

Drivers:

I was lucky enough to get my hands on 4 Creative Sound Solutions WR125ST and 4 WR125STR wide-range drivers. They're about 4" in diameter with paper cones, a phase plug, big magnets and a nice cast frame. I also got 4 very nice Swan SS1ii soft dome tweeters.

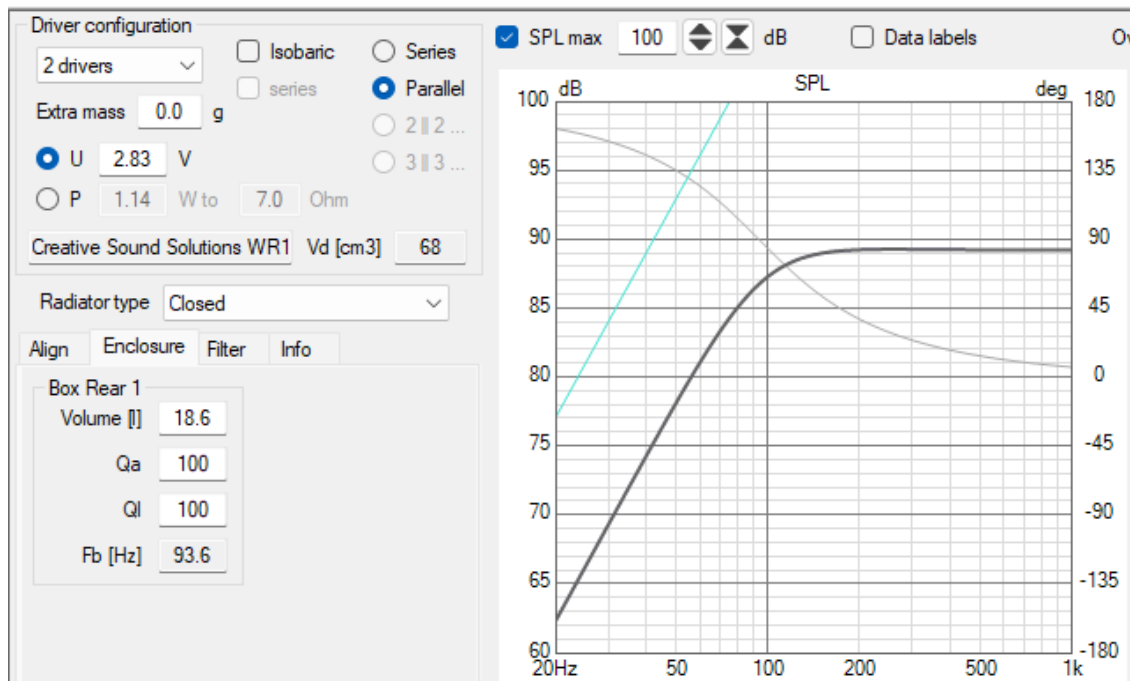
Here are the published parameters:

	CSS WR125ST	Swan SS1ii
Free air resonance (Fs)	65Hz	1300Hz
Electrical Q (Qes)	0.77	
Mechanical Q (Qms)	3.85	
Total Q (Qts)	0.64	
Volume air suspension (Vas)	5.8 liters	
DC resistance (Re)	14Ω	4.6Ω
max excursion (Xmax)	6mm one way	
cone area (Sd)	57cm ²	
inductance (Le)	0.64mH	
force factor (BL)	5.7	
SPL (1W @1m)	85.6dB	91dB

Cabinet Design:

I wanted to use up all 8 woofers in one pair of speakers. I chose a 2-compartment design with WTW on top, and a pair of woofers on the bottom. The original plan was to make a 2.5-way system, but after modeling the crossover, I realized that this would require an unreasonably large inductor. I abandoned that idea in favor of putting all 4 woofers in parallel.

I put the woofers into Vituix CAD and modeled a sealed box with 2 woofers in parallel with a Qtc of 0.8, which was 18.6 liters.



