Ignis Series 1 Tuning & Testing

FA4740: Transducer Theory

Jonathan Moths

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Tuning

Initial Crossover

The initial crossover design did not consist of any compensation or correct circuits, just the third order crossover. I decided that I would start from the basics and experiment with adding more and different component as I needed. The initial crossover circuit is shown below on the left. Testing was done with an iSEMcon EMX-7150 microphone. The microphone was placed 13" away from the tweeter. The microphone was on axis with the tweeter both horizontally and vertically. After assembling the loudspeakers with the crossover pictured at the left I received a frequency response that featured a large 6 dB boost from 900 hz to 1.5 KHz. The initial responses are shown below. Green is the combined response, yellow is the woofer and blue is the tweeter. One of the things I noticed very quickly is that both the tweeter and woofer were not rolling off at 2 KHz. The tweeter was especially having this problem and there was also a weird

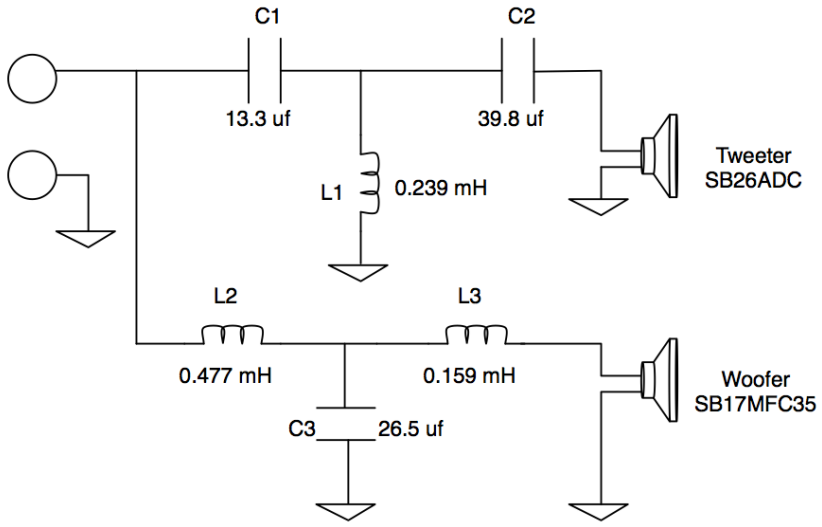


Figure 1: Initial Crossover Design

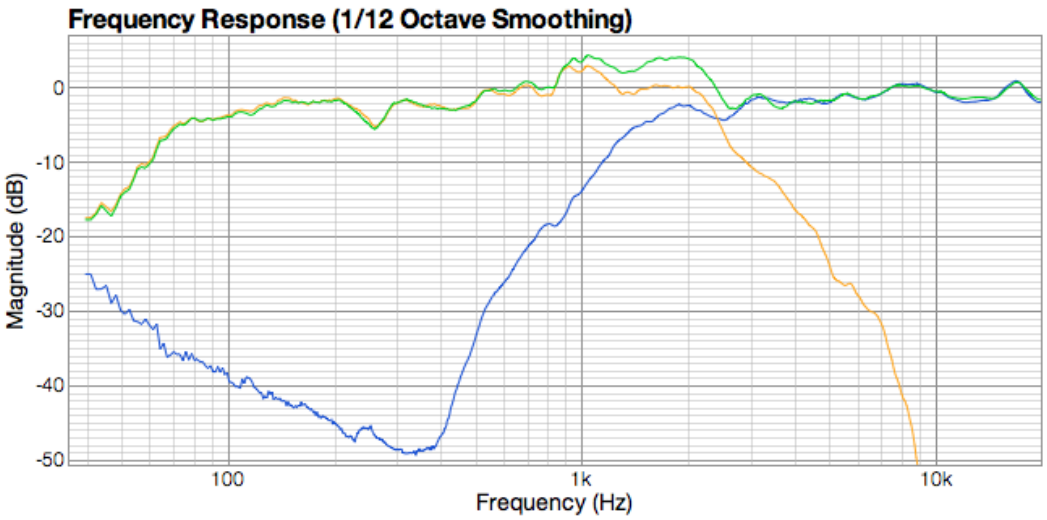


Figure 2: First Frequency Response Test

bump at around 1.5 KHz. The first step towards fixing the situation was to add a baffle step correction circuit to my woofer. This involved adding a resistor and inductor in parallel to each other at the front of the woofer crossover section. I also decided to move the crossover point to 1.8k to try and smooth out the boost I was getting. This did get rid of the large hump but also turned it into a large dip as seen on the right. From this point out getting the tuning correct was really just a lot of experimenting with different crossover parts. I kept switching in parts, running a sweep, and then seeing what it did to the frequency response. Along the way I realized that a baffle step correction circuit on the tweeter would also be a good idea. This also helped smooth out the response but it still needed more tweaking. Eventually I got a crossover that I wanted. Making a tight seal on the box with gasket tape really helped tighten up my bass response. Adding a bit of fiberglass insulation also helped smoothout some other issues.

