CALIBRATION

IoT SoundSensor™ V3.02

Author J. Roth & M. Groot
Version 1.0

The IoT SoundSensor™ V3.02 measurement accuracy explained

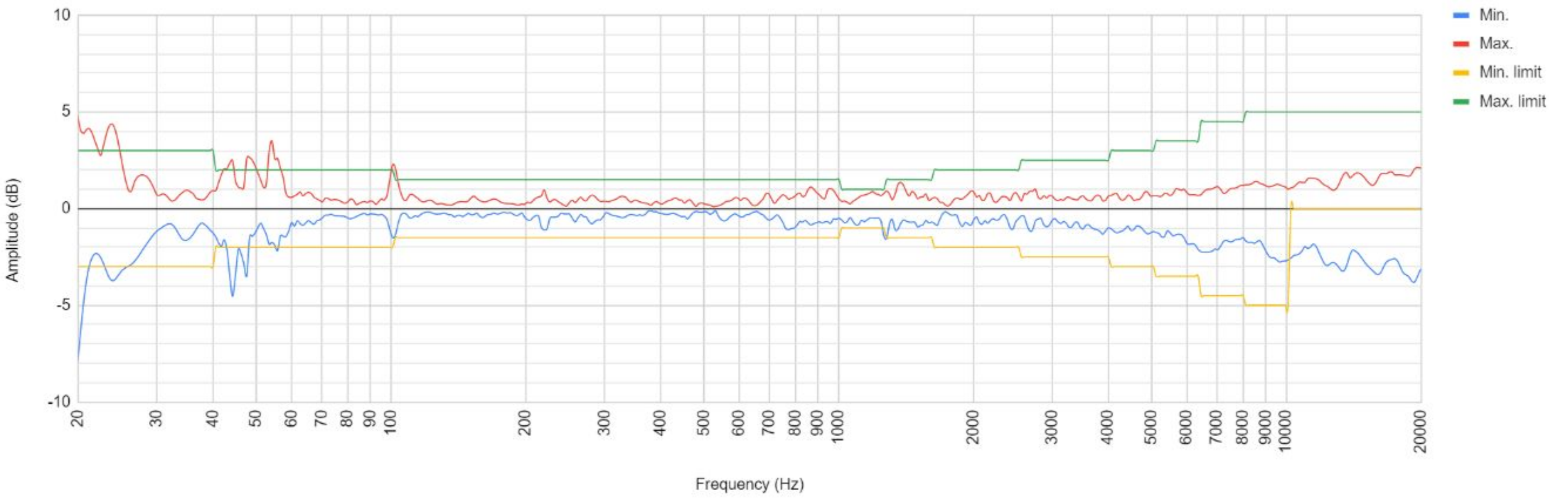

Fig. 1: The IoT SoundSensor dB accuracy tolerance vs. IEC61672 Class 2 acceptance limits.

The SoundSensor™ V3.02 does not come with an individual frequency response calibration, or a IEC61672 Class 1/2 certification (1*). However, the sensor is relatively accurate with the standard factory calibration file already. This file corrects the known average response of the microphones, but not the production tolerance in frequency response.

To verify the claimed accuracy of the sensor microphones, a test setup is made where the microphones are measured relative to a reference measurement microphone with IEC61672 class 1 specifications.The reference microphone is accurate to +/-0,5db from 10Hz to 20kHz.

The +/-0,5dB accuracy of the reference microphone has to be accounted for and needs to be added to the total response, but is not calculated into the graphs in this paper.

The reference microphone is placed in front of a sound source which is capable of producing an anechoic (2*) measured frequency response of 20Hz – 20kHz to within +/- 15dB(Z) (3*).
The microphone is placed at 0 degrees relative to the sound source.
A measurement is performed using a swept sine wave.
The reproducibility and accuracy is confirmed by performing the measurement at least two times
The frequency response of these measurements should not deviate more than +/-0,2 dB relative to each other.

THD+N (4*) of these measurements should not exceed 5% in any of the measurements of interest.
After confirming the reproducibility, one of the measurements is saved as a reference.

