sensors?

- You can find more information about the SHTC3 and SHT4x sensors in their respective datasheets available on the Sensirion website.

### Q: What is the condensation behavior of the SHTC3 and SHT4x sensors?

- The SHTC3 sensor experiences droplet formation under certain conditions, while the SHT4x sensor does not experience any signal drop due to condensation.

### Q: What is the power consumption of the SHTC3 and SHT4x sensors?

- The average power consumption of the SHTC3 sensor is typically 4.9 mW, while the average power consumption of the SHT4x sensor is typically 16.2 mW.

## SHTC3 – SHT4x Transition Guide

Boarding the new flagship RH/T sensor generation



### Features

- Improved accuracy, power consumption, and robustness
- Powerful internal heater for self-decontamination
- Superior versatility and technology from two decades of sensor development
- **Relative humidity accuracy:** up to  $\pm 1.0$  %RH
- **Temperature accuracy:** up to  $\pm 0.1$  °C
- **Supply voltage:** 1.08 V ... 5.5 V
- **Average current:** 0.4  $\mu$ A (at meas. rate 1 Hz)
- **Idle current:** 80 nA
- Fully functional in a condensing environment

### General Description

Once introduced as a specialty digital humidity (RH) and temperature (T) sensor for high-volume consumer electronics, the SHTC3 enabled outstanding sensing performance in a small package for several years. Sensirion now proudly recommends its all-new flagship successor from the SHT4x family, which profits from about two decades of RH/T sensor development. Dedicated to best-in-class performance, low power consumption, smallest footprint, and attractive pricing, our new SHT4x sensors are the products of choice for many SHTC3 applications. In particular, the SHT4x outperforms the SHTC3 in every aspect and offers versatile add-ons, such as a powerful heater for self-decontamination, conformal coating protection, or filter membranes, previously not available for the SHTC3.

### Important Changes

Parameter	SHTC3	SHT4x
Dimensions (mm3)	2.0 ´ 2.0 ´ 0.75	1.5 ´ 1.5 ´ 0.5
Pin assignment	Comparable	
Interface	I2C, single address	I2C, multiple addresses
Supply voltage (V)	1.62 – 3.6	1.08 – 5.51
Av. current (mA @ 1Hz)	4.9	0.6
Typ. RH accuracy (%RH)	±2.0	±1.8 – ±1.0
Typ. T accuracy (°C)	±0.2	±0.2 – ±0.1
Response time $t_{63\%}$ (s)	8	4
Filter membrane	Not available	Available
Conformal coating	Not possible	Possible
Additional features	–	Powerful heater with $D T^{\circ}60^{\circ}\text{C}$ ,

1. SHT4xI has a higher possible supply voltage of up to 5.5V

## Purpose

This document aims to provide a high-level guideline to replace SHTC3 with sensors from the SHT4x family and outlines important differences to be considered in design-in processes.

## Performance Comparison

### Relative Humidity and Temperature

Parameter	Conditions	SHTC3	SHT4x	Units
<b>Relative humidity</b>				
RH accuracy <sup>2</sup>	Typ.	<b>±2</b>	<b>1.0 ... ±1.8</b>	%RH
High repeatability <sup>3</sup>	–	0.1	0.08	%RH
Resolution <sup>4</sup>	–	0.01	0.01	%RH
Hysteresis	–	±1	±1	%RH
Specified range <sup>5</sup>	extended <sup>6</sup>	0 – 100	0 – 100	%RH
Response time <sup>7</sup>	<i>t</i> 63%	<b>8</b>	<b>4</b>	s
Long-term drift <sup>8</sup>	Typ.	< 0.25	< 0.25	%RH/y
Condensation behavior	Droplet formation	<b>Slight signal drop</b>	<b>No signal drop</b>	–
<b>Temperature</b>				
T Accuracy <sup>1</sup>	Typ.	<b>±0.2</b>	<b>±0.1</b>	°C
High repeatability <sup>2</sup>	–	<b>0.1</b>	<b>0.04</b>	°C
Resolution <sup>3</sup>	–	0.01	0.01	°C
Specified range <sup>4</sup>	–	–40 – +125	–40 – +125	°C
Response time <sup>9</sup>	<i>t</i> 63%	<b>&lt; 5 – 30</b>	<b>2</b>	s
Long-term drift <sup>10</sup>	Typ.	< 0.02	< 0.01, < 0.03	°C/y

Table 1. Humidity and temperature specifications of the SHTC3 and SHT4x, where bold values highlight important differences.

