Spring 13

Griff '91: Design

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Functional Description

This loudspeaker system will be used primarily for my own personal music listening purposes. Specifically, these loudspeakers will be used for backward listening, meaning that they will be used to accurately reproduce an original signal.[1] These speakers will need to be accommodating to a college student with not a lot of space, meaning they will be fairly mobile, and will be able to fit on top of a medium sized desk, probably near a wall. Finally, this system will be achieved with a budget of $700.

[1] Moulton, David. *Total Recording: The Complete Guide To Audio Production and Engineering.* KIQ Productions, 2000, 313.

Design Goals

Size

As previously mentioned in the functional description (pg. 4), I intend to use these loudspeakers mounted on a medium sized desk. Therefore, the size of these speakers is going to need to be relatively small. My approximate listening axis is about 17 inches from the top of a medium sized desk. Considering this along with other elements of my functional description, I've determined that these loudspeakers will have dimensions of 16"x12"x20" (LxWxH). This would make the volume of them 2.22 ft^3 (62.93 L).

SPL Output

On the evening of January 25th, 2013, I measured my personal SPL preferences in Walker 210 on Michigan Tech's campus. Listening to a variety of different genres and various levels, I determined that my personal preference for loud listening was about 79 dBA. Expanded results are shown in Figure 1.
Taking these results into consideration with the intended function of these loudspeakers (music mixing), I've determined that the necessary maximum continuous SPL output of these loudspeakers will be 80 dB, with a crest factor of 15-20 dB to be able to handle occasional peaks, meaning a maximum peak output of 100dB/1ft. Mixing louder than that can pose some significant negative effects to my hearing if done for long periods.[2]

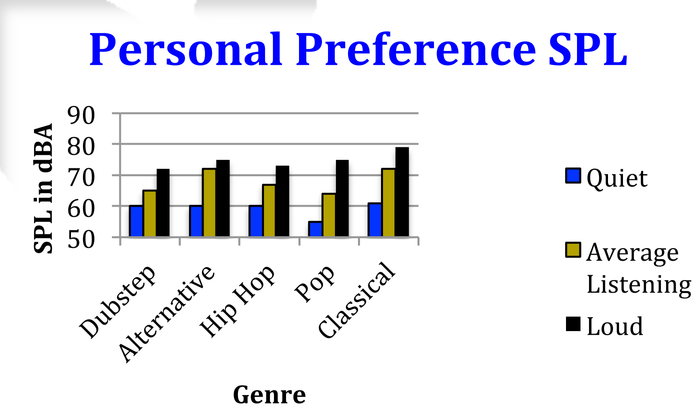

Figure 1

[2] Newell, Philip, and Keith Holland. *Loudspeakers For Music Recording and Reproduction.* Oxford: Elsevier Ltd., 2007, 251.

Bandwidth

Ideally, these loudspeakers would have low frequency extension all the way down to 20 Hz. Unfortunately, due to their smaller nature and to budget restrictions this is not really feasible. So in order to find an acceptable low frequency roll off point, I performed an experiment using Apple's Logic Pro, applying a high pass filter to some of my favorite songs from various genres in order to measure my personal preference for noticeable and acceptable low frequency roll off. The results are shown in Figure 2. Taking these results into consideration with the purpose of the system (music mixing), I have determined that these speakers need to have low frequency extension down to 70 Hz, allowing for acceptable response to low frequencies, necessary for music mixing.

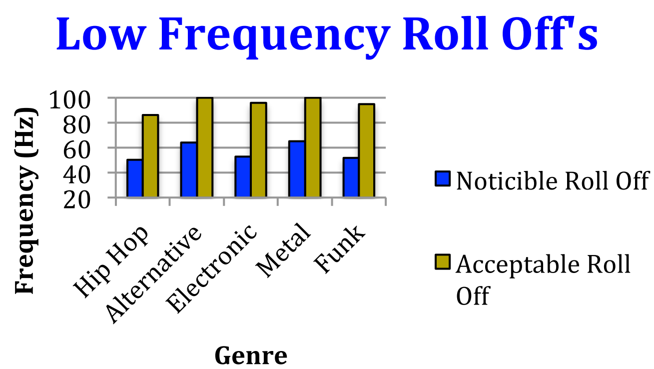

Figure 2

Directivity

I don't move around the room much when I mix music, and I tend to do it alone as well, so wide dispersion of sound is not necessary for these speakers. With that being said, dispersion should not be extremely narrow, as I do like to move my head occasionally.

Design Priorities

As shown in Figure 3, my design priorities in order of importance are size, bandwidth, and maximum SPL. I am a college student with not a lot of space, so these speakers will need to be able to function

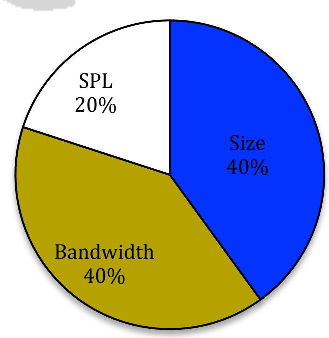

Figure 3

in small spaces, like a residence hall room or a small bedroom. The primary function of these speakers calls for accurate frequency response, which is why bandwidth is of equal importance to size. Maximum SPL is of less importance to me. I prefer not to listen and mix at very high levels, so I am willing to sacrifice dB for a more suitable size and better frequency response.

Visual Aesthetics

Visually, I would like these speakers to be simple yet aesthetically pleasing. These speakers will be painted blue, possibly with a good accent of some kind. This coincides with the name of this system, Griff ’91, named after an organization that I am a part of that uses a Griffin as its emblem, and true blue and pure gold as its colors.

Technical Details

Driver Size and Spacing

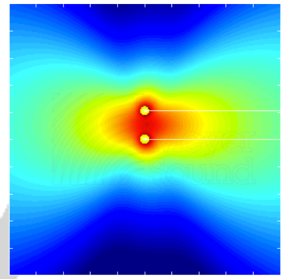

Figure 4

Figure 4 shows my desired directivity for these speakers. Taking the anticipated crossover frequency of 2.5kHz into account, the distance between the centers of the tweeter and mid range driver would need to be about 3” in order to achieve this. I anticipate the mid range drivers to be between 6” and 7” in diameter and for the tweeter to be 1” in diameter. As you can probably imagine, the ideal of 3” between the two centers is not really possible. My goal, then will be to come as close as I can to 3” between the centers in order to achieve my desired directivity.

Baffle Step

Using the formula developed by John L. Murphy, I can easily find the frequency at which a 3 to 6 dB drop in low frequency response occurs as a result of the size of the baffle of these loudspeakers. The formula is:

$$f_3 = 4560/W_B, \text{ Where } W_B \text{ is baffle width in inches-}$$ [3]

Using my maximum baffle width of 12” (stated earlier in the “Size” section on page 4), I found the calculated frequency to be 380 Hz.

Low Frequency Alignment

In order to extend the low frequency response of my speakers, I will be constructing a vented box. While this will result in a worse off transient response, I am willing to trade that off for the extended bass response of a vented box.

[3] Murphy, John L. *True Audio.* June 20, 2000. http://trueaudio.com/st_diff1.htm (accessed February 3, 2013)

Diffraction Effects

Figure 5 from Newell and Holland shows the diffraction effects of a cabinet with a sharp edge.[4] This edge diffraction can cause decreases in low frequency response due to the transition from baffled to unbaffled conditions at the edge of the cabinet. Edge diffraction can also cause uneven midrange response due to the "length differences from the diaphragm to different parts of the diffracting edges and on to the on-axis observation point." While diffraction can't be completely avoided, I plan to combat these issues by using contoured edges to make the baffled to unbaffled transitions less abrupt.[5]

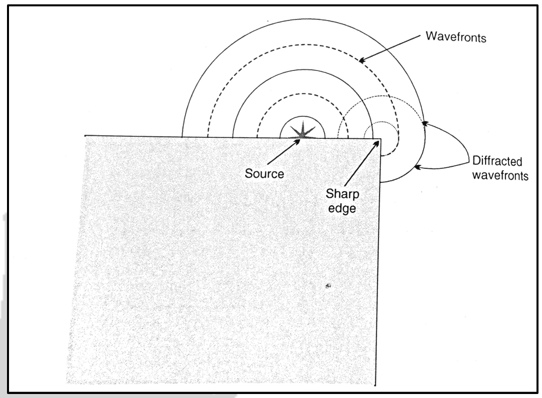

Figure 5

The frequency responses of certain cabinet shapes are shown in Figure 6.[6] Note the difference in responses between the cabinets with contoured edges and those without. I plan to shape my speakers like what is shown on the top right, a rectangular shape with contoured edges.

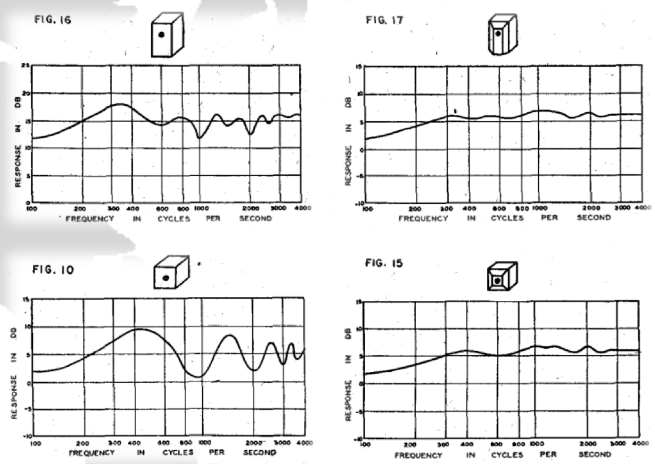

Figure 6

Wall Construction and Bracing

*Note: Drafting can be found in the Appendix

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4 Newell and Holland, *Loudspeakers*, 90.
5 Newell and Holland, *Loudspeakers*, 90.
6 Olson, Harry F. "Direct Radiator Loudspeaker Enclosures." *Audio Engineering*, November 1951: 38.

I will be constructing my cabinet walls using ¾" plywood for all of the outside walls. On the inside of the front and back walls, I will be using ¾" MDF in order to solidify them. For bracing, I will be using ¾" MDF in the shape of the figure 8, similar to what is shown in Figure 7.[7]

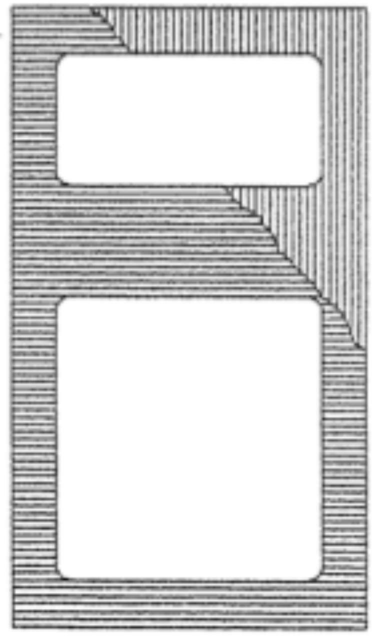


Figure 7

[7] North Creek Music Systems. *Cabinet Handbook.* 2nd Edition. Old Forge, New York: North Creek Music Systems, 1992.

Driver Selection

*Note: Manufacturer specification sheets for each driver below can be found in the Appendix

Tweeter Analysis and Selection

When it came to selecting tweeters, I wanted something that would offer a flat response above the crossover frequency, as well as offering the sensitivity necessary to reach my SPL output needs. Also, I needed to find something with a low enough resonant frequency to not cause any colorations. I ended up choosing the Vifa XT25TG30-04. Below are some more specifications and descriptions for the 5 tweeters that I evaluated.

Tweeter Name	Sensitivity	Max SPL (1ft)	X-Max	Fs	Size	Price
Tang Band 25-1719S	90 dB	109 dB	Ceramic Dome	800 Hz	1"	$31.58
Vifa XT25TG30-04	89 dB	110 dB	Ring Radiator	530 Hz	1"	$31.12
Fountek NeoCd2.0	97 dB	114 dB	Ribbon	Not specified	5"	$199.00
ScanSpeak Classic D2905/9300	90 dB	111 dB	Soft Dome	650 Hz	1"	$122.55
SEAS Prestige 27TDFC (H1189)	90 dB	109 dB	Soft Dome	550 Hz	1"	$50.70

Tang Band 25-1719S

Table 1 shows some specifications for the Tang Band 25-1719S tweeter. This tweeter reaches my SPL needs and also has a low enough resonant frequency, as I expect my crossover frequency to be somewhere around 2500 Hz. The frequency response of this tweeter is something that I liked as well. It appears to pretty flat throughout the spectrum that I plan to use it (appox. 2kHz-20kHz). Finally, at a price of just over $31, it fits well into my budget. One troubling thing, however, is that off-axis response is not shown on it's response plot.

Tweeter Name	Sensitivity	Max SPL (1ft)	Style	Fs	Size	Price
Tang Band 25-1719S	90 dB	109 dB	Dome	800 Hz	1”	$31.58

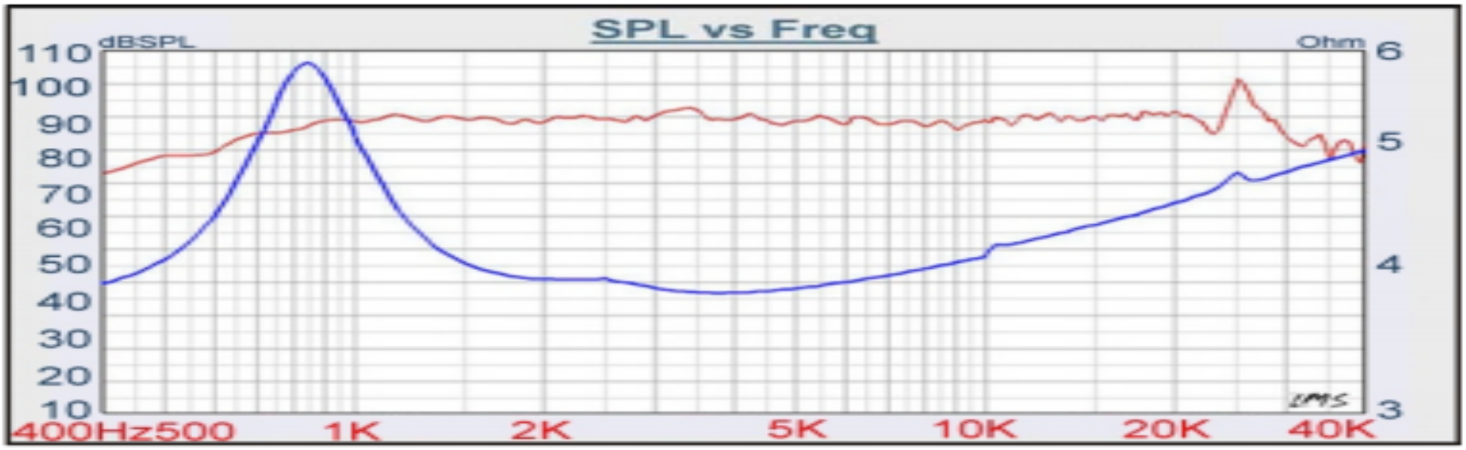
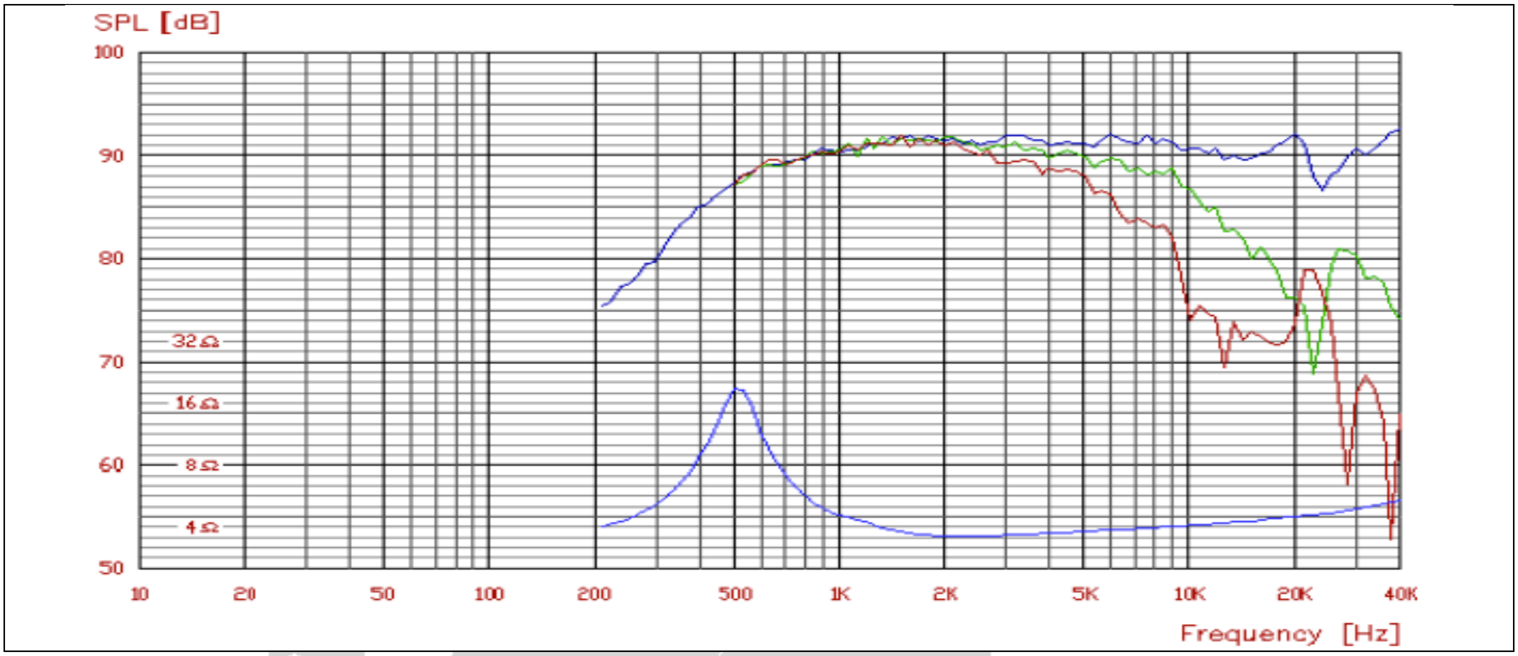


Table 1

Vifa XT25TG30-04

Table 2 shows specifications for the Vifa XT25TG30-04. This tweeter is appealing to me because of its flat frequency response. It stays within about 2 dB of 90 dB through its entire intended use spectrum. Also, its sensitivity exceeds my needs, and its resonant frequency is low enough to not cause any real issues for me. The price is very good as well.

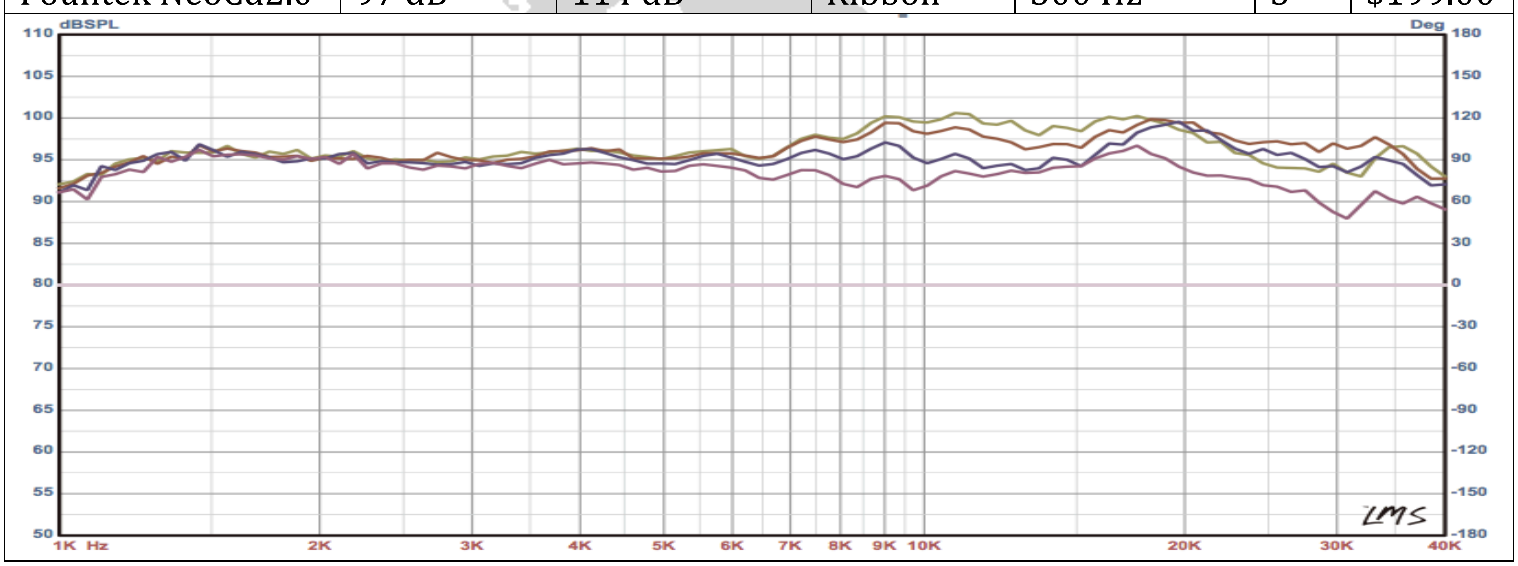
Tweeter Name	Sensitivity	Max SPL (1ft)	Style	Fs	Size	Price
Vifa XT25TG30-04	89 dB	110 dB	Ring Radiator	530 Hz	1”	$31.12



Fountek NeoCd2.0

Figure 3 shows specifications for the Fountek NeoCd2.0. A ribbon tweeter, I was impressed by steady frequency response throughout such a large spectrum. However, the price is a bit too steep for me to try out.

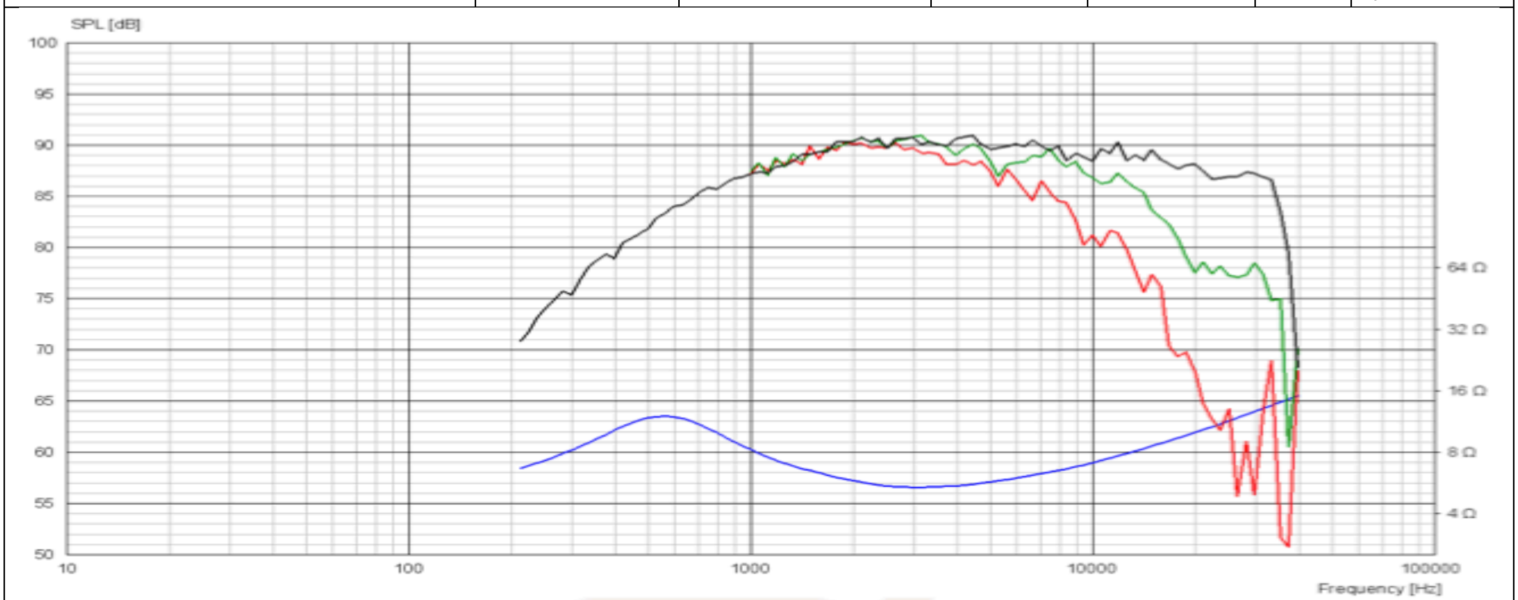
Tweeter Name	Sensitivity	Max SPL (1ft)	Style	Fs	Size	Price
Fountek NeoCd2.0	97 dB	114 dB	Ribbon	300 Hz	5”	$199.00



ScanSpeak Classic D2905/9300

Figure 4 shows specifications for the ScanSpeak Classic D2905/9300. The frequency response of this tweeter is pretty impressive, staying pretty flat until about 15kHz, where it begins to fall. However, like the Fountek ribbon tweeter, this tweeter is a little bit out of my price range.

