

Earendel surround

This project uses the SEAS T18REX/XFC¹ coaxial loudspeakers as rear surround speakers for a home cinema system. The loudspeakers are placed in fairly small, closed box (3.8l) despite the 42l Vas, this is made possible because the Qts is quite low and the surround speakers are offloaded by a subwoofer.

The low/mid band unit is simulated in a 3.8l box as shown Figure 1. The frequency response in Figure 2 shows a -3dB point around 100Hz which is low enough to be complemented by a subwoofer.

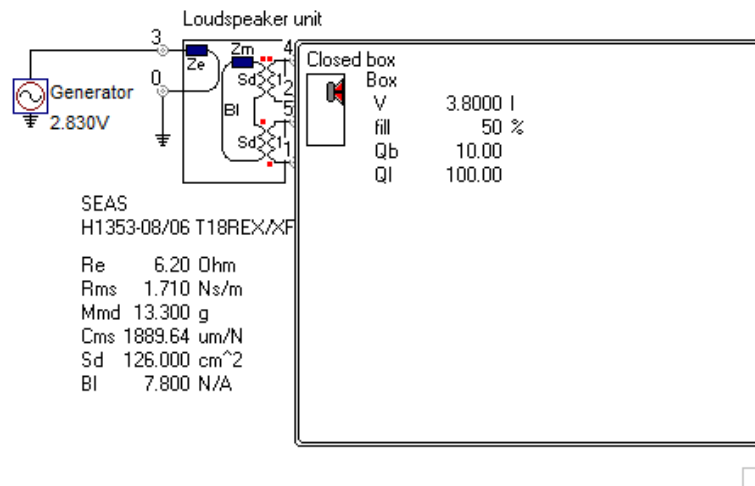


Figure 1 Loudspeaker simulation

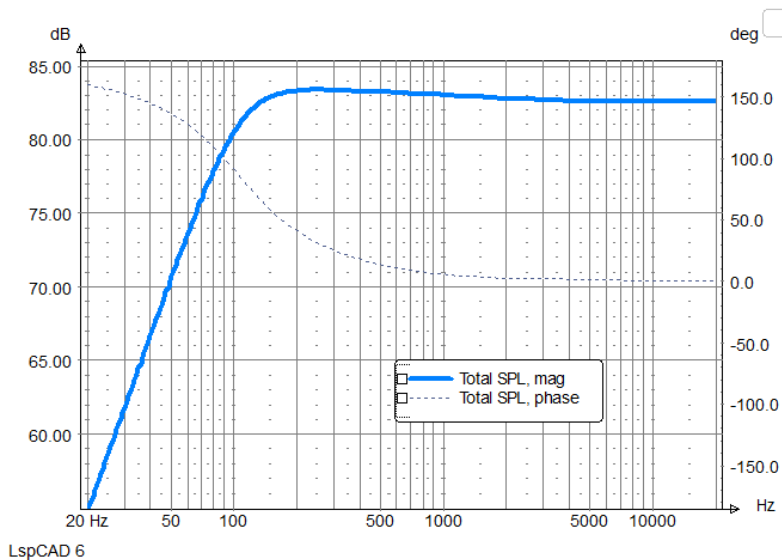


Figure 2 Simulated response

¹ https://www.seas.no/index.php?option=com_content&view=article&id=522:h1353-0806-t18rexxfc&catid=52&Itemid=464

The drive units are measured in the box and with the box mounted in a corner. The measurement distance is 1m, 15 degrees off axis, this means that there will be ample amounts of nearby reflections that affect the response. The 15 degrees off axis direction is because the loudspeaker are to be located closer to the roof than the listening position.

