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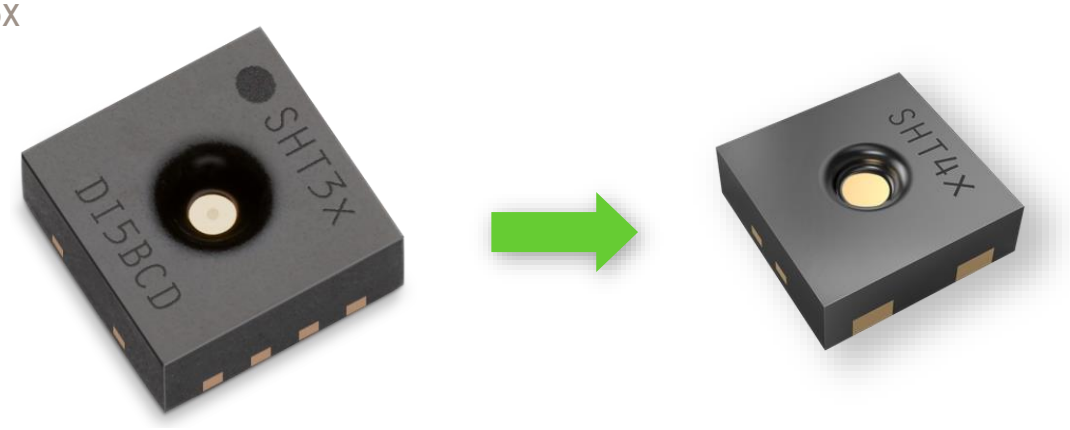
SHT3x – SHT4x Transition Guide

Boarding the new flagship RH/T sensor generation

SHT3x SHT4x



- Improved accuracy, power consumption, and robustness
- Powerful internal heater for self-decontamination
- Superior versatility and technology from two decades of sensor development

Abstract

Introduced as a highly versatile digital humidity (RH) and temperature (T) sensor platform, the SHT3x family already enables outstanding sensing performance for several years. Sensirion now proudly features its all new flagship sensors from the SHT4x family, which profit 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 SHT3x applications. In particular, the SHT4x outperforms the SHT3x in every aspect and offers versatile add-ons, such as a powerful heater for self-decontamination, conformal coating protection, or filter membranes.

Important changes

Parameter	SHT3x	SHT4x
Dimensions (mm^3)	2.5 × 2.5 × 0.9	1.5 × 1.5 × 0.5
Pin assignment	8 pins	4 pins
Interface	I^2C, 2 Adresses	I^2C, multiple addresses
Supply voltage (V)	2.15 – 5.5	1.08 – 3.6
Av. current (µA @ 1Hz)	1.7	0.6
Typ. RH accuracy (%RH)	±2.0 – ±1.5	±1.8 – ±1.0
Typ. T accuracy (°C)	±0.2 – ±0.1	±0.2 – ±0.1
Response time τ63% (s)	8	4
Additional features	Heater for plausibility checks only.	Powerful heater with $\Delta T \geq 60°C$, Full condensation robustness

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Table of Contents

1 General

This document aims to provide a high-level guideline to replace SHT3x with sensors from the SHT4x family and outlines important differences to be considered in design-in processes.

2 Performance Comparison

2.1 Relative Humidity and Temperature

Parameter	Conditions	SHT3x	SHT4x	Units
Relative humidity				
RH accuracy[1]	Typ.	**±2**	**±1.0 … 1.8**	%RH
Repeatability[2]	-	0.08/0.15/0.21	0.08/0.15/0.25	%RH
Resolution[3]	-	0.01	0.01	%RH
Hysteresis	-	±0.8	±1	%RH
Specified range[4]	extended[5]	0 – 100	0 – 100	%RH
Response time[6]	τ 63%	**8**	**4**	s
Long-term drift[7]	Typ.	<0.25	<0.25	%RH/y
Condensation behavior	Droplet formation	**Slight signal drop**	**No signal drop**	-
Temperature				
T Accuracy[1]	Typ.	**±0.2**	**±0.1**	°C
Repeatability[2]	-	**0.04/0.08/0.15**	**0.04/0.07/0.1**	°C
Resolution[3]	-	0.01	0.01	°C
Specified range[4]	-	−40 – +125	−40 – +125	°C
Response time[8]	τ 63%	**>2**	**2**	s
Long-term drift[9]	Typ.	< 0.03	< 0.03	°C/y

Table 1. Humidity and temperature specifications of the SHT3x and SHT4x, where bold values highlight important differences. For further details, kindly refer to the SHT3x and SHT4x datasheets.

[1] For definition of typ. 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 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-in of the sensor.

[7] Typical value for operation in normal RH/T operating range. Max. value is < 0.5 %RH/y. 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 heat conductivity of sensor substrate and design-in of sensor in application.