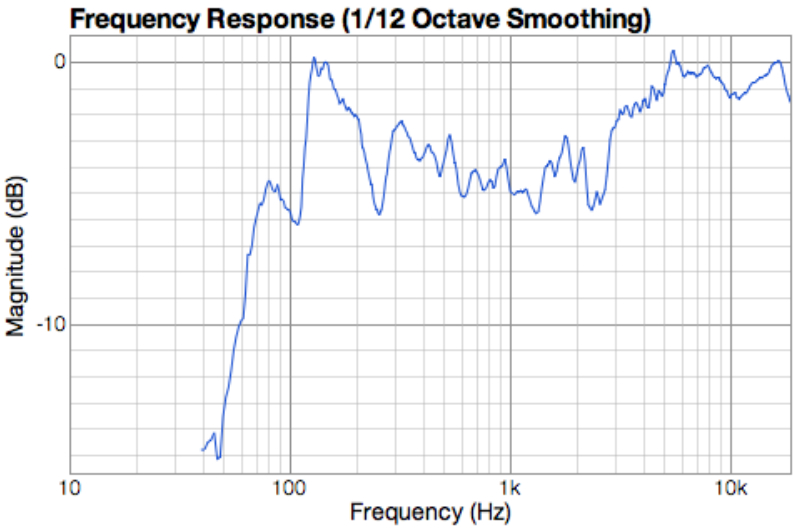


Figure 3: XOver at 1.8k with baffle step correction

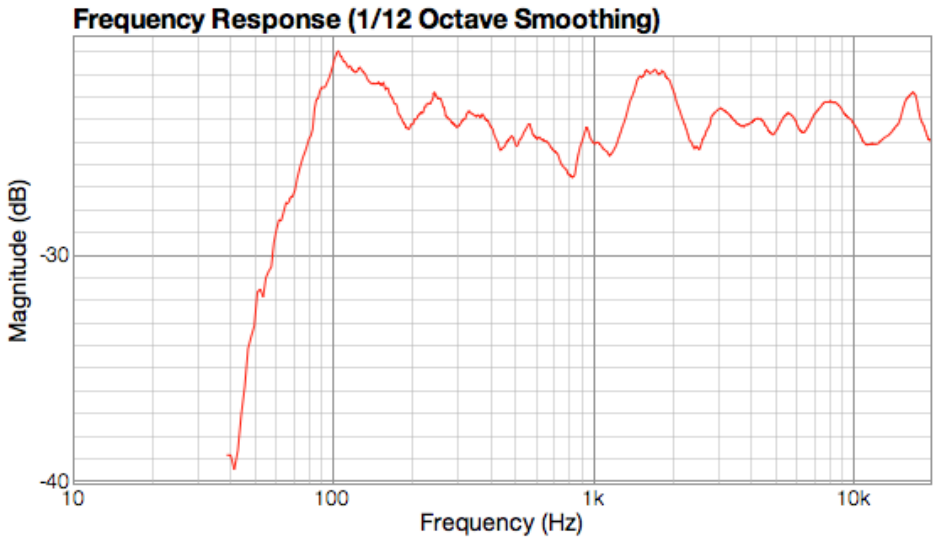


Figure 4: With Baffle Step for Tweeter

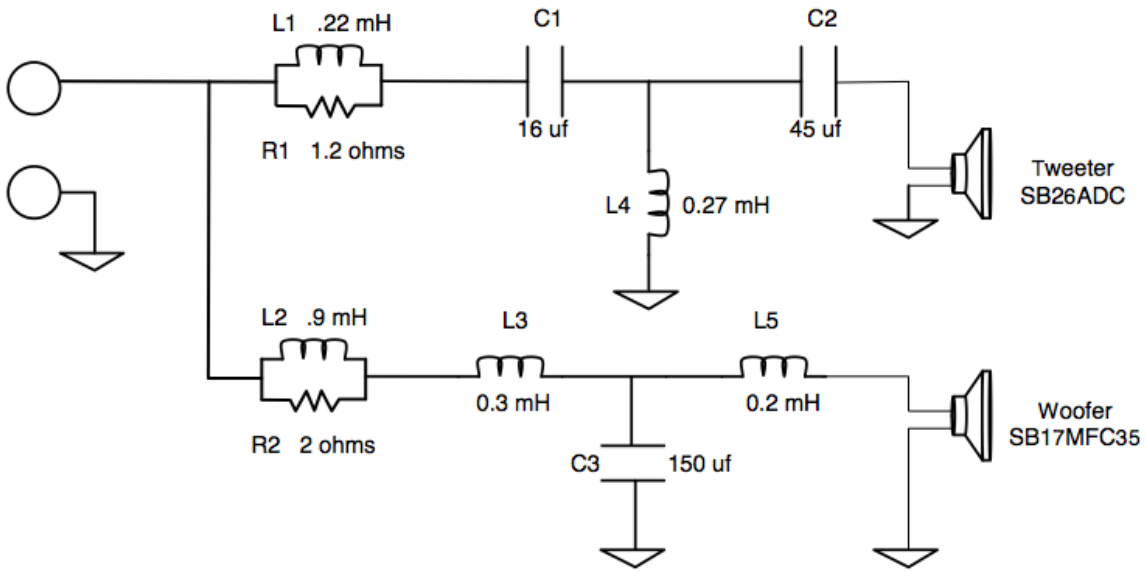


Figure 5: Finalized Crossover

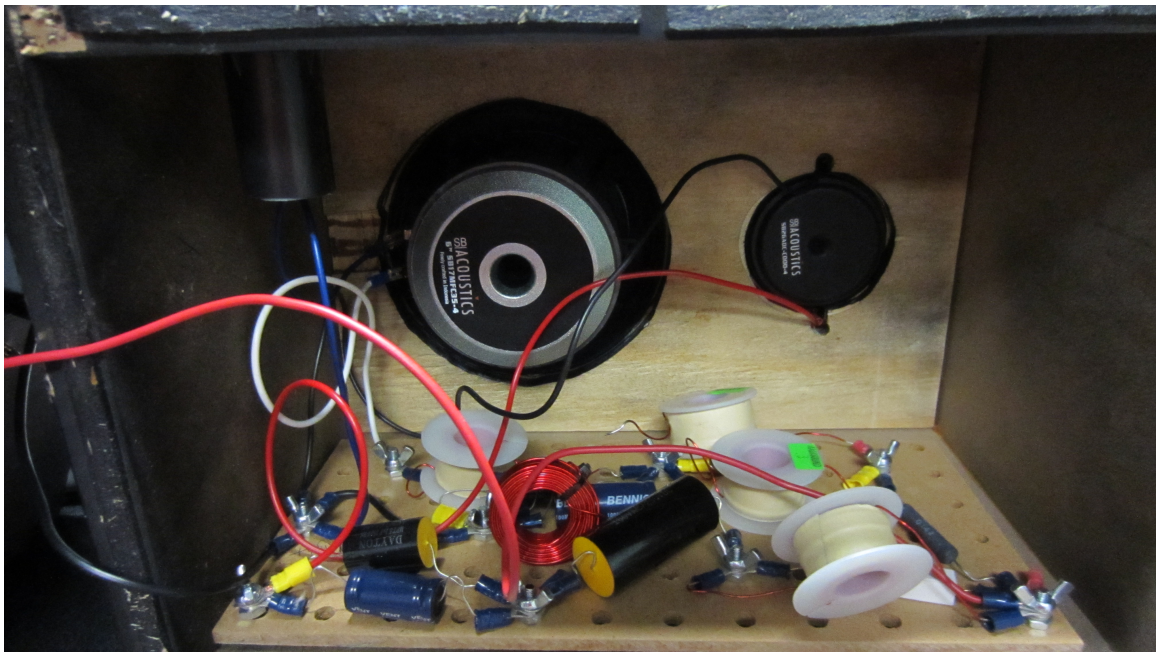


Figure 6: Crossover Inside the Loudspeaker

Wrap-Up

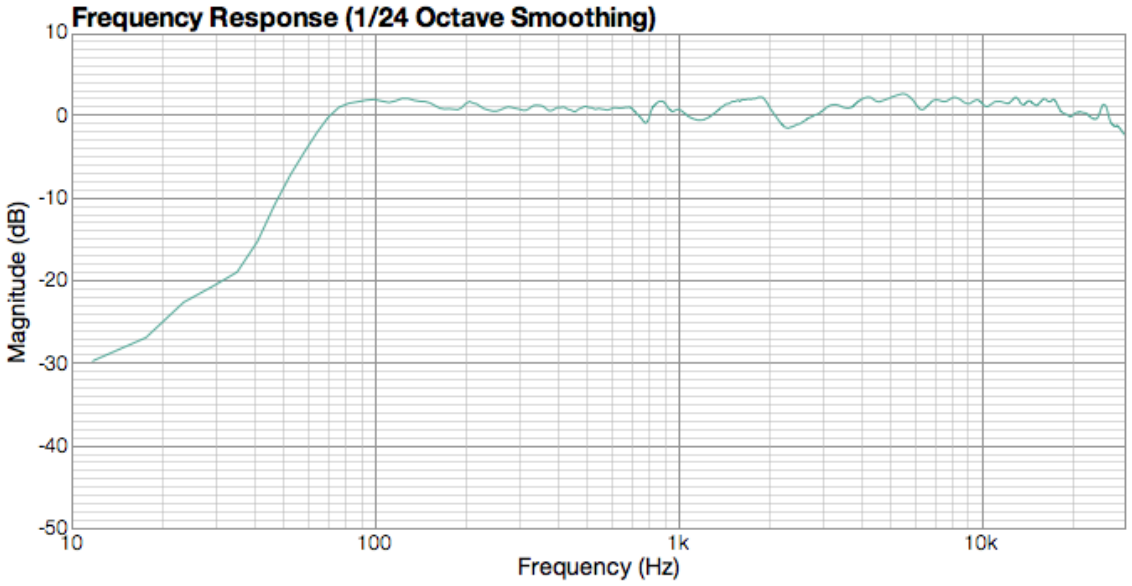
The finished product did manage to meet my design goals. The *Ignis Series 1* had a dimension of 9 ½" by 9 ¼" by 14". It had a flat frequency response of plus/minus 2 dB from 70 Hz to 20 KHz. The f3 of the loudspeakers was around 60 Hz. When put on a surface or near a wall, reflections also helped give a bass boost. Depending on the final cost of the crossover, the total loudspeaker cost will come to between $395-425. I have enjoyed listening to these loudspeakers so far and I'm sure I will continue to enjoy them in the future.

