

SGP40 – Quick Testing Guide

Version 1.1
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Setup

The goal of this quick testing guide is to enable any customer to verify that their Sensirion SGP40 sensors are performing according to specifications. Using only common household items we can create an accurate dilution series of a volatile organic compound (VOC) that will be sufficient to reach this goal.

Required items

- 2 large bottles (1 l or more)
- 2 bowls
- 4 small containers (50–200 ml)
- Tap water
- Approximately 200 g of table salt (for keeping the relative humidity constant)
- 1 teaspoon of ethanol⁽¹⁾ (ca. 40% vol. or more)
- Either Sensirion SGP40 sensors or SEK-SVM40 EvalKit and Control Center Software (running on any conventional computer), also see sensirion.com/my-sgp-ek

required time: 2 hours

(1) Any hard liquor or rubbing alcohol will do; you can also try some other concentrated VOC source such as nail polish remover, paint thinner or the like

Step one: salt solution

We first want to prepare a reference solutions for diluting: a saturated salt solution.

- Mix 200 g of table salt with 1 l of tap water (room temperature) in one of the bottles
- Shake bottle well and let it settle. A lot of the salt won't be dissolved and deposit at the bottom. This is your **salt solution**⁽²⁾ stock.

(2) We use a saturated salt solution because its headspace is non-condensing (ca. 70% relative humidity) and thus more realistic for mimicking indoor climate

Step two: high VOC concentration solution

Next, we prepare a high concentration VOC solution as the starting point of the dilution series.

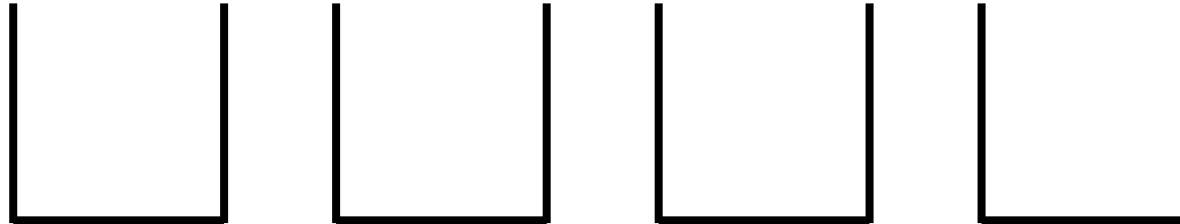
1. In a bowl, mix 250 ml (1 cup) of the salt solution with 1 teaspoon of ethanol
2. Dilute it 10:1 in the second bowl: mix two tablespoons of the solution from step 1 with 250 ml of the salt solution
3. Dilute it 10:1 once more: in the second bottle, mix two tablespoons of the solution from step 2. with 250 ml of the salt solution (now we have diluted it roughly 100:1)

This is your **high concentration solution** stock.

You should close the lid of the high concentration solution so that the ethanol does not evaporate and the concentration remains constant.

Step three: concentration series

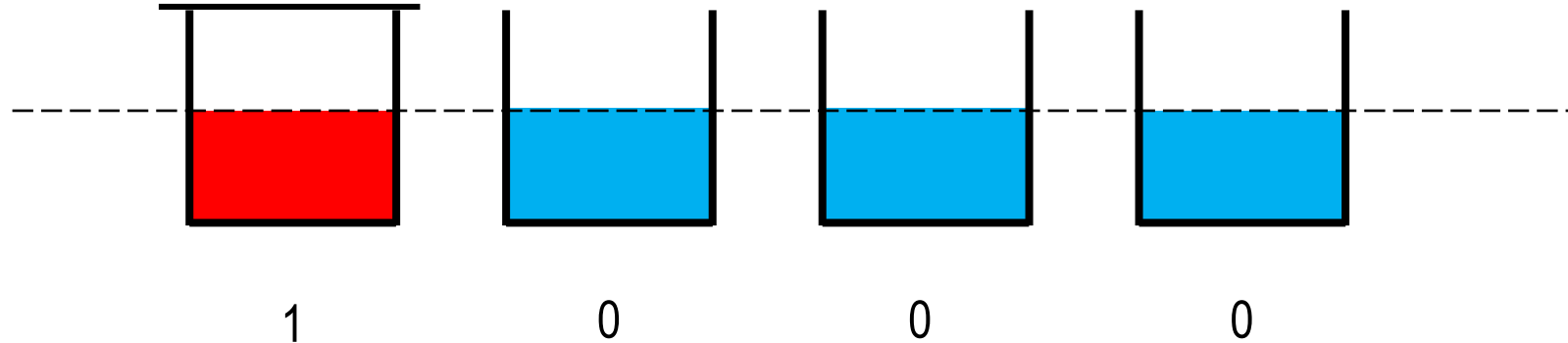
In a next step, we prepare 4 different concentration solutions by diluting our high concentration solution several times. Arrange the 4 small empty containers in front of you.