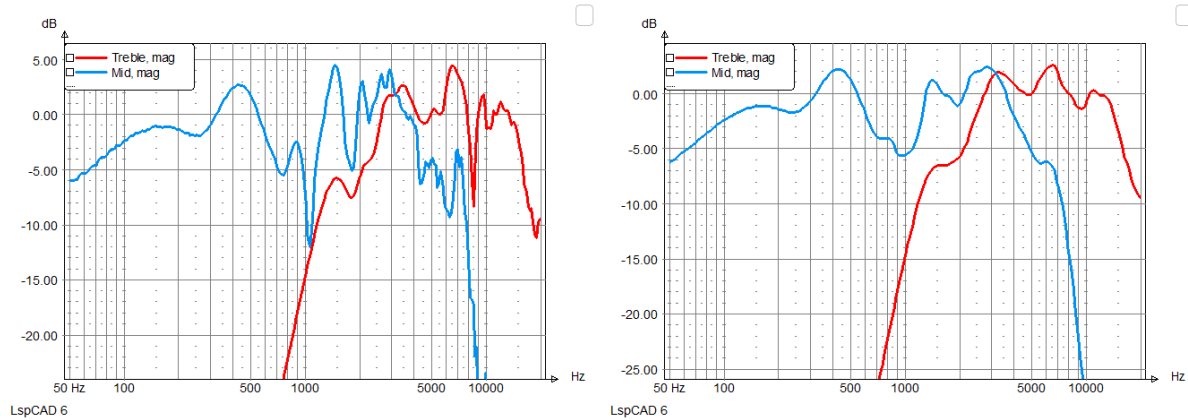


Figure 3 Measured response at 1m distance 15 degrees off axis, Left = no smoothing, right = 1/6th octave smoothing

A 1/6th octave smoothing is selected to make it easier to optimize the crossover

The crossover is optimized with a 1-ohm series resistance in speaker cables. The design eventually ended in a 2500Hz crossover point. An additional constraint was set that the impedance should not go below 5.5 ohm.