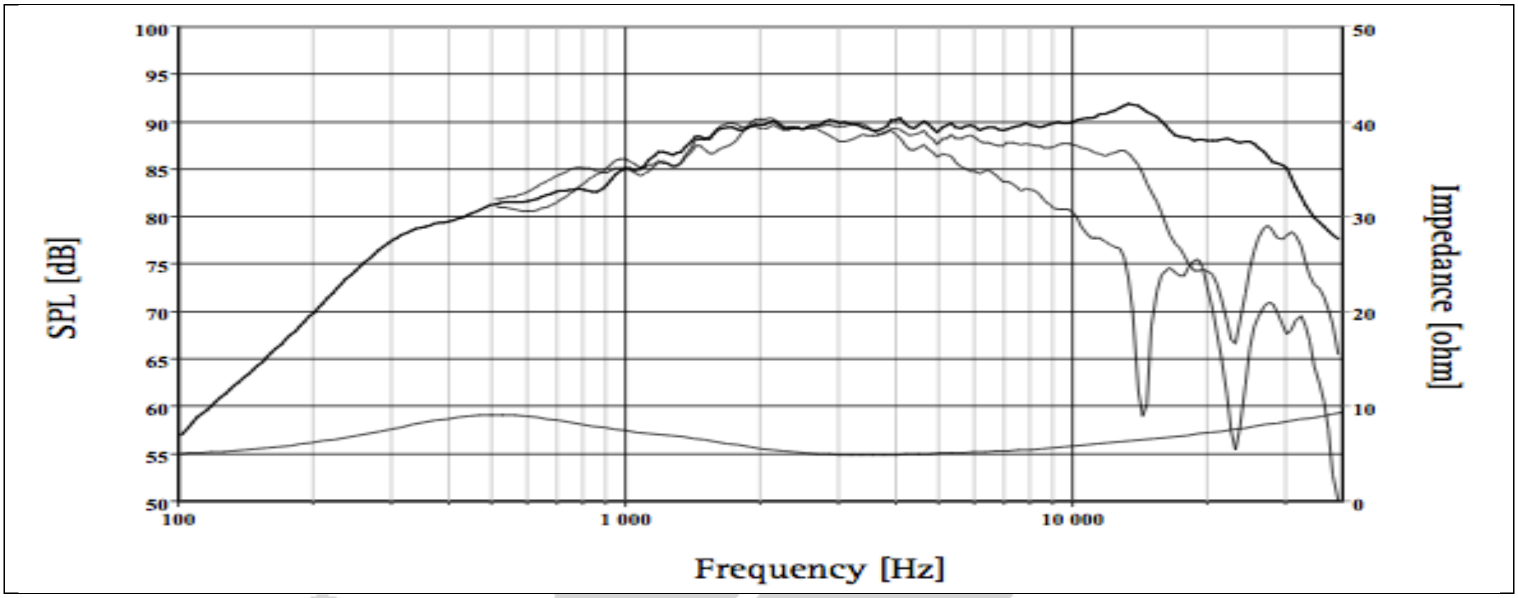
Tweeter Name	Sensitivity	Max SPL (1ft)	Style	Fs	Size	Price
ScanSpeak Classic D2905/9300	90 dB	111 dB	Dome	650 Hz	1”	$122.55



SEAS Prestige 27TDFC (H1189)

This tweeter is one that I actually like a lot. At 109 dB, its Max SPL fits well into my needs, and its frequency response is very flat until the higher frequencies. Also, its resonant frequency is low enough to not cause any problems for me. Lastly, the price is very appealing, at just over $50 apiece.

Tweeter Name	Sensitivity	Max SPL (1ft)	Style	Fs	Size	Price
SEAS Prestige 27TDFC (H1189)	90 dB	109 dB	Dome	550 Hz	1”	$50.70



Woofer Analysis and Selection

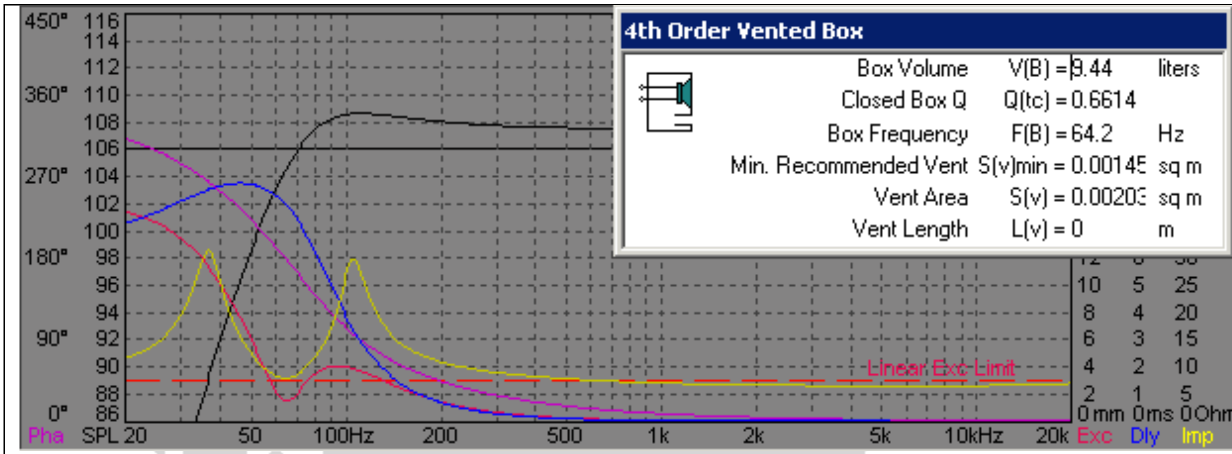
When it came to selecting a woofer. I wanted to get as low as I possibly could, while also achieving a flat frequency response. Below are 5 woofers that evaluated closely before making my driver decision. The driver that I chose was the SB Acoustics SB17NRXC35.

Woofer Name	Sensitivity	Max SPL (1ft)	X-Max	P(t)	Fs	Size	Price
Tang Band W5-1611SAF	90 dB	107 dB	3mm	56W	60 Hz	5”	$50.32
HiVi F8	87 dB	104 dB	5mm	60W	36 Hz	8”	$73.74
Peerless 830883	87.5 dB	104.5 dB	5.6mm	60W	52 Hz	6.5”	$79.14
ScanSpeak Classic P17WJ00	88 dB	109 dB	4mm	150W	37 Hz	6.5”	$76.90
SB Acoustics SB17NRXC35-8	89 dB	106 dB	5.5mm	60W	32 Hz	6”	$48.00

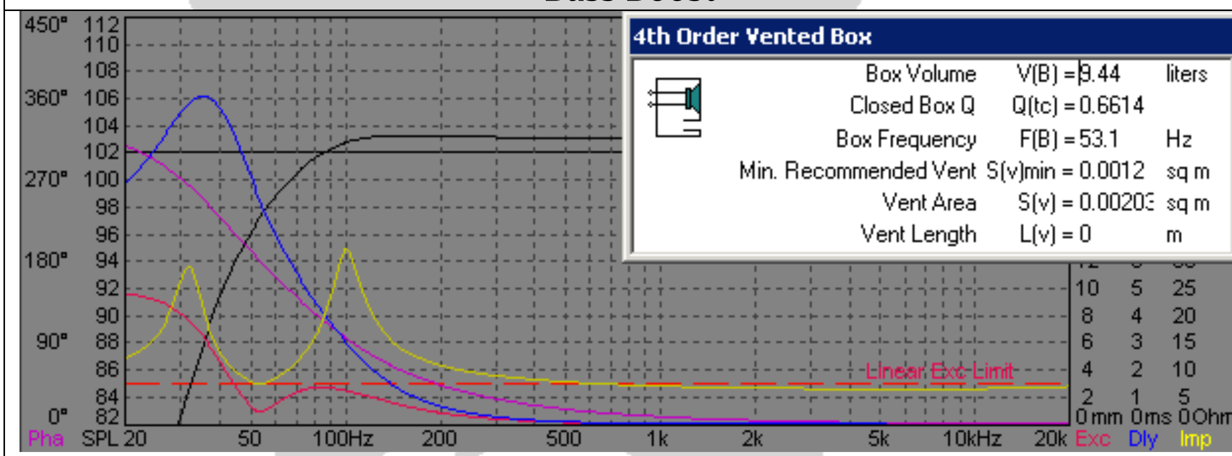
Tang Band W5-1611 SAF

I like this Tang Band woofer because of its tight frequency response and its price. However, its low Xmax and its relatively high F3 trouble me. Also, in order to achieve ideal performance, a very small enclosure is necessary. I am designing something small, but not *that* small.

Woofer Name	Sensitivity	Max SPL (1ft)	X-max	P(t)	Size	Price
Tang Band W5-1611SAF	90 dB	107 dB	3mm	56W	5”	$50.32



Bass Boost



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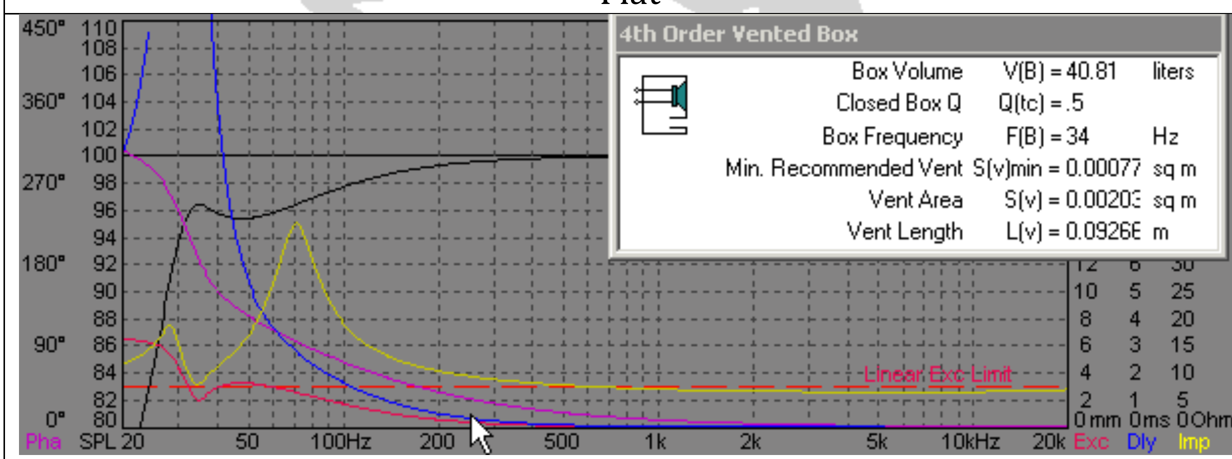
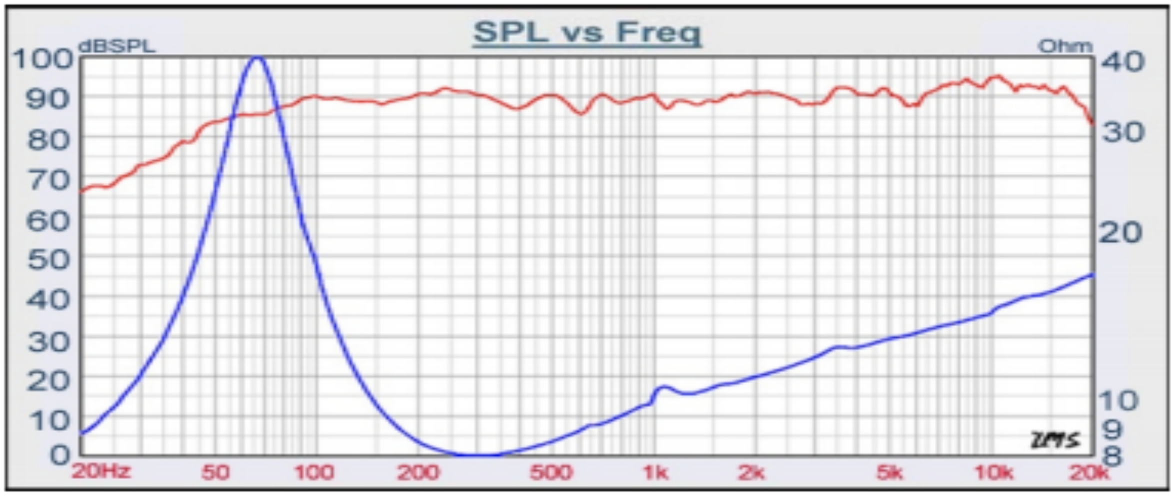


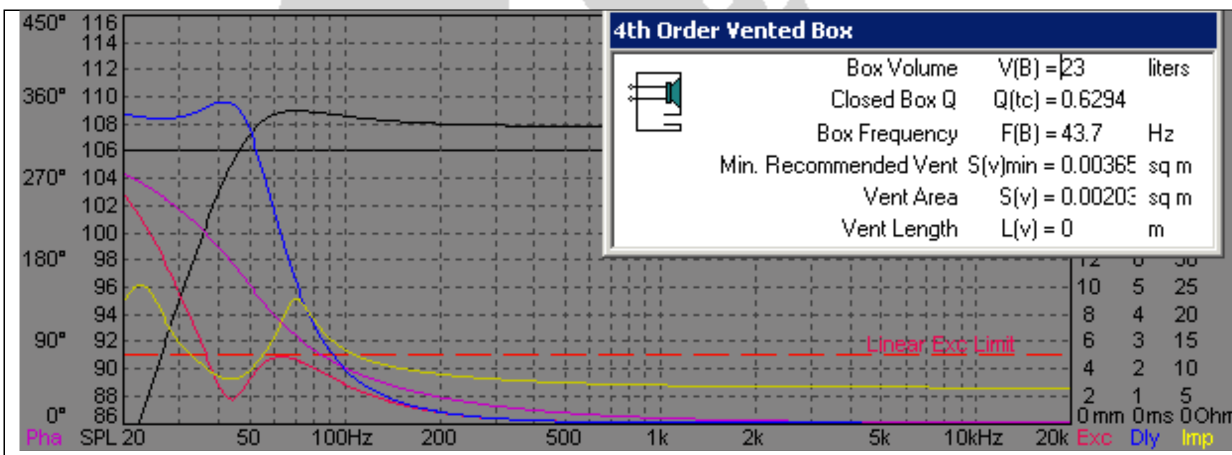
Extended Shelf



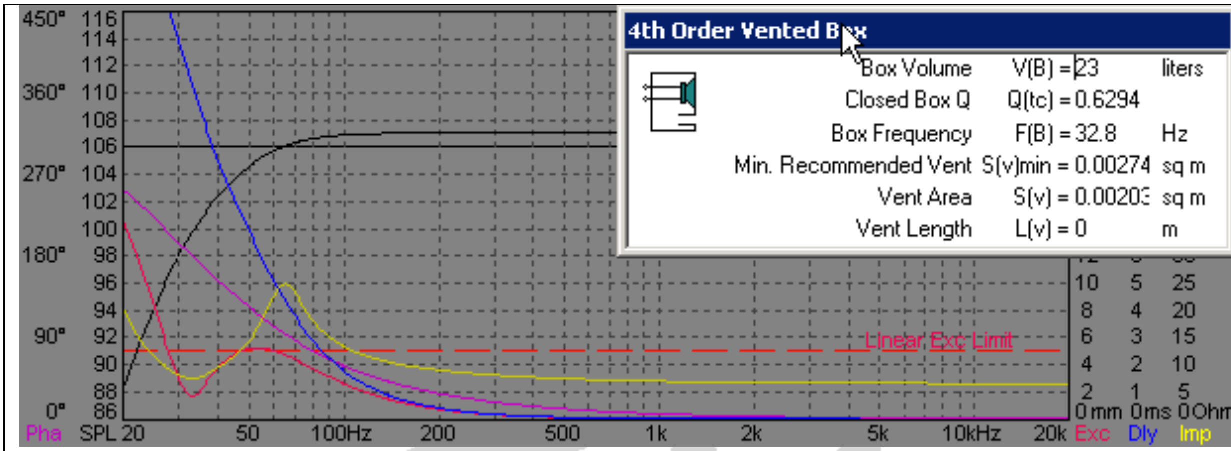
HiVi F8

The HiVi F8 is appealing to me for a few reasons. First off, I like the low F_3. I also like that when this driver is given max power it is just barely hitting its max excursion. One other aspect that I like is its aesthetic quality. Its yellow color follows my color scheme. While it's not necessarily a top priority, it is still a bonus. There are a couple of trouble spots in its frequency response such as dip at 850 Hz.

Woofer Name	Sensitivity	Max SPL (1ft)	X-Max	P(t)	Fs	Size	Price
HiVi F8	87 dB	104 dB	5mm	60W	36 Hz	8"	$73.74



Bass Boost



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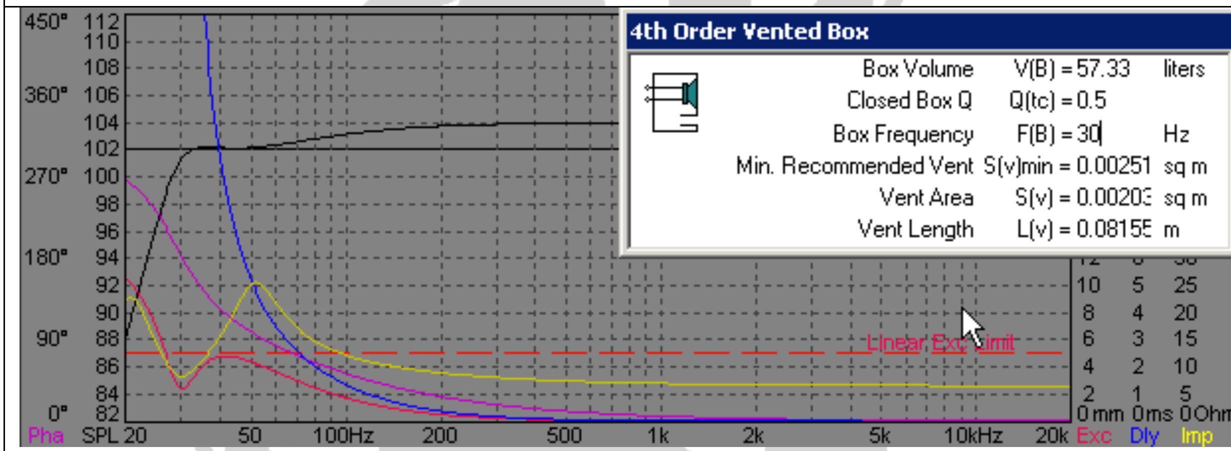

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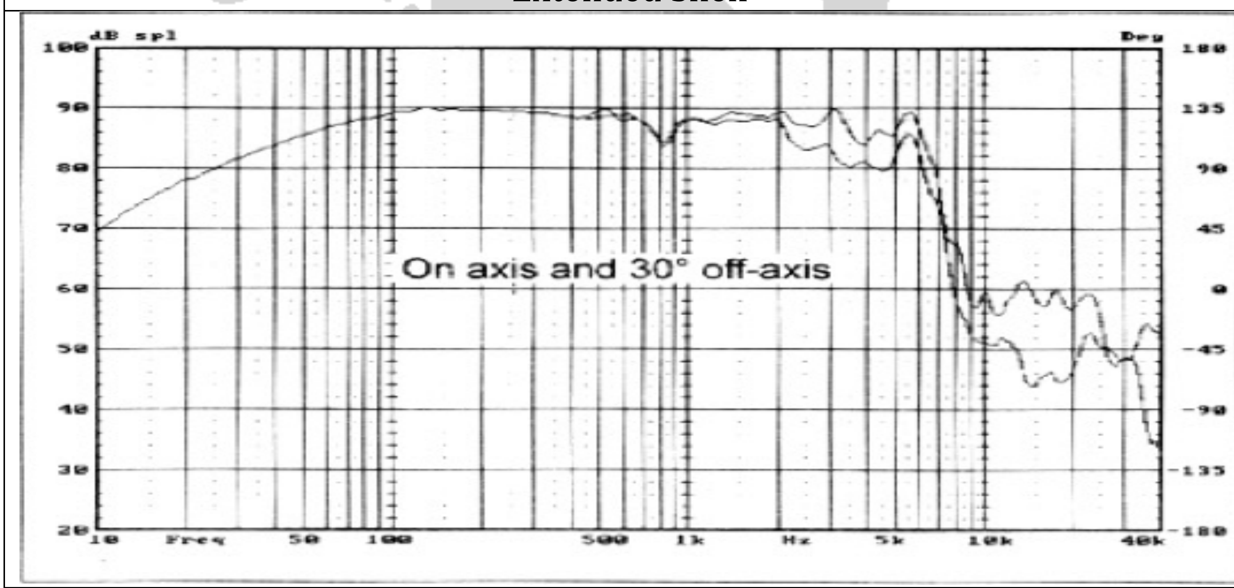
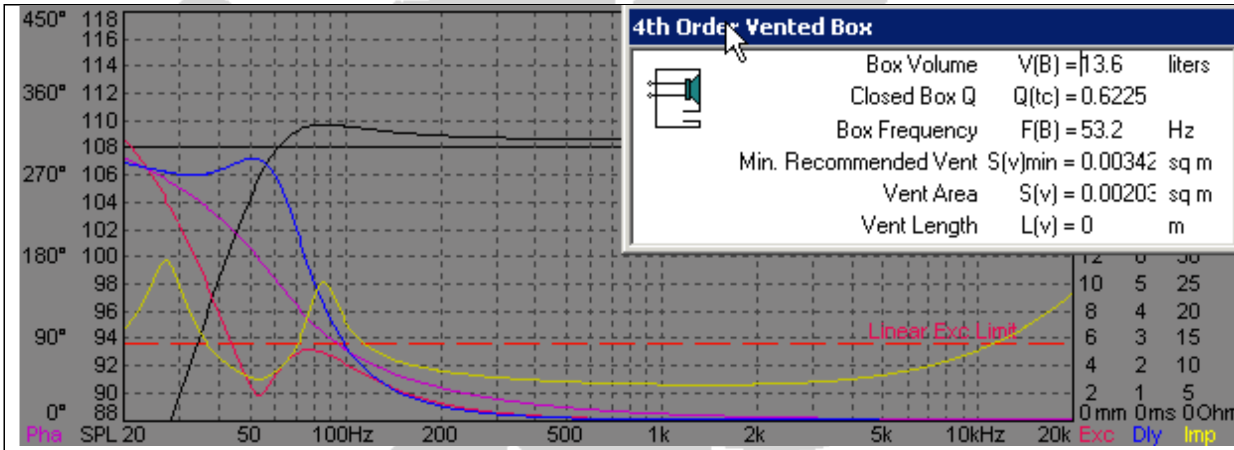


Peerless 830883

There are some things that I really like about this Peerless woofer, like its tight response. However, in order to achieve its max potential, a small box size is necessary, even smaller than what I am hoping to make. Its sensitivity works for me, and its max SPL is suitable as well. The price is a little bit high but is in my range.