Then I figured the stuffing would make up for any loss due to braces and the drivers.

I wanted a minimal baffle width, but a 6" wide 44" tall tower is awfully skinny, so I opted for a trapezoid cross section. It also looks kind of cool. It also made construction tricky.

To the right are the exterior dimensions.

height	44.5"
baffle width	5.75"
back width	14.5"
depth	7.25"
baffle-side angle	110°
back-side angle	60°

Build:

I'm a member of the Guild of Oregon Woodworkers, which has a fantastic shop, so I had all the tools I needed at my disposal.

I went for solid white oak baffles, tops and bottoms, and oak veneered $\frac{3}{4}$ " MDF sides. Back and braces are $\frac{3}{4}$ "MDF.

Everything laid out:



Glue up:



Almost done:



They got 3 coats of quick drying oil-based polyurethane. Final step was to polish them with a rag soaked in mineral spirits. That's a trick I learned at the Guild of Oregon Woodworkers.

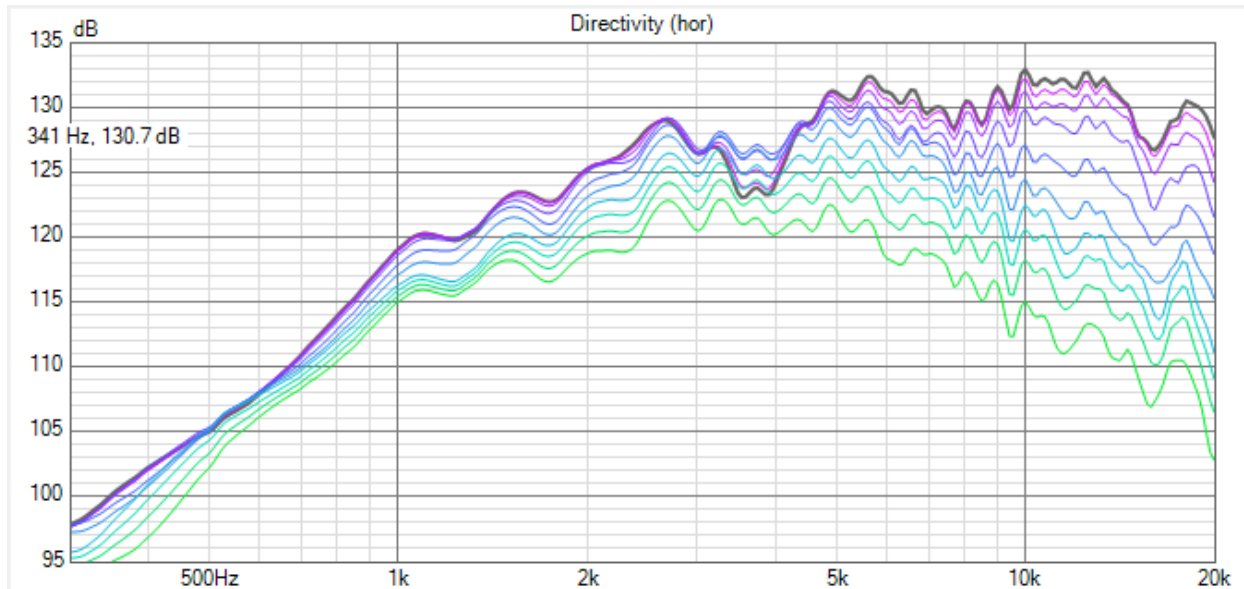
The final product:



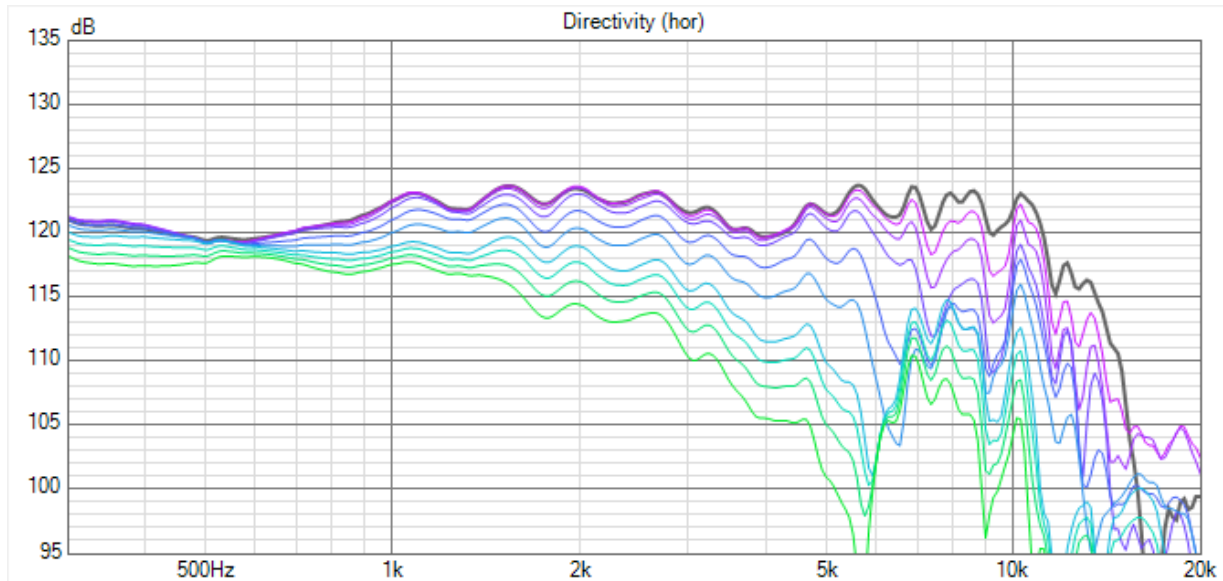
Crossover Design:

After mounting the drivers, I got frequency response with ARTA, and impedance with Dayton Audio DATS. I measured the top two woofers in parallel, treating them as a single driver. I didn't measure the bottom woofers. I gated at 300Hz. I took 11 measurements from -90° to $+90^\circ$ at 1 meter, 2.82V RMS.

Tweeter:

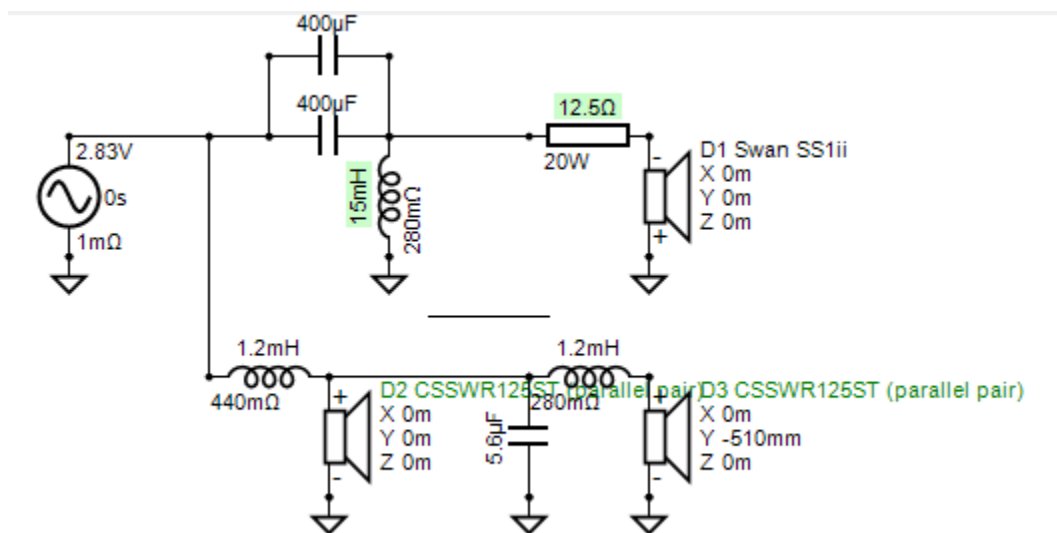


Upper Woofers in parallel:



Crossover design was done in Vituix CAD.