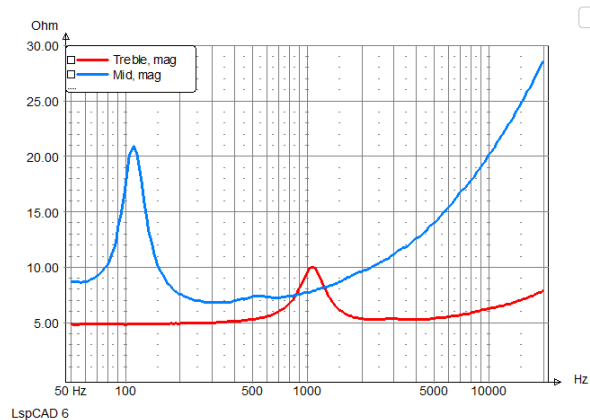


Figure 4 Measured impedance

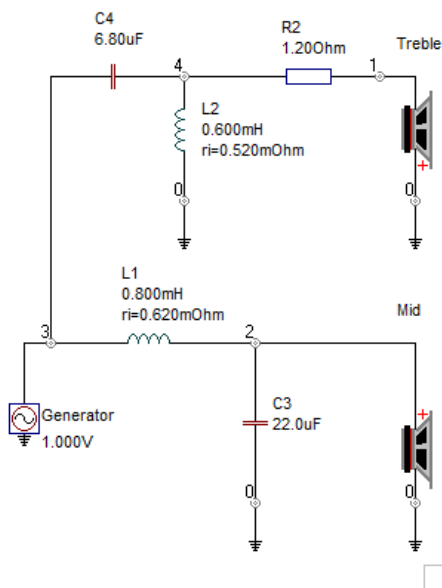


Figure 6 Final crossover

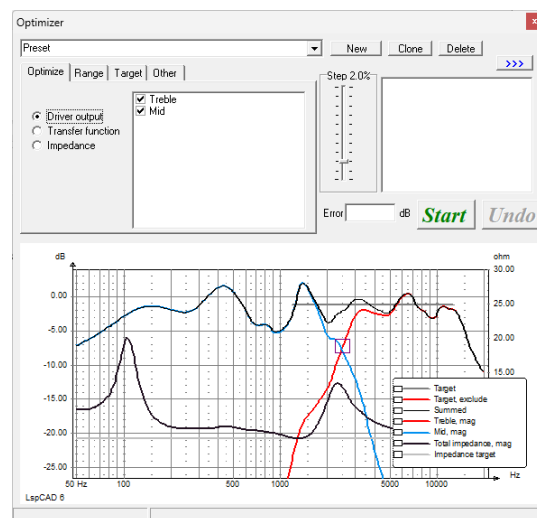
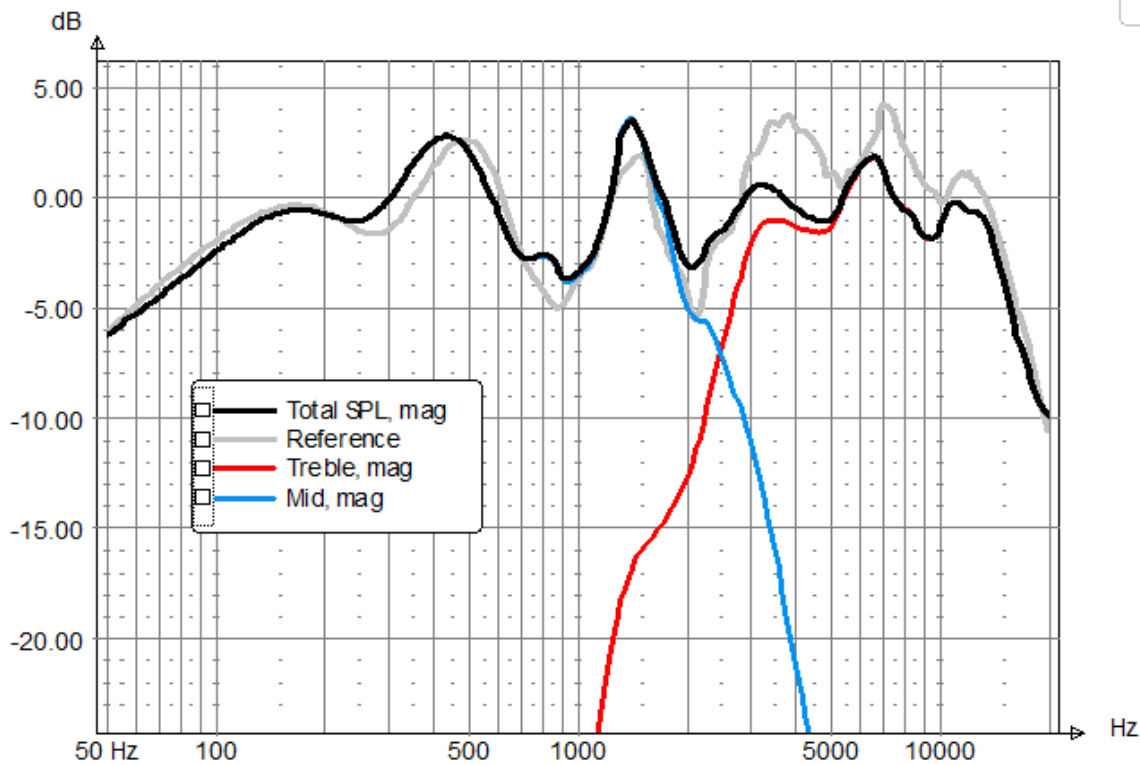


Figure 5 Optimizer

The final simulated crossover is compared with a measurement. The response deviates a bit at higher frequencies. The likely reason is that the microphone position was not the same as when the midrange and treble was measured individually



LspCAD 6

Figure 7 Simulated vs measured response. 1m 15 degrees off axis, measured response with 1/6th octave smoothing.

A final measurement was performed to convince the author that the midrange and treble units are wired correctly. The coaxial unit shows a null at straight on axis. This appears to be a common trait in coaxial loudspeakers. Coaxial loudspeakers should not be listened to straight on axis it seems.

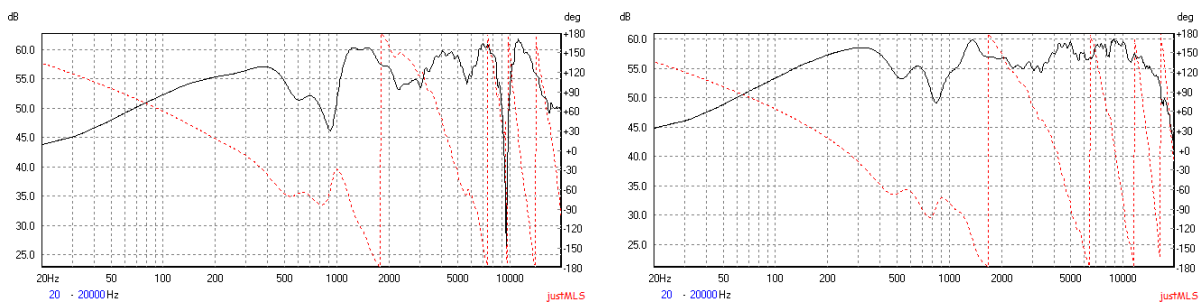


Figure 8 Measured response at 30cm. Left=on axis, right is 15 degrees off axis. Note the null at 10kHz on axis.

The response also shows a low Q notch around 800Hz. This is corrected with the home cinema calibration.