Woofer Name	Sensitivity	Max SPL (1ft)	X-Max	P(t)	Fs	Size	Price
Peerless 830883	87.5 dB	104.5 dB	5.6mm	60W	52 Hz	6.5"	$79.14



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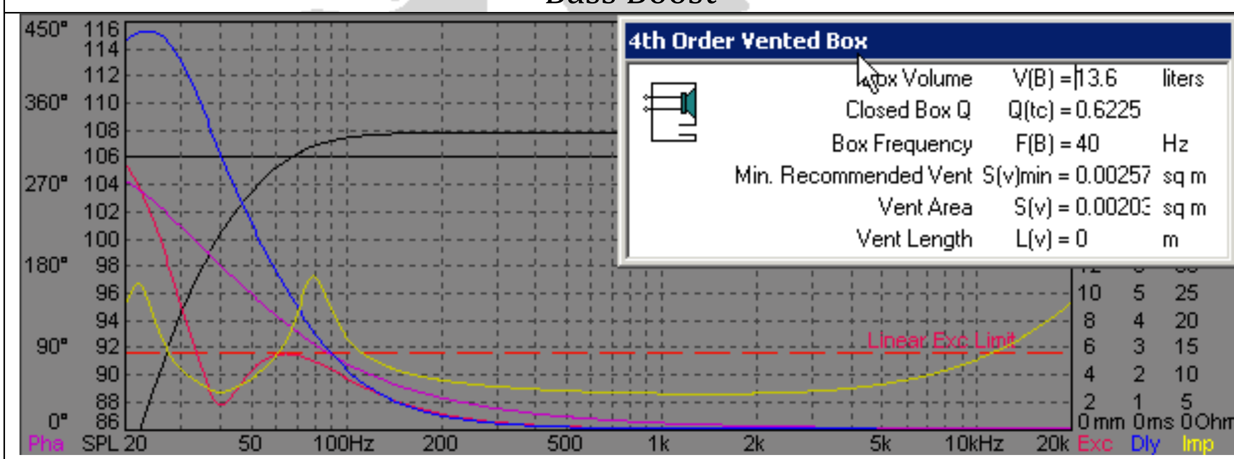

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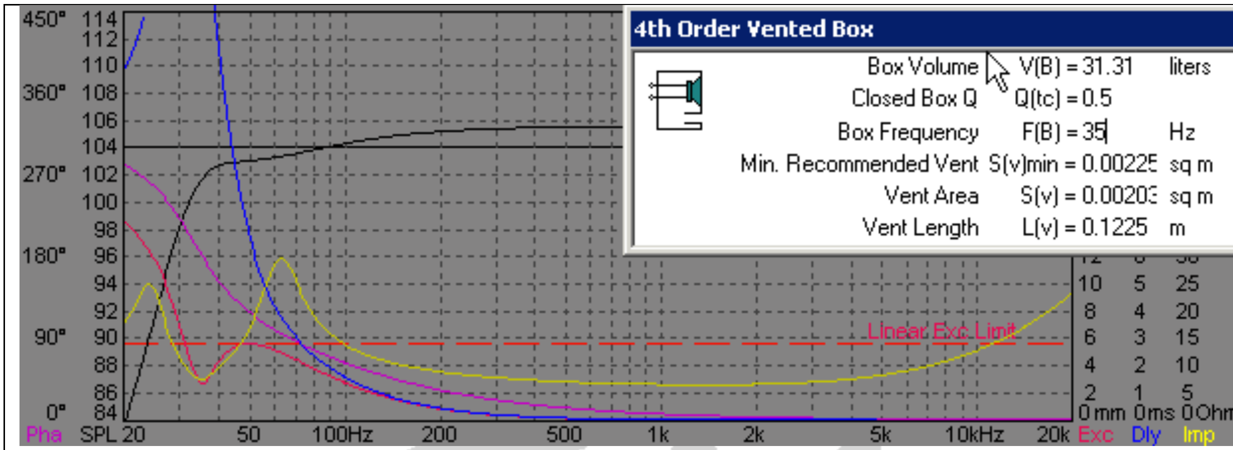

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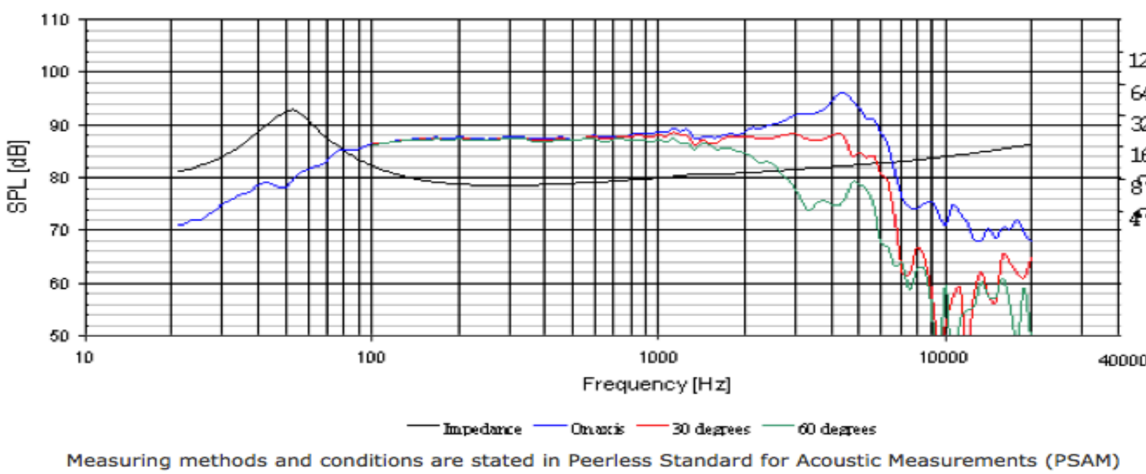
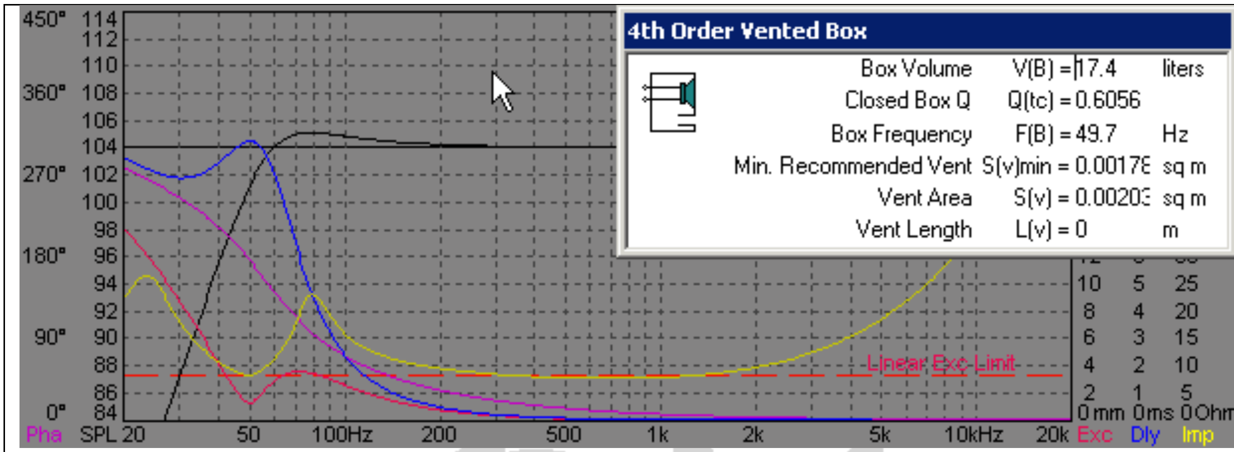


ScanSpeak Classic P17WJ00

Some good qualities of this ScanSpeak woofer are that it can get loud and it can get low. However, when it is given max power it far surpasses its max excursion limit. I'm not looking for distortion. Also, the price is a little bit on the high end of my range.

Woofer Name	Sensitivity	Max SPL (1ft)	X-Max	P(t)	Fs	Size	Price
ScanSpeak Classic P17WJ00	88 dB	109 dB	4mm	150W	37 Hz	6.5”	$76.90



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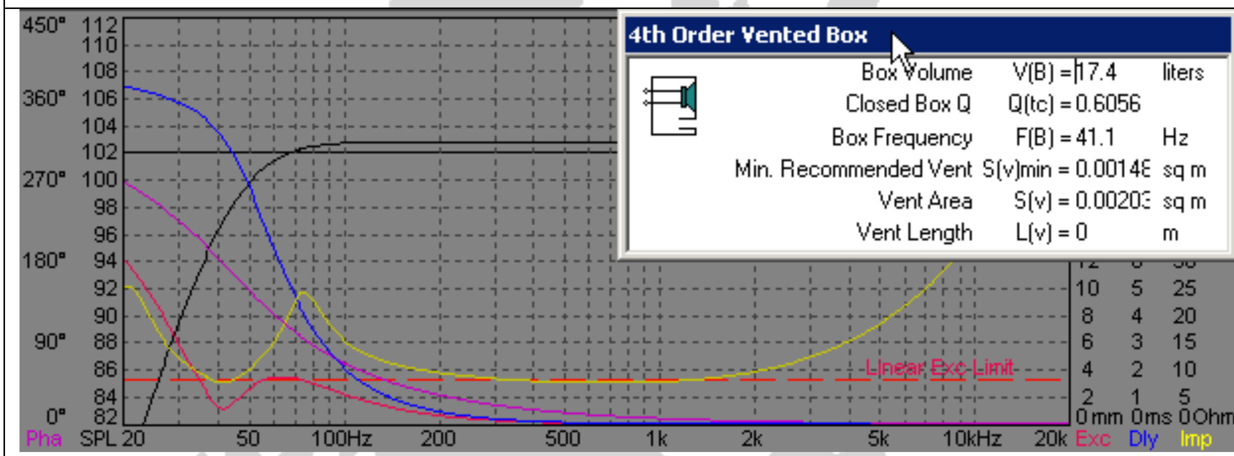

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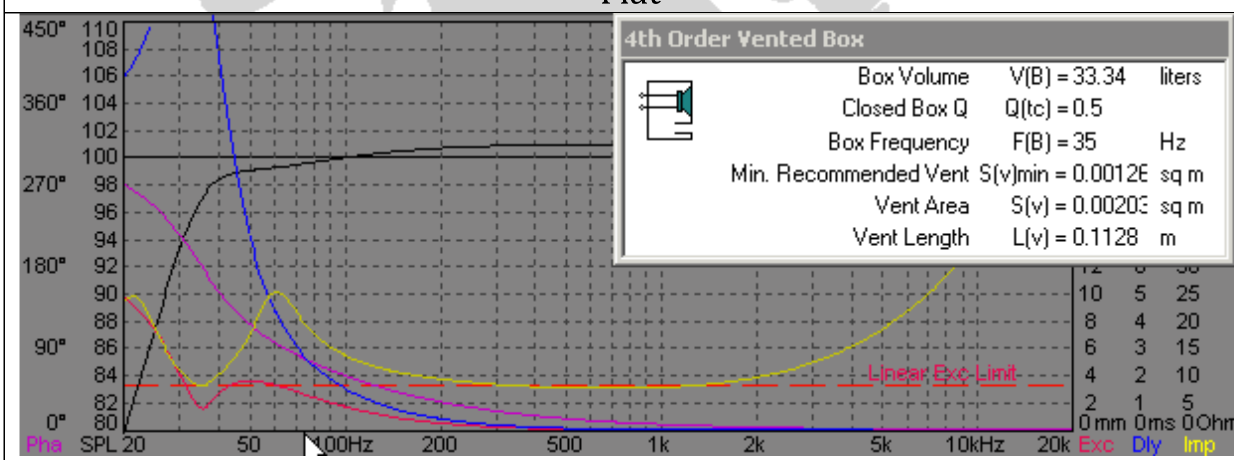

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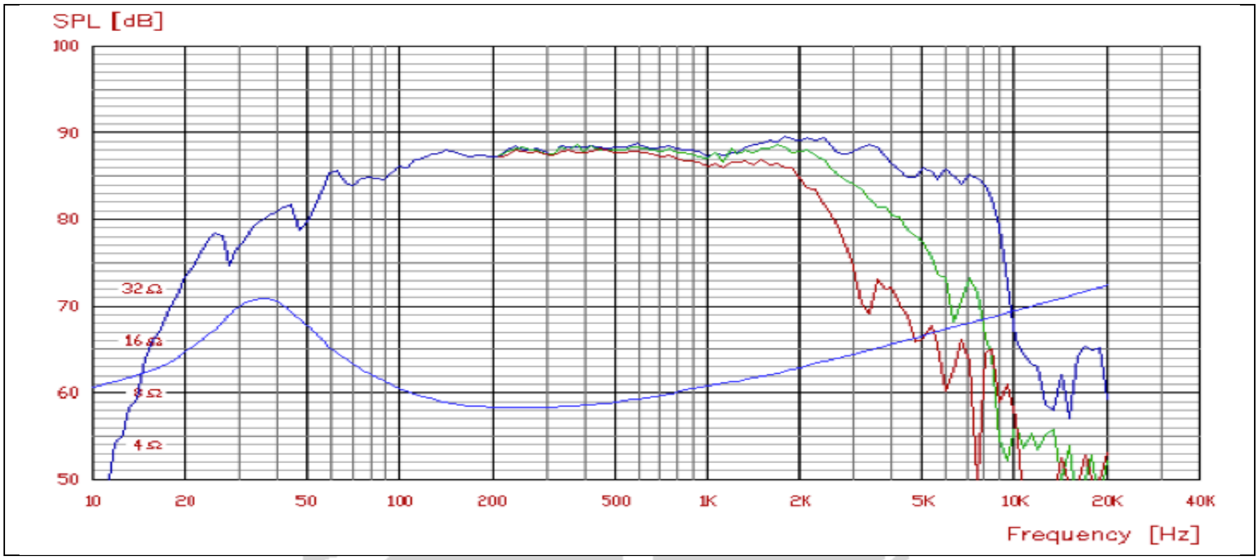
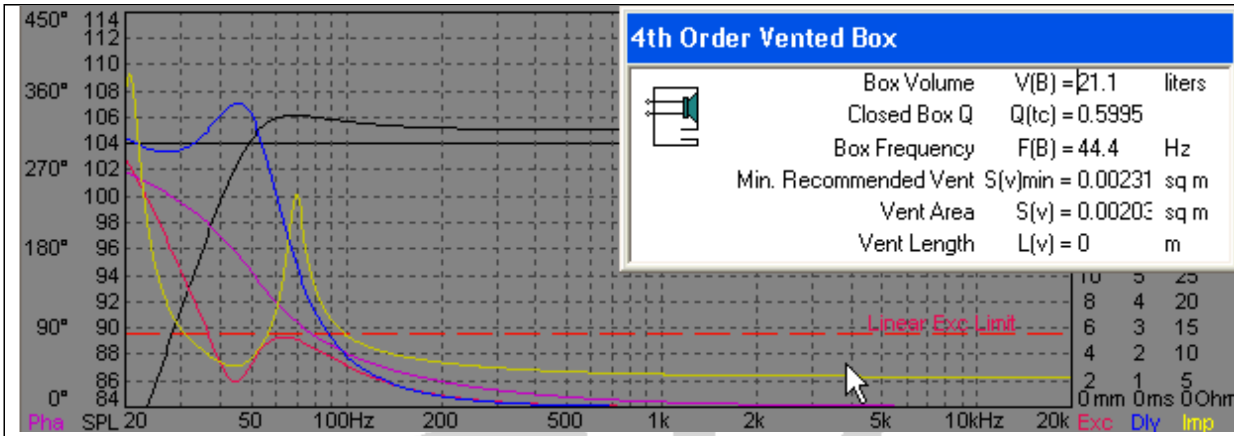


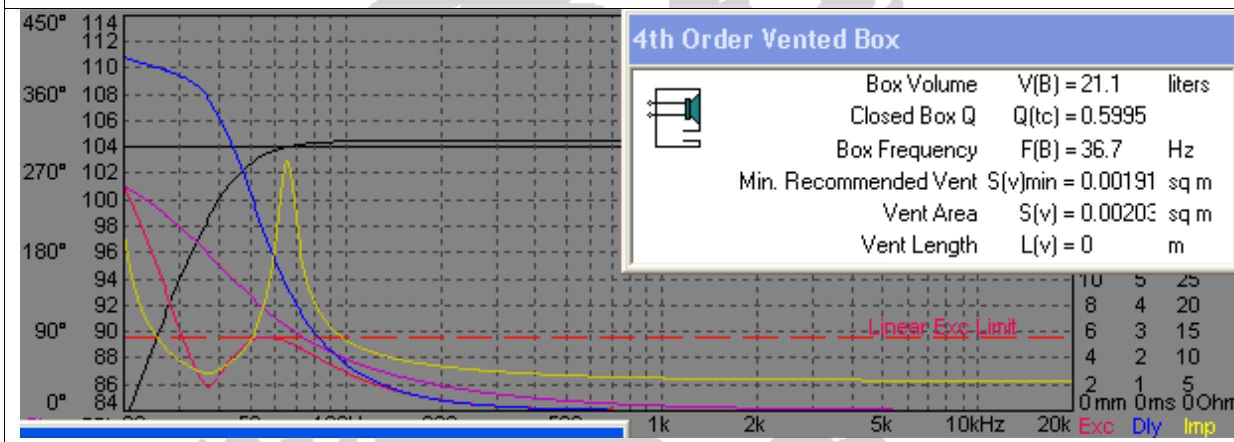
SB Acoustics SB17NRXC35-8

One thing that I really like about this SB Acoustics woofer is that it can achieve a pretty low F_3 (about 45 Hz) while still being able to get loud, and the price is very attractive. I'm also very pleased with the low frequency response of this woofer. One other thing that I liked was that when this driver is given power up to its maximum handling, it still doesn't really approach its maximum linear excursion limit. One area of concern is the sharp increase in frequency response around 3.5kHz. This is close to where my crossover frequency will be and there is some worry about whether or not this rise will cause any issues. Specs for this driver are shown below.

Woofer Name	Sensitivity	Max SPL	X-Max	P(t)	Fs	Size	Price
SB Acoustics SB17NRXC35-8	89 dB	106 dB	5.5mm	60W	32 Hz	6"	$48.00



Bass Boost



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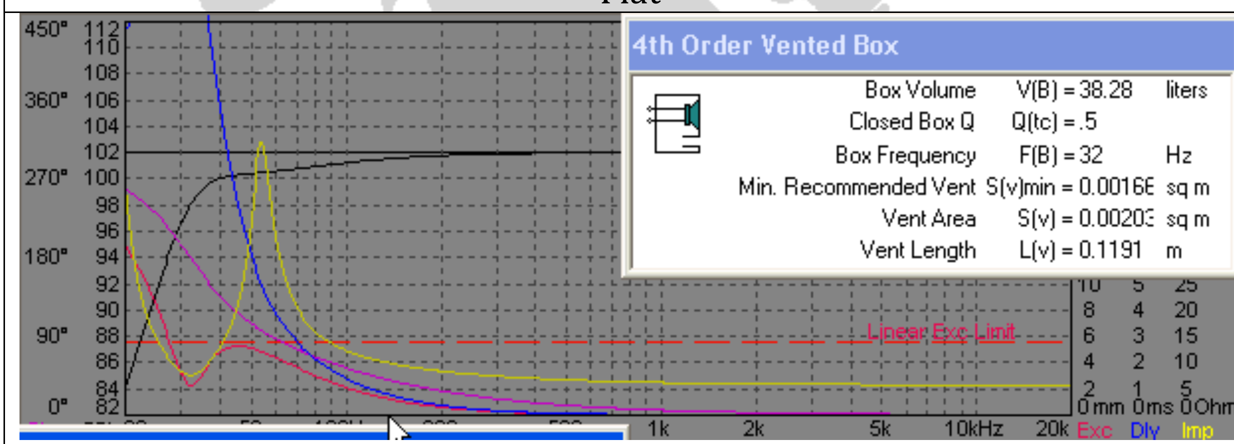

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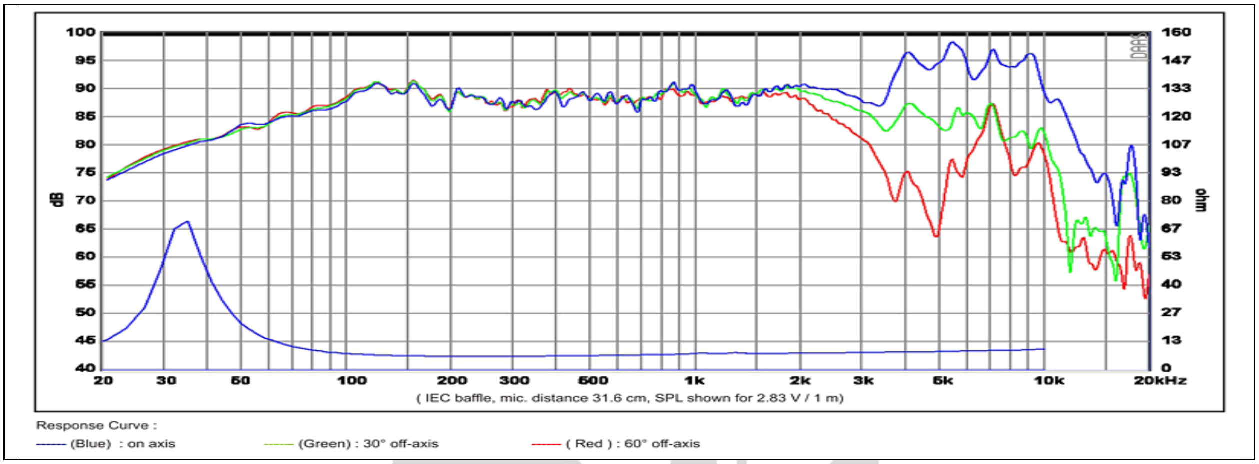
dB
ohm
100
95
90
85
80
75
70
65
60
55
50
45
40
160
147
133
120
107
93
80
67
53
40
27
13
0
20
30
50
100
200
300
500
1k
2k
3k
5k
10k
20kHz
(IEC baffle, mic. distance 31.6 cm, SPL shown for 2.83 V / 1 m)
Response Curve :
(Blue) : on axis
(Green) : 30° off-axis
(Red) : 60° off-axis

Cross-Over Design

Type

I have decided to design a 4th-order Linkwitz-Riley crossover at 2000 Hz. The decision to design a Linkwitz-Riley type crossover over, say, a Butterworth type crossover is the flat response resulting from summation. As you can see in Figure 7, a Butterworth type would result in a bump in frequency response at the crossover point due to summation, which is not something I want.

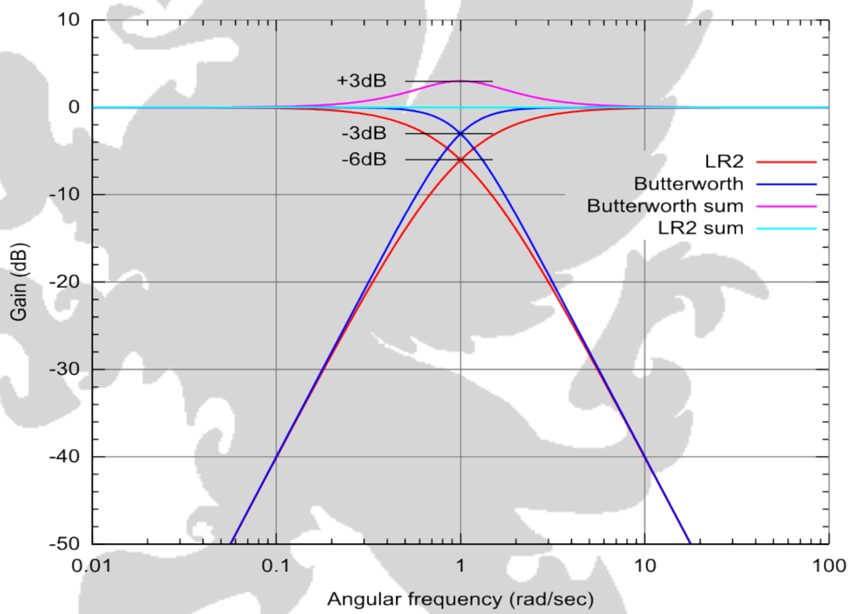

Figure 7[8]

Driver Attenuation

Due to the difference in the sensitivities of my tweeter and woofer, I will need to incorporate driver attenuation into my crossover design. My woofer has a sensitivity of 88 dB while my tweeter has a sensitivity of 91 dB. Figure 8 shows a starting point for creating 3 dB of attenuation for my tweeter in the crossover, created at DIYaudioandvideo.com.

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[8] Wikipedia. *Audio Crossover.* Feb 25, 2013. http://en.wikipedia.org/wiki/Audio_crossover (accessed Mar 2, 2013).

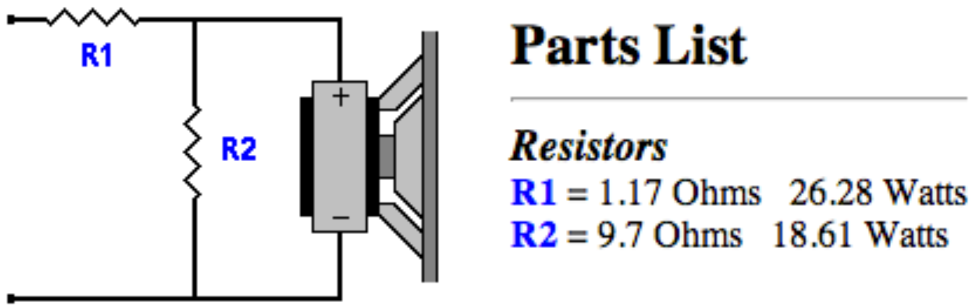


Figure 8[9]

Impedance Equalization

In order to equalize the impedance of my woofer, I need to incorporate some components in my crossover to do so. Figure 9 shows a starting point for impedance equalization for the woofer I have chosen.

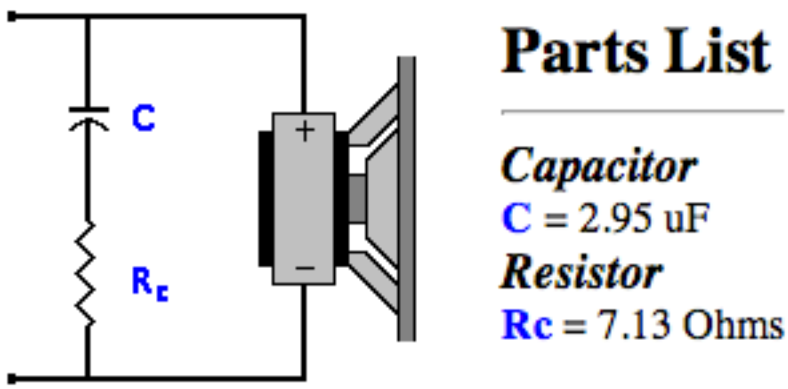


Figure 9[10]

Crossover Schematic Draft

[9] Lalena, Michael. *2-Way Crossover Designer / Calculator.* lalena.com network. 2013. http://www.diyaudioandvideo.com/Calculator/XOver/ (accessed Mar 2, 2013).

