Transition guide for HTS221 to SHT4x

Introduction

This technical note provides a high-level reference to guide the user in replacing the HTS221 humidity sensor with sensors from the SHT4x family from Sensirion and outlines important differences to be considered in the design-in processes. Table 1 below summarizes the features and key differences.

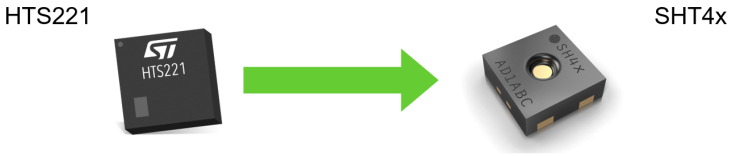


Table 1. Key differences

Parameter	HTS221	SHT4x
Dimensions (mm^3)	2.0 x 2.0 x 0.9	1.5 x 1.5 x 0.5
Pin assignment	6-pin HLGA package	4-pin DFN package
Interface	SPI and I²C, single address	I²C, multiple addresses
Supply voltage (V)	1.7 – 3.6	1.08 – 3.6
Average current (µA @ 1 Hz)	2.0	0.6
Typ. RH accuracy (%RH)	±3.5 … ±5.0	±1.0 … ±1.8
Typ. T accuracy (°C)	±0.5 … ±1.0	±0.1 … ±0.2
Response time τ 63% (s)	10	4
Optional filter membrane	Not available	Available
Optional protection cover	Not available	Available
Additional features	-	Powerful heater with $\Delta T \geq 60$ °C, Full condensation robustness

1 Performance comparison

1.1 Relative humidity and temperature

For further details, refer to the respective datasheets.

Table 2. Humidity and temperature specifications of HTS221 and SHT4x

Parameter	Conditions	HTS221	SHT4x	Unit
Relative humidity				
RH accuracy(1)	Typ.	±3.5 … ±5.0	±1.0 … ±1.8	%RH
High repeatability(2)	-	-	0.1	%RH
Resolution(3)	-	-	0.01	%RH
Hysteresis	-	±1	±1	%RH
Specified range(4)	Extended(5)	0 – 100	0 – 100	%RH
Response time(6)	τ 63%	10	4	s
Long-term drift(7)	Typ.	0.5	< 0.25	%RH/y
Condensation behavior	Droplet formation	No signal drop	No signal drop	-
Temperature				
T accuracy(1)	Typ.	±0.5 … ±1.0	±0.1 … ±0.2	°C
High repeatability(2)	-	-	0.04	°C
Resolution(3)	-	-	0.01	°C
Specified range(4)	-	−40 to +120	−40 to +125	°C
Response time(8)	τ 63%	15	2	s
Long-term drift(9)	Typ.	< 0.05	< 0.02	°C/y

1. *For the definition of typ. accuracy, 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 6.*
3. *Resolution of A/D converter.*
4. *The 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, refer to the SHT4x datasheet.*
6. *Time for achieving 63% of a humidity step function, valid at 25°C and 1 m/s airflow. The 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. This value may be higher in environments with vaporized solvents, outgassing tapes, adhesives, packaging materials, and so forth. For more details, refer to the handling instructions.*
8. *The temperature response time depends on the heat conductivity of the sensor substrate and the design-in of the sensor in the application.*
9. *Max. value is < 0.04°C/y.*

1.2 Electrical characteristics

For further details, refer to the HTS221 and SHT4x datasheets.

Table 3. Key electrical specifications of HTS221 and SHT4x

Parameter	Symbol	Conditions	HTS221			SHT4x			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Supply voltage	V_{DD}		1.7	-	3.6	1.08	3.3	3.6	V
Power-up/down level	V_{POR}	Static power supply	-	-	-	0.6	-	1.08	V
Supply current (heater not activated)	I_{DD}	Sleep/Idle	-	0.5	-	-	0.08	-	µA
		Meas.	-	-	-	-	350	-	µA
		Average	-	2.0	-	-	1.5	-	µA
Power consumption	-	Average		5.0		-	1.8	-	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	-	-	For details, see HTS221 datasheet.			For details, see SHT4x datasheet.			-

1.3 Timing specifications

For further details, refer to the HTS221 and SHT4x datasheets.