For further details, kindly refer to the SHTC3 and SHT4x datasheets.

1. For definition of type. accuracy, please refer to the document “Sensirion Humidity Sensor Specification Statement”.
2. The stated repeatability is 3 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 5.
3. Resolution of A/D converter.
4. Specified range refers to the range for which the humidity or temperature sensor specification is guaranteed.
5. For details about the recommended humidity and temperature operating range, please refer to the SHT4x Datasheet.
6. Time for achieving 63% of a humidity step function, valid at 25°C and 1 m/s airflow. Humidity response time in the application depends on the design of the sensor.
7. Typical value for operation in normal RH/T operating range. Max. value is < 0.5 %RH/y. The value may be higher in environments with vaporized solvents, out-gassing tapes, adhesives, packaging materials, etc. For more details, please refer to Handling Instructions.
8. Temperature response time depends on the heat conductivity of the sensor substrate and design-in of the sensor in the application.

9. Max. value is < 0.04°C/y. The long-term drift for SHT43 is < 0.01 C/y.

## Electrical Characteristics

Parameter	Symbol	Conditions	SHTC3			SHT4x			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Supply voltage	VDD		<b>1.62</b>	<b>3.3</b>	<b>3.6</b>	<b>1.08</b>	<b>3.3</b>	<b>3.6</b>	V
Power-up/down level	VAPOR	Static power supply	<b>1.28</b>	<b>1.4</b>	<b>1.55</b>	<b>0.6</b>	–	<b>1.08</b>	V
Supply current (heater not activated)	ADD	Sleep/Idle	–	<b>0.3</b>	<b>0.6</b>	–	<b>0.08</b>	–	µA
		Meas.	–	<b>430</b>	<b>900</b>	–	<b>320</b>	–	µA
		Average	–	<b>4.9</b>	–	–	<b>0.4 (low)</b> <b>2.2 (high)</b>	–	µA
Power consumption	–	Average	<b>16.2</b>	–	–	–	<b>0.5 (low)</b> <b>2.6 (high)</b>	–	µW
Low-level input voltage	VIL	–	–	–	<b>0.42 VDD</b>	0	–	<b>0.3 VDD</b>	V
High-level input voltage	VIA	–	<b>0.7 VDD</b>	–	–	<b>0.7 VDD</b>	–	<b>VDD</b>	V
Application circuit design	–	–	Identical, for details see SHTC3 or SHT4x datasheet						–

Table 2. Key electrical specifications of the SHTC3 and SHT4x, where bold values highlight important differences. For further details, kindly refer to the SHTC3 and SHT4x datasheets.

## Timing Specifications

Parameter	Symbol	Conditions	SHTC3			SHT4x			Units
			Min	Typ.	Max	Min	Typ.	Max	
Power-up time	$t_{PU}$	After hard reset, $V_{DD} \geq V_{POR}$	–	<b>0.18</b>	<b>0.24</b>	–	–	<b>1</b>	ms
Soft reset time	$t_{SR}$	After soft reset	–	<b>0.18</b>	<b>0.24</b>	–	–	<b>1</b>	ms
Measurement duration	$t_{eas}$	Medium repeatability	–	<b>10.8</b>	<b>12.1</b>	–	<b>3.7</b>	<b>4.5</b>	ms
Heater-on duration	$t_{heater}$		–	–	–	0.1	–	1.0	s

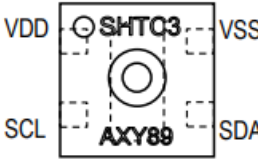
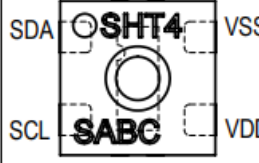
**Table 3.** Key timing specifications of the SHTC3 and SHT4x, where bold values highlight important differences. For further details, kindly refer to the SHTC3 and SHT4x datasheets.