Figure 7: Finished Product (Photo Courtesy of Christopher Plummer)

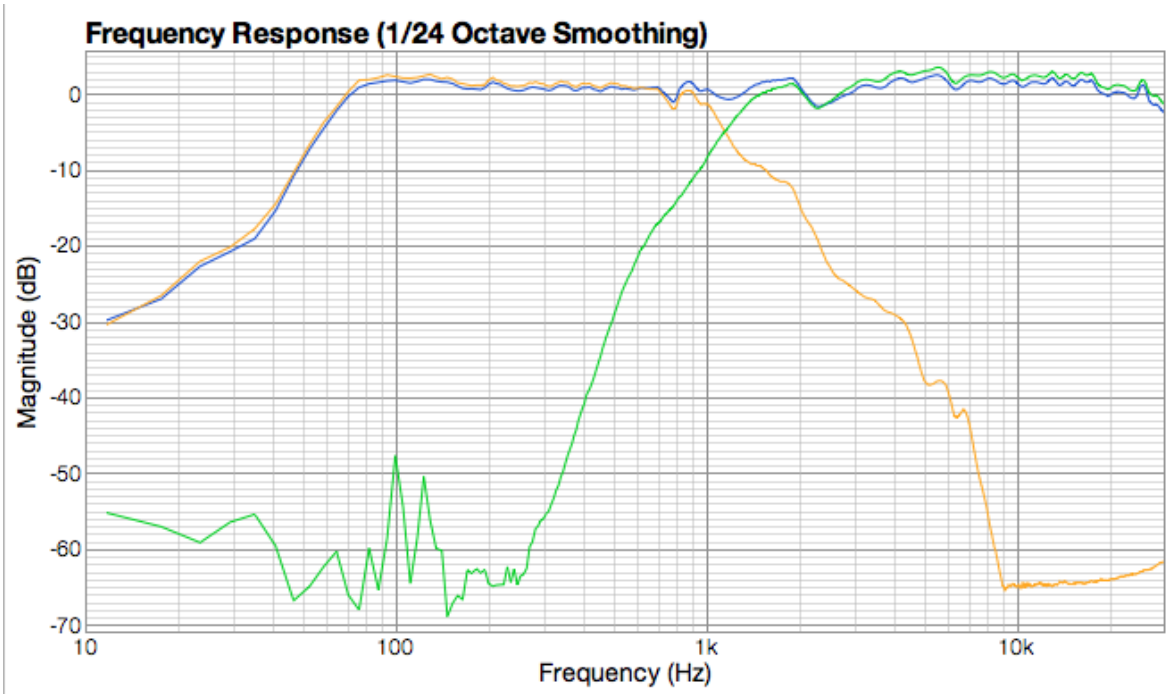
Final Test Results

Overall Loudspeaker Performance

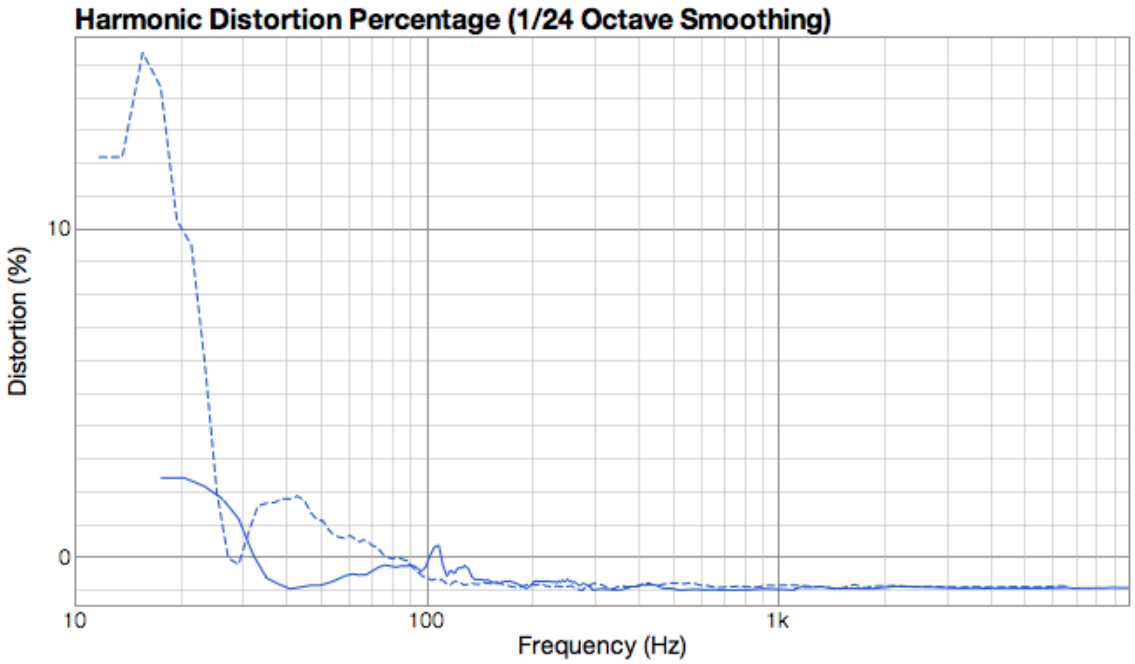
Frequency Response