[10] Lalena, Michael. *2-Way Crossover Designer / Calculator.* 2013.

Figure 10 shows the draft that will serve as the starting point for my crossover. All of the previously stated factors are incorporated into this schematic.

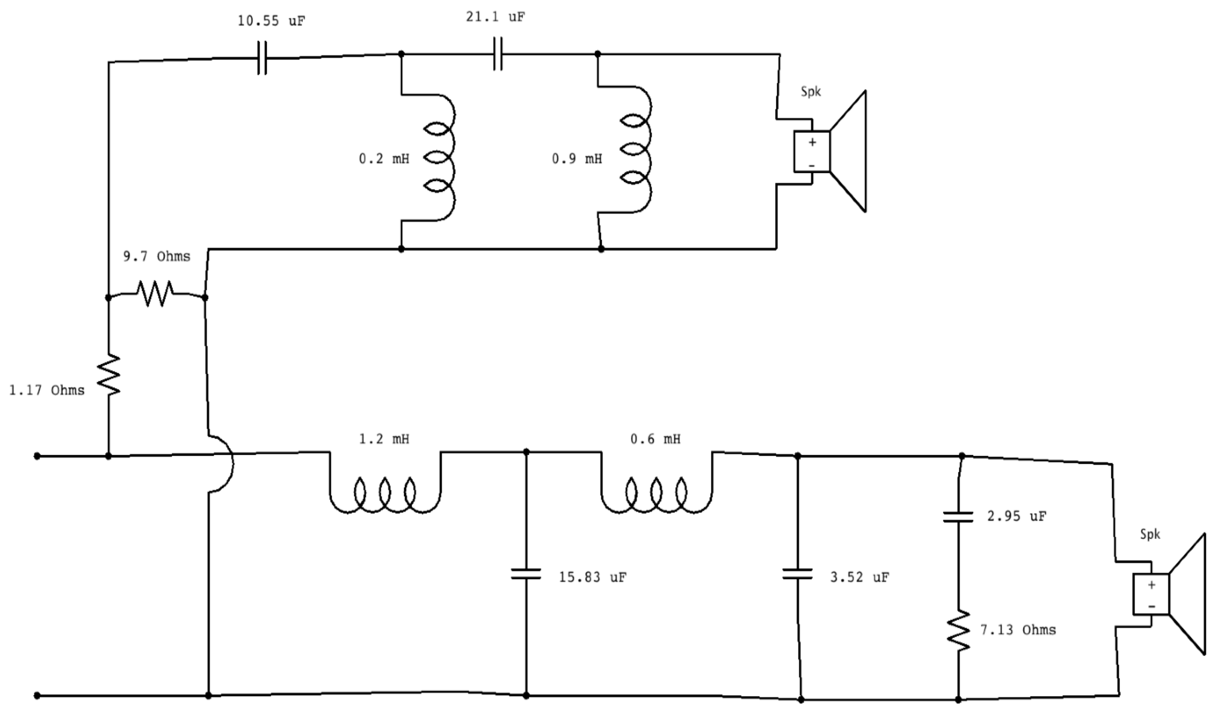


Figure 10

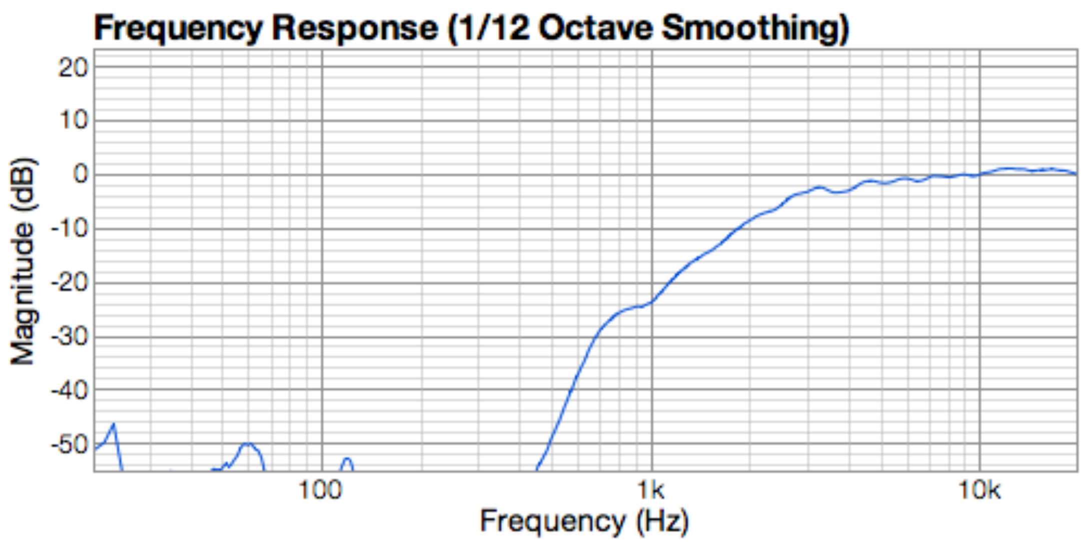
Testing and Tuning

*Note: All initial testing and tuning was done about 6 feet from the ground, with a pad being used to minimize floor bounce.

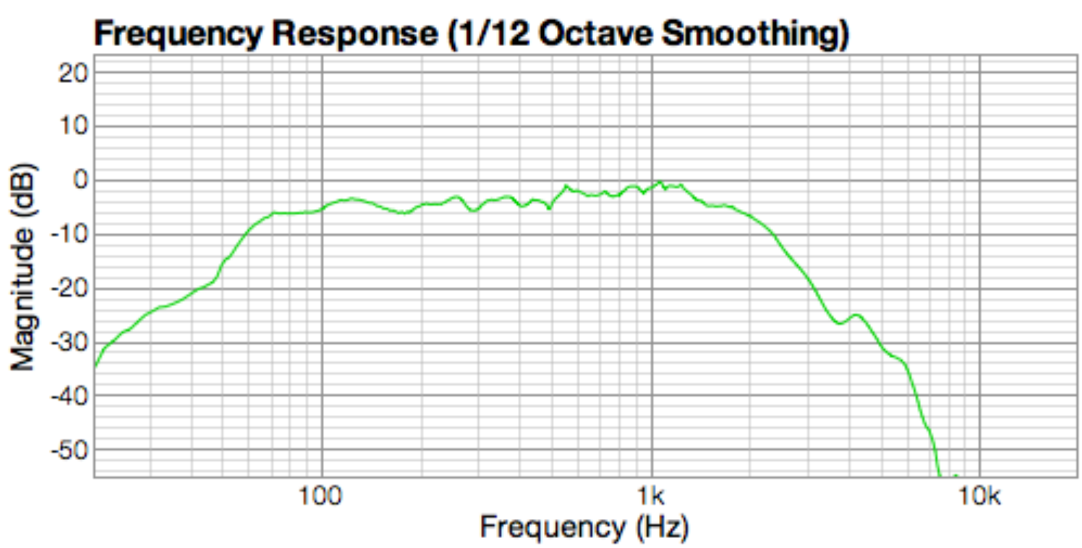
Driver Performance

Below are the initial tests for each driver respectively, before tuning.

<u>Tweeter</u>

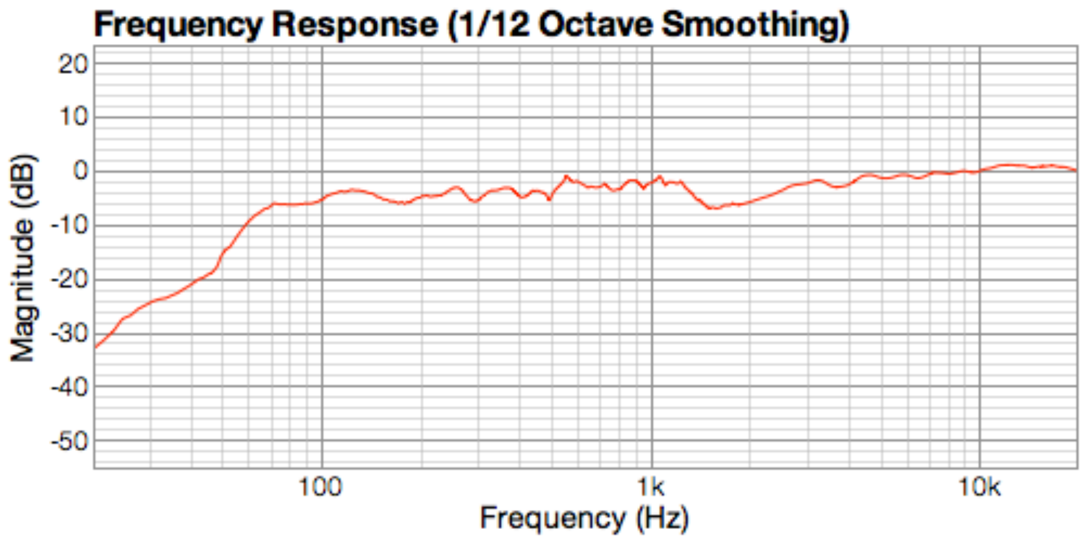


<u>Woofer</u>



Enclosure Optimization

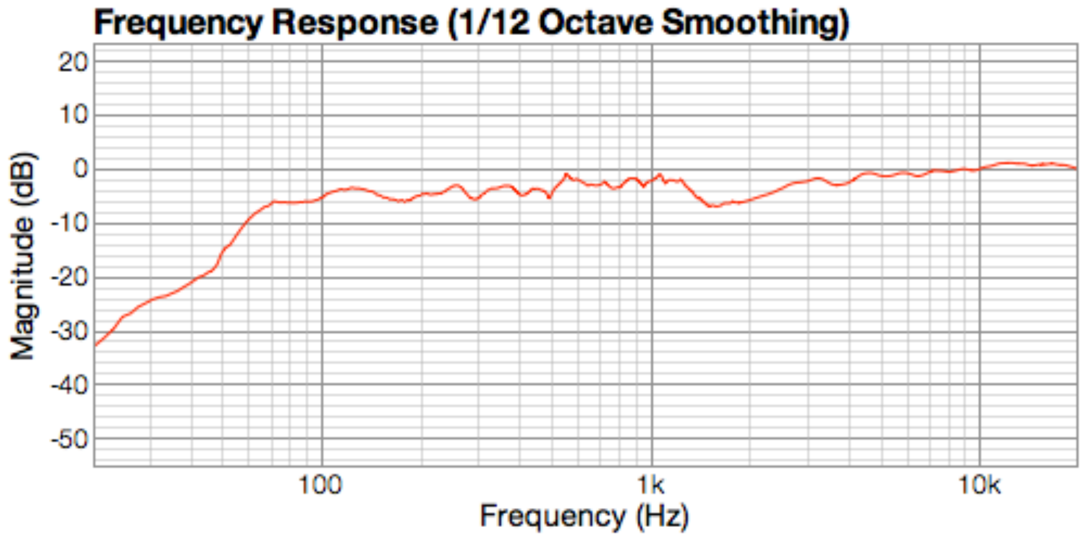
Below is the initial response of the loudspeaker system, before tuning.



One thing that I wanted to fix with the enclosure was the jagged response between about 500Hz and 1.2kHz. I slowly began adding fiberglass to the enclosure until both the response was smoothed out, and I enjoyed the sound.

Cross-over Tuning

Below is the initial response of the loudspeaker system, before tuning.

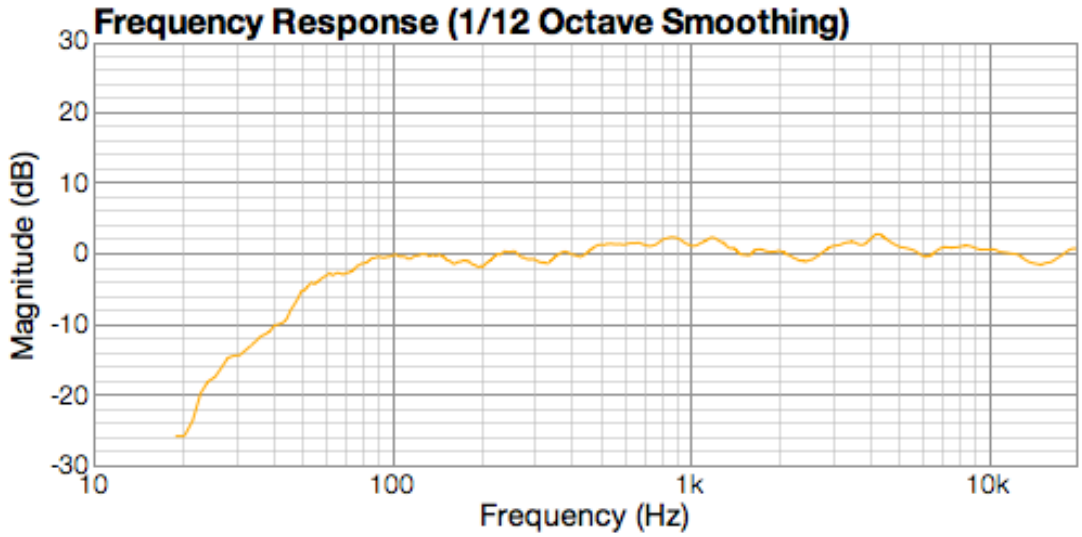


Some issues that I looked to fix with crossover tuning were: 1) the overall difference in level between the two drivers, and 2) the issues in the crossover region.

I was able to easily fix the level of the tweeter by increasing the attenuation. This involved changing resistors in different combinations. I found that changing the resistor on the hot path changed the response of the tweeter from about 12kHz and up, while changing the resistor in the hot and ground path changed the response below 12kHz. Realizing this, I was able to fine-tune the response of the tweeter.

At the crossover region, I found that the tweeter was rolling off far too soon, and the woofer was not rolling of steep enough. By adjusting some of the values of the first inductor and capacitor of each circuit I was able to tune the crossover region to a more flat response.

Below is the response of the finished crossover circuit:



One of the most interesting things throughout this process is how similar my final crossover design is to my initial design, despite how complicated and different I had (unnecessarily) attempted to make it. Throughout the process I had created various notch filters, none of which were necessary in the final design.

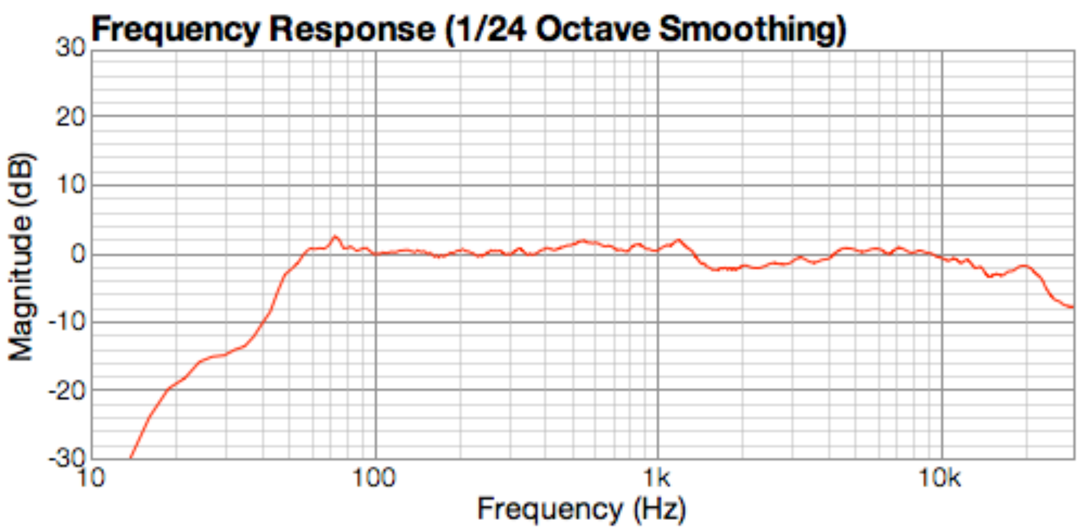
Final System Documentation

Final Testing Results

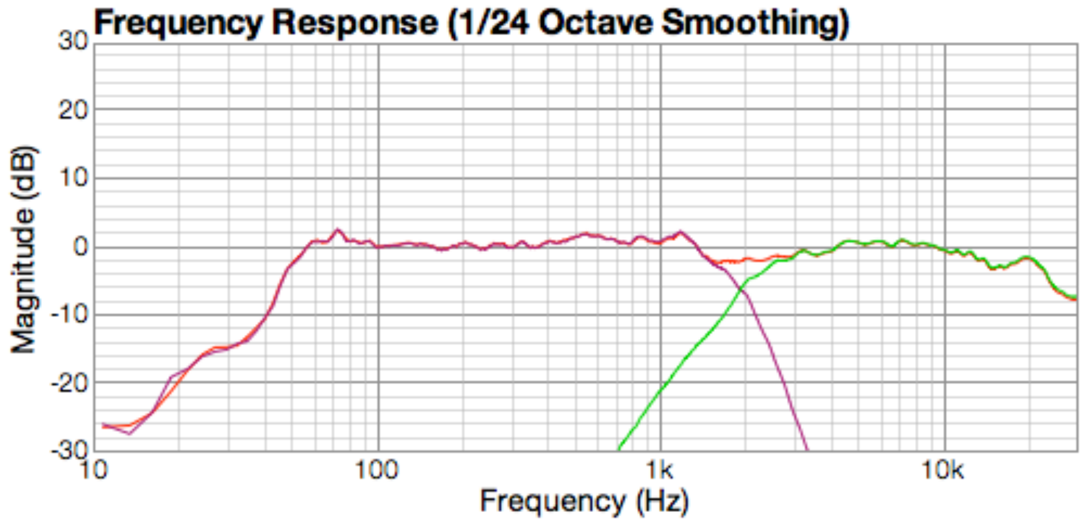
The final testing of the system was done about 12 feet from the ground. Upon this testing, I found that there was a slight dip in the response from 1.5kHz and up, as you can see the difference between the response shown below and the one shown above.