Step three: concentration series

Fill the first container exactly halfway⁽³⁾ with **high concentration solution**, the rest halfway with **salt solution**.

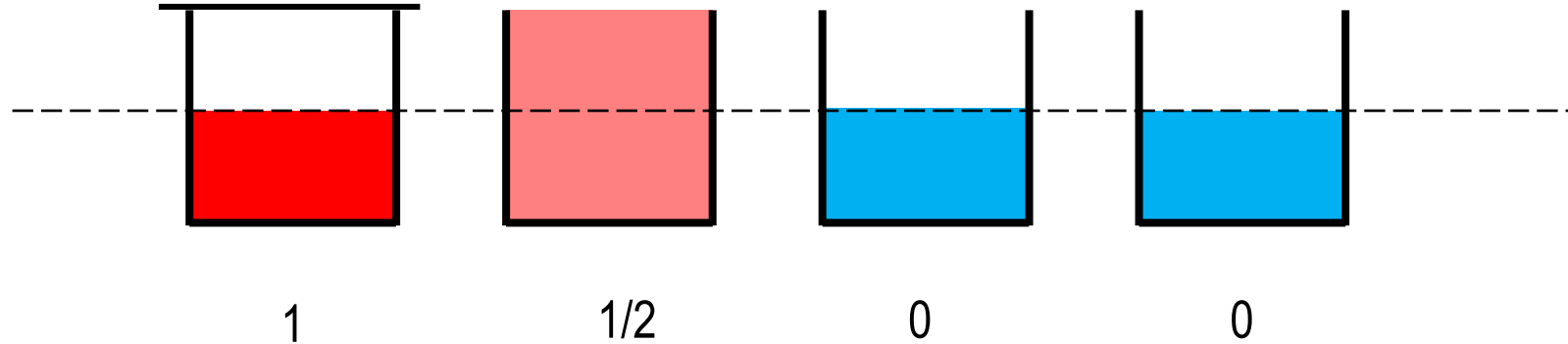
Note: Always cover containers when you are not exposing them to sensors so that the VOCs do not evaporate.



(3) The absolute amounts are not critical and depend on the size of your containers; just make sure «halfway» is every time precisely the same, and «full» is twice «halfway»

