# Dumbo dipole

Dumbo is a dipole 2-channel loudspeaker with the speakers located on each side of computer monitor. A dipole design was selected as it was deemed likely that the large computer monitor would make it possible to stretch the midrange response low enough so that a subwoofer could handle the low frequency range. The name Dumbo is because the final design reminds the author of Dumbo, the flying elephant.

As loudspeaker units, the Dayton RS100-8[1] was selected, mainly because they were leftovers from an earlier project. The units are wideband 4" loudspeakers, but any drive units will do. It is however recommended that they have a Qts between 0.5 and 0.8.

The modelling requires diffraction analysis for proper results. The front and the rear sides of the driver units are modelled as radiation elements. The overall simulation schematic is shown in Figure 1.

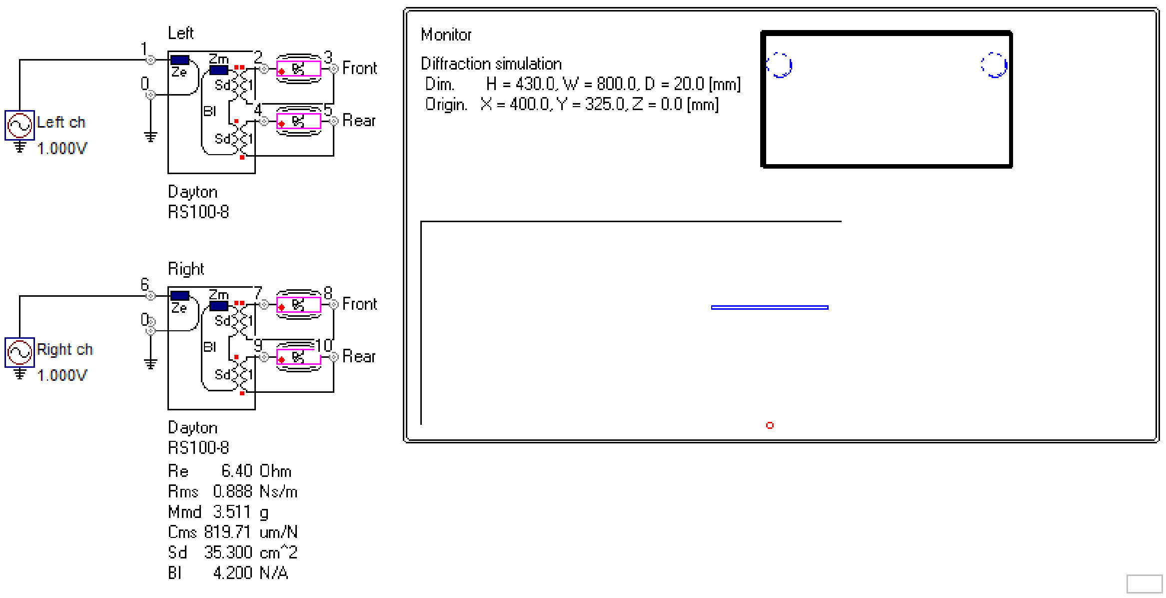


*Figure 1 Schema for the simulation of a dipole*

[1] https://www.daytonaudio.com/product/90/rs100-8-4-reference-full-range-driver-8-ohm

The radiation elements for the front and rear are configured differently. For the rear side the Location is set to “Rear” to model the diffraction because of the radiation on the rear side.