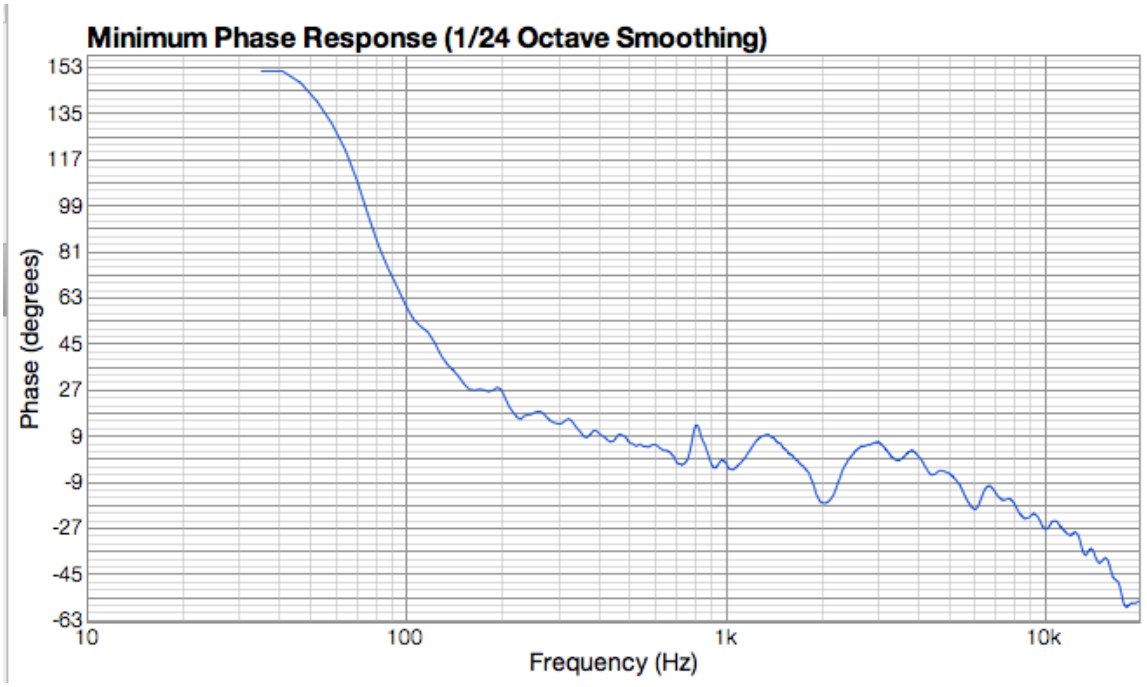
Integrated Frequency Response



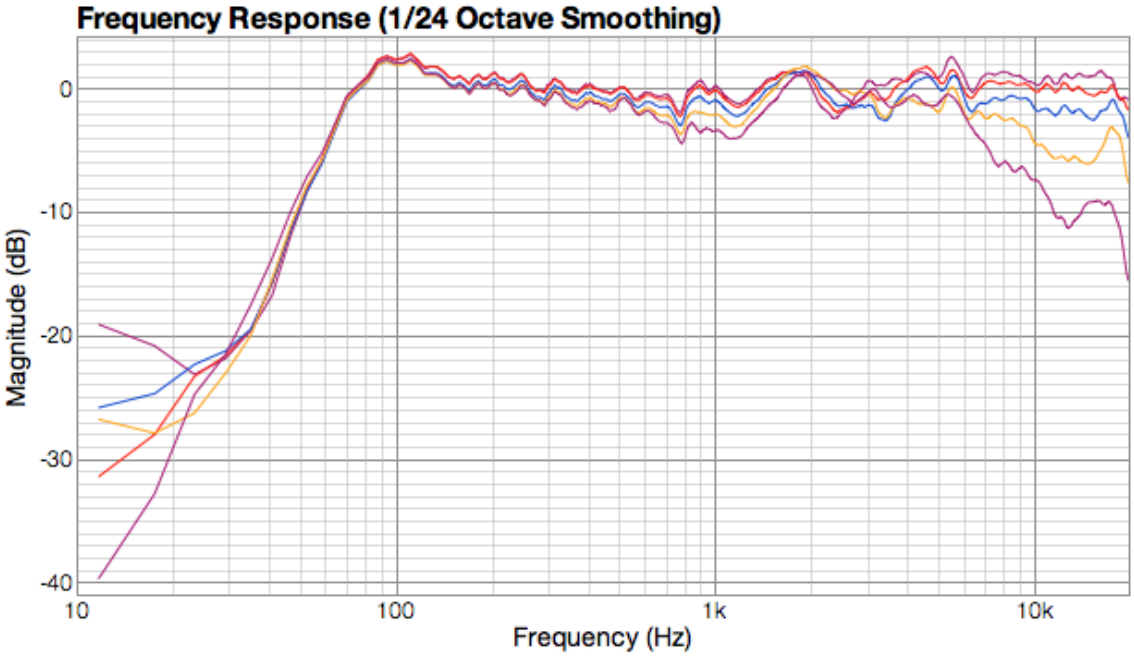
Harmonic Distortion Percentage



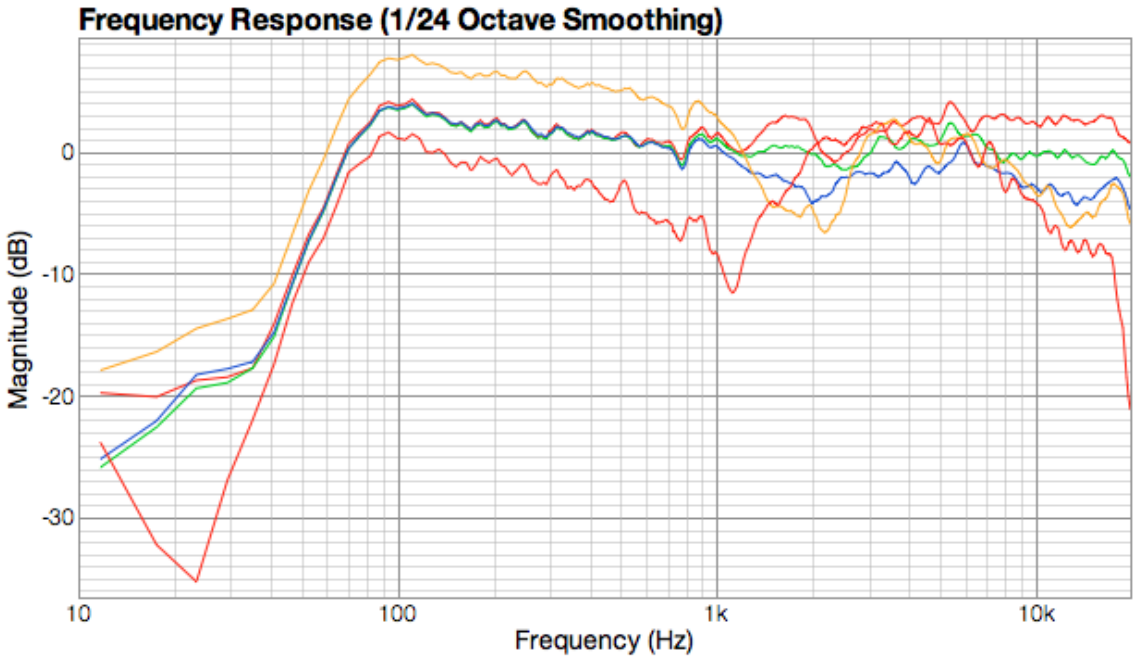
Minimum Phase



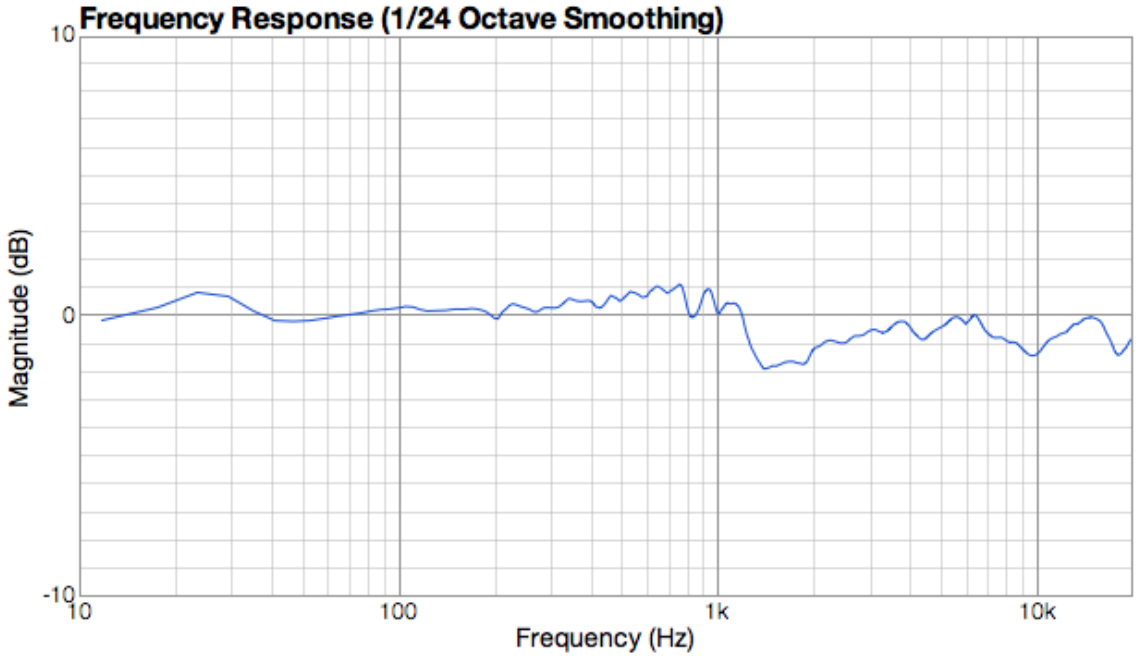