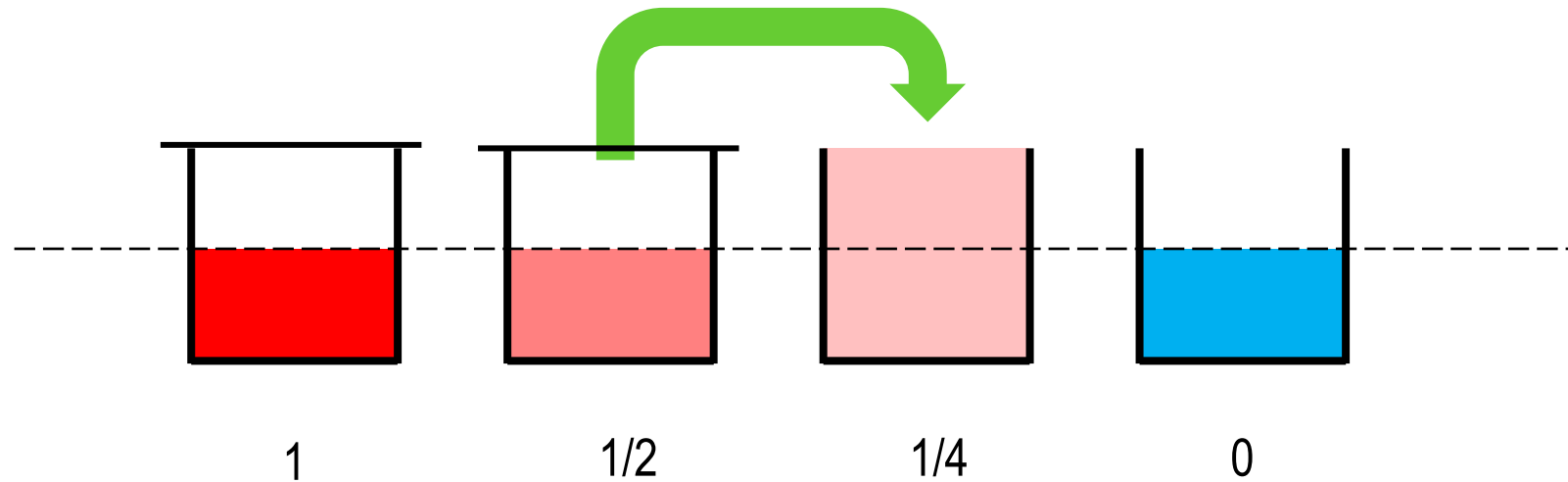
Step three: concentration series

Fill the second container with high concentration solution from the stock bottle. Container 3 is now full with half concentration solution.



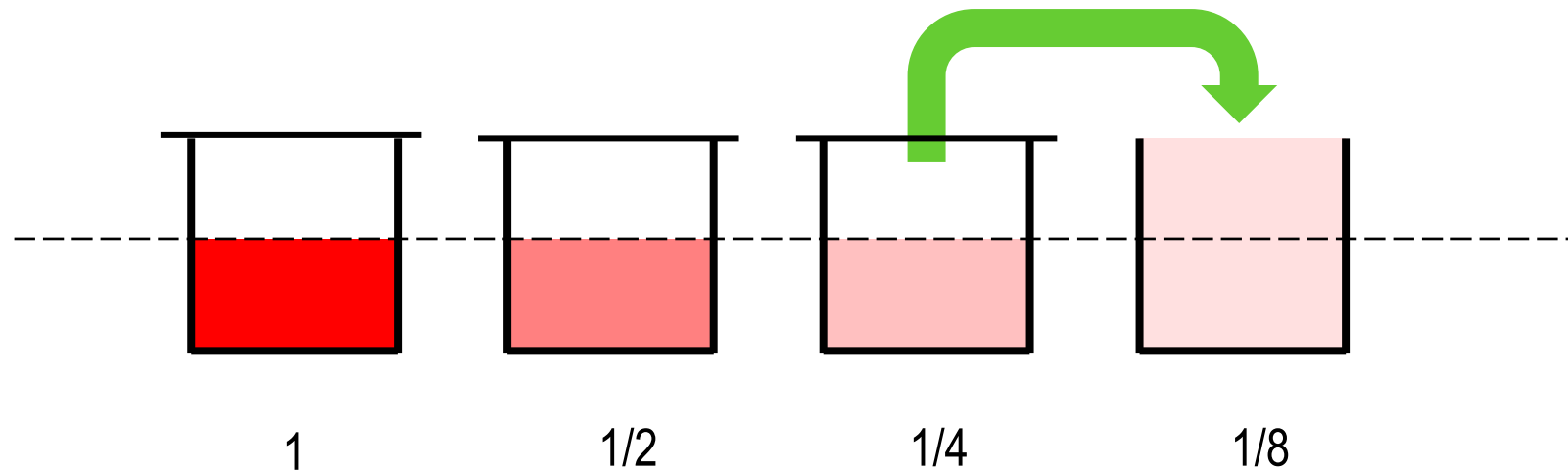
Step three: concentration series

Fill the third container with half concentration solution from container 2. Then close container 2. Container 3 is now full with quarter concentration.