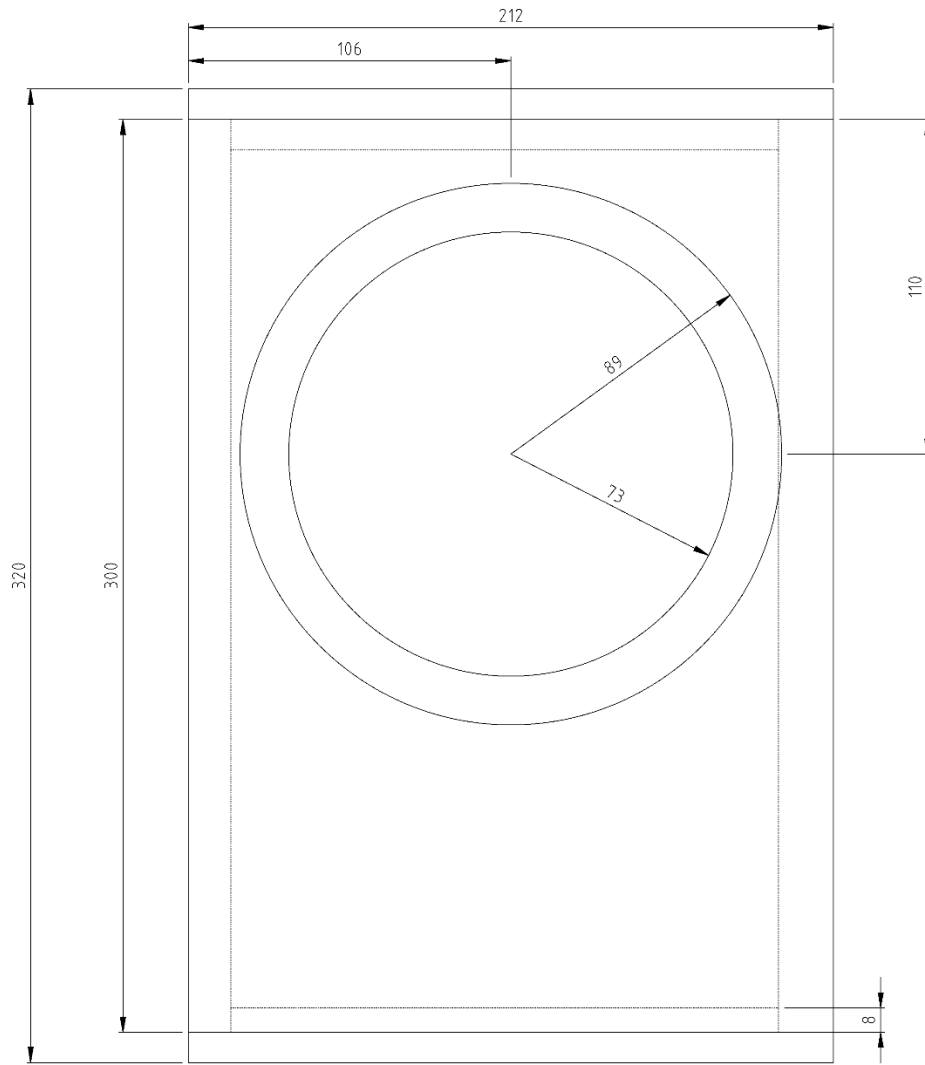
Photos of the final loudspeakers are show below. Note that the loudspeakers are mirrored as they are intended to be placed on the left and right corner of the rear wall. Placing loudspeakers in corner is generally seen as a bit unorthodox. In this case it is however deliberate to make some room for other things than loudspeakers and achieve an acceptable SAF score. The loudspeakers are designed with a 30-degree angle against the room to point directly towards the couch potato's listening position.



Figure 9 Left and right speakers. The avocado plant is optional



Figure 10 Rear left speaker mounted in the corner



Rear: 12mm plywood

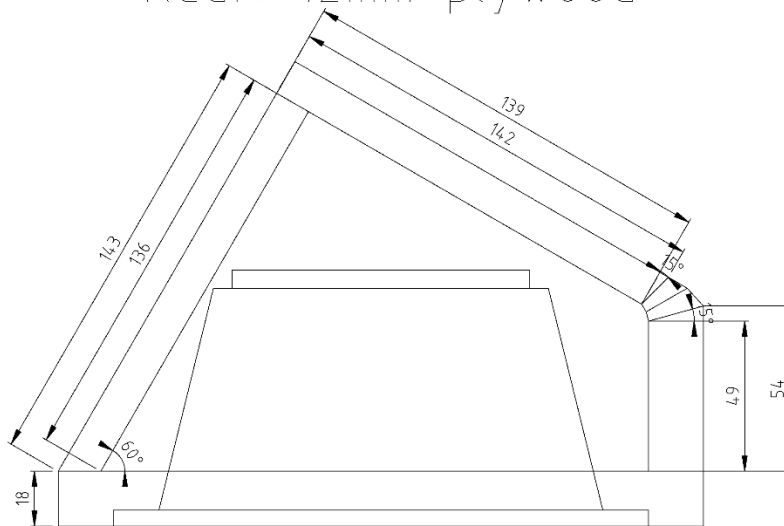


Figure 11 Drawing. Rear side is 12mm plywood, front is 18mm staff clued beech wood.