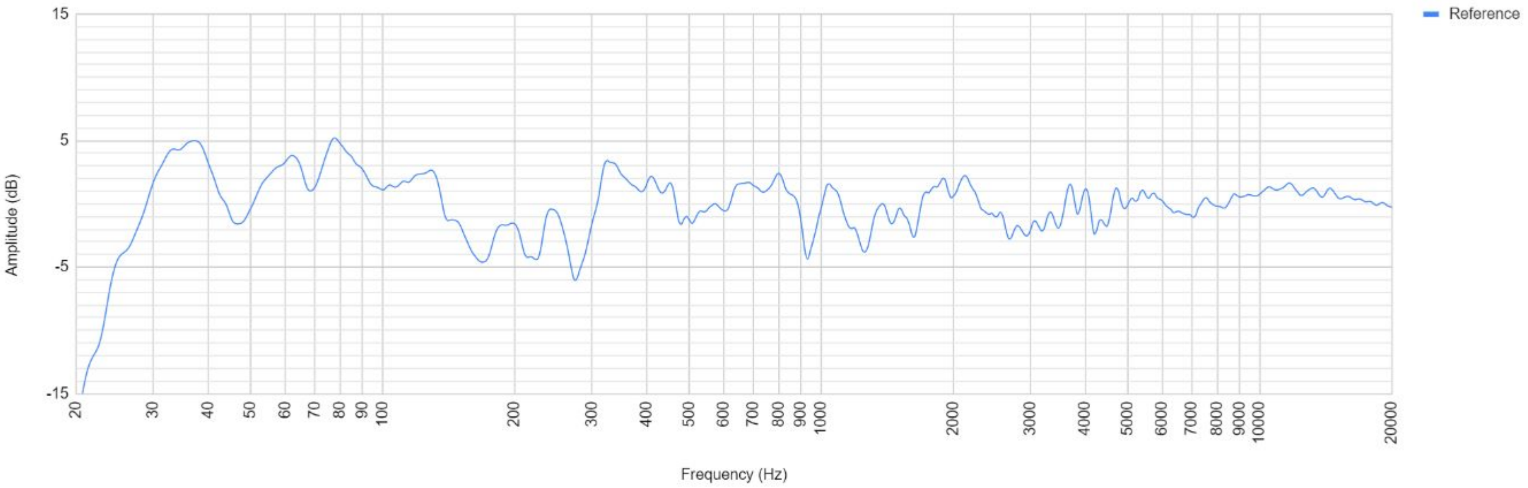

Fig. 2: The the reference microphone frequency response.
IEC61672 Class 1 microphone, calibrated with +/-0,5dB tolerance, measuring a sound source.

The reference measurement microphone is removed, and is replaced by the sensor microphone. While doing this it is made sure that the measurement conditions are kept exactly the same as before so the influence of the acoustics (room, objects, etc.) is the same for both the reference and the sensor microphone measurement.

A new measurement is performed with the sensor microphone, in the same way as before but with the IoT SoundSensor dB in the signalpath as a preamplifier. Linearity of the IoT SoundSensor dB input to onboard DAC (5*) output has been confirmed to be negligible beforehand.

An offset is given to the overall frequency response of the measurement to match the average sensitivity to that of the reference microphone. The difference between the frequency response measurements of the reference microphone and the sensor microphone is the deviation from flatness. Therefore the measurement of the reference microphone is subtracted which results in the relative frequency response.