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

2.2 Electrical Characteristics

Parameter	Symbol	Conditions	SHT3x			SHT4x			Units
			Min	Typ.	Max	Min	Typ.	Max	
Supply voltage	V_{DD}		**2.15**	**3.3**	**5.5**	**1.08**	**3.3**	**3.6**	V
Power-up/down level	V_{POR}	Static power supply	**1.8**	**2.1**	**2.15**	**0.6**	-	**1.08**	V
Supply current (heater not activated)[10]	I_{DD}	Idle state	-	**0.2**	**2.0**	-	**0.08**	-	µA
		Measurement	-	**600**	**1500**	-	**320**	-	µA
		Average	-	**1.7**		-	**0.4 (low) 2.2 (high)**	-	µA
Power consumption[11]	-	Average	-	**5.6**		-	**0.5 (low) 2.6 (high)**	-	µW
Low level input voltage	V_{IL}	-	0	-	0.3 V_{DD}	0	-	0.3 V_{DD}	V
High level input voltage	V_{IH}	-	0.7 V_{DD}	-	V_{DD}	0.7 V_{DD}	-	V_{DD}	V
Application circuit design	-	-	Similar, for details see SHT3x or SHT4x datasheet						-

Table 2. Key electrical specifications of the SHT3x and SHT4x, where bold values highlight important differences. For further details, kindly refer to the SHT3x and SHT4x datasheets.

2.3 Timing Specifications

Parameter	Symbol	Conditions	SHT3x			SHT4x			Units
			Min	Typ.	Max	Min	Typ.	Max	
Power-up time	t_{PU}	After hard reset, $V_{DD} \geq V_{POR}$	-	**0.5**	1	-	-	1	ms
Soft reset time	t_{SR}	After soft reset	-	0.5	1	-	-	1	ms
Measurement duration	t_{Meas}	Medium repeatability	-	**4.5**	**6**	-	**3.7**	**4.5**	ms
Heater-on duration	t_{Heater}		-	-	-	**0.1**	**-**	**1**	s

Table 3. Key timing specifications of the SHT3x and SHT4x, where bold values highlight important differences. For further details, kindly refer to the SHT3x and SHT4x datasheets.

3 Flagship SHT4x Feature: Built-In Heater

The SHT4 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 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 0.1 or 1 second. After the heater on-time, 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 since it has an internal timer set to 1s after which it is switched off automatically. If higher heating temperatures than achievable in 1 second are desired, consecutive heating commands need to be sent to the sensor.

[10] SHT4x values for 1.2 V supply voltage
[11] SHT4x values for 1.2 V supply voltage

4 Package Design Differences

The SHT4x comes in a new open-cavity dual flat no lead (DFN) package design in order to enable additional features, such as conformal coating, protection cover, and filter membrane compatibility. In comparison to the SHT3x, the package is considerably smaller, enabling power efficient, accurate, and robust RH/T sensing with fast reaction times. Instead of featuring eight pins, the bottom side of the SHT4x DFN package exposes four metallic contacts, which are Ni/Pd/Au coated.

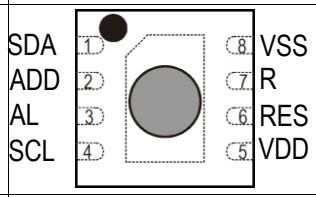
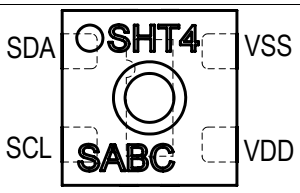
Parameter	Units	SHT3x	SHT4x	Comment
Size	mm	2.5 x 2.5 x 0.9	1.5 x 1.5 x 0.5	For details, see Figures 1,2.
Sensor opening	-	Top	Top	
Protection compatibility	-	Compatible with conformal coating, Compatible with filter membranes	Compatible with conformal coating, Compatible with filter membranes	
Pin Layout	-	2 x 4 pins	2 x 2 pins	
Necessity for fine-print PCB	-	no	no	
Pin Assignment	-			Drawings not to scale VDD: Supply voltage SCL: Serial clock SDA: Serial data bidirectional VSS: Ground
Pin Size	mm	0.25 x 0.35	0.3 x 0.3	
Pin Pitch	mm	0.5	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 SHT3x and SHT4x. For further details, kindly refer to the SHT3x and SHT4x datasheets.