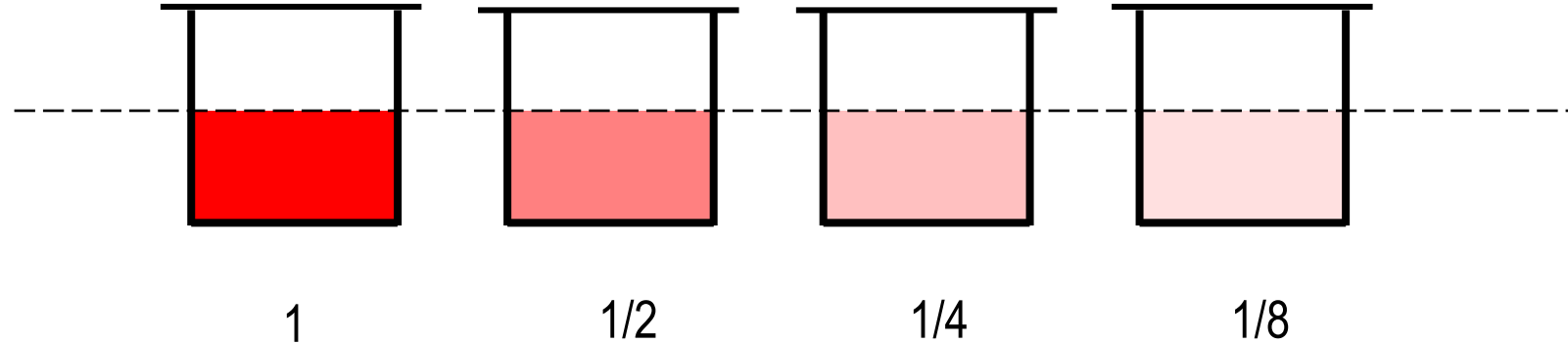
Step three: concentration series

Fill the fourth container with quarter concentration solution from container 3. Then close container 3. Container 4 is now full with $1/8$ of the high concentration. We call it the “**baseline concentration**”.



Step three: concentration series

Discard half of the baseline concentration. We now have four different VOC concentration solutions.



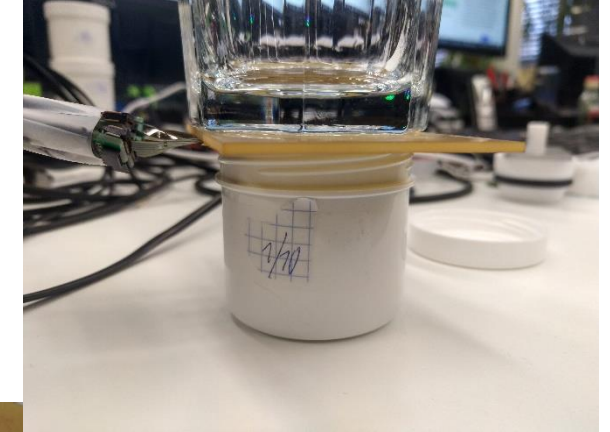
Step four: training and verification

First we want to train the sensors for the VOC concentration range used in our experiment. Start the measurement using Sensirion Control Center.

- expose⁽⁴⁾ the sensors to the baseline concentration (the container with the lowest concentration) for 60 min
- expose the sensors to the high concentration for 15 min
- expose the sensors to the baseline concentration again for 30 min

Your sensors are now trained and are ready for the following verification steps.

- expose the sensors to the quarter concentration for 5 min
- expose the sensors to the half concentration for 5 min
- expose the sensors to the high concentration for 5 min
- expose the sensors to the baseline concentration again



(4) Expose the sensor for instance as shown in the pictures on the right; you should measure under a lid of sorts so that there is no convection; try to avoid using any glue in order not to add another VOC source

Step five: evaluation

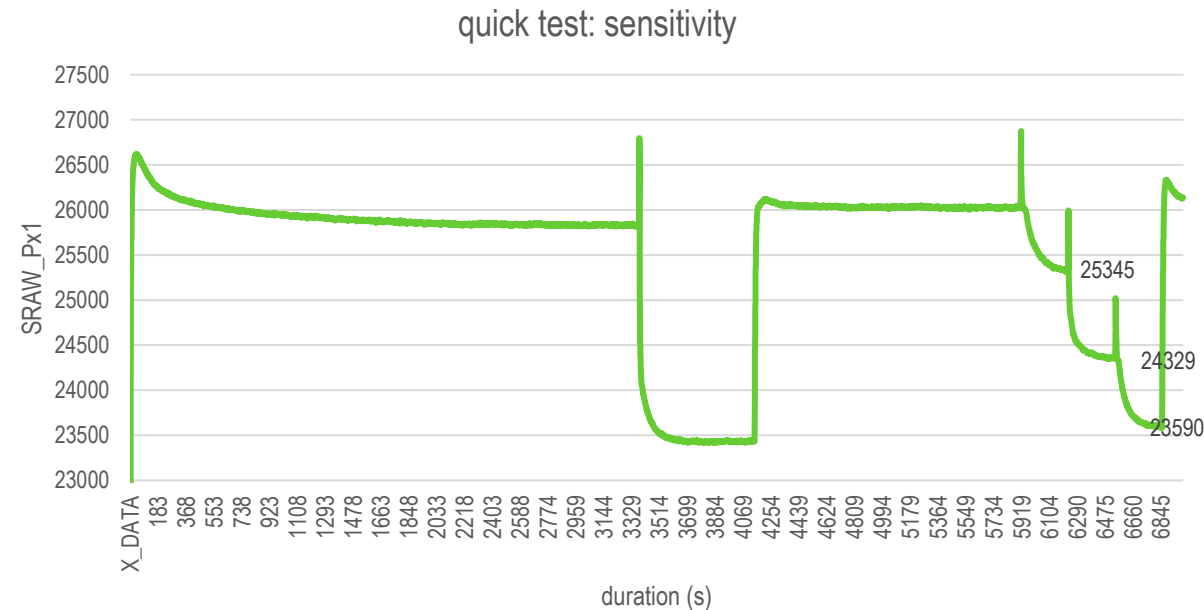
You can now easily assess two key performance indicators of your SGP40 sensors: sensitivity and device-to-device variation (in case you have measured several sensors simultaneously).