Table 4. Key timing specifications of HTS221 and SHT4x

Parameter	Symbol	Conditions	HTS221			SHT4x			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Power-up time	t_{PU}	After hard reset, $V_{DD} \geq V_{POR}$	-	-	2.7	-	-	1	ms
Soft reset time	t_{SR}	After soft reset	-	-	2.7	-	-	1	ms
Measurement duration	t_{Meas}	Medium repeatability	-	5.1[1]	-	-	3.7	5.5	ms
Heater-on duration	t_{Heater}		-	-	-	0.8	1	1.2	s

1. *One-shot mode, temperature (AVGT) = 16, humidity (AVGH) = 32.*

2 SHT4x feature: built-in heater

The SHT4x sensor incorporates a powerful on-chip heater, which can be used for self-decontamination, for example, in environments with solvents present, and periodical creep compensation in applications with prolonged high humidity. It yields a temperature increase of about 60 °C and can be switched on by the command specified in Table 6, after which the heater runs for 1 second. After 1 second, temperature and humidity measurements are started and the heater is automatically turned off after the measurement is finished. The auto-turnoff prevents accidental permanent heating. There is no dedicated command to turn off the heater. If higher temperatures are desired, consecutive heating commands need to be sent to the sensor.

3 Package design differences

The SHT4x comes in an open-cavity dual flat no-lead (DFN) package, where the sensor opening is centered on the top side of the package (see Figure 2). The bottom side of the package exposes metallic contacts, which are Ni/Pd/Au coated.

For further details, refer to the HTS221 and SHT4x datasheets.

Table 5. Key package differences between HTS221 and SHT4x

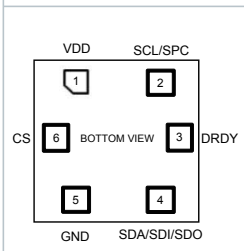
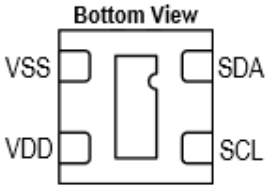
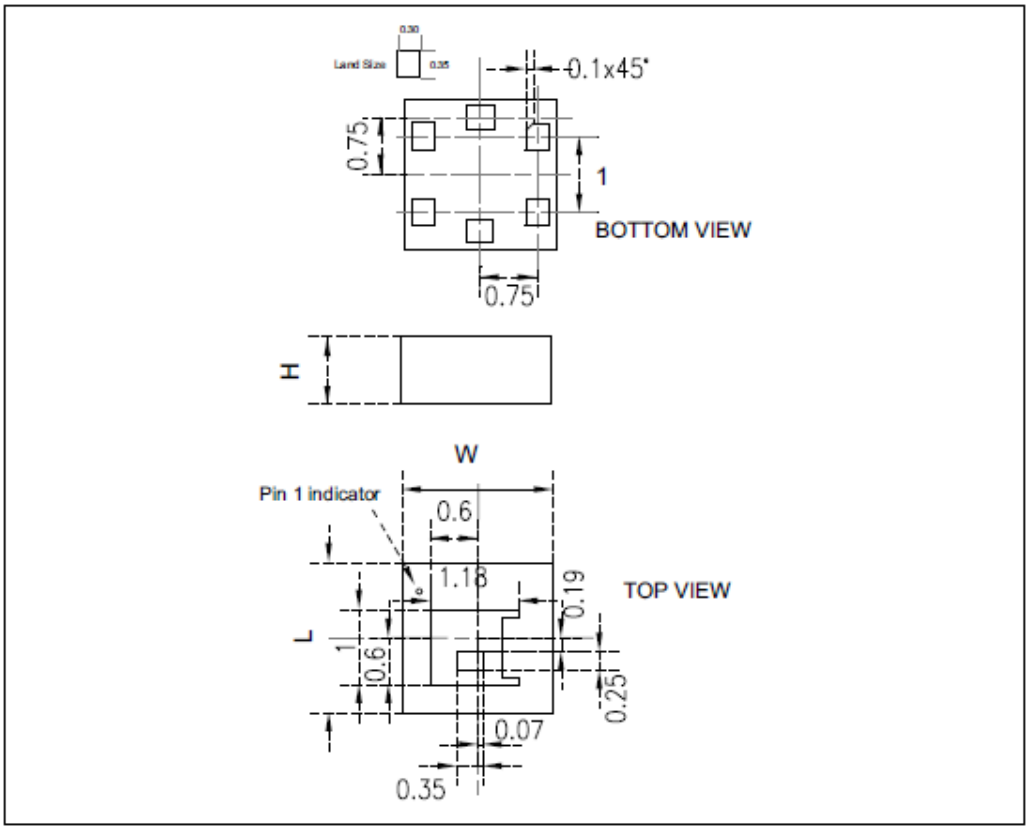
Parameter	Unit	HTS221	SHT4x	Comment
Size	mm^3	2.0 x 2.0 x 0.9	1.5 x 1.5 x 0.5	For details, see Figure 1, 2.
Sensor opening	-	Top	Top	
Protection compatibility	-	-	Compatible with conformal coating and filter membranes	
Pin layout	-	-	2 x 2 pins	
Pin assignment	-	**Bottom view** 	**Bottom view** 	Drawings not to scale VDD: supply voltage SCL: serial clock SDA: serial data bidirectional VSS: ground
Pin size	mm^2	0.30 x 0.35	0.3 x 0.3	
Pin pitch	mm	0.75	0.8	
Pin material	-	Ni/Au	Ni/Pd/Au coated Cu	
Housing haterial	-	Epoxy housing	Epoxy housing	