### 3 Flagship SHT4x Feature: Built-In Heater

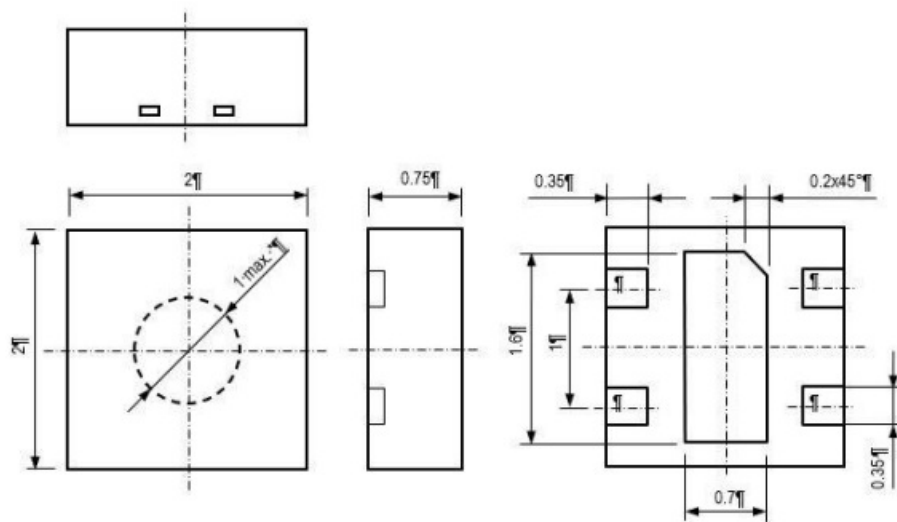
- The SHT4x sensor incorporates a powerful on-chip heater, which can be used for self-decontamination, e.g. in environments with solvents present, and periodical creep compensation in prolonged application in the highest humidity.
- It provides an over-temperature of about 60 °C and can be switched on by the command specified in Table 5, after which the heater will run for 1 second.
- After 1 second, a temperature and humidity measurement is started and the heater will be automatically turned off after the measurement is finished.
- This safety feature prevents permanent turn-on of the heater. There is no dedicated command to turn off the heater. If higher temperatures than achievable by heating for 1 second are desired, consecutive heating commands need to be sent to the sensor.

### Package Design Differences

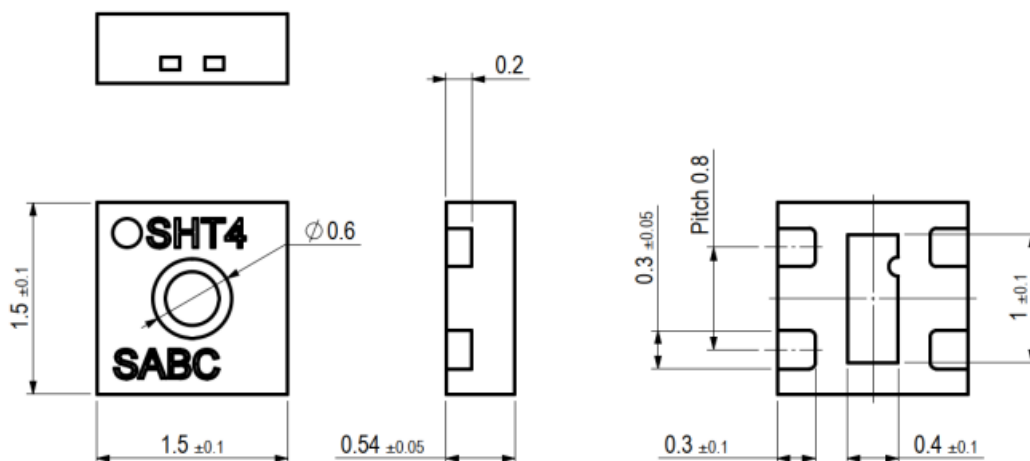
The SHT4x comes in a new open-cavity dual flat no-lead (DFN) package design to enable significant size reduction while allowing additional features, such as conformal coating, protection cover, and filter membrane compatibility. Similar to the SHTC3, the humidity sensor opening is centered on the top side of the SHT4x package (see Figure 1,2). The bottom side of both DFN packages exposes metallic contacts, which are Ni/Pd/Au coated, while the side walls of the contacts are bare copper.