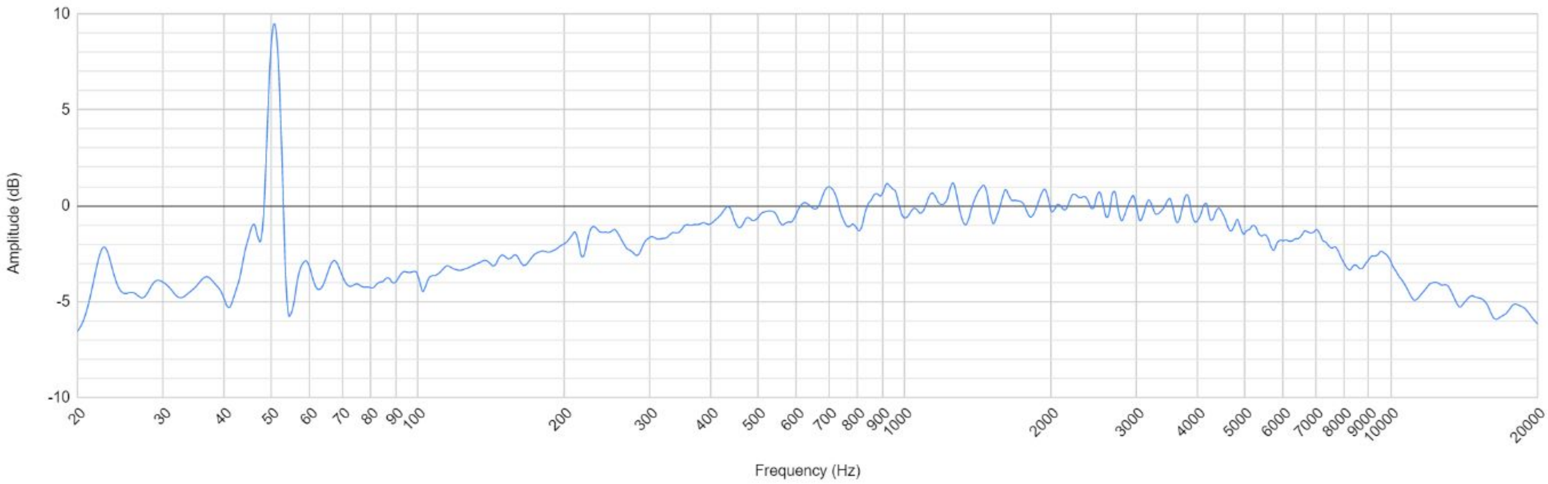

Fig. 3: The frequency response measurement of one IoT SoundSensor dB microphone.
Relative to the reference microphone measurement.

The sensor microphone frequency response production tolerance needs to be known.
10 of our microphones are measured using the same setup as used for the previous measurements.
Again an offset is given to the overall frequency response to match all the measured microphones.