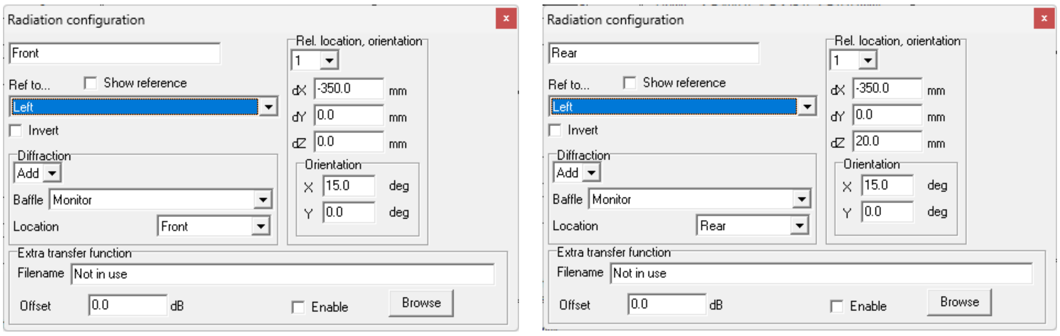


*Figure 2 Configuration of front and rear radiation elements*

The modelled frequency response is shown in Figure 3 with a listener position 80cm from the loudspeakers. A +2dB bump is seen at 1000Hz with a notch around 1800Hz. A roll off is seen below 200Hz with a -3dB point at 150Hz.

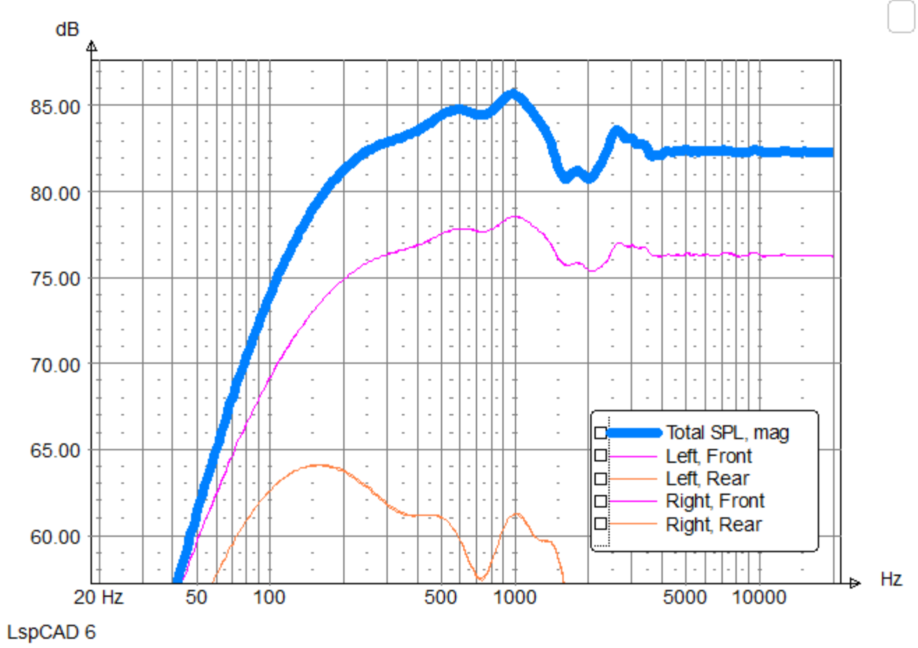


*Figure 3 Simulated frequency response at 80cm distance from monitor.*

A comparison against a measurement is shown in Figure 4. Measurements in a room with nearby reflections is always problematic. One can draw the conclusion that the response between 800Hz and 1500Hz is around 3dB higher than simulated. In addition, the notch between 1500 and 2000Hz is not seen in the measurement. The roll off below 200Hz appears to match well, however.