Horizontal Off-Axis Response



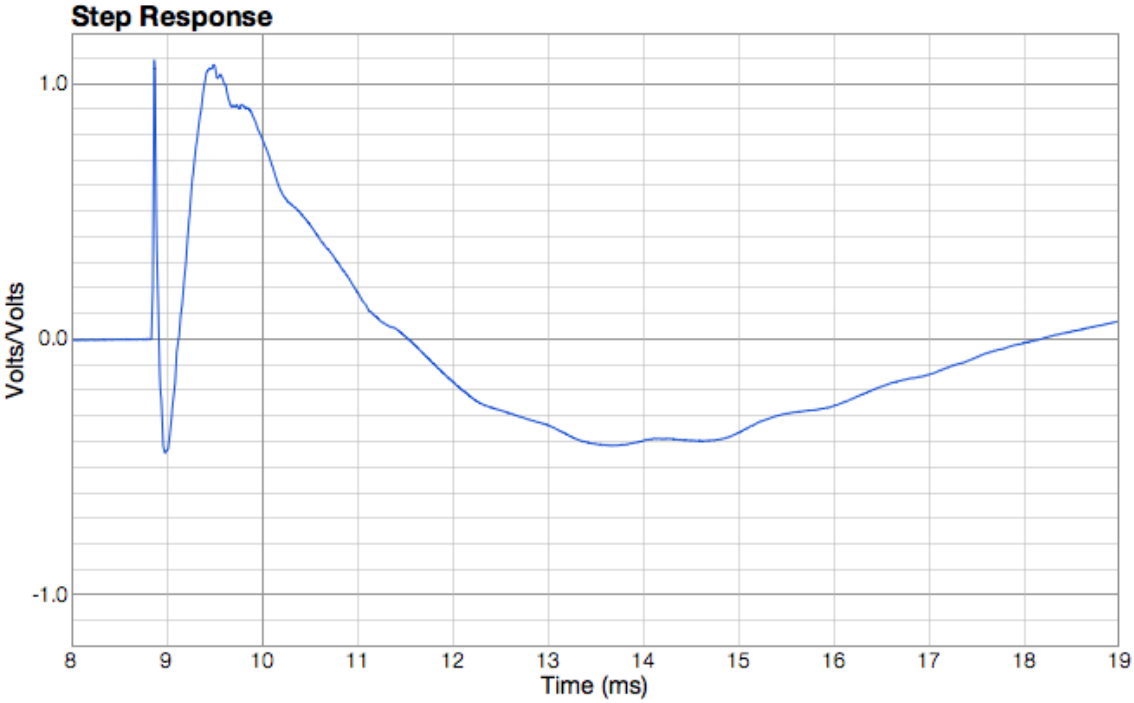
Vertical Off-Axis Response



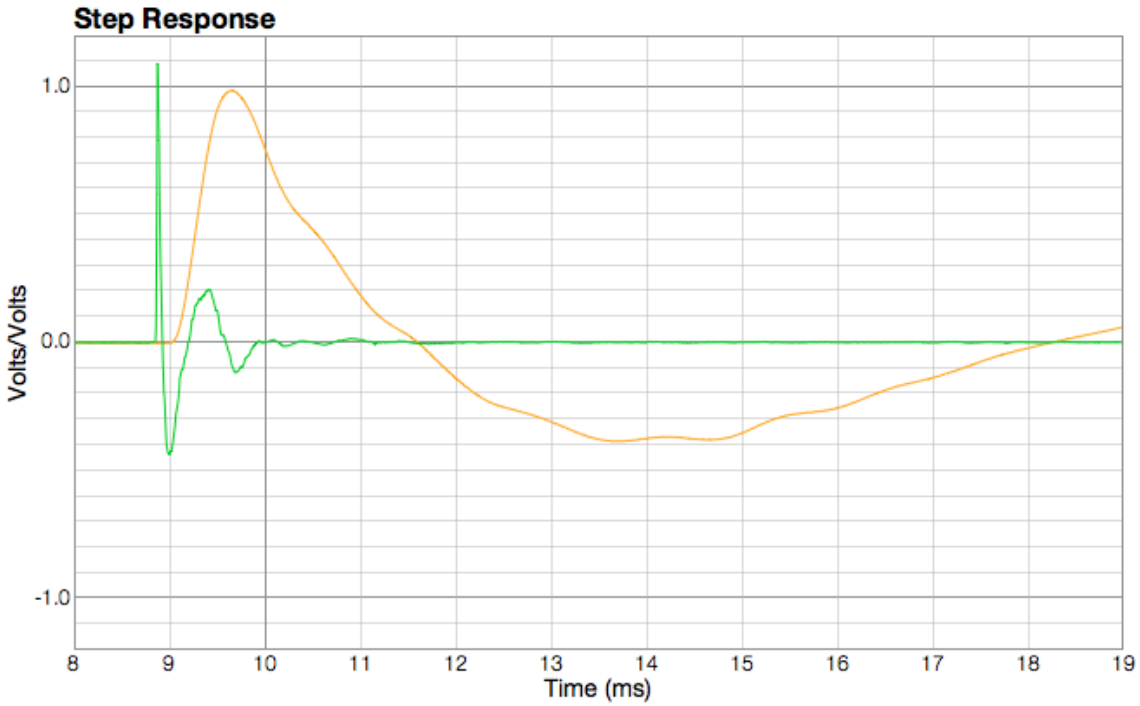
Difference Plot



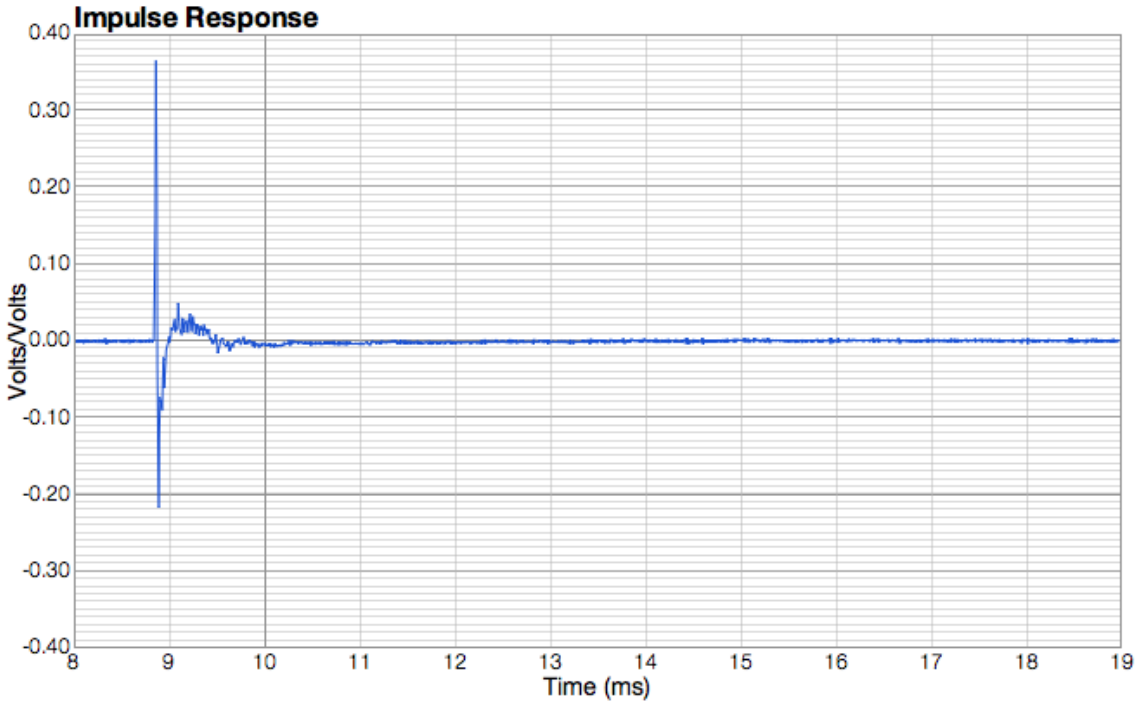
Step Response



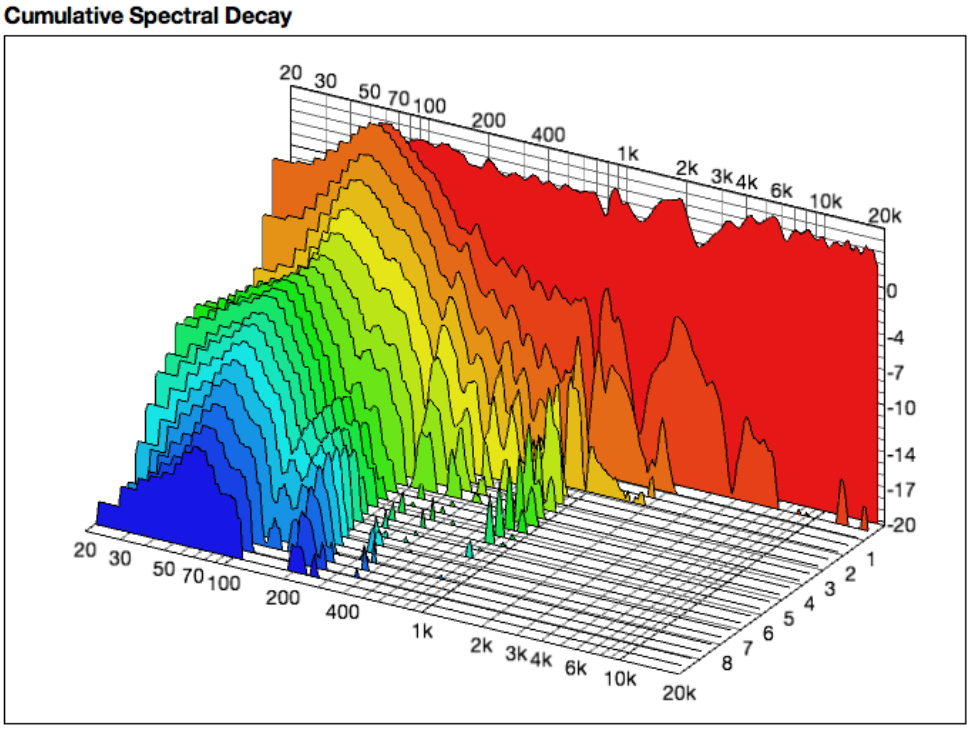