Overall Loudspeaker Performance

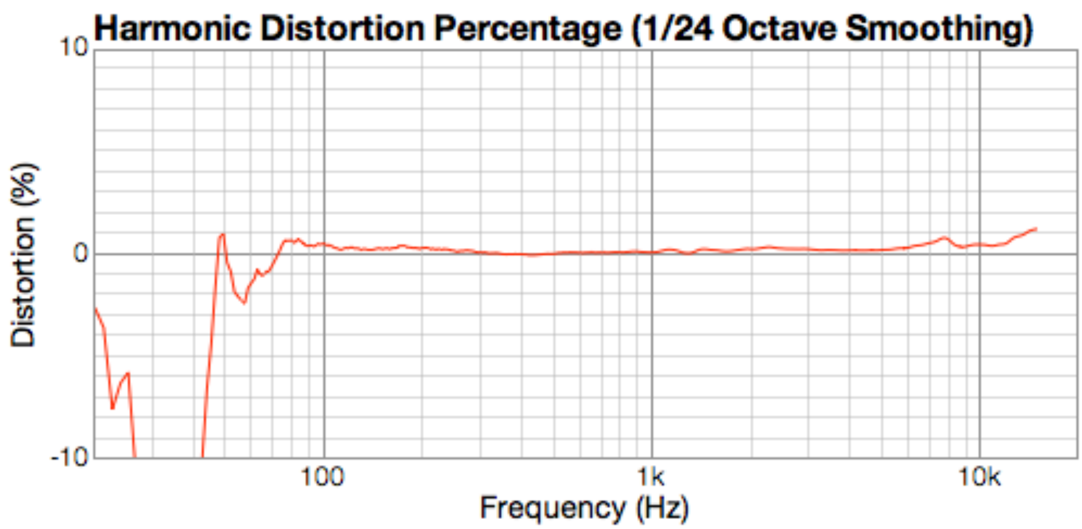
Frequency Response



Integrated Frequency Response

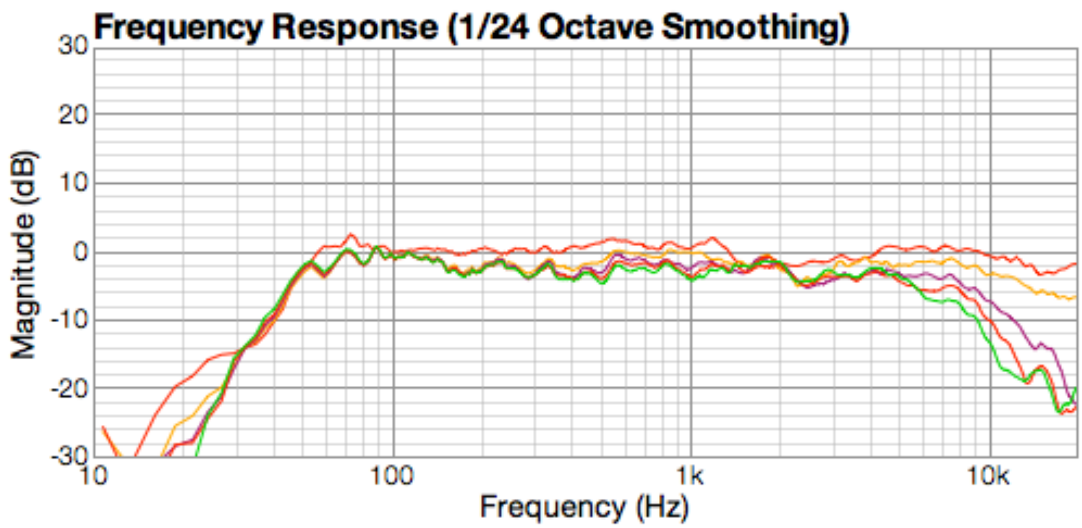


Harmonic Distortion Percentage

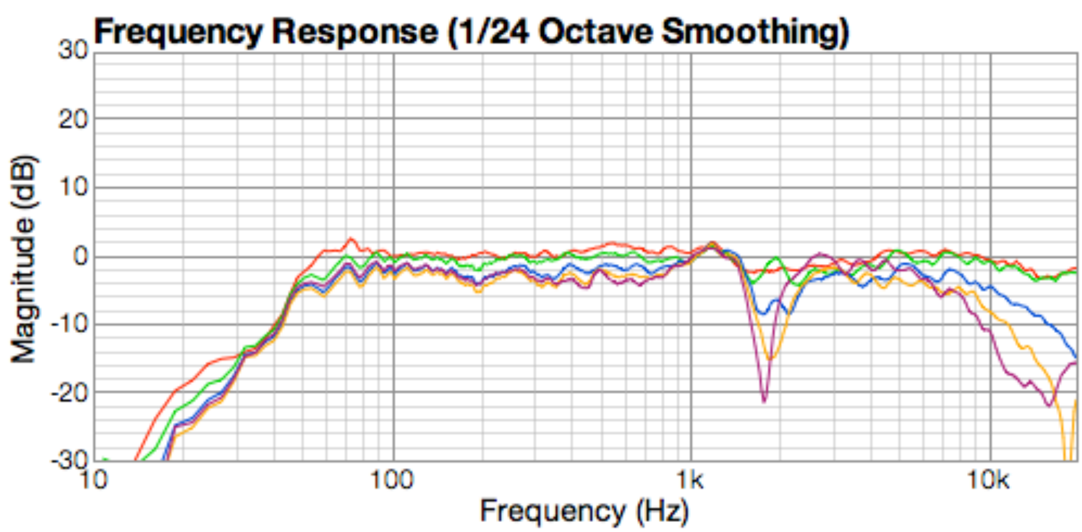


Minumum Phase

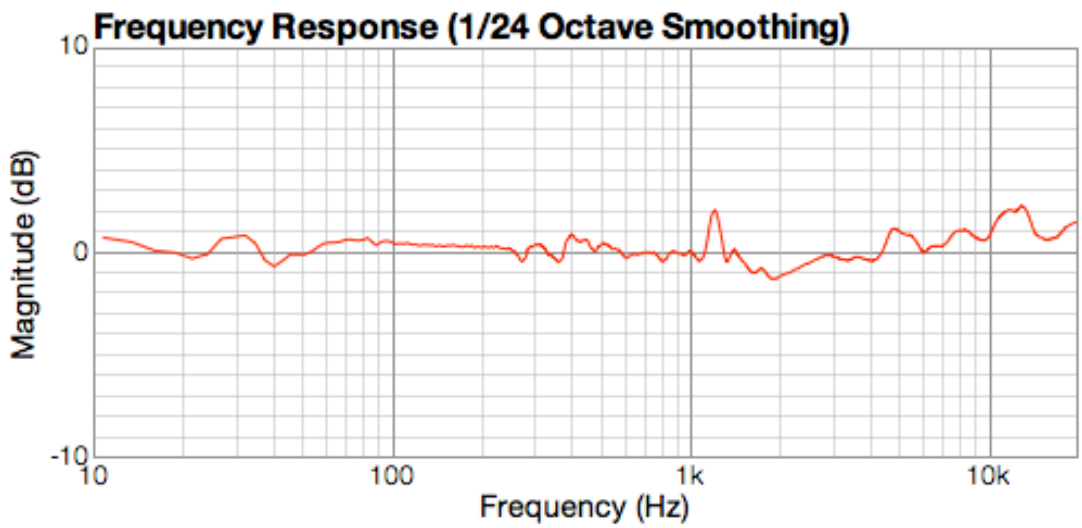
Horizontal Off-Axis Response



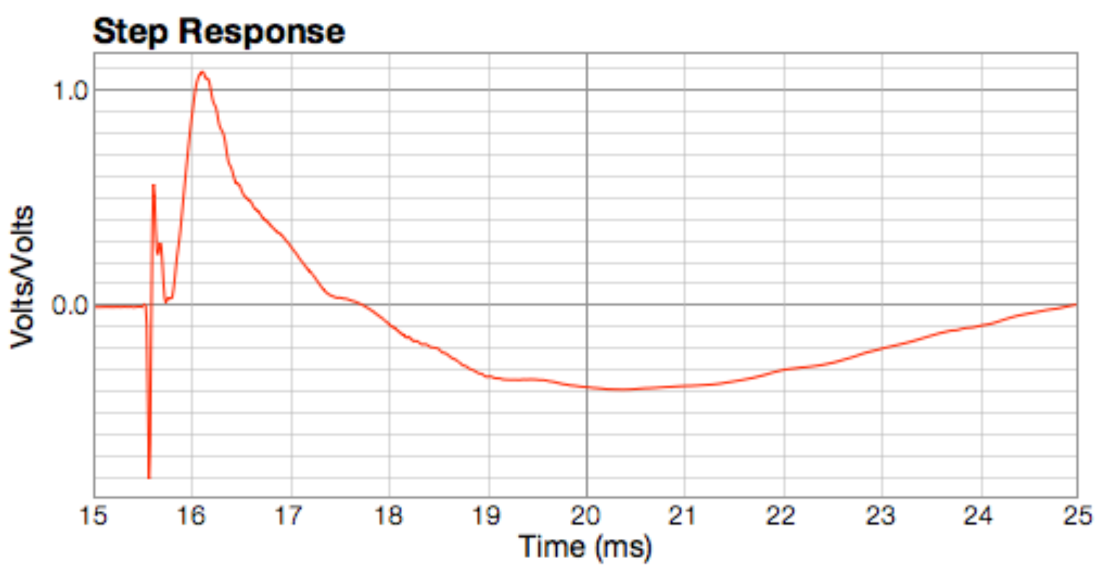
Vertical Off-Axis Response



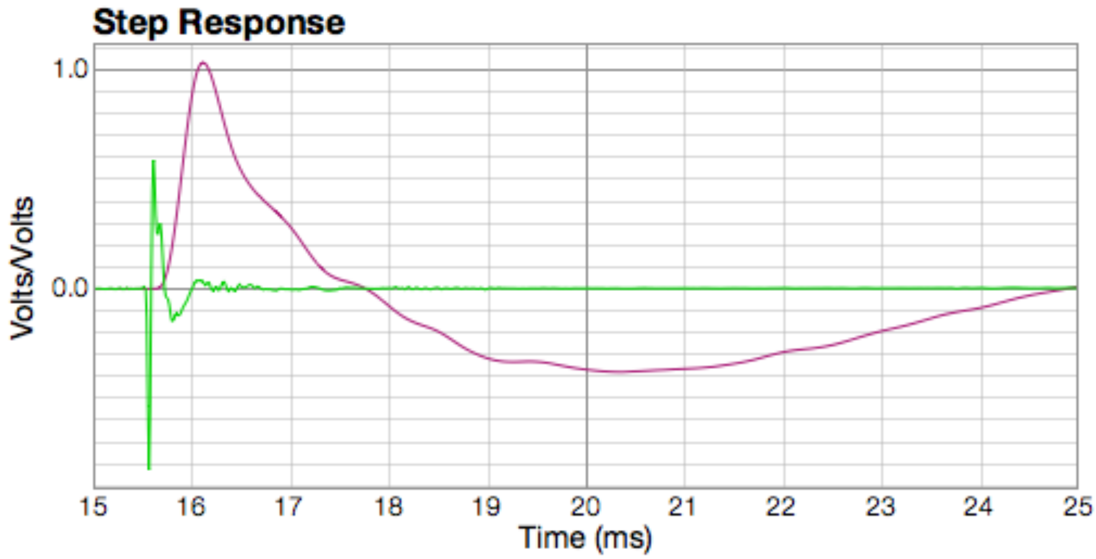
Difference Plot



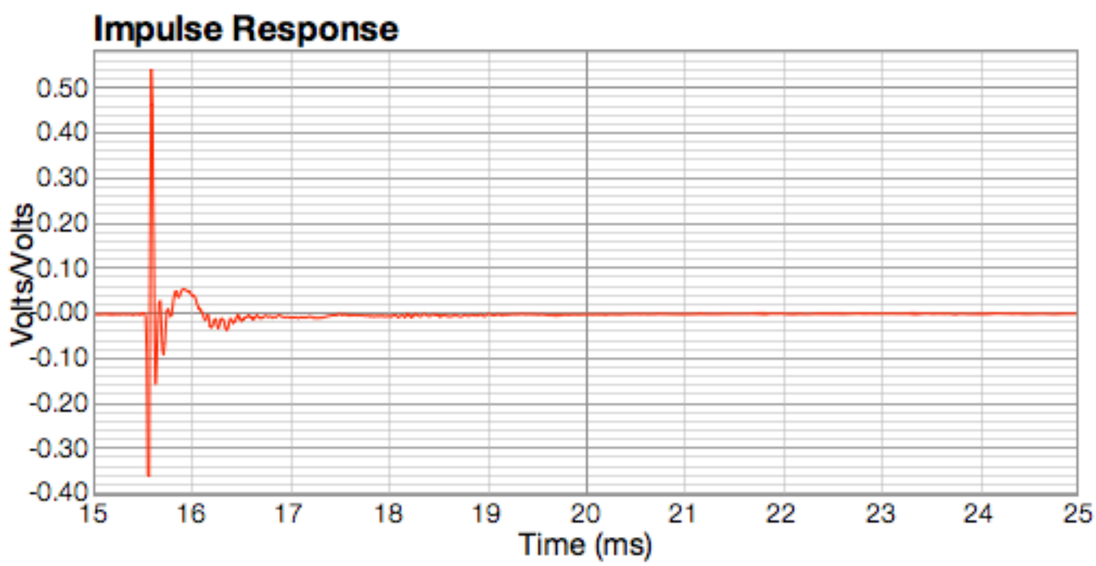
Step Response



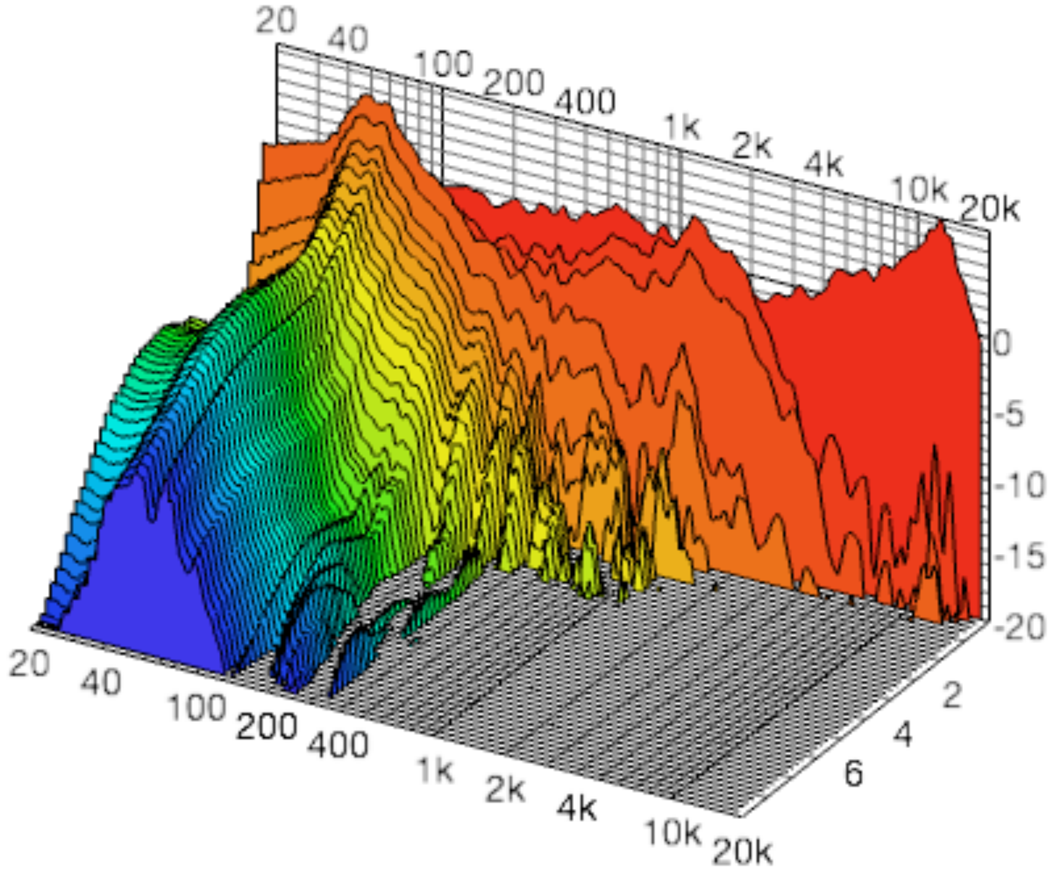
Integrated Step Response



Impulse Response



Waterfall Plot



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100
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400
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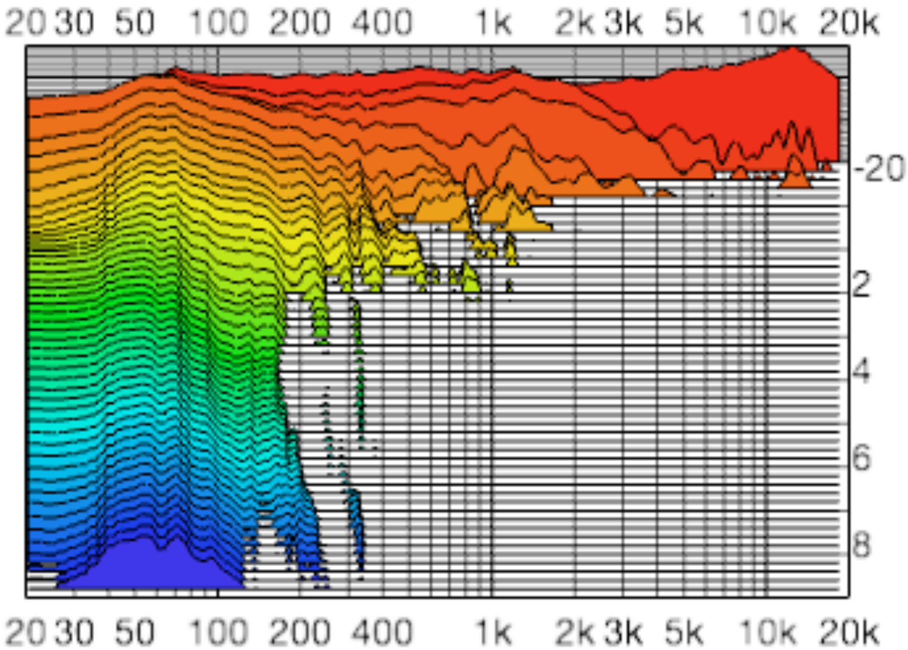
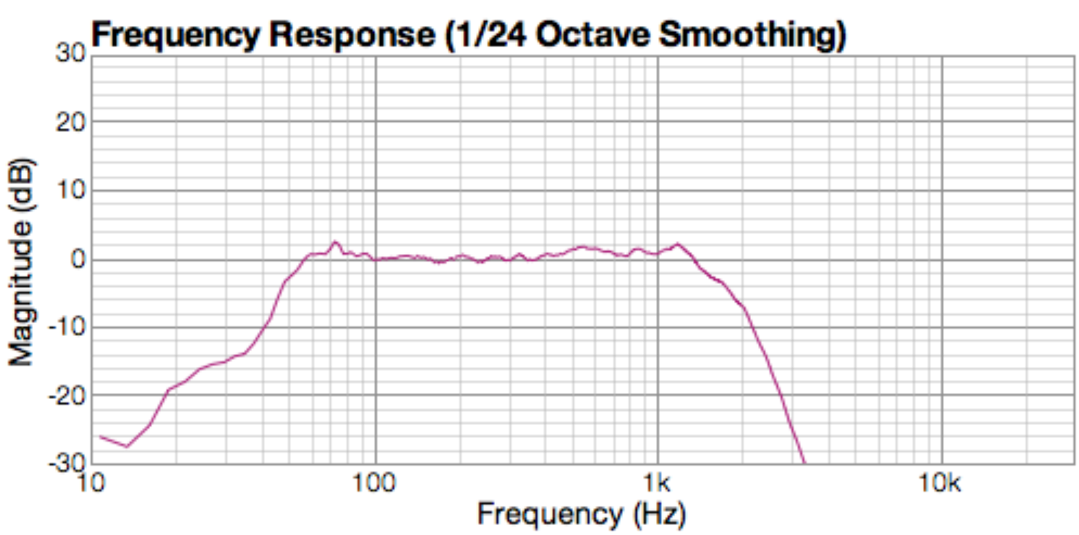
2k
4k
10k
20k
0
-5
-10
-15
-20
2
4
6



Woofer Performance

Frequency Response



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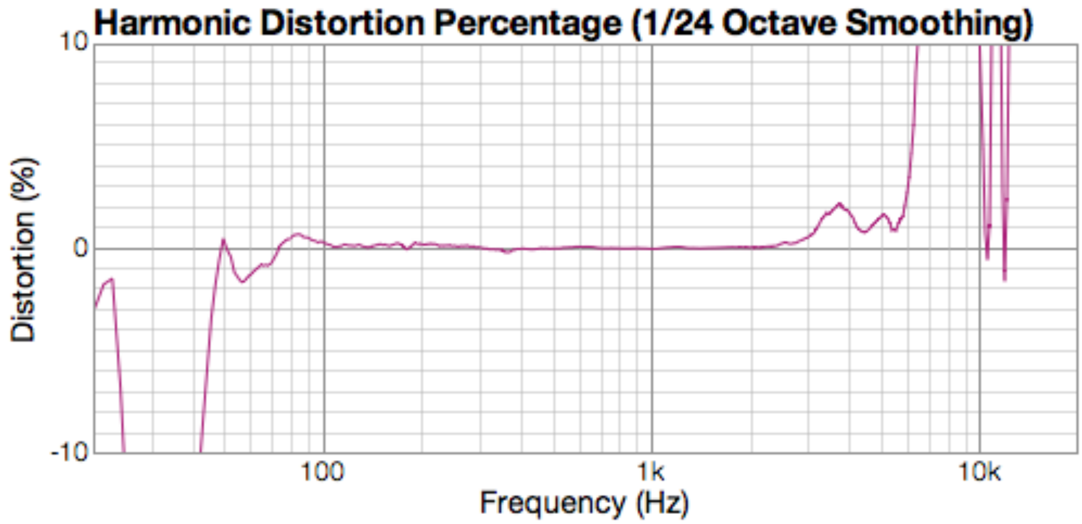

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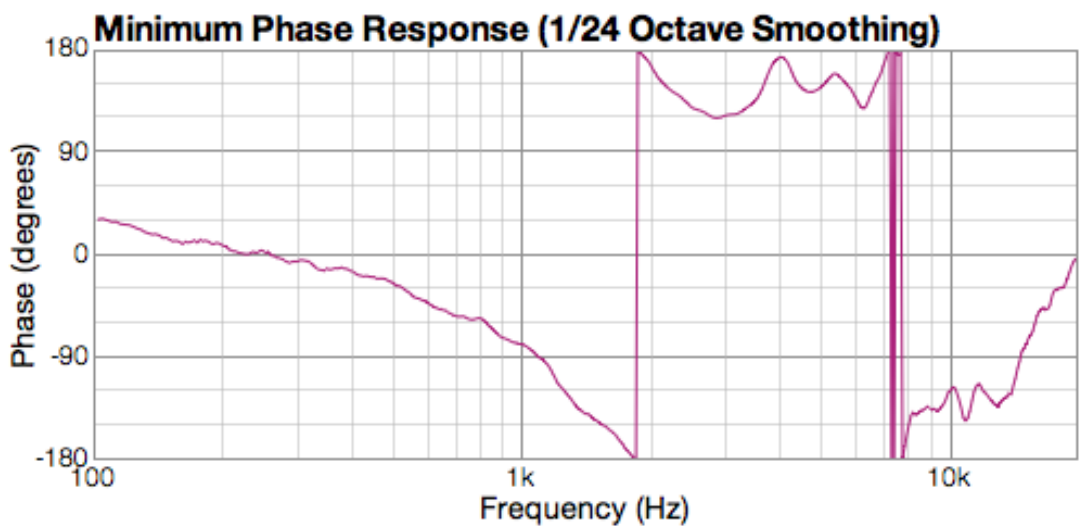

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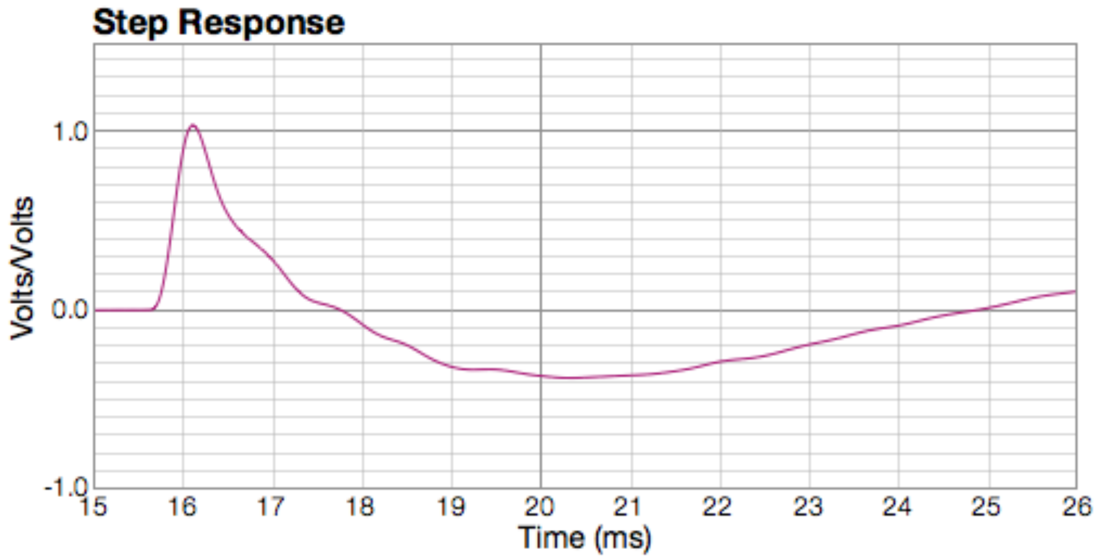
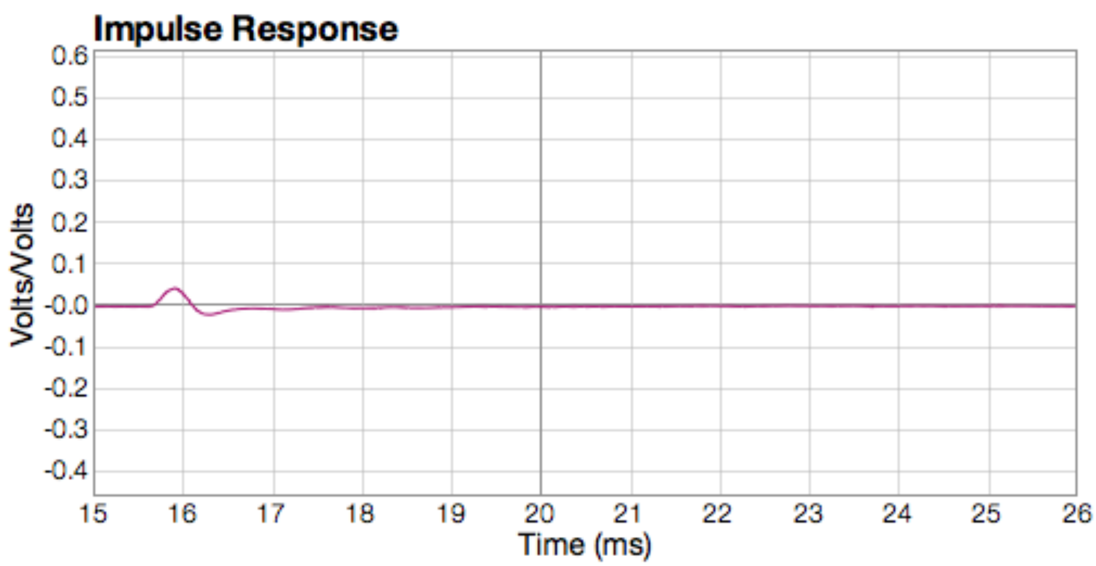
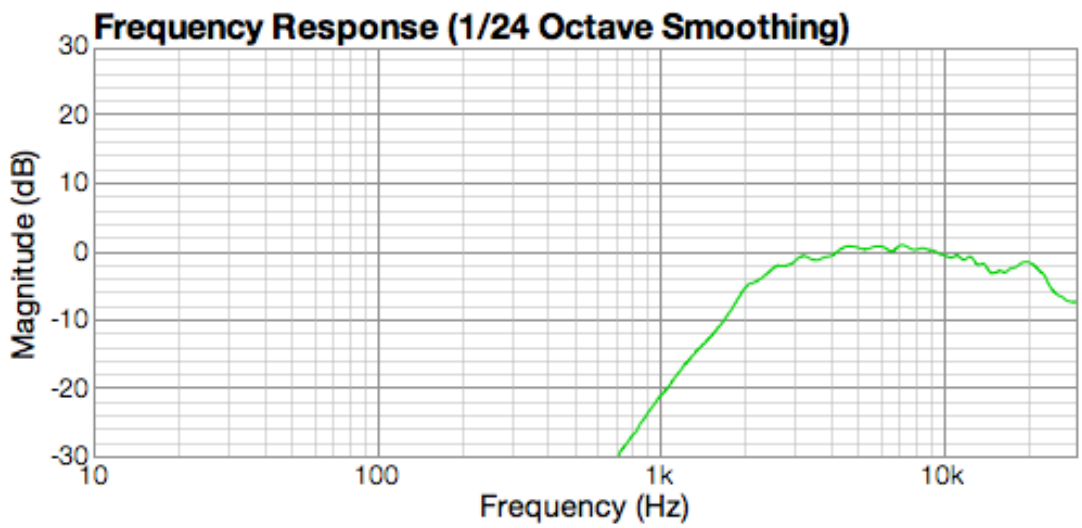


