Design-in Guide

For Sensirion's STC Thermal Conductivity Sensor

Sensirion's STC sensors are highly accurate and long-term stable thermal conductivity sensors. A few design-in recommendations must be followed to take full advantage of their outstanding performance. This guide describes an easy-to-implement and affordable design-in to achieve a superior performance. In addition to this document, it is recommended to consult the *Handling and Assembly Instruction* to ensure the specified accuracy of the STC Thermal Conductivity Sensor is achieved.

Introduction

Sensirion's STC sensors are fully calibrated and come with a lot of functionalities to ensure high performance. This will minimize work regarding sensor integration. Nevertheless, a suitable design-in of the sensor in the final product is still required to reap the full benefits of the sensor. This guide will give some practical recommendations that will ensure optimal working conditions and best performance.

Coupling to ambient

A good coupling to ambient is essential to ensure that the local conditions at the sensor correspond to the environmental conditions outside the device.

Firstly, a large opening (2 mm) and sensor placement close to the device's outer shell will give a good coupling of the sensor to ambient. It can either be a single or mesh opening.

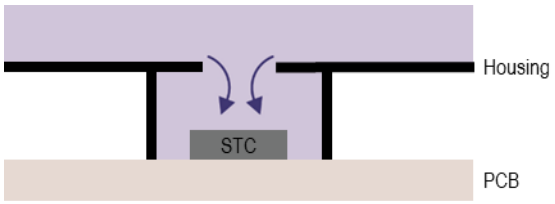

Figure 1: Large opening and sensor placed close to surface.

Secondly, seal the sensor compartment to decouple it from the device itself.

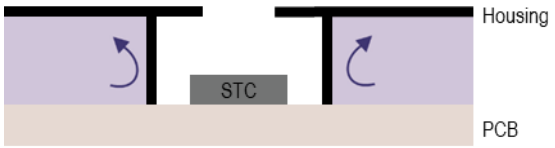

Figure 2: Sensor compartment sealed

Thirdly, a small dead volume allows for rapid adaption to changes in the environment. This is especially important for applications that require a fast response time.

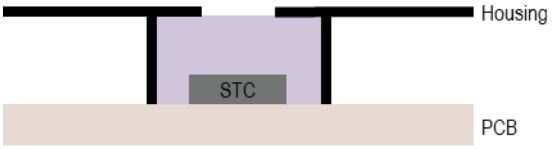

Figure 3: A small dead volume allows for rapid adaption to changes in the environment.

Decoupling from heat sources

The STC31 uses a thermal principle. Therefore, care should be taken considering external heat sources or self-heating. The following measures are recommended:

- Reduce non-essential I2C communication with the sensor to a minimum
- Use a measurement interval of 1 s or longer
- Prefer a high resistance pull-up resistor to a low resistance pull-up resistor
- Thermally decouple the I2C bus from the MCU if the MCU can get hot and the I2C bus is short
- Prevent sources emitting infrared to the sensor element
- Keep the sensor away from other components that can transfer heat to the sensor, e.g. power converters, motors, communications modules, etc.

Figure 4: Decoupling the sensor from heat sources

Thermal coupling between STC and SHT sensor

One of Sensirion's humidity and temperature sensors (SHTxx) is required for humidity compensation and it can also be used for improved temperature compensation. It is essential that the STC and SHT sensor are thermally coupled well. Placing these sensors on the same PCB and minimizing the distance between them is the most efficient way to achieve this.

The STC and SHTxx sensors have different I2C addresses and the supply voltage range for the SHTC3 and SHT3x overlaps with that of the STC3x. Therefore, the STC3x and SHTC3/SHT3x can be used on the same I2C bus without any additional requirements.

In addition, it is advised to consult the *SHTxx and STSxx Design Guide* concerning recommendations for the SHT sensor design-in.