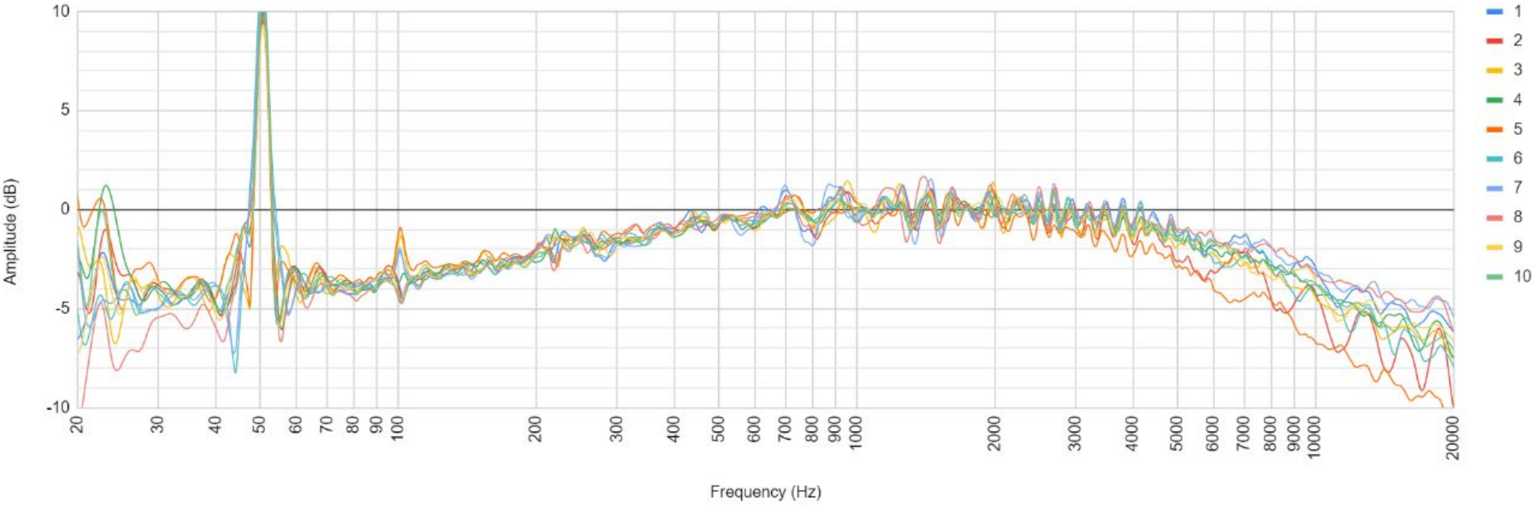

Fig. 4: The frequency response of 10 IoT SoundSensor dB microphones.
Relative to reference microphone measurement.

The minimum and maximum deviation is calculated from the measurements.

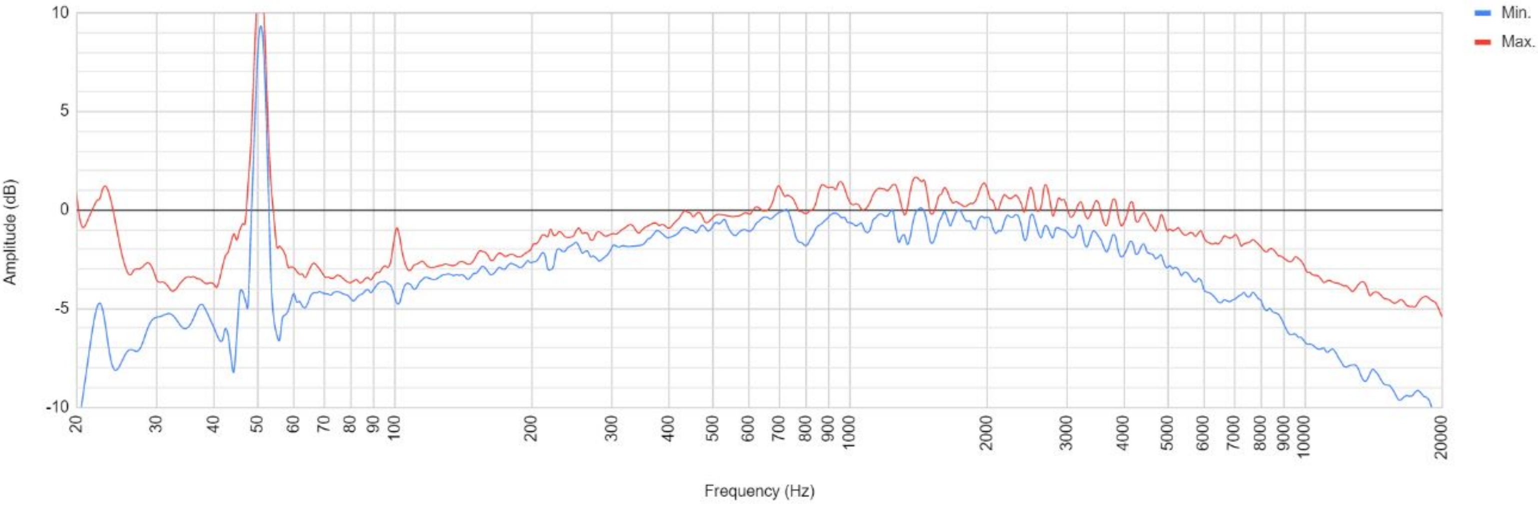

Fig. 5: The min. and max. spread of the frequency response of 10 IoT SoundSensor dB microphones.
Relative to the reference microphone measurement.

With the data collected so far, the factory calibration curve is calculated.
This curve is an average of the frequency response of the 10 measured IoT SoundSensor dB microphones.