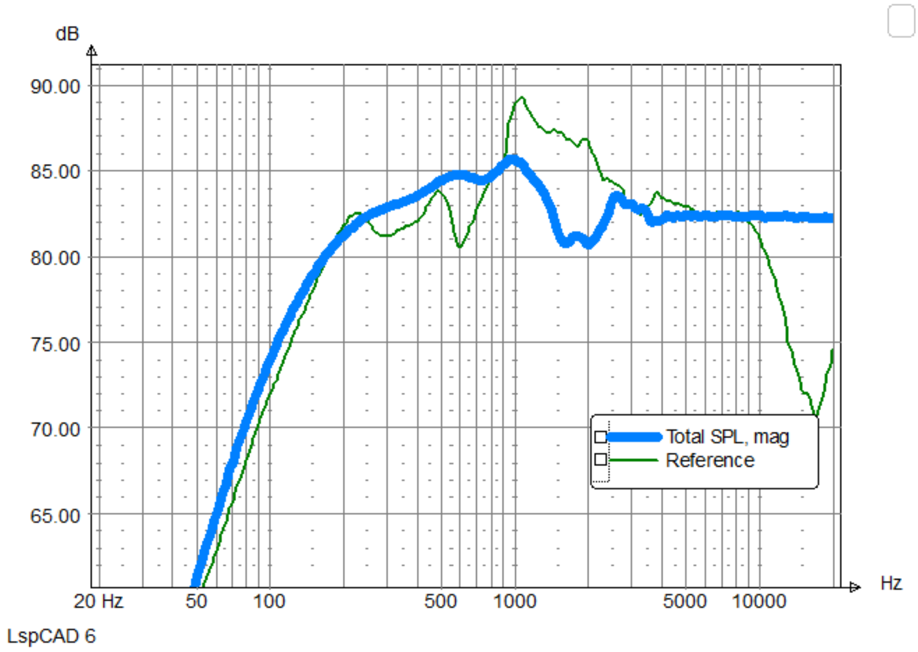


*Figure 4 Simulated versus measured frequency response.*

Part of this difference can be a nearby reflection and/or that the diffraction model misses this. A closer look in the specs for the driver unit reveals that the range between 1000Hz and 4000Hz is a bit amplified. The response anomaly for 15 degrees off axis is added to the simulation (Figure 5) and this reduces the difference between simulated and measured a bit. Still, the difference cannot be completely explained without a measurement outside in free field on a sunny rain free day.

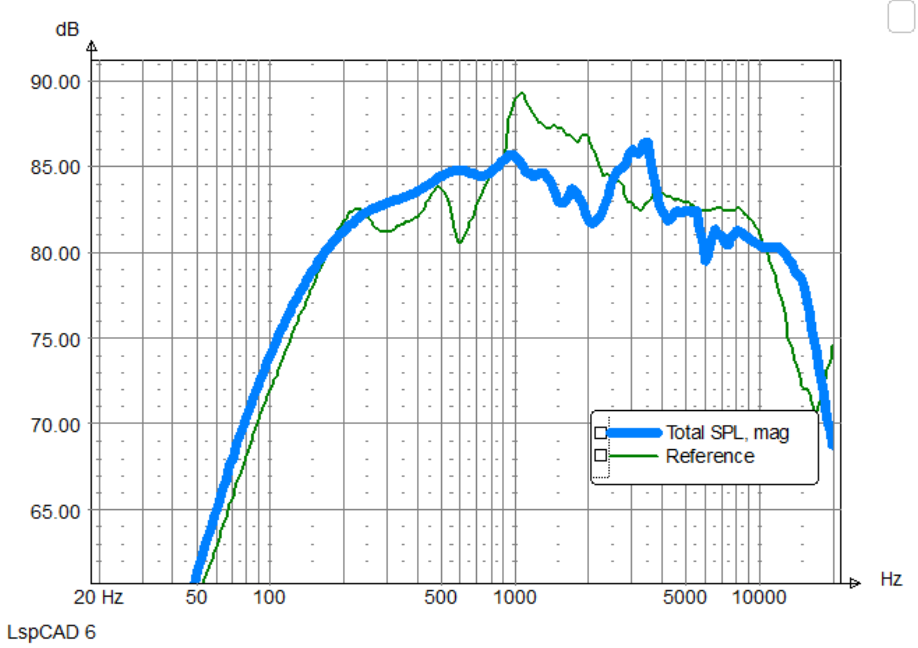


*Figure 5 Simulated versus measured response with mid/high band response form specification.*

Addition of rear reflection in the simulation however gives some insight. One can see that especially the contribution from the rear radiation increases, this makes the response up to around 1200Hz match the measured response better. Absorbents on the rear wall may be a good idea.