Integrated Step Response



Impulse Response



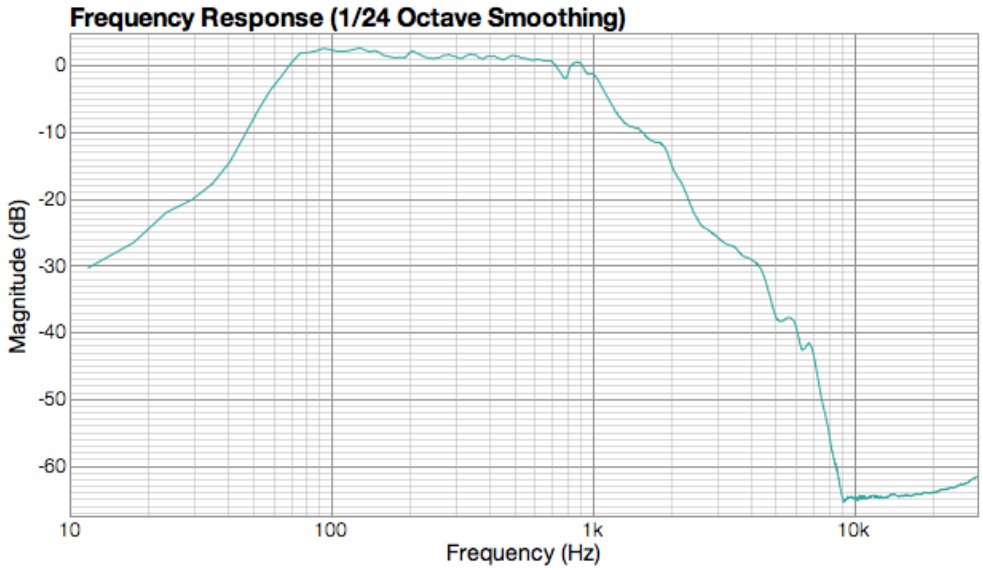
Waterfall Plot



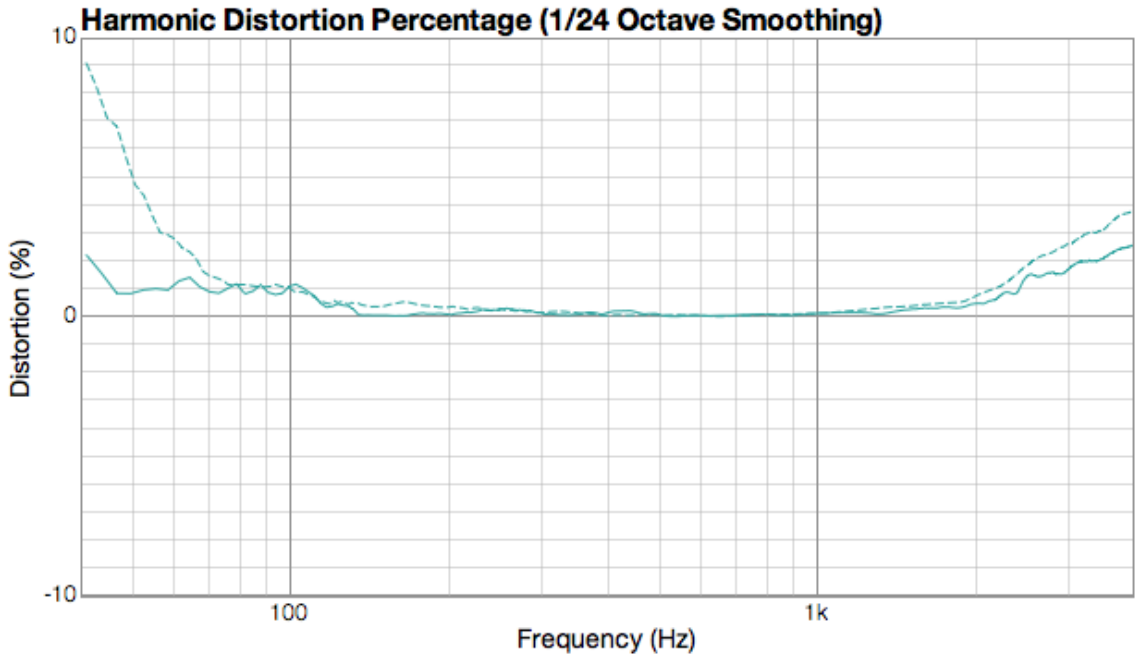
Individual Driver Reponses

Woofer

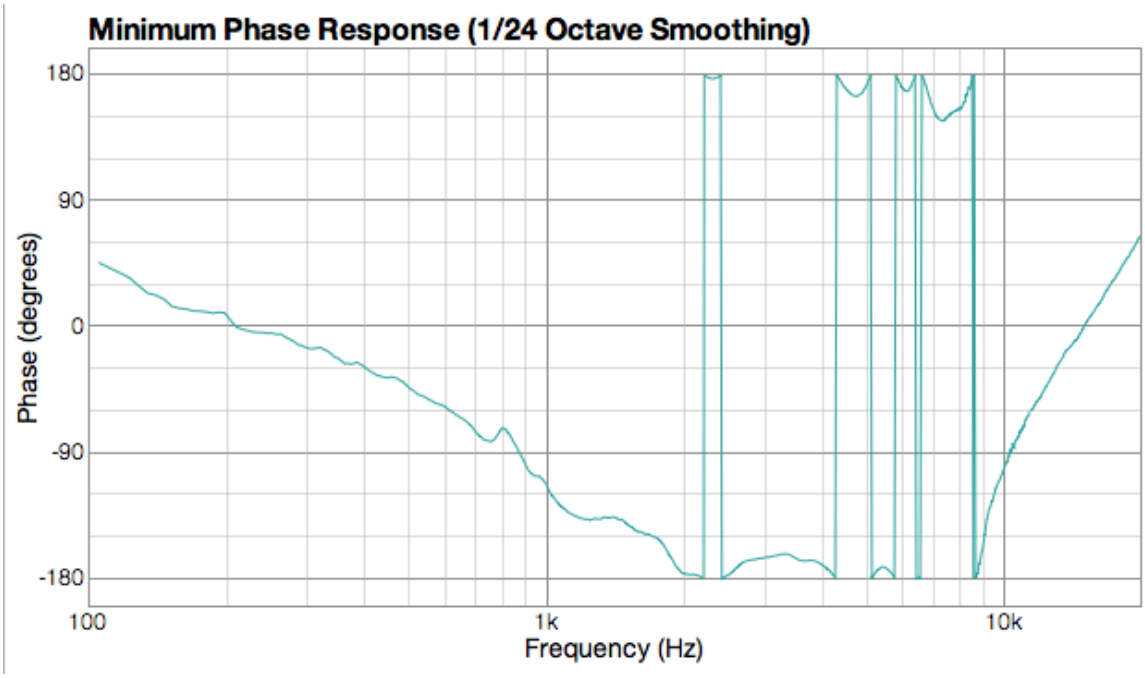