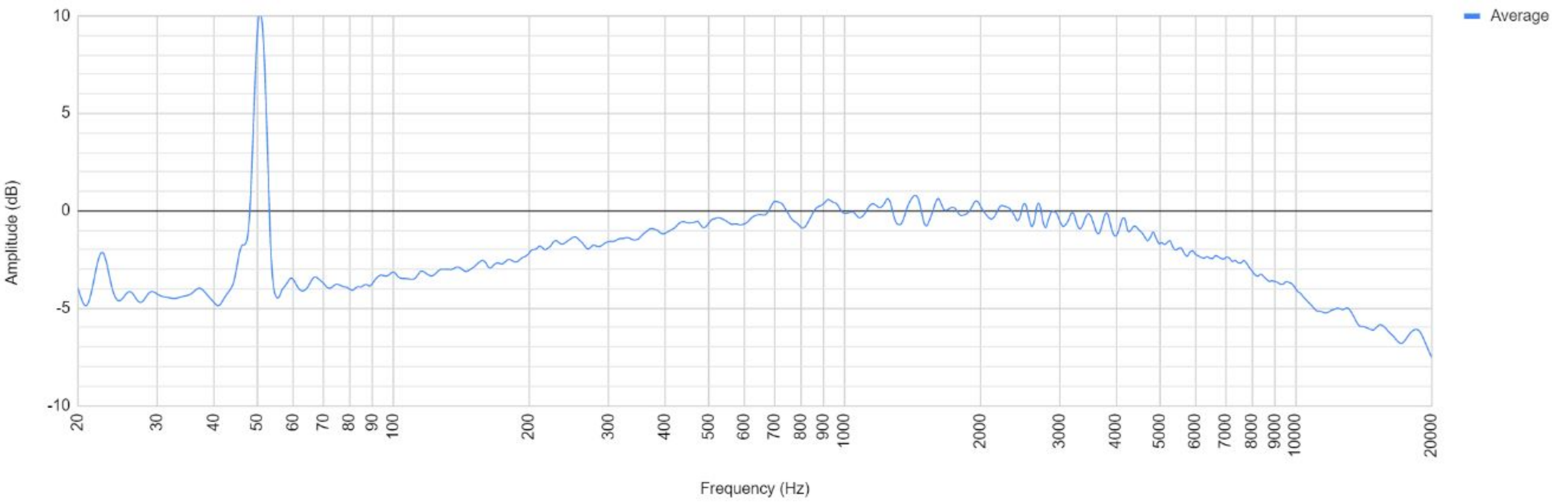

Fig. 6: The average frequency response of 10 IoT SoundSensor dB microphones. Relative to the reference microphone measurement.

The accuracy tolerance is calculated. This is done by applying the calibration curve to the min. and max. spread of the 10 measured IoT SoundSensor dB microphones.