Impulse Response

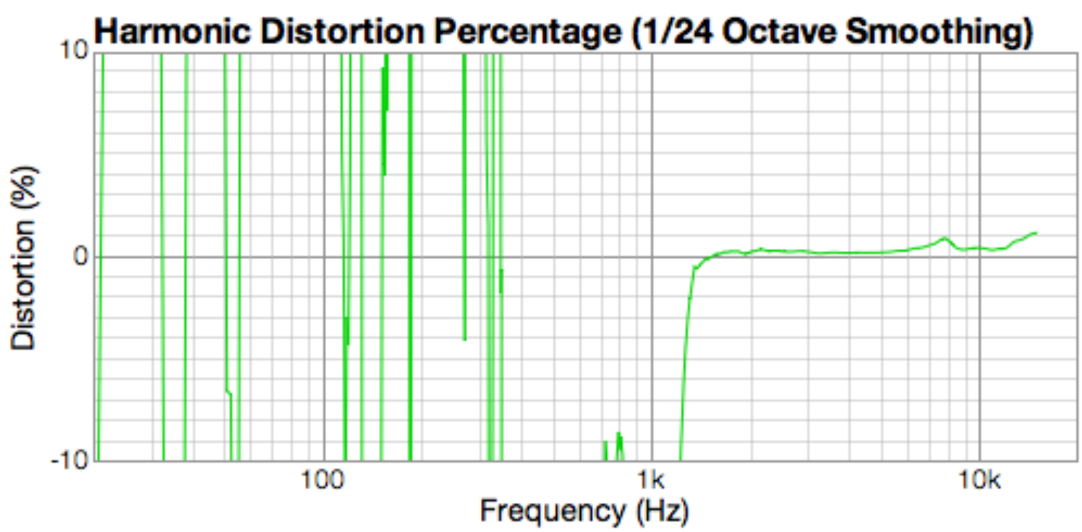


Tweeter Performance

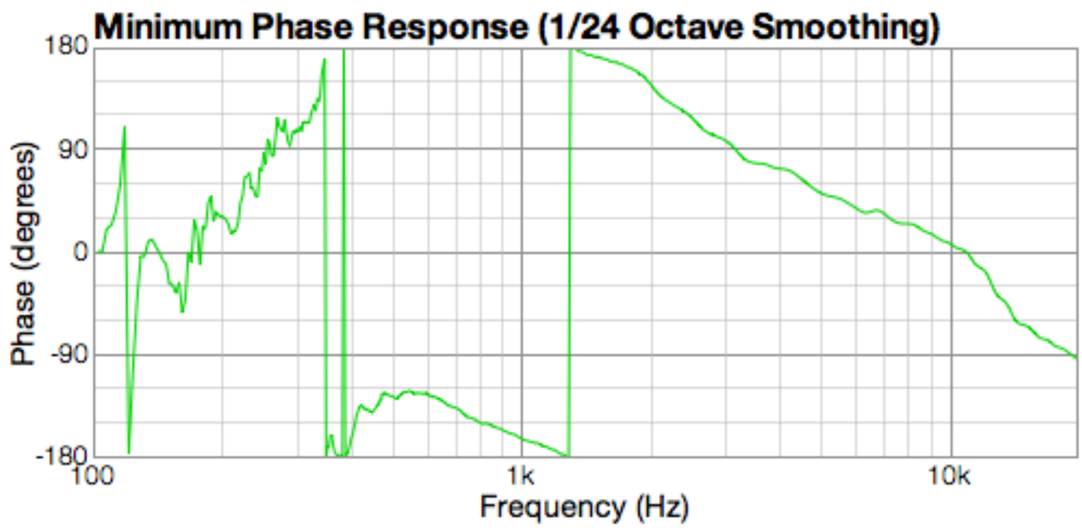
Frequency Response



Harmonic Distortion



Minimum Phase



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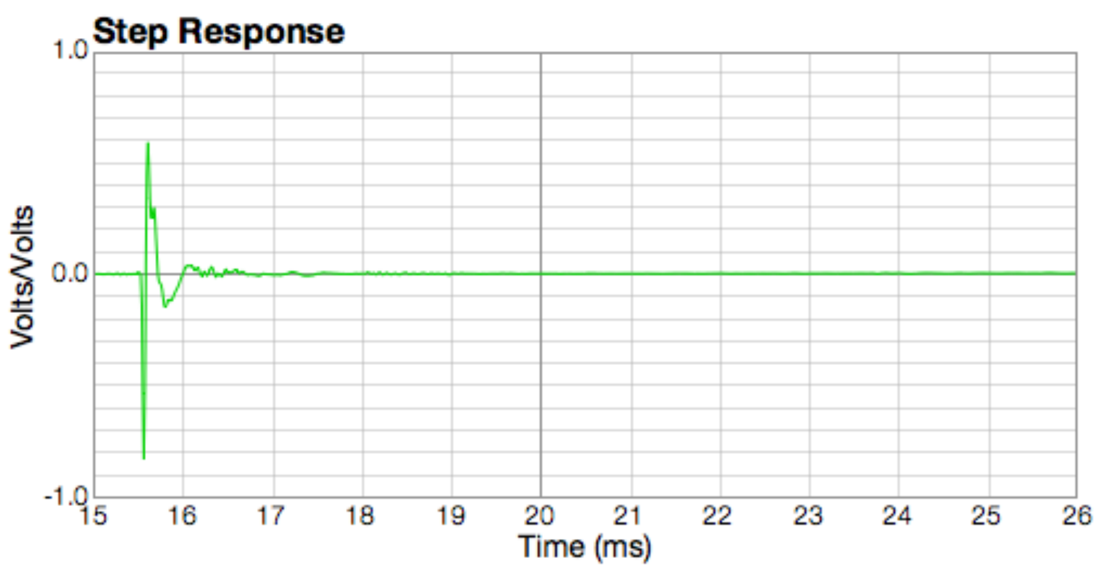
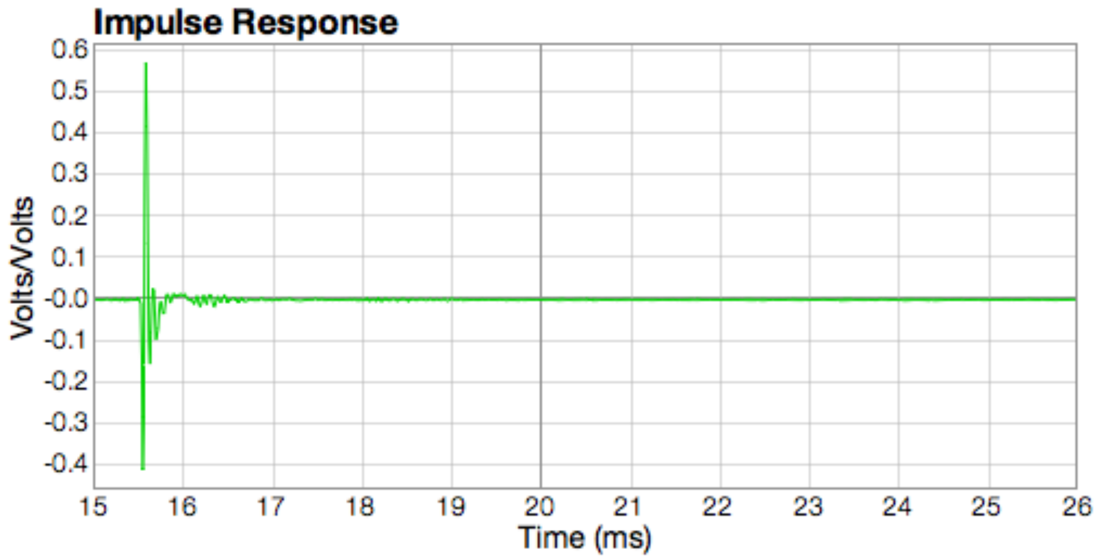
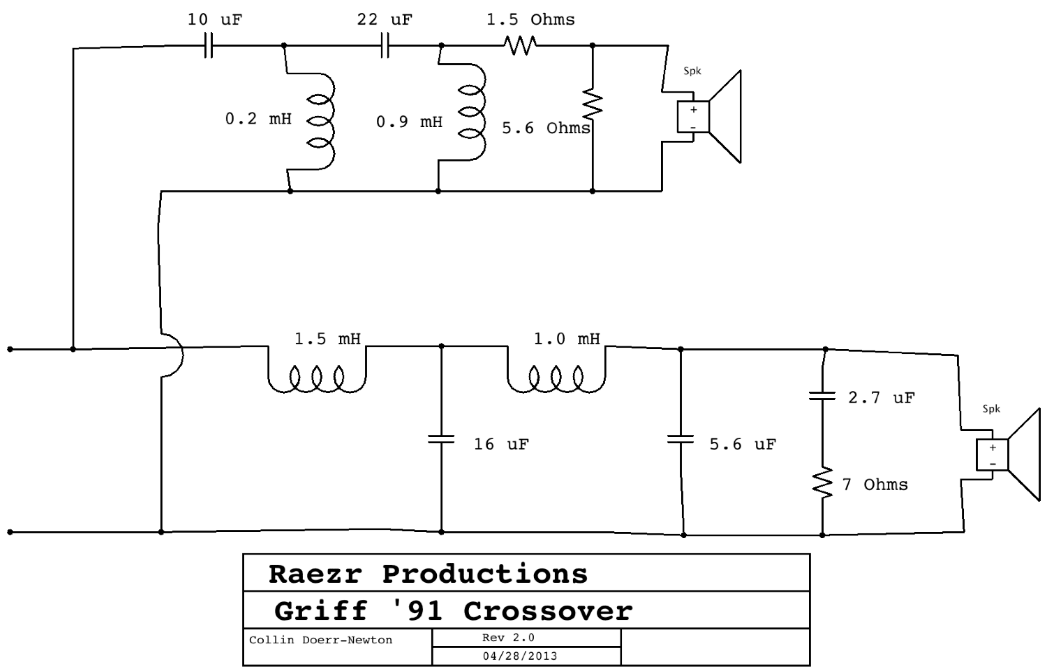


Impulse Response



Cross-over Schematic



As-built Drafting

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4	Front Interior	2
5	Side Exterior	4
6	Back Exterior	2
7	Back Interior	2
8	Top Exterior	4
9	Cut Away	N/A
10	Brace	2
11	Cut Sheet	N/A

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Designed and Drafted By Collin Doerr–Newton | Griff '91

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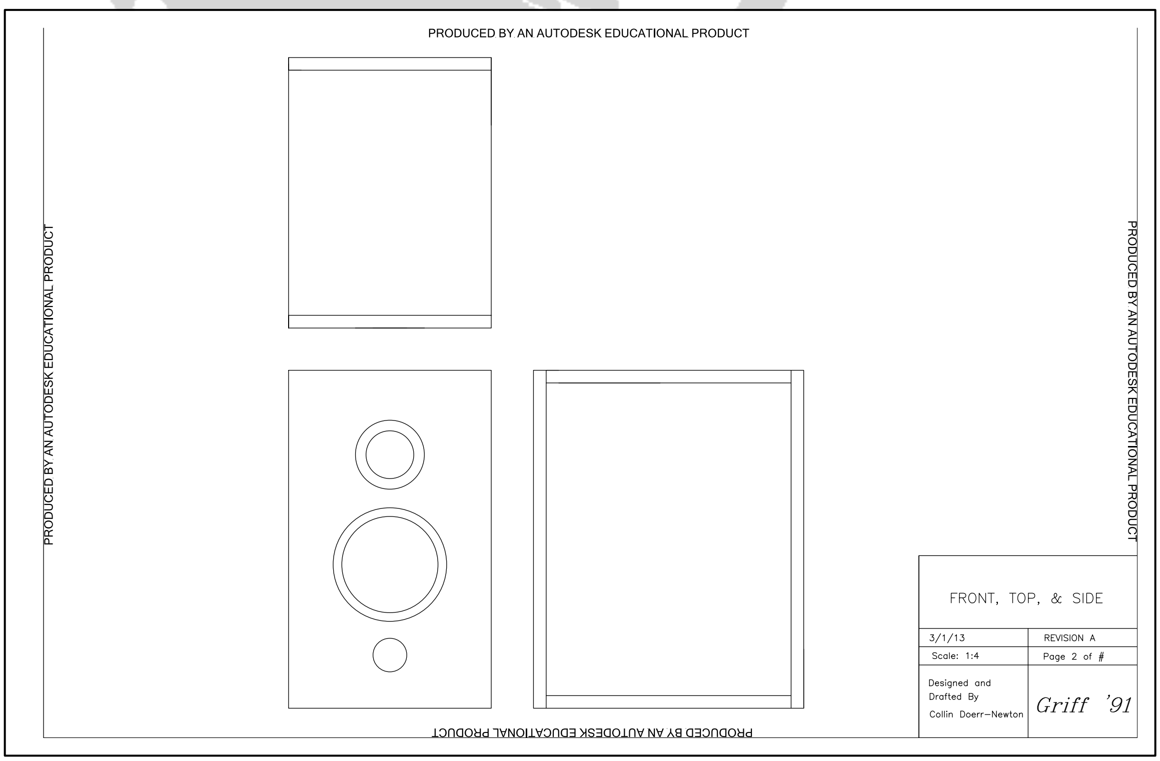

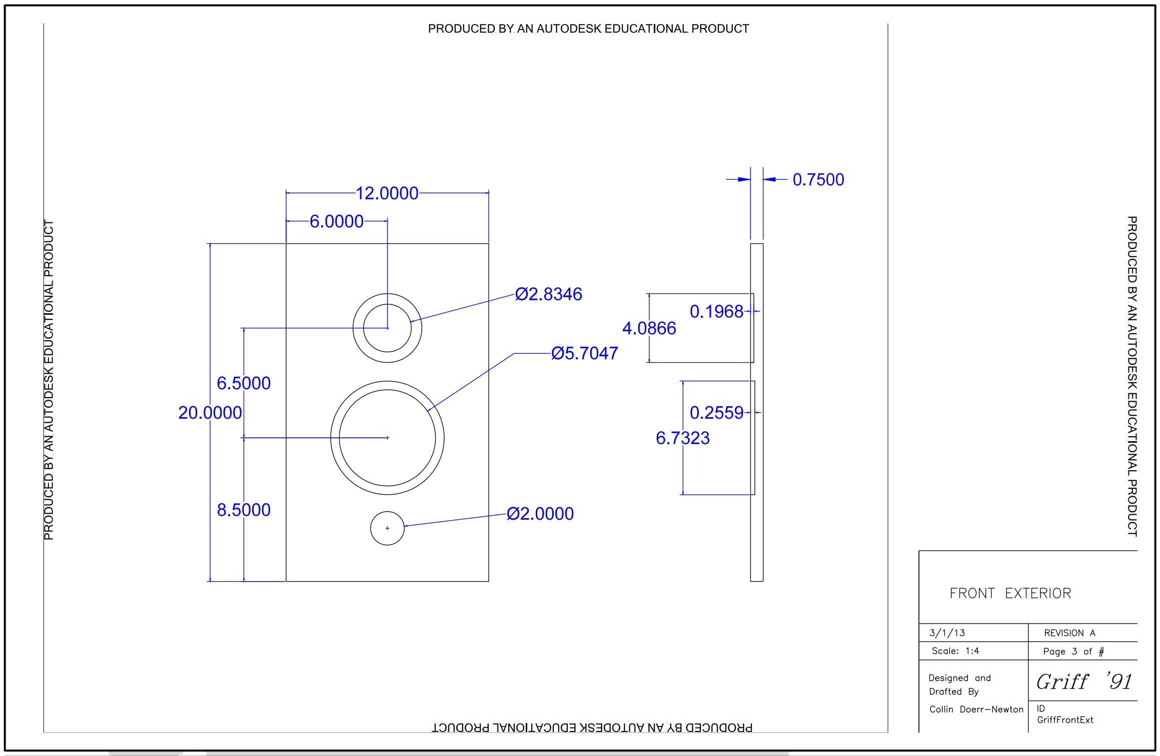
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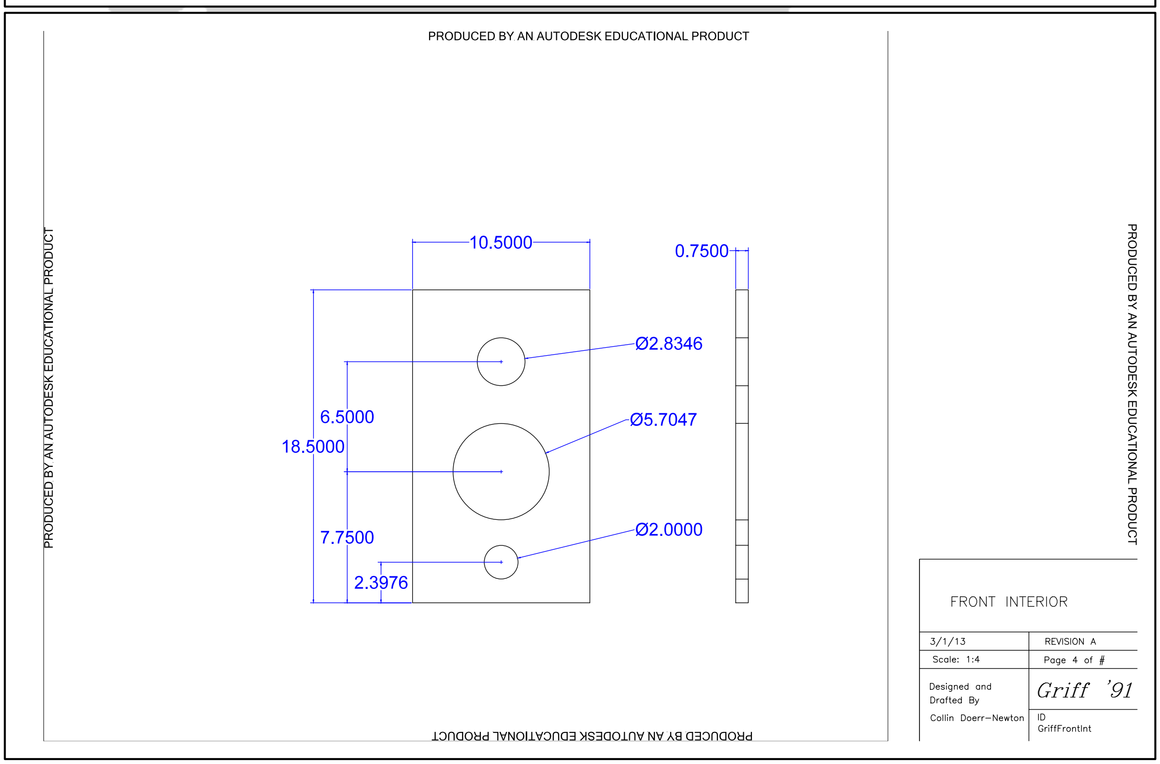
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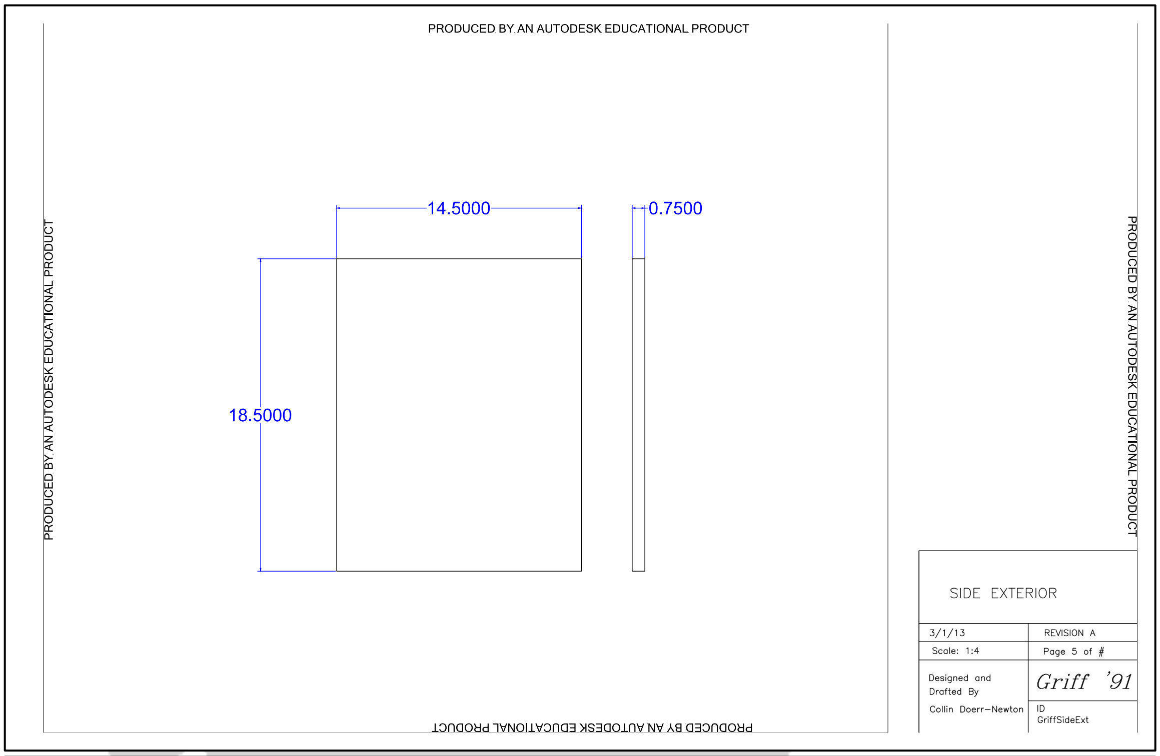
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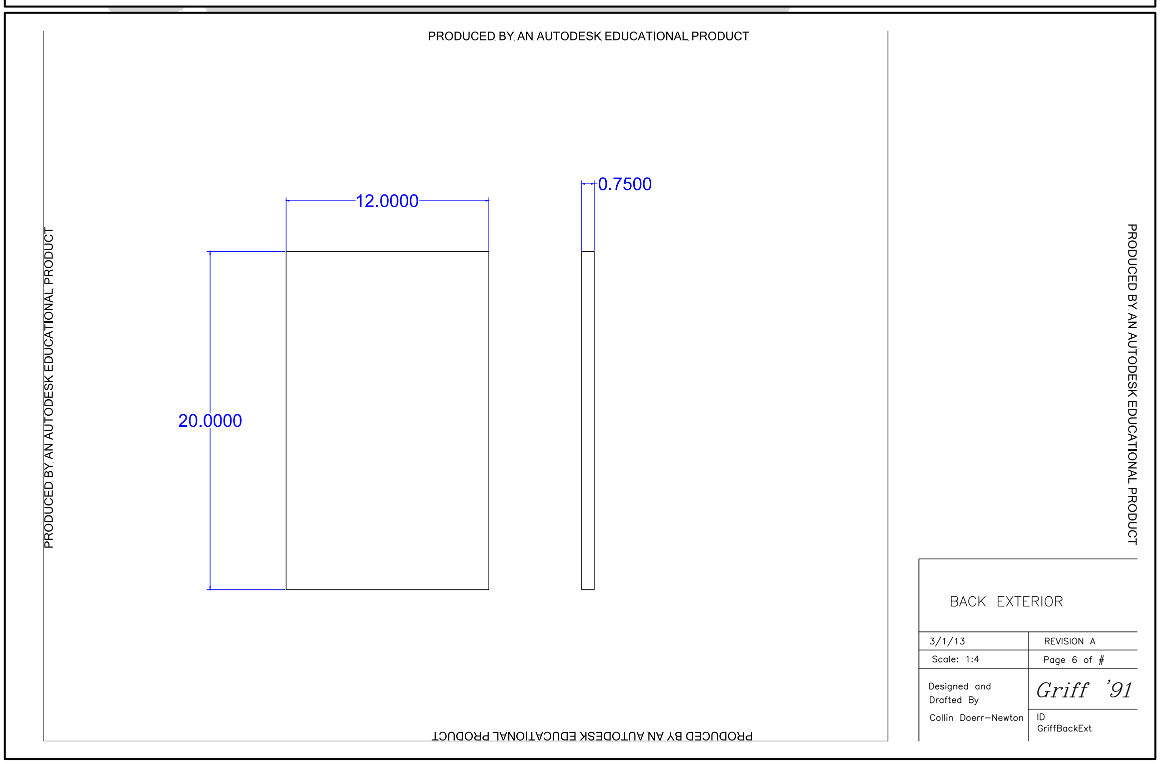
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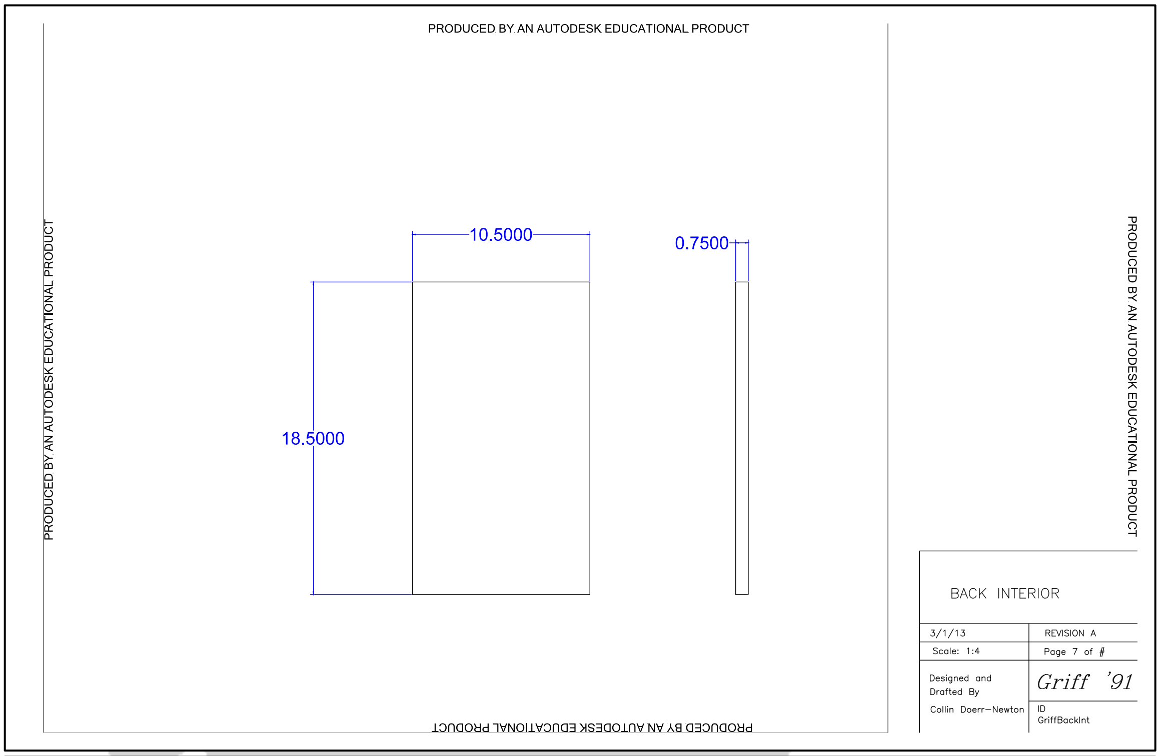
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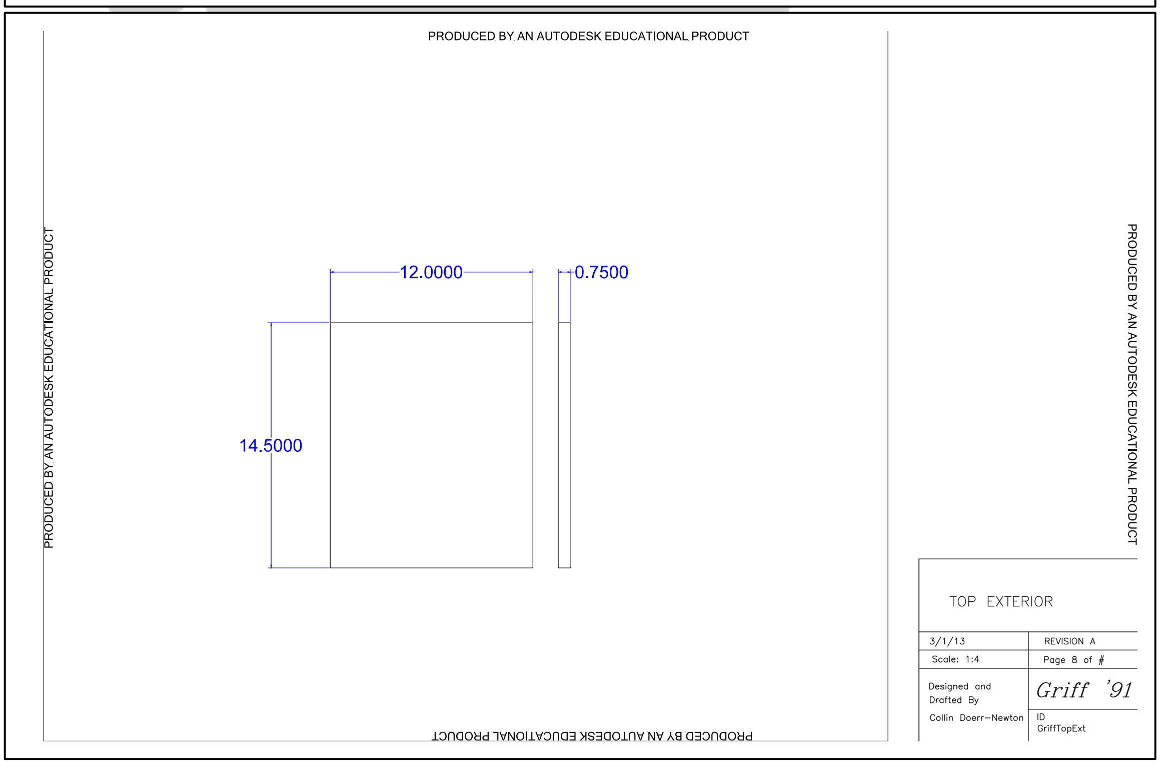
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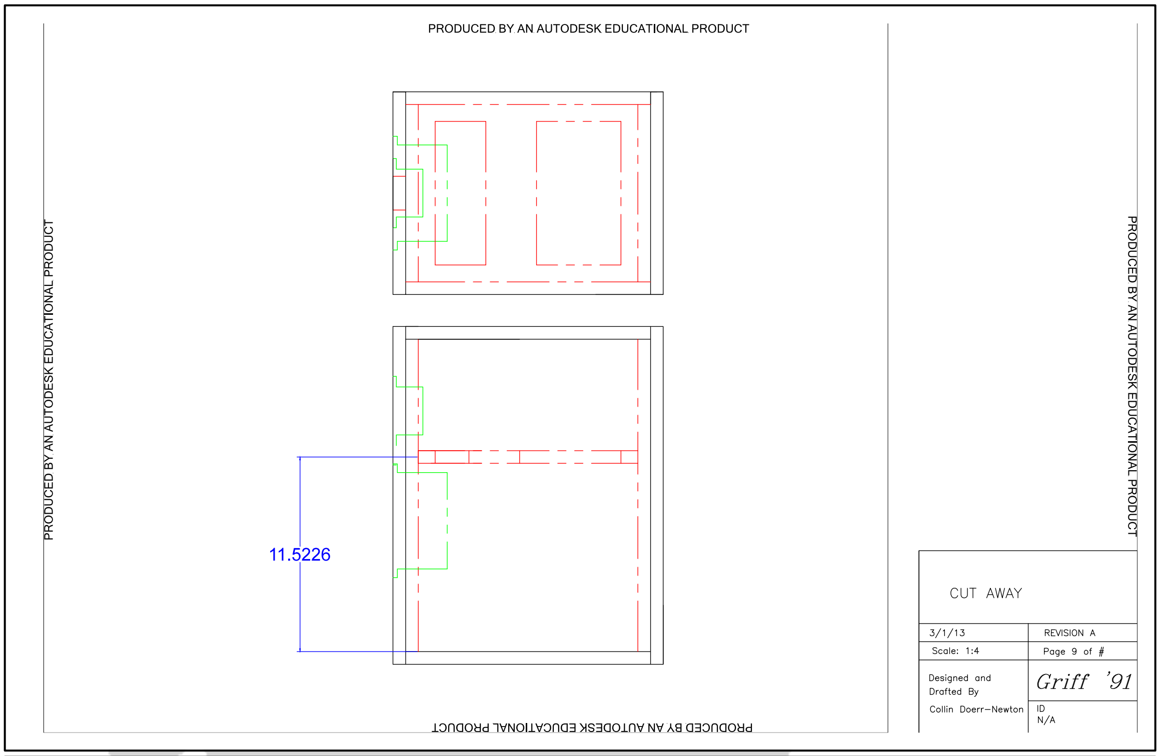
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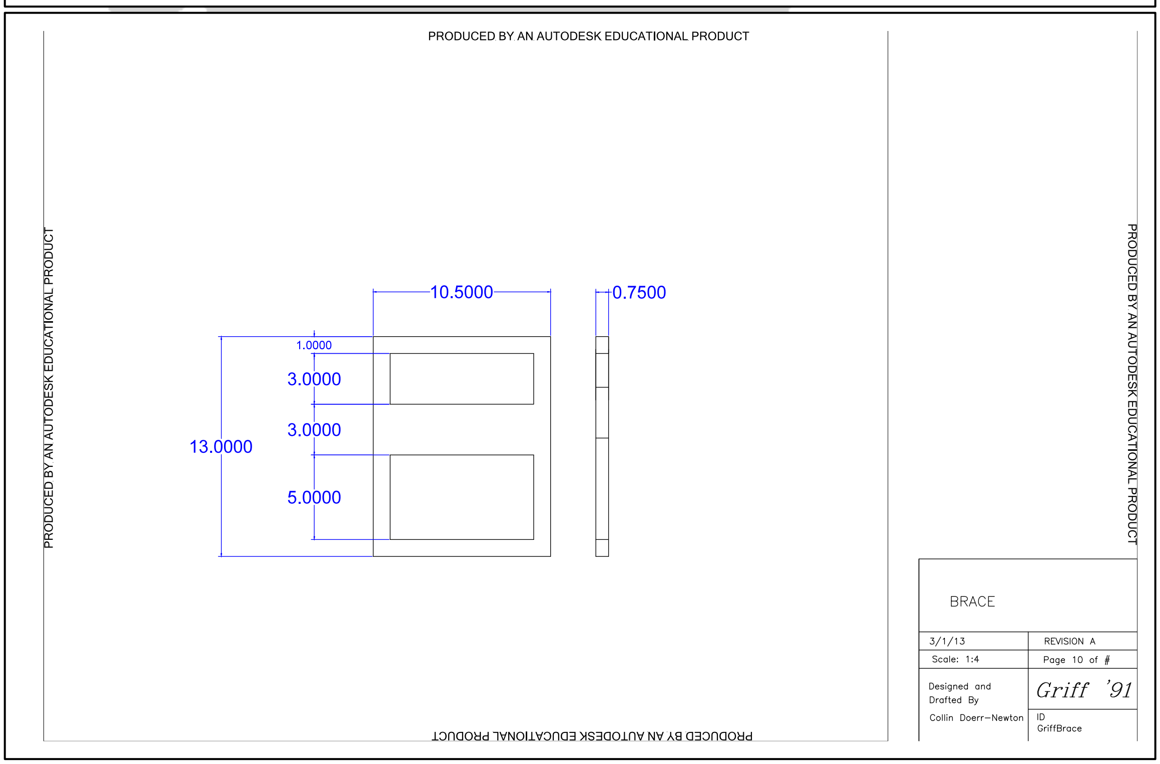
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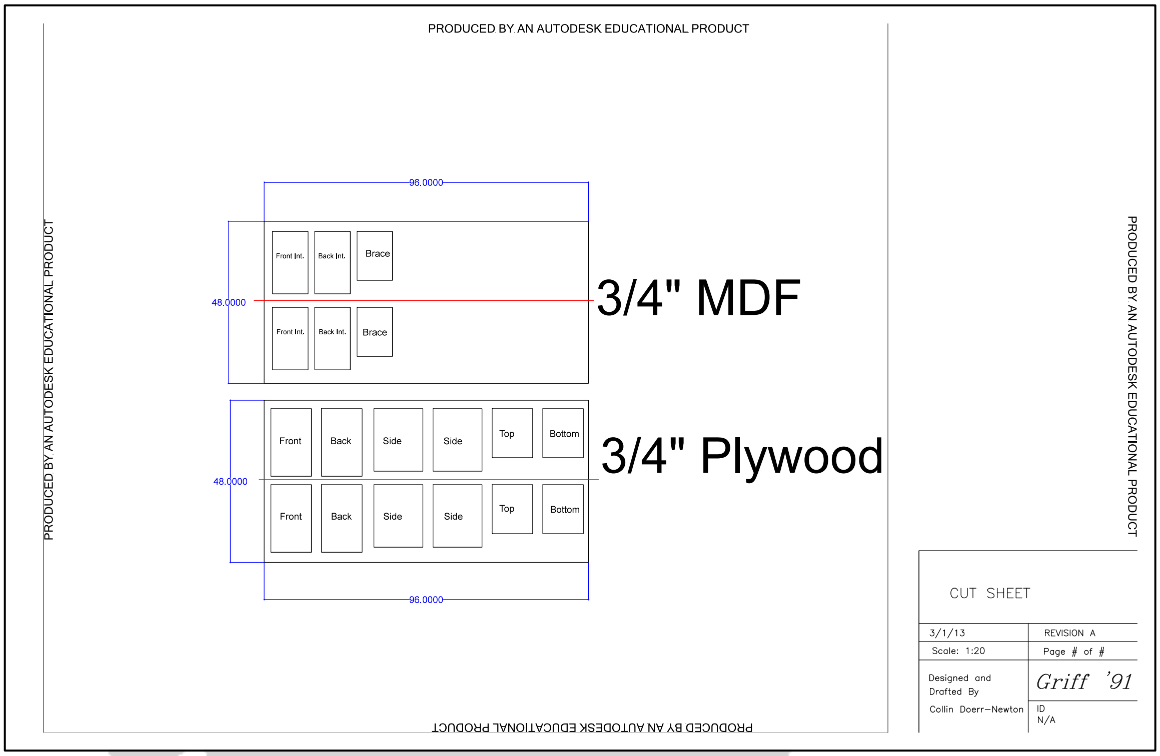