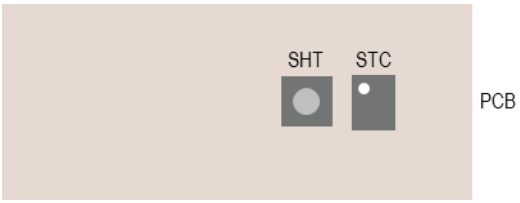

Figure 5: Minimize the distance between the STC and SHT sensors

Isolation from gas flow

Gas flow can affect the thermal balance between the STC, SHT and PCB. This is most notable when the gas and PCB are at a different temperature. If the gas concentration needs to be measured in a flow, it is advised to avoid direct flow over the sensor, for example by placing the sensor in a compartment sealed with a Teflon membrane.

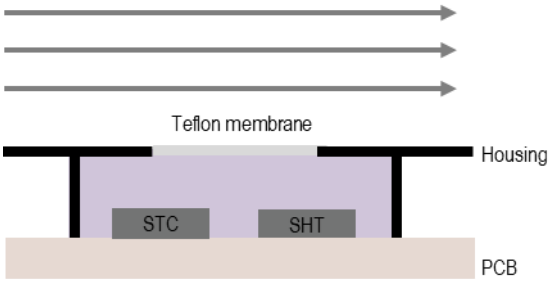

Figure 6: The sensor can be shielded from a gas flow by using a Teflon membrane.

Protection from direct sunlight

Exposing the STC sensor to direct sunlight can lead to undesired heating of the sensor. Therefore, the sensor is to be shielded from direct sunlight.

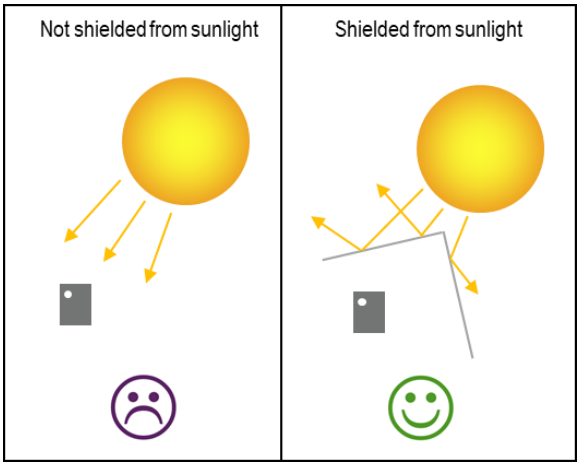

Figure 7: Shield the STC sensor from direct sunlight

ESD protection

A large meshed metal grid which is connected to ground in front of the sensor helps to protect the STC sensor against ESD. TVS diodes on the PCB between Ground and the three other lines (SDA, SCL and VDD) help to protect against voltage spikes on the lines.

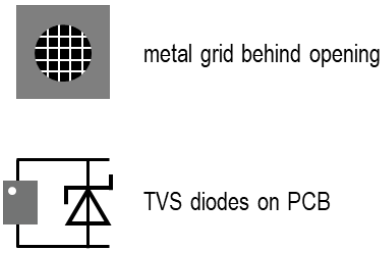

Figure 8: ESD protection.

Capacitor and pull-up resistors

To decouple the power-supply voltage (VDD) and ground (GND) pins, a 100 nF capacitor must be placed as close as possible to the STC between these two lines.

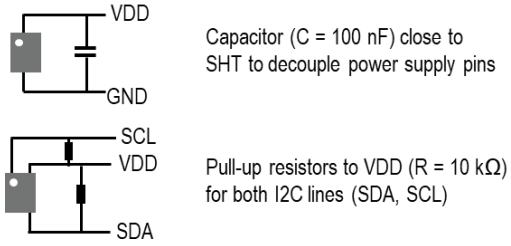

Figure 9 Electronic integration of the STC sensor.

Further, two pull-up resistors must be introduced to pull the signals SDA and SCL high. We propose a 10 kΩ resistor each. However, the bus capacity requirements must be taken into account as well.

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