Parameter	Units	SHTC3	SHT4x	Comment
Size	mm	2.0 x 2.0 x 0.75	1.5 x 1.5 x 0.5	For details, see Figures 1,2.
Sensor opening	-	Top	Top	
Protection compatibility	-	none	Compatible with conformal coating and filter membranes	
Pin Layout	-	2 x 2 pins	2 x 2 pins	
Pin Assignment	-			Drawings not to scale. VDD: Supply voltage SCL: Serial clock SDA: Serial data bidirectional VSS: Ground
Pin Size	mm	0.35 x 0.35	0.3 x 0.3	
Pin Pitch	mm	1.0	0.8	
Pin Material	-	Ni/Pd/Au coated Cu	Ni/Pd/Au coated Cu	
Housing Material	-	Epoxy housing	Epoxy housing	

**Table 4.** Key package differences between the SHTC3 and SHT4x. For further details, kindly refer to the SHTC3 and SHT4x datasheets.



**Figure 1.** Dimensional drawing of the SHTC3 (units mm).



**Figure 2.** Dimensional drawing of the SHT4x including package tolerances (units mm).

## Communication Compatibility

- Both chips feature the I2C communication protocol, however, while the SHTC3 has a fixed I2C address, the

SHT4x features a default I2C address (0x44) and alternative addresses for high flexibility in all applications.

- Addressing a specific SHT4x sensor is done by sending its 7-bit I2C address followed by an eighth bit, denoting the communication direction: “Zero” indicates transmission to the sensor, i.e. “write”, a “one” indicates a “read” request.
- In addition, the SHT4x features different measurement options for different precision needs and a heater option, as detailed in Table 5 and Section 3.

Command		Description
BIN	HEX	
1111 1101	FD	Measure T & RH with the highest precision (high repeatability)
1111 0110	F6	Measure T & RH with medium precision (medium repeatability)
1110 0000	E0	Measure T & RH with the lowest precision (low repeatability)
1000 1001	89	Read serial
1001 0100	94	Soft Reset
0011 1001	39	Activate highest heater power for 1s

- Table 5. Short overview of I2C commands for the SHT4x.
- For further details on the I2C communication, such as general protocol description, data types and lengths, and checksum calculation, kindly refer to the SHT4x datasheet.

## Quality and Material Contents

- Qualification of the SHTC3 and SHT4x is performed based on the JEDEC JESD47 qualification test method. While both devices are fully RoHS and REACH compliant, the SHT4x is also WEEE compliant.

## Further Information

This transition guide aims to provide an overview of the key differences between the SHTC3 and the SHT4x, yet it might not be fully inclusive. For further reading on the SHT4x specifications, communication, operation, and application, please consult the dedicated SHTC3 and SHT4x documents provided on the Sensirion webpage [www.sensirion.com](http://www.sensirion.com). In case you require specific details, or would like to request assistance in transitioning from the SHTC3 to the SHT4x or any other Sensirion product, please consult us directly at [www.sensirion.com/en/about-us/contact/](http://www.sensirion.com/en/about-us/contact/).

## Revision History

Date	Version	Page(s)	Changes
April 2021	1	all	Initial release
November 2023	1.1	All	Updated SHT4x information

## Important Notices Warning, Personal Injury

- Do not use this product as a safety or emergency stop device 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 datasheet 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, the 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 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 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
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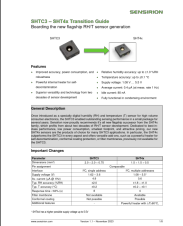
customer's applications by the customer's technical experts. Recommended parameters can and do vary in different applications.

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## Documents / Resources

	<p><b><a href="#">SENSIRION SHTC3 Digital Humidity and Temperature Sensor</a></b> [pdf] User Guide SHTC3, SHT4x, SHTC3 Digital Humidity and Temperature Sensor, Digital Humidity and Temperature Sensor, Humidity and Temperature Sensor, Temperature Sensor, Sensor</p>
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## References

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