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Top
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3/4" Plywood
CUT SHEET
3/1/13
REVISION A
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Page # of #
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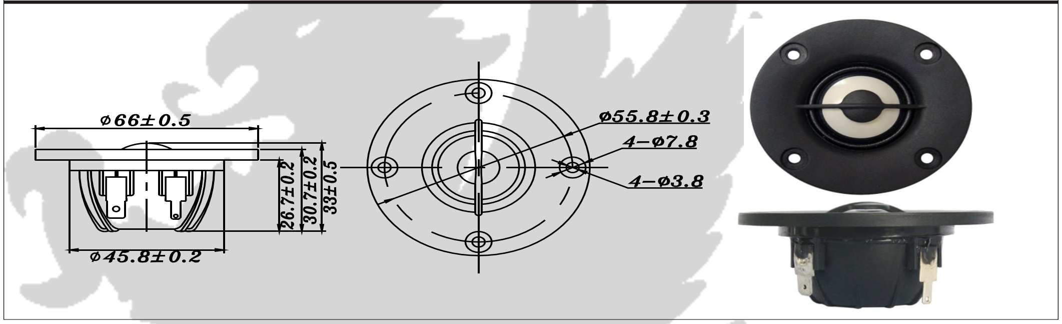
Appendix

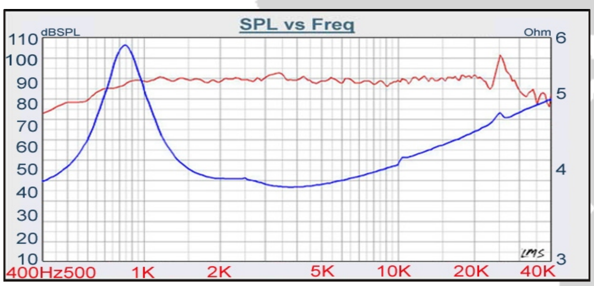
A) Tweeter Specification Sheets

Tang Band 25-1719S

TW SERIES **25-1719S**



- CERAMIC DIAPHRAGM WITH FABRIC SURROUND
- BACK CHAMBER DESIGN, Fo OF 800Hz
- LOW 2nd AND 3rd DISTORTION (LOW THD)
- EXCELLENT OFF-AXIS DISPERSION
- FREQUENCY RESPONSE OF 800Hz ~ 30KHz
- FERROFLUID COOLED
- MAGNETIC SHIELDED



25mm CERAMIC DOME TWEETER

DIAPHRAGM MTL	Ceramic
SURROUND MTL	Fabric
NOMINAL IMPEDANCE	4 Ω
DCR IMPEDANCE	3 Ω
SENSITIVITY 1W/1M	90 dB
FREQUENCY RESPONSE	800Hz -30K Hz
FREE AIR RESONANCE	800 Hz
VOICE COIL DIAMETER	25.4 mm
AIR GAP HEIGHT	2 mm
RATED POWER INPUT	8 W
MAXIMUM POWER INPUT	80 W
FORCE FACTOR, BL	N/A
MAGNET WEIGHT (oz)	Neodymium
MOVING MASS	N/A
FERROFLUID ENHANCED	Yes
SUSPENSION COMPLIANCE	N/A
EFFECTIVE PISTON AREA	N/A
Levc	0.002 mH
Zo	5.8 ohm
Xmax	N/A
Vas	N/A
Qts	N/A
Qms	N/A
Qes	N/A

TB SPEAKERS

VOICE: 886.2.26570282 FAX: 886.2.26580166
E-MAIL:info@tb-speaker.com

Vifa XT25TG30-04

TYMPHANY

XT/DX
1" Tweeter

vifa

Type Number: XT25TG30-04

Features:

The goal for this tweeter series was to create a transducer that has a frequency response that is flat to above 20K, and where the distortion is far lower than normal and more friendly to the ear. The tweeters represent a unique approach to tweeter design that has resulted in unrivaled performance, as well as in several patents (Dual Ring Radiator diaphragm, wave-guide center plug).

Driver Highlights: Dual Ring Radiator diaphragm (Patent), Wave-guide center plug (Patent), copper-clad aluwire

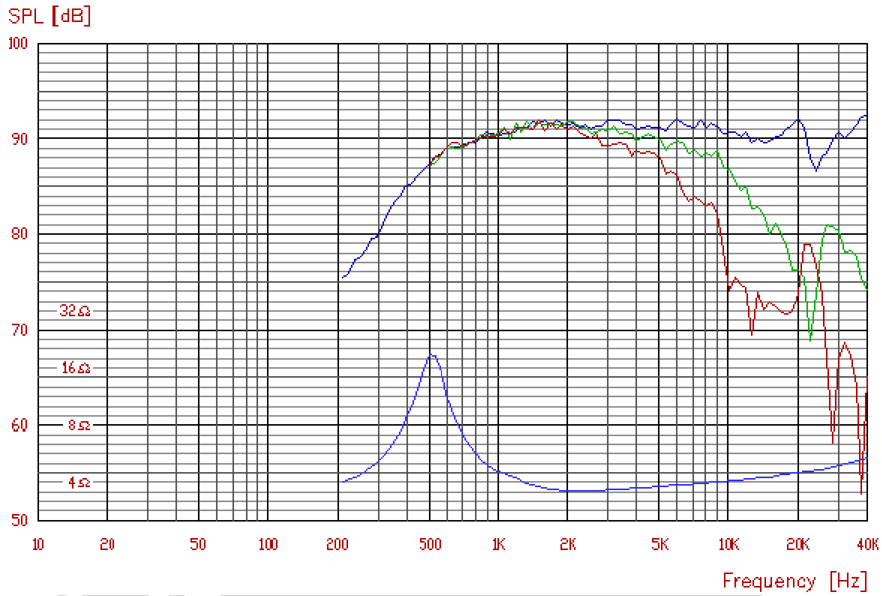
Specs:

Electrical Data			
Nominal impedance	Zn	4	ohm
Minimum impedance	Zmin	--	ohm
Maximum impedance	Zo	19	ohm
DC resistance	Re	2.9	ohm
Voice coil inductance	Le	--	mH
T-S Parameters			
Resonance Frequency	fs	530	Hz
Mechanical Q factor	Qms	--	
Electrical Q factor	Qes	--	
Total Q factor	Qts	--	
Force factor	Bl	2.5	Tm
Mechanical resistance	Rms	0.38	Kg/s
Moving mass	Mms	0.3	g
Suspension compliance	Cms	--	mm/N
Effective cone diameter	D	--	cm
Effective piston area	Sd	5.4	cm^2
Equivalent volume	Vas	--	ltrs
Sensitivity (2.83V/1m)		91.1	dB

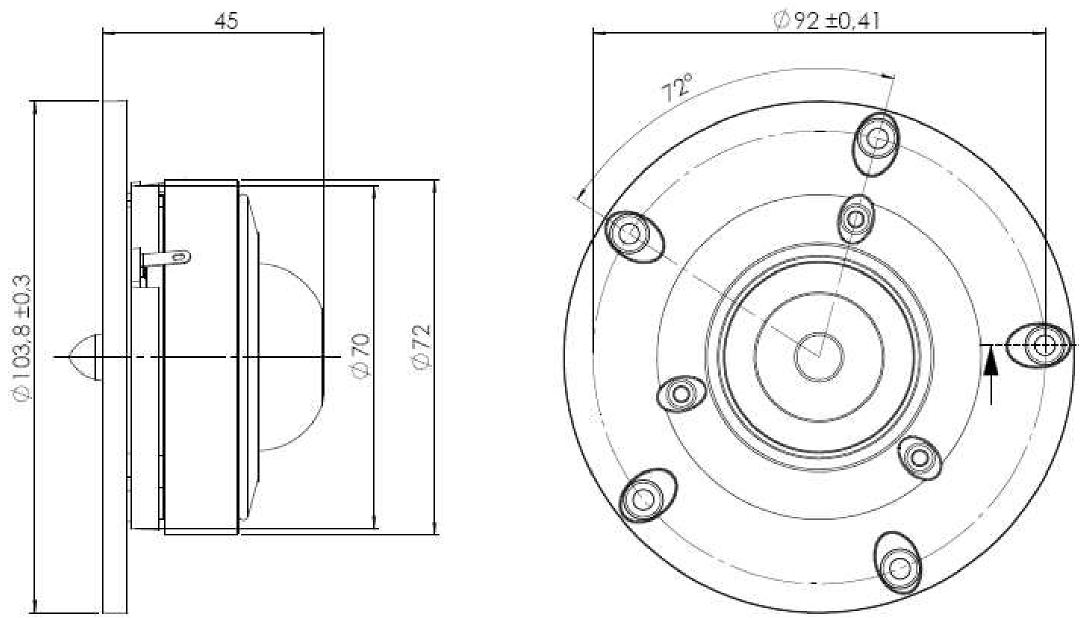
Power handling		
Long-term Max Power (IEC 18.3)	--	W
Short Term Max power (IEC 18.2)	--	W
Voice Coil and Magnet Parameters		
Voice coil diameter	26	mm
Voice coil height	2.2	mm
Voice coil layers	--	
Height of the gap	2.5	mm
Flux density of gap	--	mWb
Total useful flux	--	mWb
Diameter of magnet	--	mm
Height of magnet	--	mm
Weight of magnet	--	Kg

Notes:
IEC specs refer to IEC 60268-5 third edition.
All Tymphany products are RoHS compliant.

www.tymphany.com



Mechanical Dimensions:XT25TG30-04



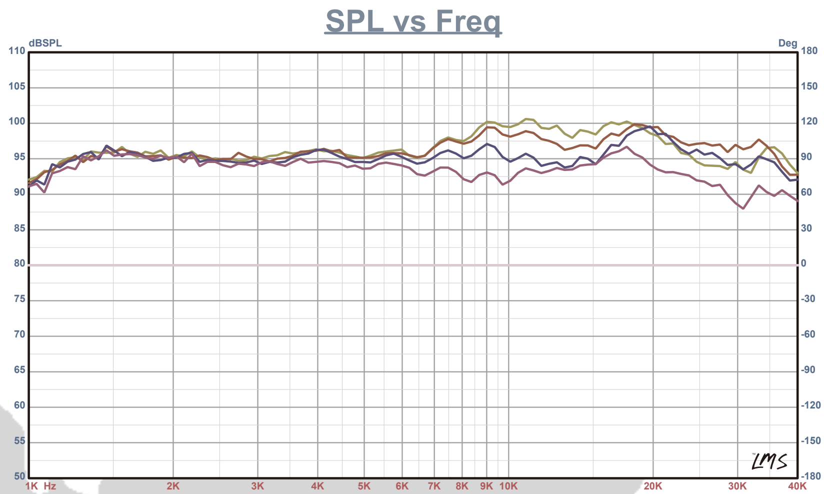
Fountek NeoCd2.0

NeoCD2.0 True Ribbon Tweeter

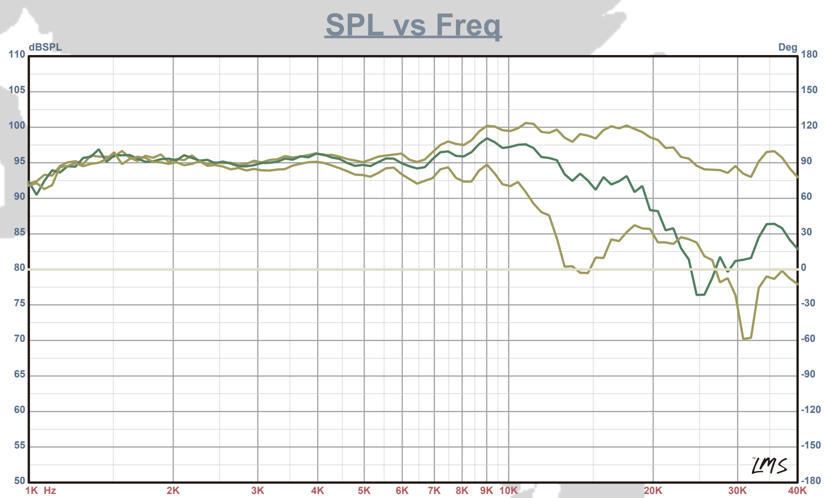
FEATURES
- strong Neodymium magnet
- 5 inch enforced sandwich diaphragm
- build-in impedance convertor
- low distortion, very fast transition

Parameter	
Sensitivity	97dB/1m/2.83v
Power handling	20W nominal, 50W max
Frequency range	1,200-40,000Hz
Nominal impedance	7 ohm
DCR	0.02 ohm
Ribbon dimension	8mmX120mmX0.015mm
Effective ribbon area	960 square millimeter
Ribbon weight	36 milligram
Gap flux	0.6 Telsa average
Gap height	3 millimeter
Recommend crossover frequency	2,500Hz with 3-order
Net. Weight	1050 gram

www.fountek.net
email: info@fountek.net
tel: +86-573-8301 9220 fax: +86-573-8301 9221