Frequency Response



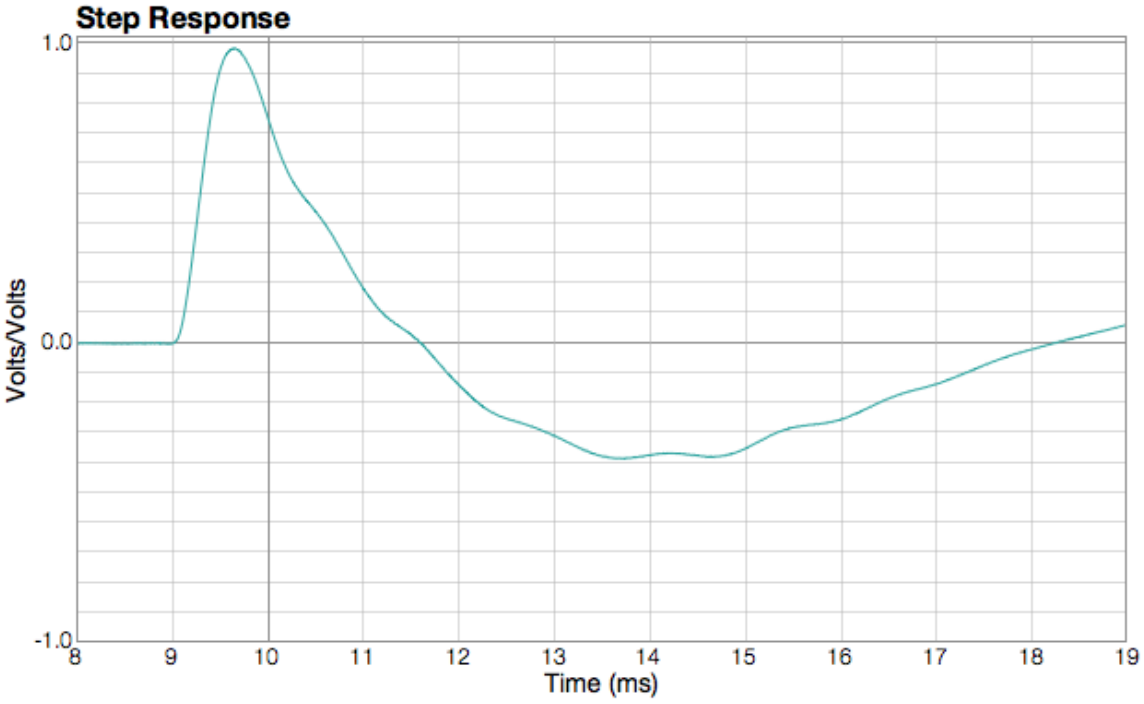
Harmonic Distortion



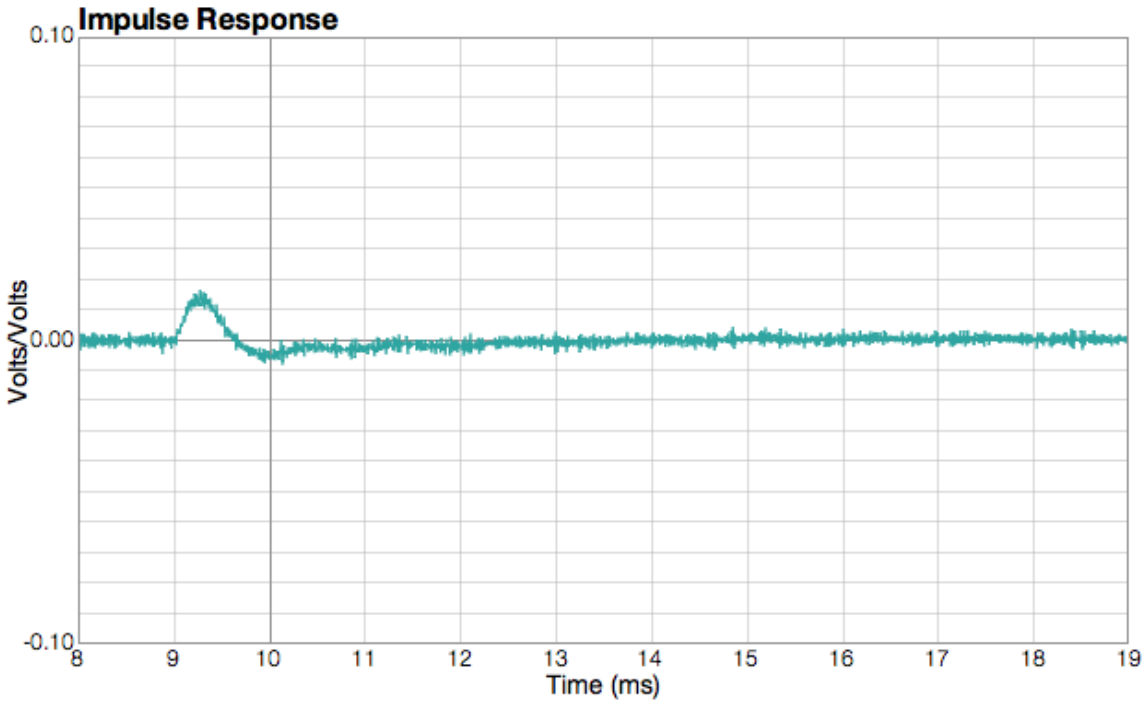
Minimum Phase



Step Response

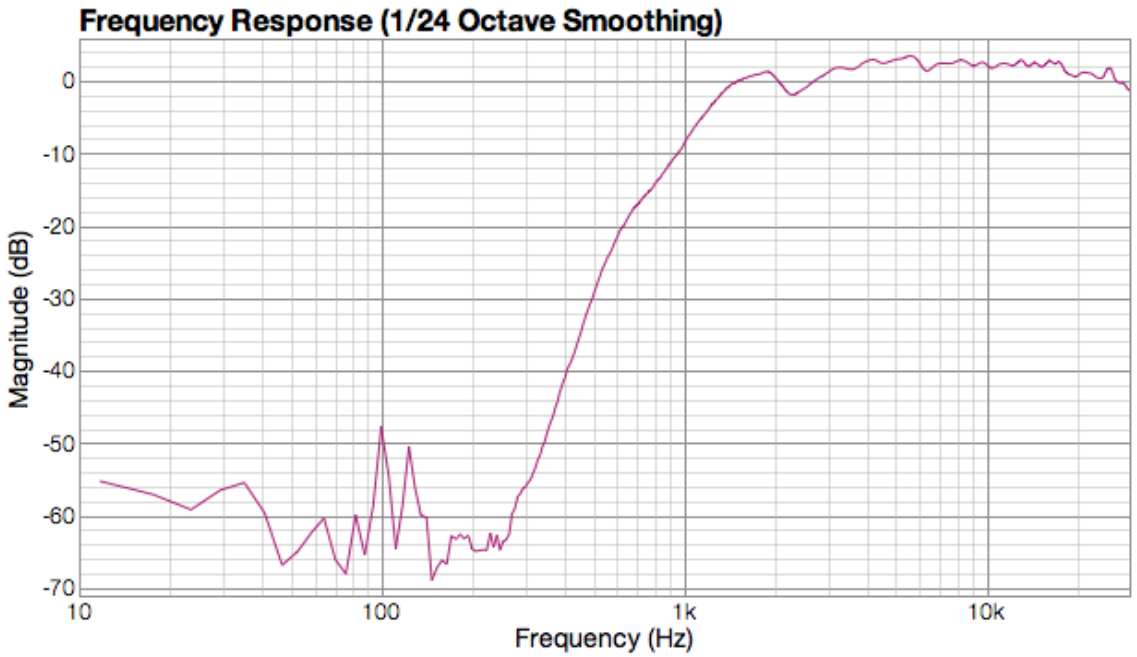


Impulse Response

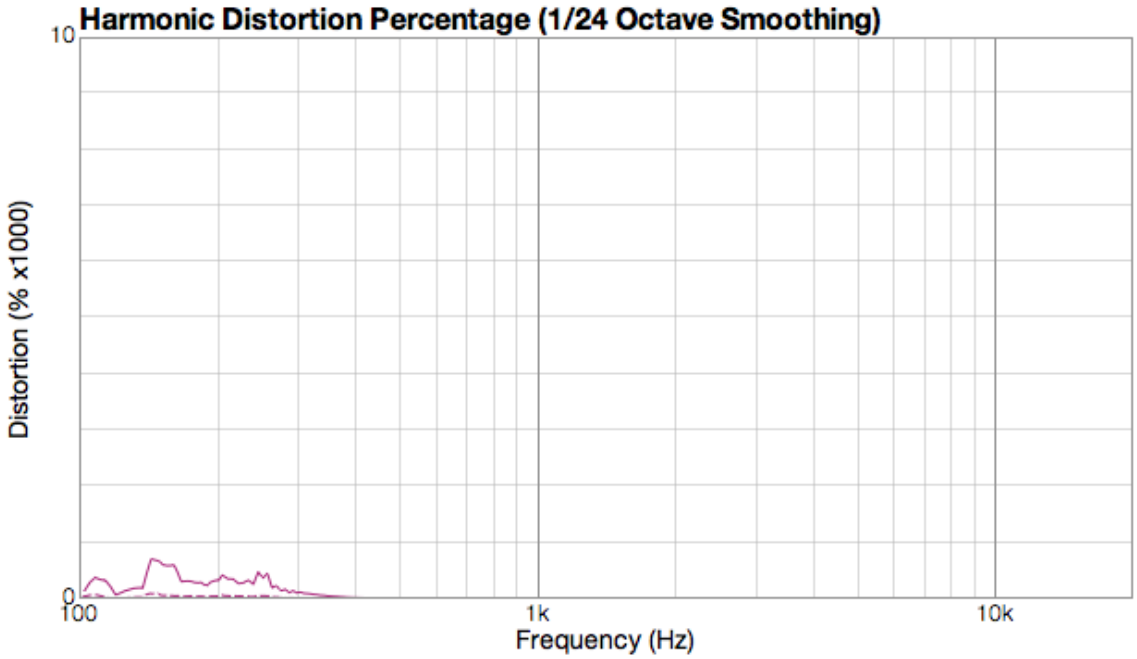