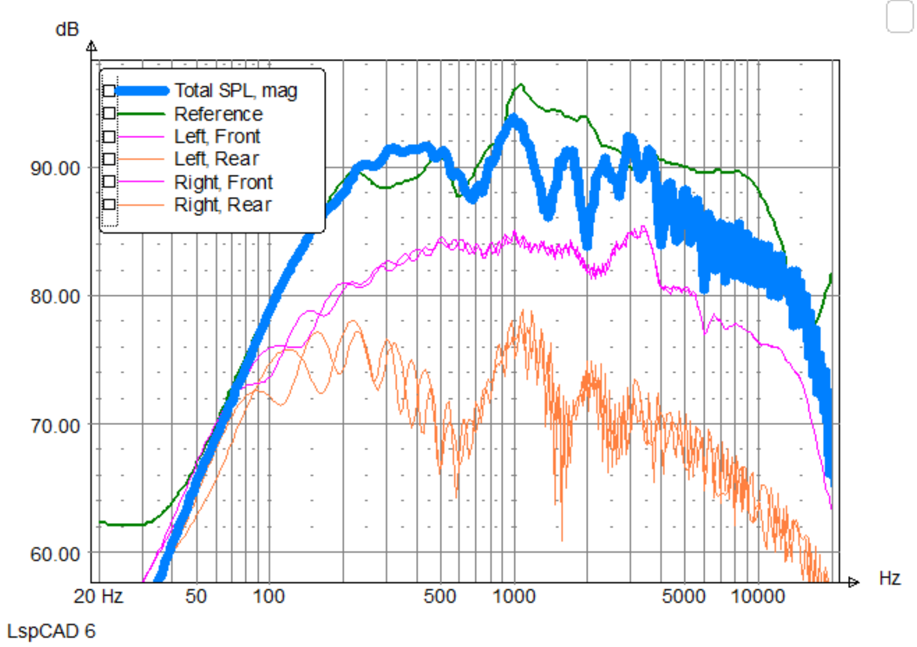


*Figure 6 Measured vs simulated response with rear reflection added*

The measured bump between 800 and 2000Hz can be easily remedied by adding an inductor in parallel with a resistor as shown in Figure 7

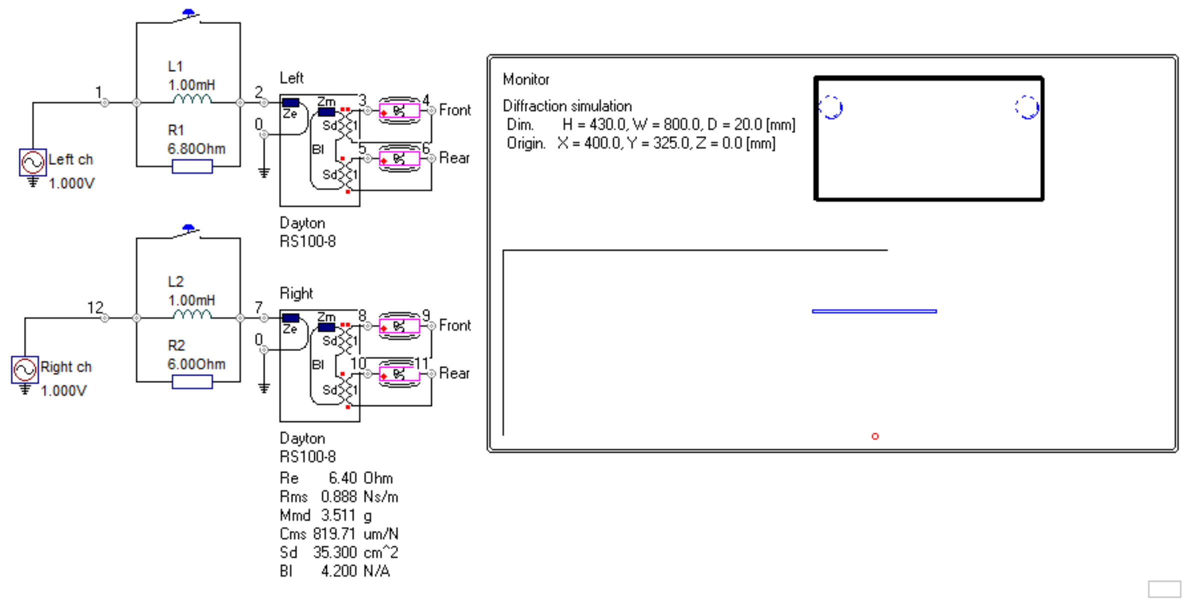


*Figure 7 Schema with additional components to for a 5dB notch around 1500Hz*

This will give a transfer function with a 5dB notch around ~1500Hz.