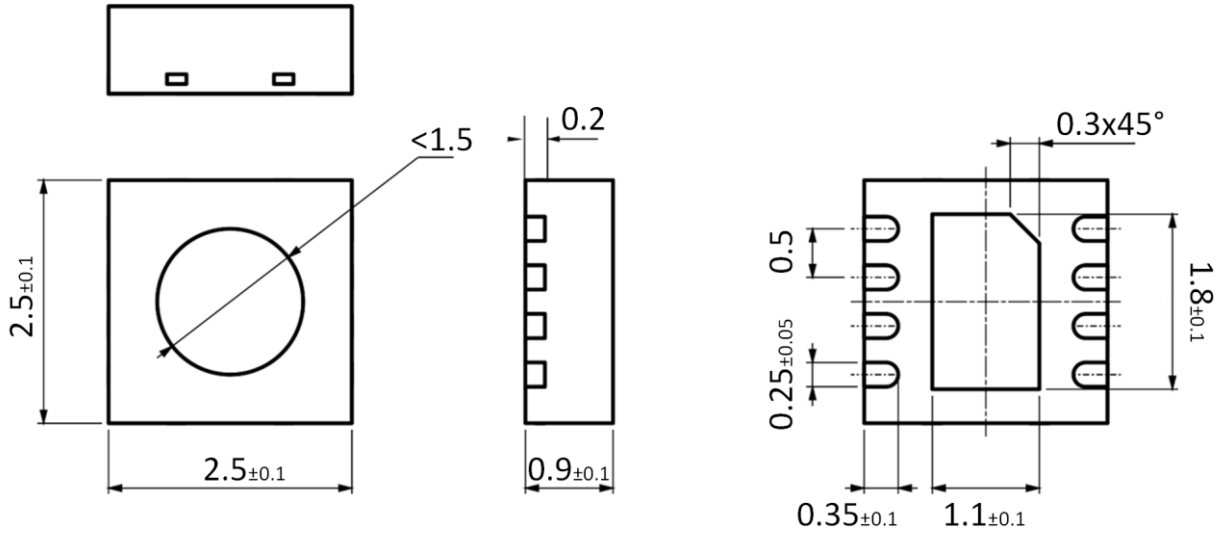


Figure 1. Dimensional drawing of the SHT3x including (units mm).

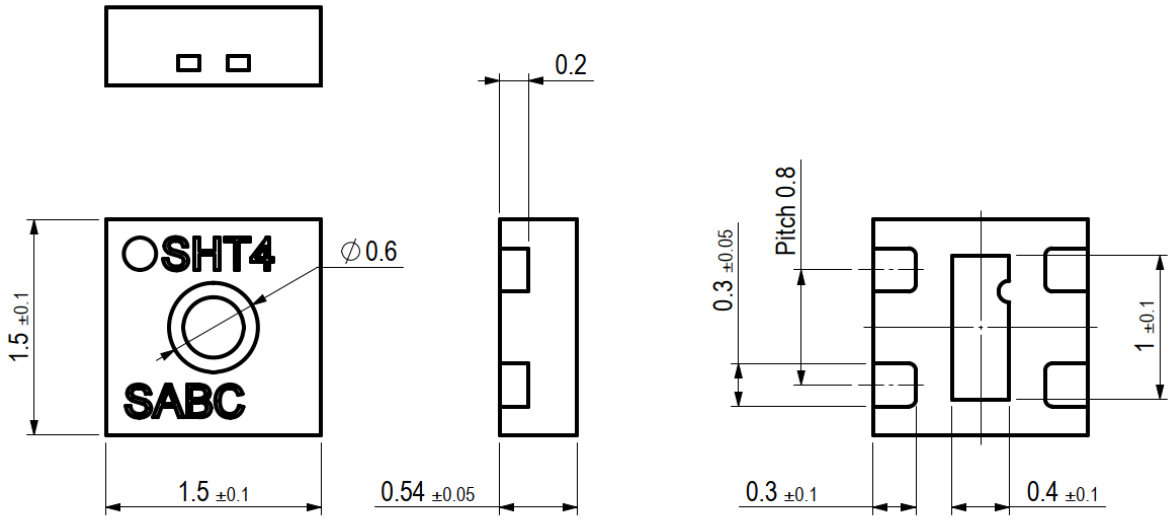


Figure 2. Dimensional drawing of SHT4x including package tolerances (units mm).

5 Communication Compatibility

Both chips feature the I²C communication protocol 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 highest precision (high repeatability)
1111 0110	F6	Measure T & RH with medium precision (medium repeatability)
1110 0000	E0	Measure T & RH with 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. 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.

6 Quality and Material Contents

Qualification of the SHT3x 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.

7 Further Information

This transition guide aims at providing an overview of the key differences between the SHT3x and the SHT4x, yet might not be fully inclusive. For further reading on the SHT4x specifications, communication, operation, and application, please consult the dedicated SHT3x and SHT4x documents provided on the Sensirion webpage www.sensirion.com. In case you are in need of specific details, or would like to request assistance in transitioning from the SHT3x to the SHT4x or any other Sensirion product, please consult us directly at www.sensirion.com/en/about-us/contact/.

8 Revision History

Date	Version	Page(s)	Changes
October 2021	1	all	Initial version
November 2023	1.1	all	Updated SHT4x information

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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