Figure 1. **Mechanical drawing of HTS221 (dimensions in mm)**

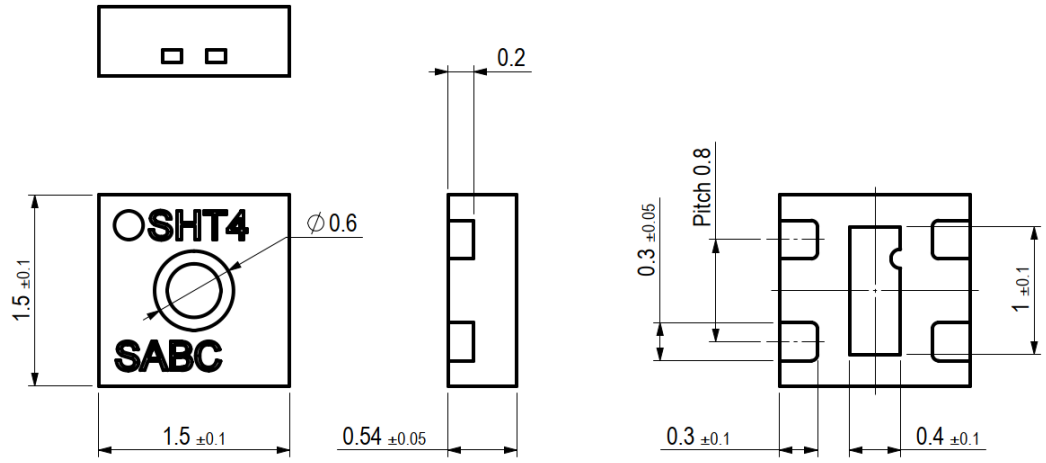


Item	Dimension [mm]	Tolerance [mm]
Length [L]	2	± 0.1
Width [W]	2	± 0.1
Height [H]	0.9	± 0.1
Land size	0.30 x 0.35	± 0.05

Dimensions are in millimeters unless otherwise specified.

General tolerance is ± 0.1 mm unless otherwise specified.

Figure 2. **Mechanical drawing of SHT4x including package tolerances (dimensions in mm)**



4 Communication compatibility

Both chips feature the I²C communication protocol with the I²C addresses 0xBE (HTS221) and 0x44 (SHT4x). 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, that is, “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 6 and Section 2 SHT4x feature: built-in heater.

Table 6. Short overview of the I²C commands for the SHT4x

Command		Description
Binary	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 1 s

For further details on the I²C communication, such as the general protocol description, data types and lengths, and checksum calculation, refer to the SHT4x datasheet.

The HTS221 I²C is a bus slave. The I²C is employed to write data into registers whose content can also be read back.

There are two signals associated with the I²C bus: the serial clock line (SCL) and the serial data line (SDA). The latter is a bidirectional line used for sending and receiving the data to/from the interface. Both lines must be connected to VDD through pull-up resistors. The I²C interface is compliant with fast mode (400 kHz) I²C standards as well as with normal mode. Refer to the HTS221 datasheet for further details.

5 Quality and material contents

Qualification of the SHT4x is performed based on the JEDEC JESD47 qualification test method. It is RoHS, REACH, and WEEE compliant.

The HTS221 qualification follows the stress-driven approach based on Jedec standard JESD47 (Stress-Test-Driven Qualification of Integrated Circuits). To improve the level of quality, some adjustments have been integrated into ST internal methods.

Appendix A Resources

The SHT4x or HTS221 datasheet is available from the Sensirion or ST website, respectively:

SHT4x datasheet

HTS221 datasheet

For assistance in transitioning from HTS221 to SHT4x, consult Sensirion directly at contact Sensirion or by email at partners-support@sensirion.com.

Revision history

Table 7. **Document revision history**

Date	Version	Changes
08-Nov-2022	1	Initial release

Contents