1. **Sensitivity:** read out the difference in raw ADC tick values whenever the concentration is doubled (so going from half to high, or quarter to half concentration). If your sensors behave according to specifications this difference should be in the range of **-710... - 1030 ticks**.
2. **Device-to-device variation:** in the VOC index output, the different sensors should never be further apart than 15% (or 15 index points if below 100 index points)

Step five: evaluation example

The result should look something like this:

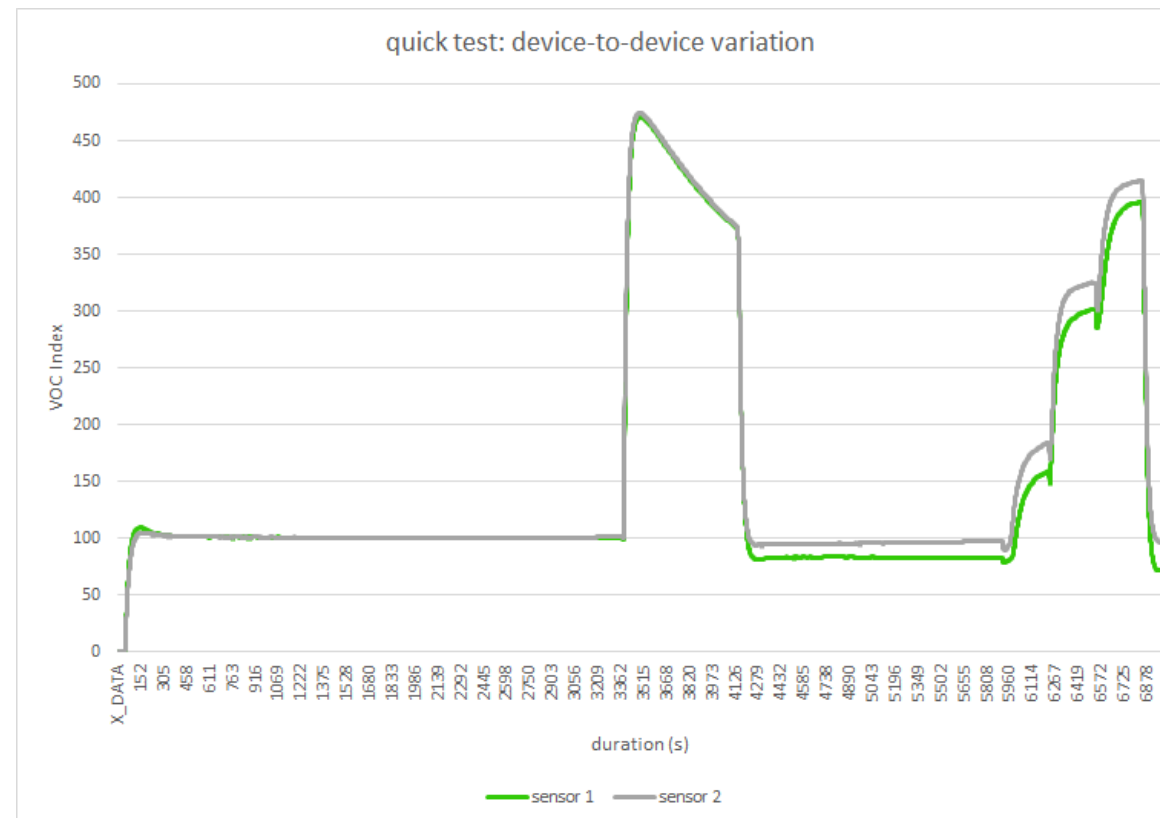
1. **Sensitivity:** we can read off the differences from quarter to half concentration as $24'239 - 25'345 = -1016$, and the difference from half to high concentration as $23'590 - 24'329 = -739$ so well within specifications.



Step five: evaluation example

The result should look something like this:

- 2. Device-to-device variation:** the difference of the two sensors is barely discernible and well within specifications.



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