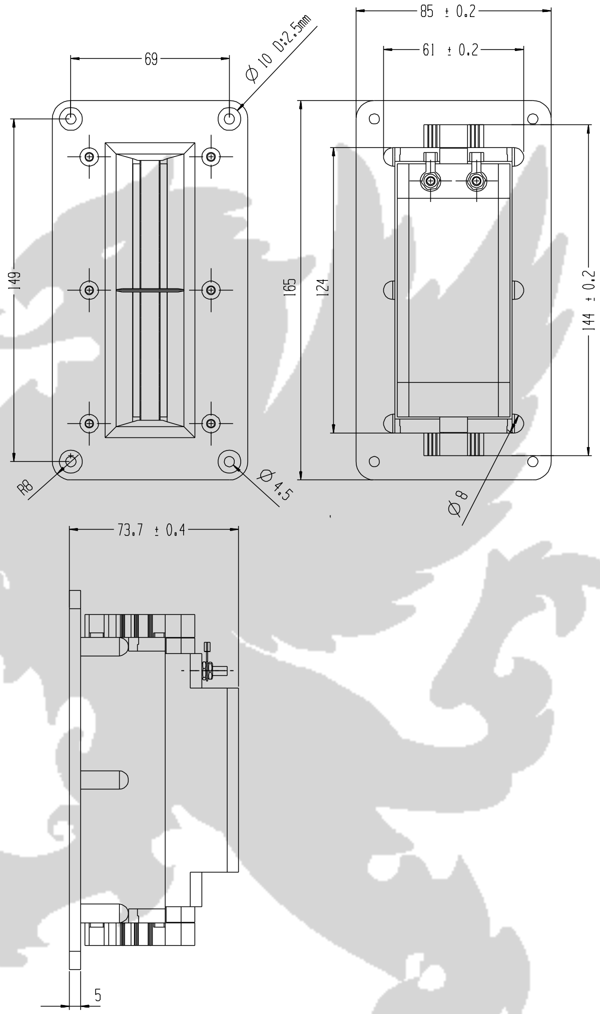


horizontal diffusion: on-axis, 15 degree , 30 degree, 45 degree



vertical diffusion: on-axis, 5 degree , 10 degree

www.fountek.net
email: info@fountek.net
tel: +86-573-8301 9220 fax: +86-573-8301 9221



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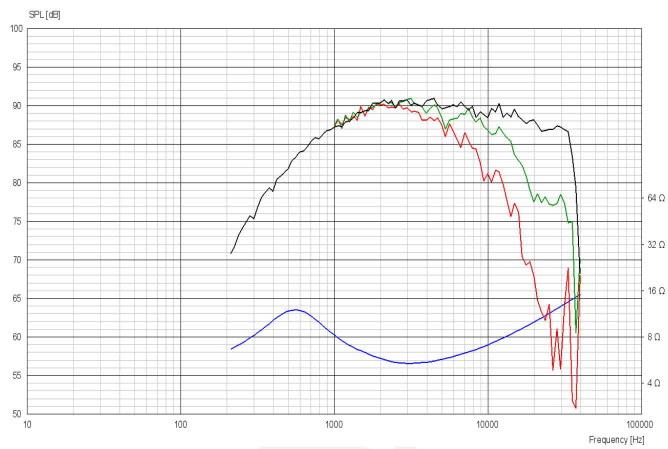
tel: +86-573-8301 9220 fax: +86-573-8301 9221

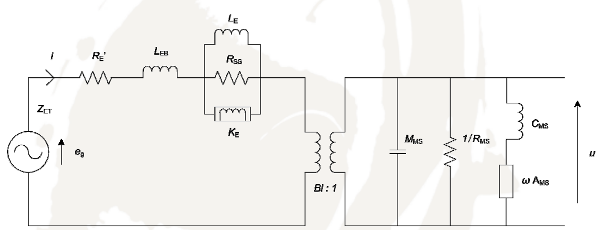
ScanSpeak Classic D2905/9300

CLASSIC

TWEETER D2905/930000



Advanced Parameters (Preliminary)



Electrical data:	
Resistance [Re']	- Ω
Free inductance [Leb]	- mH
Bound inductance [Le]	- mH
Semi-inductance [Ke]	- SH
Shunt resistance [Rss]	- Ω

Mechanical Data	
Force Factor [Bl]	- Tm
Moving mass [Mms]	- g
Compliance [Cms]	- mm/N
Mechanical resistance [Rms]	- kg/s
Admittance [Ams]	- mm/N

SCANSPEAK
N.C. Madsensvej 1 · 6920 Videbæk · Denmark · Phone: +45 6040 5200 · www.scan-speak.dk

27TDFC H1189

SEAS PRESTIGE

27TDFC is a High Definition precoated fabric dome tweeter with a wide, soft polymer surround and a rear chamber.

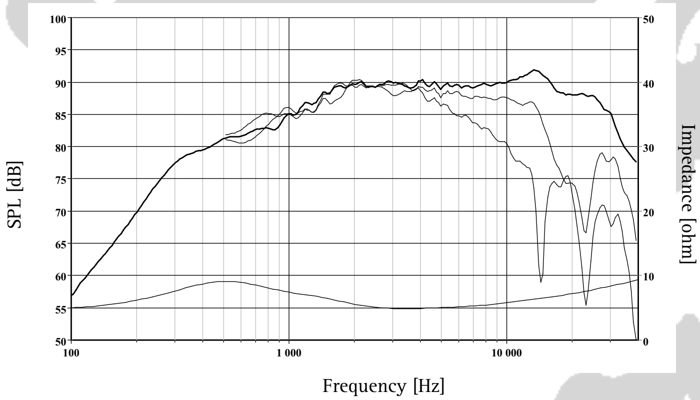
Sonotex precoated fabric diaphragm with high consistency and excellent stability against variations in air humidity

Sonomax surround for low resonance and excellent mechanical linearity.

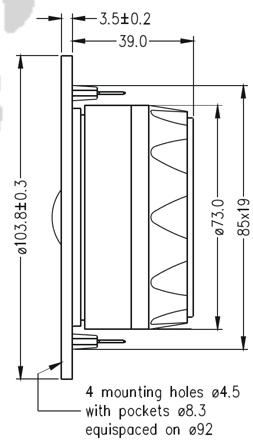
Voice coil windings immersed in magnetic fluid increase short term power handling capacity and reduce the compression at high power levels.

Stiff and stable rear chamber with optimal acoustic damping allows the tweeter to be used with moderately low crossover frequencies.

The chassis is precision moulded from glass fibre reinforced plastic, and its front design offers optimum radiation conditions.



The frequency responses above show measured free field sound pressure in 0, 30, and 60 degrees, mounted in a 0.6m by 0.8m baffle. Input 2.83 Vrms, microphone distance 0.5m, normalized to SPL 1m. The impedance is measured without baffle using a 2V sine signal.



Nominal Impedance	6 Ohms	Voice Coil Resistance	4.8 Ohms
Recommended Frequency Range	1500 - 25000 Hz	Voice Coil Inductance	0.05 mH
Short Term Power Handling *	220 W	Force Factor	3.5 N/A
Long Term Power Handling *	90 W	Free Air Resonance	550 Hz
Characteristic Sensitivity (2.83V, 1m)	90 dB	Moving Mass	0.37 g
Voice Coil Diameter	26 mm	Effective Piston Area	7.5 cm^2
Voice Coil Height	1.5 mm	Magnetic Gap Flux Density	1.8 T
Air Gap Height	2.0 mm	Magnet Weight	0.25 kg
Linear Coil Travel (p-p)	0.5 mm	Total Weight	0.50 kg

Jul 2007-1

*IEC 268-5, via High Pass Butterworth Filter 2500Hz 12 dB/oct.
SEAS reserves the right to change technical data

T27-531

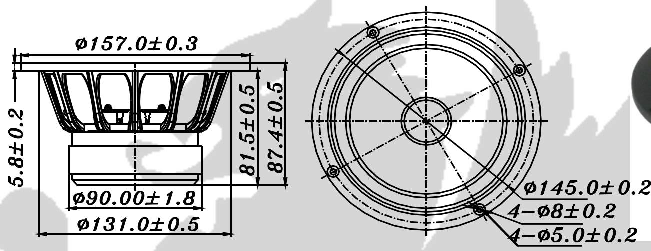
RoHS compliant product

www.seas.no

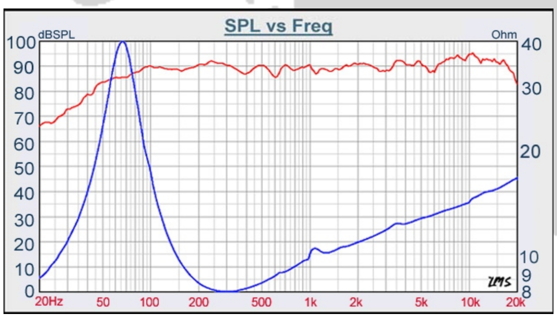
B) Woofer Specification Sheets

Tang Band W5-1611 SAF

F SERIES **W5-1611SAF**



- FULL RANGE DESIGN
- BLACK COLOR PP CONE WITH WIDE RANGE TEMPERATURE,HIGH LOSS RECIPE OF RUBBER SURROUND
- UNDERHUNG MOTOR DESIGN
- GF REINFORCED NYLON BASKET



5" PP FULL RANGE

DIAPHRAGM MTL	Black color pp
SURROUND MTL	Rubber
NOMINAL IMPEDANCE	8 Ω
DCR IMPEDANCE	6.3 Ω
SENSITIVITY 1W/1M	90 dB
FREQUENCY RESPONSE	60 - 20K Hz
FREE AIR RESONANCE	60 Hz
VOICE COIL DIAMETER	25.4 mm
AIR GAP HEIGHT	10 mm
RATED POWER INPUT	28 W
MAXIMUM POWER INPUT	56 W
FORCE FACTOR, BL	5.53 TM
MAGNET WEIGHT (18.6 oz)	525 g
MOVING MASS	5.99 g
FERROFLUID ENHANCED	No
SUSPENSION COMPLIANCE	1307 uMN^{-1}
EFFECTIVE PISTON AREA	0.0094 M^2
Levc	0.023 mh
Zo	40 o hm
X-max	3 mm
Vas	11.69 Litr
Qts	0.44
Qms	2.80
Qes	0.52

TB SPEAKERS

VOICE:886.2.26570282 FAX:886.2.26580166
E-MAIL :info@tb-speaker.com

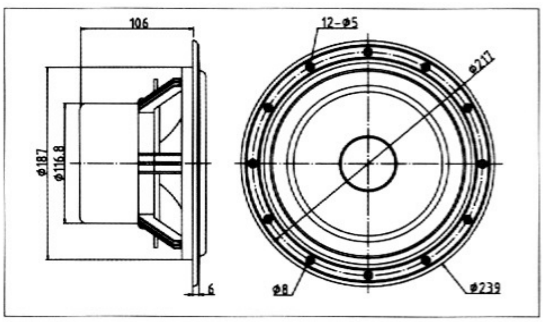
HiVi F8

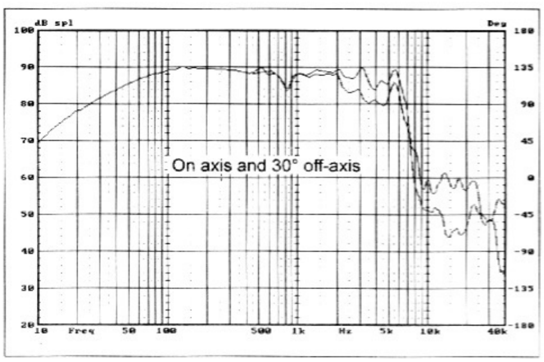
Hi-Vi RESEARCH®

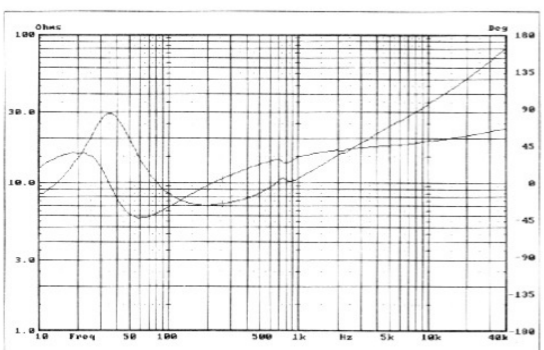
It could be your solution for perfect low frequency reproduction

F8

Bass-Midrange







F8 Bass-Midrange Features:

- Light and extremely rigid cone made from Kevlar®/paper composite
- Specially made high-loss rubber surround
- Shielded double magnet motor structure
- High power handling Kapton® former voice coil
- Flat linear spider
- High-density aluminum die-cast basket

An accurate and uncompressed sound performance at realistic loudness levels represents the ideology implemented in this driver. The design of the F8 has been optimized for balanced and dynamic low bass reproduction in compact or medium vented systems. Midrange clarity and tonal balance is remarkable.

The F8 utilizes a newly developed matrix of Kevlar® and paper fibers. As a result the cone weighs less, is more rigid, and has an improved dampening factor over conventional Kevlar® materials. The back of the cone is hand-coated with a special dampening compound to further maximize performance stability and control of structural resonances. The driver utilizes a vented Kapton® voice coil former and air transparent spider to avoid air compression and ensure maximum power handling.

The massive aluminum die-cast basket has been developed to minimize parasitic structural resonances.

A shielded magnet structure allows the F8 to be easily incorporated into audio/video applications.

Recommended crossover frequency for two-way system design is 1.8-2.2 kHz.

F8 SPECIFICATIONS		
Nominal Impedance (Ω)	Z	8
Resonance Frequency (Hz)	Fs	36
Nominal Power Handling (W)	Pnom	60
Sensitivity (2.83v/1m) (dB)	E	87
Weight (Kg)	M	2.9
Voice Coil Diameter (mm)	Ø	35
DC Resistance (Ω)	Re	6.5
Voice Coil Length (mm)	H	17.5
Voice Coil Former	Kapton®	
Force Factor (TM)	BL	10.1
Gap Height (mm)	He	7.5
Linear Excursion (mm)	Xmax	5.0
Suspension Compliance (uM/N)	Cms	567
Mechanical Q	Qms	1.73
Electrical Q	Qes	0.51
Total Q	Qts	0.39
Moving Mass (g)	Mms	35.3
Equivalent Air Volume (L)	Vas	36.9
Cabinet Type	Vented Box	
Recommended Box Volume (L)	Vb	19
Tuning Frequency (Hz)	Fb	40
-3dB Cut-Off Frequency (Hz)	F3	47

Peerless 830883

print close drawing application

Peerless Data Sheet

Type: HDS EXCLUSIVE 180 WR 33 102 NWP AL CU PH LS 8 OHM - 830883

Electrical data		
Nominal impedance	Zn	8 (ohm)
Minimum imp./at freq.	Zmin	6.7/274 (ohm/Hz)
Maximum impedance	Zo	38.1 (ohm)
Dc resistance	Re	5.8 (ohm)
Voice coil inductance	Le	1.3 (mH)
TS Parameters		
Resonance Frequency	fs	52.3 (Hz)
Mechanical Q factor	Qms	2.79
Electrical Q factor	Qes	0.50
Total Q factor	Qts	0.43
Force factor	Bl	8.2 (Tm)
Mechanical resistance	Rms	2.09 (Kg/s)
Moving mass	Mms	17.7 (g)
Suspens. compliance	Cms	0.52 (mm/N)
Effective cone diam.	D	13.1 (cm)
Effective piston area	Sd	134 (cm)
Equivalent volume	Vas	13.0 (ltrs)
SPL 2.83V/1m at fmin		87.5 (dB)

Voice coil and magnet parameters	
Voice coil diameter	33.0 (mm)
Voice coil length	17.0 (mm)
Voice coil layers	2
Height of the gap	6.0 (mm)
Linear excursion +/-	5.5 (mm)
Max mech. excursion +/-	- (mm)
Total useful flux	1.1 (mWb)
Diameter of magnet	102 (mm)
Height of magnet	20 (mm)
Weight of magnet	0.68 (kg)
Factors	
Ratio fs/Qts	122
Ratio BL/sqrt(Re)	3.4

Special remarks

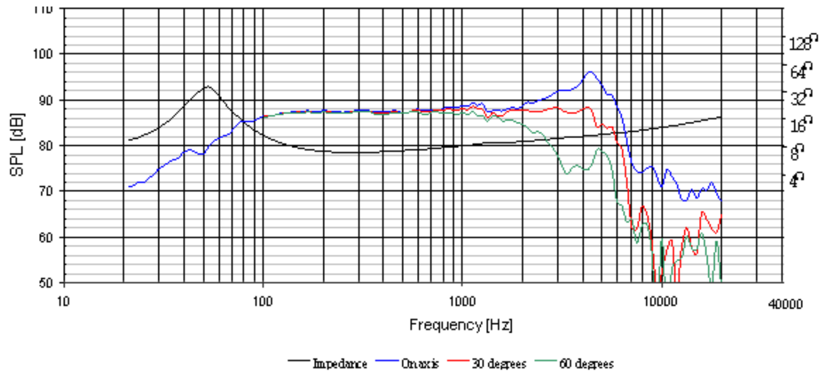
-

Power handling	
100h RMS noise test (IEC)	- (W)
Longterm Max System Power (IEC)	- (W)

IEC268-5 noise signal is used for the powertest.

Remarks on powertest

-

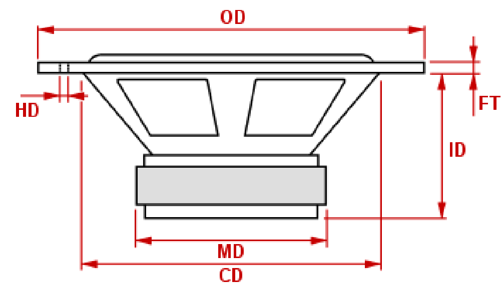


Measuring methods and conditions are stated in Peerless Standard for Acoustic Measurements (PSAM)

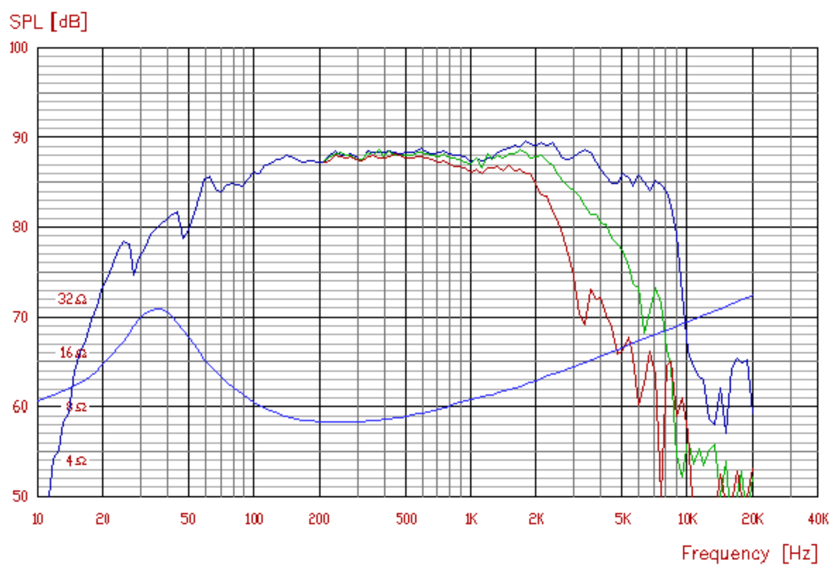
ScanSpeak Classic P17WJ00

P17WJ-00-08

Nominal impedance [ohm]	8
Voice coil resistance [ohm]	5.8
Nominal power [W]	40
Short term max power [W]	350
Long term max power [W]	150
Operating power [W]	6.3
Sensitivity [dB]	88
Frequency range [Hz]	37-5000
Free air resonance [Hz]	37
Voice coil diameter [mm]	32
Voice coil height [mm]	14
Air gap height [mm]	6
Voice coil inductance [mH]	0.55
Eff. diaphragm Area [cm²]	136
Moving mass [g]	14
Magnet weight [g]/[oz]	415/14.6
Force factor [Bl]	6.5
VAS [l]	34.7
Qms	1.55
Qes	0.45
Qts	0.35



OD:	170 mm	CD:	146 mm
FT:	4.2 mm	ID:	71.3 mm
MD:	91.8 mm	HD:	4xø5@ø162

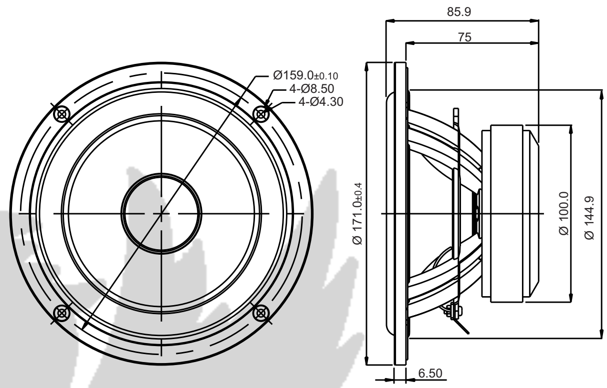


Frequency response: 2.83V / 1m

SB Acoustics SB17NRXC35-8

SB ACOUSTICS

6” SB17NRXC35-8



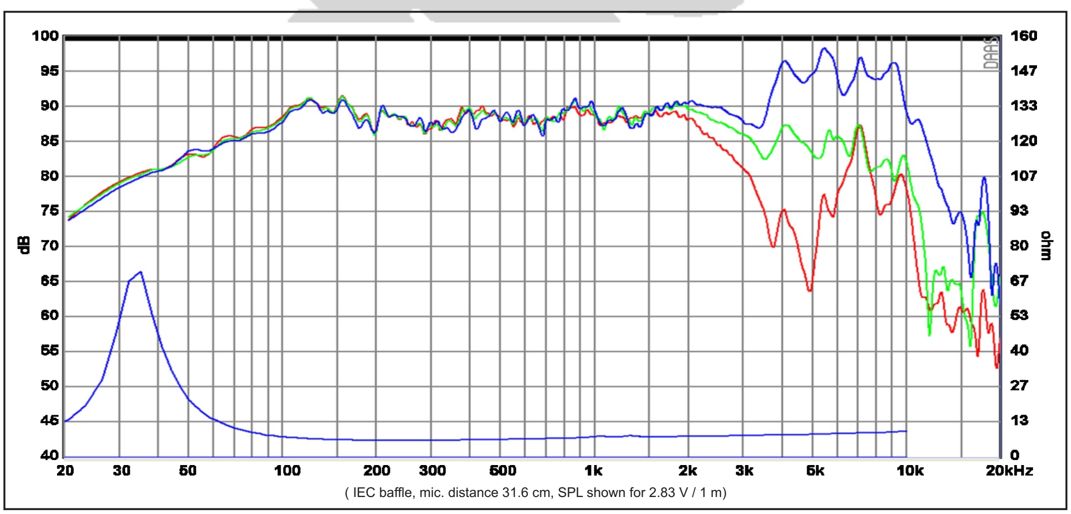
FEATURES

- Vented cast aluminum chassis for optimum strength and low compression
- Proprietary cone material with natural fibers made in-house
- Soft low damping rubber surround for transient response
- Non-conducting fiber glass voice coil former for minimum damping
- Extended copper sleeve on pole piece for low inductance and low distortion
- CCAW voice coil for reduced moving mass
- Long life silver lead wires
- Vented pole piece for reduced compression

Specs :

Nominal Impedance	8 Ω	Free air resonance, Fs	32 Hz
DC resistance, Re	5.7 Ω	Sensitivity (2.83 V / 1 m)	89 dB
Voice coil inductance, Le	0.15 mH	Mechanical Q-factor, Qms	5.0
Effective piston area, Sd	118 cm^2	Electrical Q-factor, Qes	0.36
Voice coil diameter	35.5 mm	Total Q-factor, Qts	0.34
Voice coil height	16 mm	Moving mass incl.air, Mms	11.0 g
Air gap height	5 mm	Force factor, Bl	5.9 Tm
Linear coil travel (p-p)	11 mm	Equivalent volume, Vas	44.5 liters
Magnetic flux density	1.0 T	Compliance, Cms	2.25 mm/N
Magnet weight	0.54 kg	Mechanical loss, Rms	0.44 kg/s
Net weight	1.56 kg	Rated power handling*	60 W

* IEC 268-5, T/S parameters measured on drive units that are broken in.



(IEC baffle, mic. distance 31.6 cm, SPL shown for 2.83 V / 1 m)

Response Curve :

------ (Blue) : on axis ------ (Green) : 30° off-axis ------ (Red) : 60° off-axis

Bibliography

Lalena, Michael. *2-Way Crossover Designer / Calculator.* lalena.com network. 2013. http://www.diyaudioandvideo.com/Calculator/XOver/.

Moulton, David. *Total Recording: The Complete Guide To Audio Production and Engineering.* KIQ Productions, 2000.

Murphy, John L. *True Audio.* June 20, 2000. http://trueaudio.com/st_diff1.htm (accessed February 3, 2013).

Newell, Philip, and Keith Holland. *Loudspeakers For Music Recording and Reproduction.* Oxford: Elsevier Ltd., 2007.

North Creek Music Systems. *Cabinet Handbook.* 2nd Edition. Old Forge, New York: North Creek Music Systems, 1992.

Olson, Harry F. "Direct Radiator Loudspeaker Enclosures." *Audio Engineering*, November 1951: 38.

Toole, Floyd E. *Sound Reproduction.* Oxford: Elviser Ltd., 2008.

Wikipedia. *Audio Crossover.* Feb 25, 2013. http://en.wikipedia.org/wiki/Audio_crossover (accessed Mar 2, 2013).