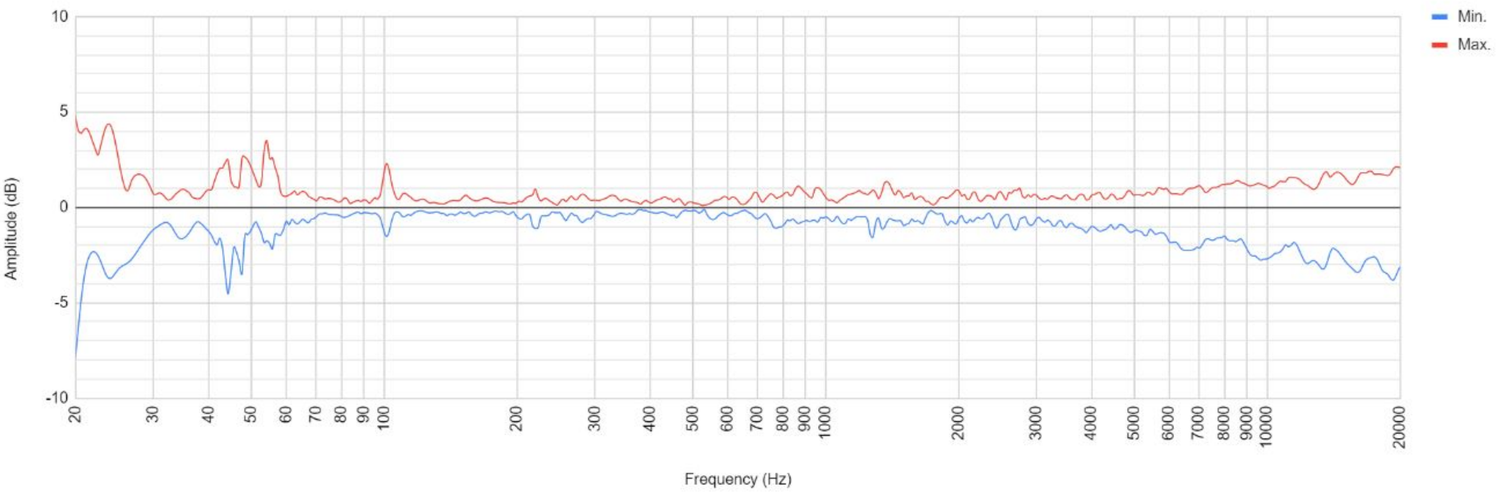

Fig. 7: The calculated accuracy tolerance frequency response. With calibration applied (min. and max. spread of 10 IoT SoundSensor dB microphones, minus average of 10 IoT SoundSensor dB microphones relative to reference microphone measurement).

Finally the IEC61672 Class 2 acceptance limits are overlaid so we can see the relative performance.

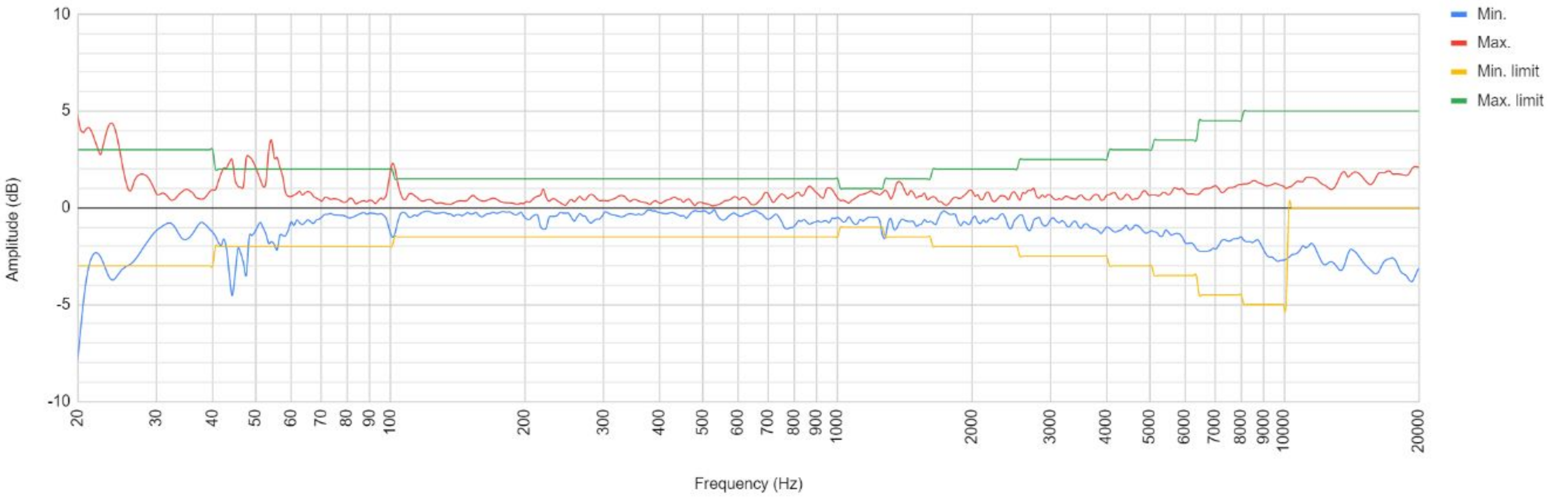

Fig. 8: The calculated accuracy tolerance vs. IEC61672 Class 2 acceptance limits.