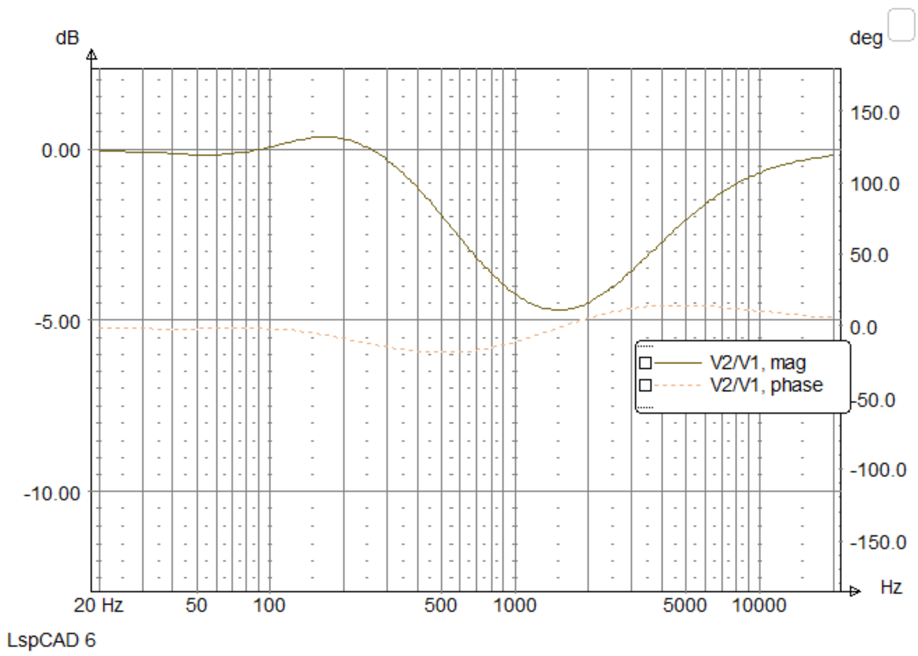


*Figure 8 Transfer function with additional inductor/resistor*

That is however left as a potential future improvement that may or may not happen. The purpose with the PC monitor loudspeakers presented here is anyway not to win an audiophile competition.

The final frequency response with a subwoofer tuned to match in crossover frequency and phase is shown in Figure 9.