Tweeter

Frequency Response



Harmonic Distortion



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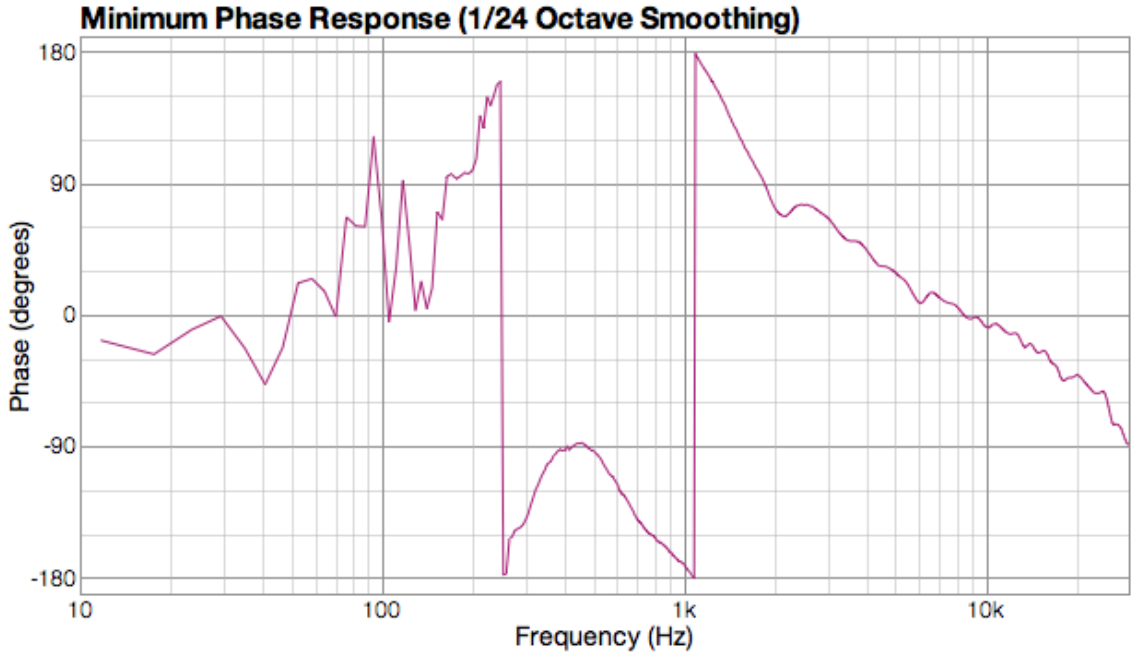
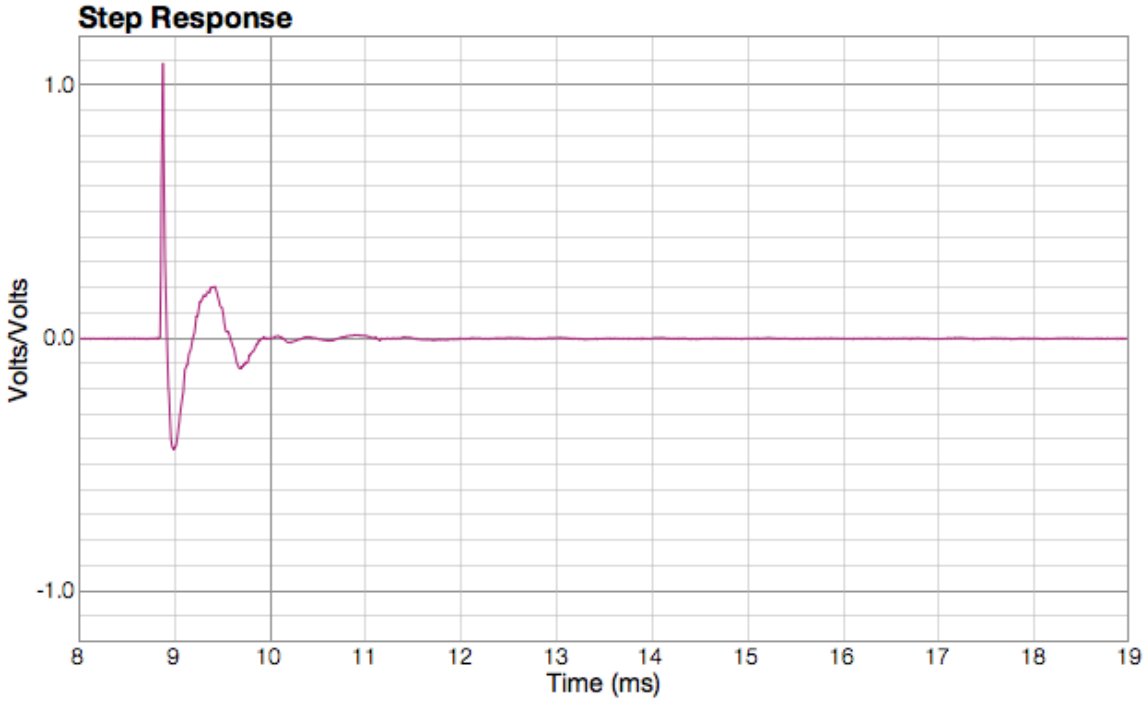


Step Response



Impulse Response