First design:



However, when I did an impedance sweep, I found they were 0.5Ω in the bass! My mistake was that, when optimizing in Vituix, I told the software to optimize from 500Hz on up, because that's what my *.frd files covered. The software ignored the impedance below 300Hz. It turns out that those 400μF capacitors aren't really doing anything. 800μF is too high. This lets that 15mH inductor send all the low frequencies to ground.

I wanted to take them to the Sound DIY Club's "The Puget Sound DIY Speaker contest" the next day and it was getting late, so I just clipped that 15mH inductor out. After a few minutes of listening, I put a 10Ω resistor in parallel with the 12.5Ω resistor – because that's what I had lying around.

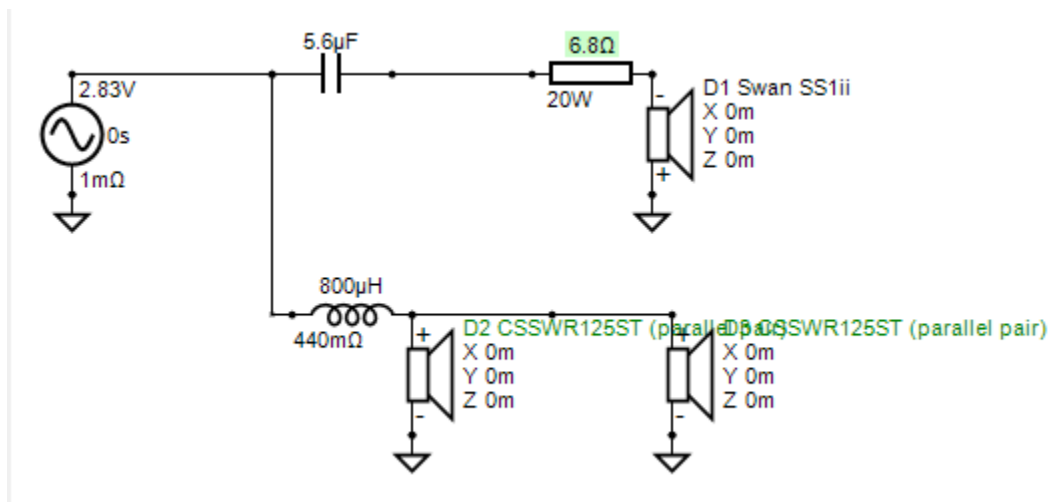
Initial Results:

The speakers did well at the DIY speaker contest. They got 3rd place out of 15 or 16 entries. Judges commented on the imaging and clarity. Those little woofers also went lower than a 4" woofer in a sealed box has the right to go. I never got to listen to them much.

Crossover redesign and final results:

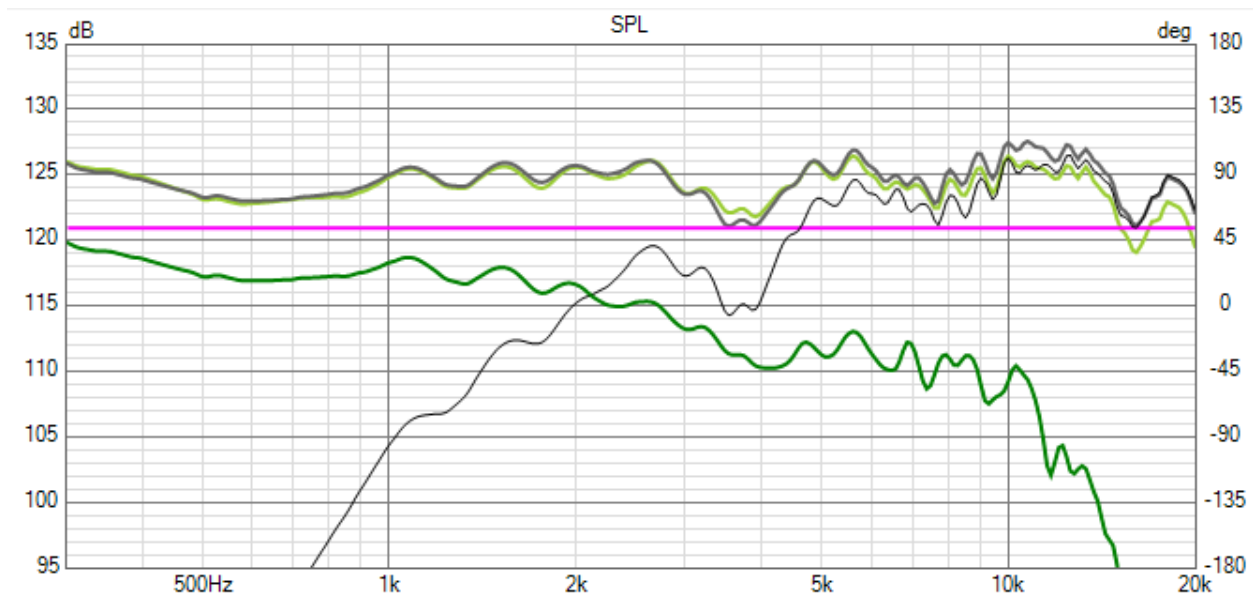
I decided to redesign the crossover from scratch. I learned not to rely on software so much, and to understand what the software was doing and why. I made intelligent decisions about values and slopes I wanted and forced the software to work within those limits.

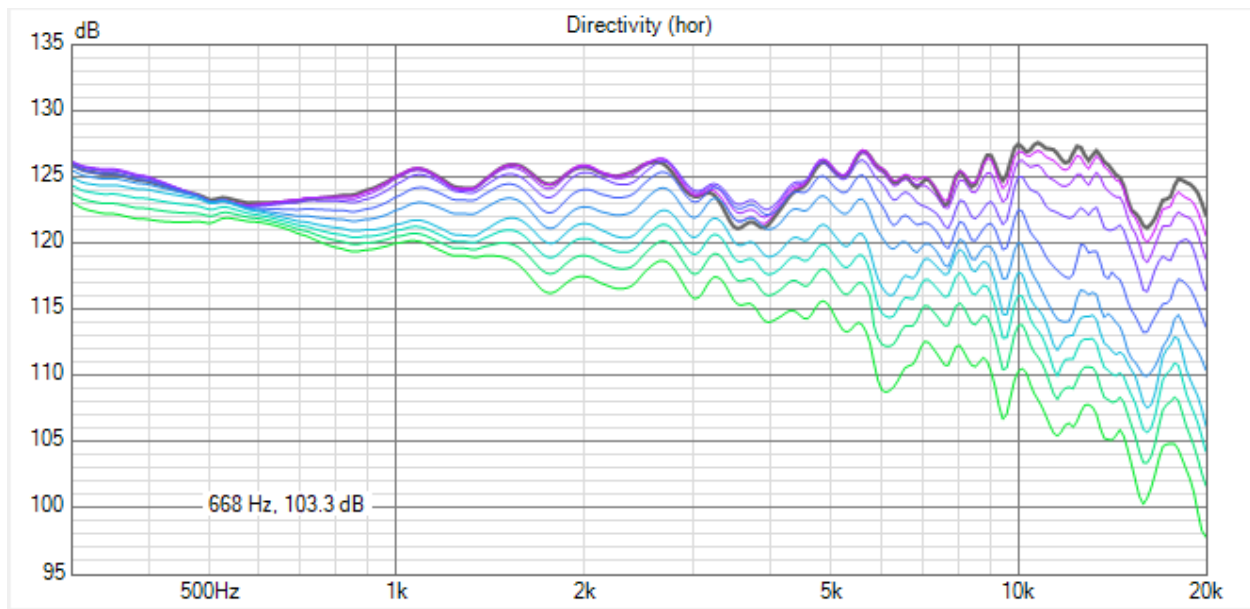
Final crossover:



The observant among you may notice that, in the redesigned crossover, I set the Y-axis offset for the lower pair of woofers to 0, whereas it was -510mm (correct value) in the initial crossover design. I think that Vituix was optimizing for a close listening distance, so it was predicting a big dip at 3.2kHz due to interference, and accounting for that in its design. But I think that at real listening distance, after sound has bounced off the walls and floor, that dip isn't going to be there. So, I removed the modeled interference by removing the lower woofer offset.

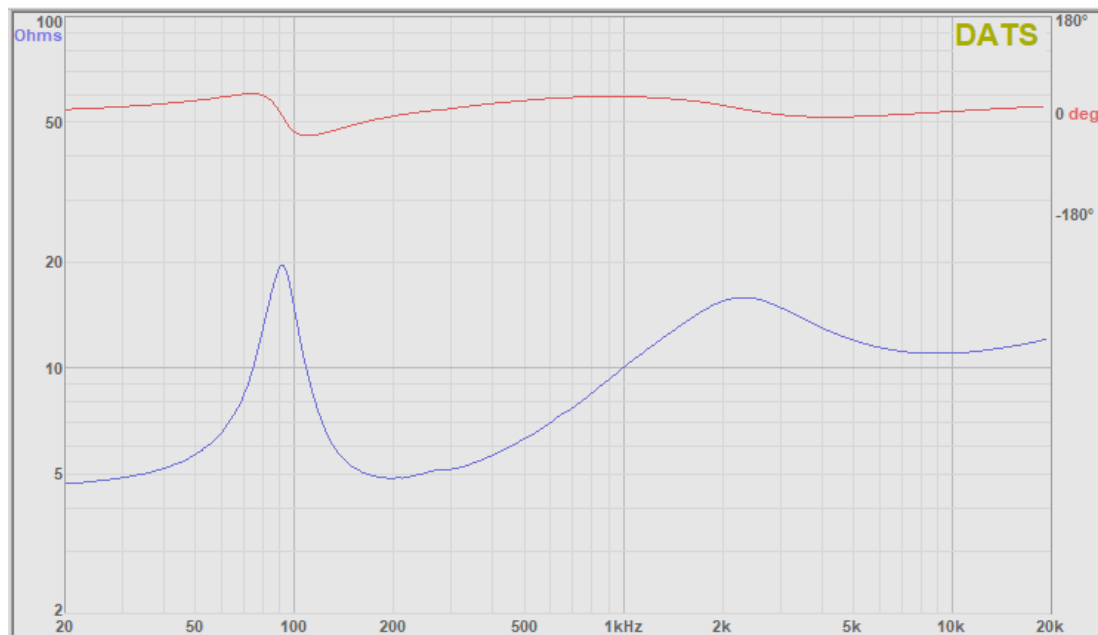
*Vituix model, **not** measured:*





I was fortunate to have spare parts very close to these values, so I didn't have to order and wait for new parts to arrive.

Measured impedance:



Thank you:

- Cal Weldon, for selling me these awesome drivers at a great price!
- Guild of Oregon Woodworkers, for a lot of mentoring and advice.
- Birdbox for taking a better picture of my speakers than I could.
- Many diyAudio members for helping me with ARTA and Vituix, and providing the CSS WR125ST data sheets which are not available on-line anymore.