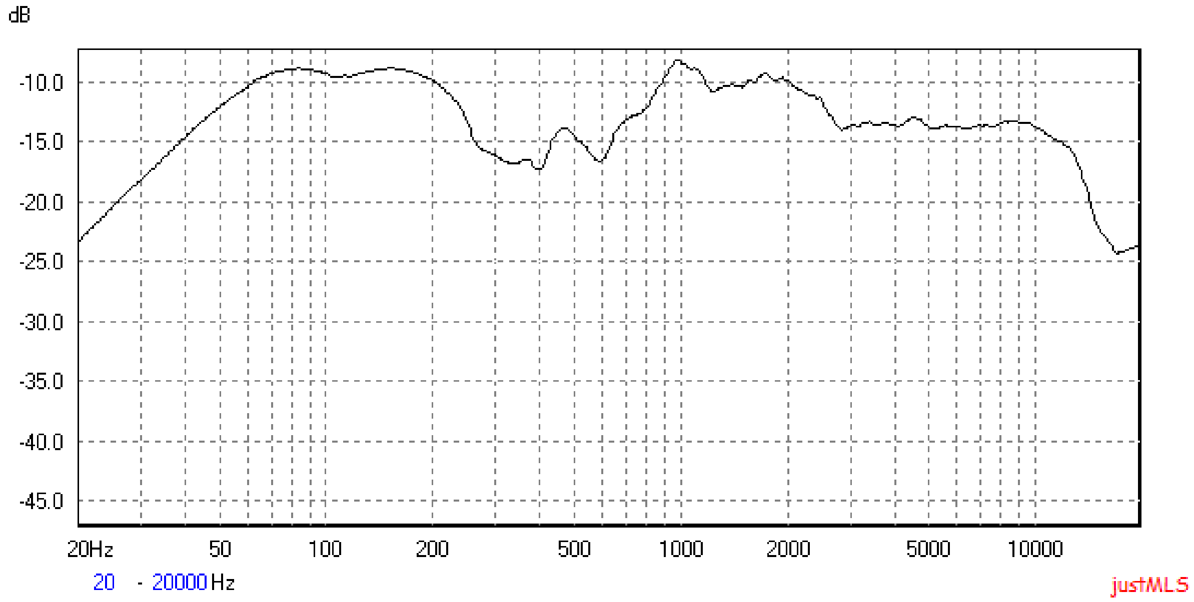


*Figure 9 Frequency response with subwoofer at 80cm from monitor, ½ octave averaging.*

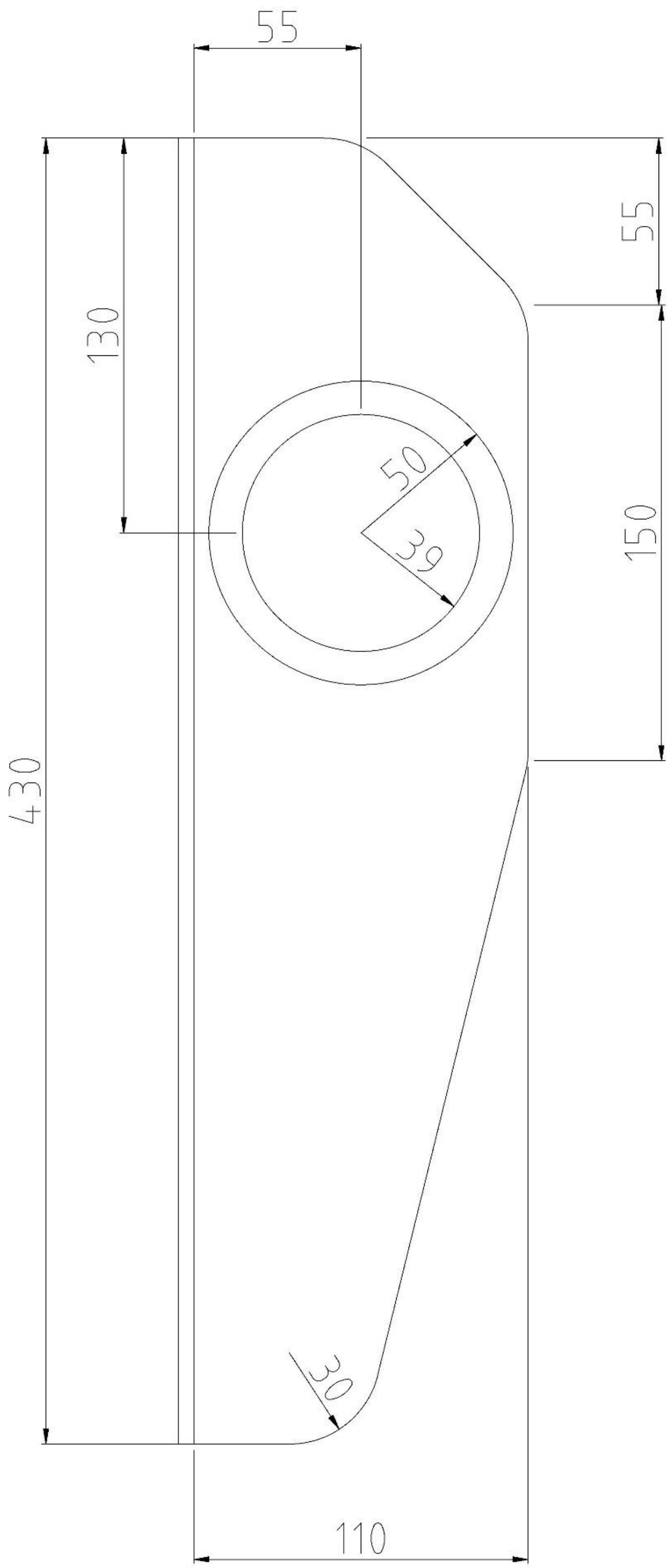


*Figure 10 CAD drawing*