SCARY STEREO

High Fidelity Home Theater Stereo Speakers

Designed by: Rowan Parsons

Table of Contents

1.0 Functional Description

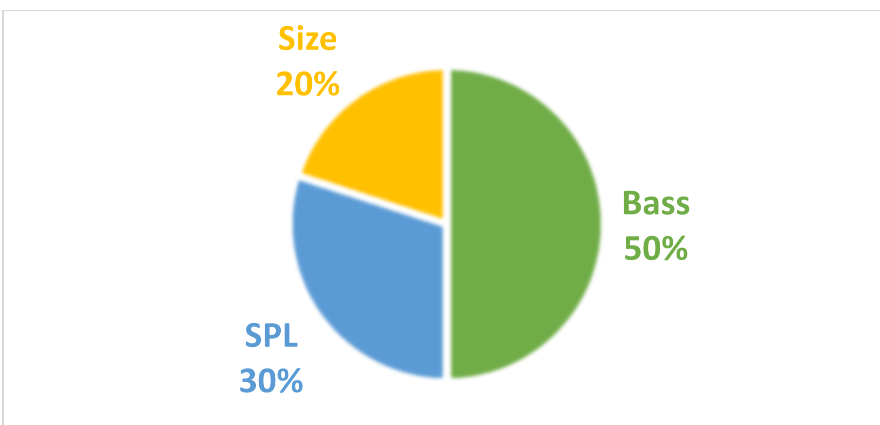
This speaker will be a floor standing home theater speaker. It will be designed to stand on either side of a central screen, pointed at a central listening point at the far end of the room. The speakers will be sizable, up to three or four feet tall, and will be a multiple driver system.

The speakers will sit eight to twelve feet away from the central listener and will therefore need to be capable of mid to high SPL outputs. Their use as home theater speakers also means they should have good SPL output capabilities to allow for high volume films.

These speakers will be stationary and as such weight and size are not large concerns. For moving purposes, two people will easily be able to wrangle and maneuver the speakers.

Low distortion will be a primary goal for sound quality to allow for enjoyable listening at both low and high SPL outputs. This will allow for listening in a wide dynamic range. A totally flat frequency response is not a concern, as the goal is to have a pleasant to listen to, high fidelity speaker for enjoyment. The goal is for these to be listening forward speakers, meant for enjoying an end product without concern for perfectly recreating the recorded audio.[1]

Based on John L. Murphey's three-point design tradeoffs this speaker is going to prioritize low frequency extension, then SPL output, and lastly size.[2]



[1] Moulton, David. *Total recording,* pg. 313
[2] Murphy, John L. *Introduction to loudspeaker design*, pg. 62

2.0 Reference Systems

2.1 Overview

A review of floor standing high fidelity home theater speakers was done to find the general characteristics of similar speakers. The findings are as follows:

Speaker	Sensitivity	Frequency Response	Dimensions (inch)	Drivers	Price (US$, pair)
Klipsch Forte IV	99 dB	38-20,000 Hz (±3dB)	35-3/4"H x 16-11/16"W x 13"D	4	$4,998.00
Volti Rival Type 1	100 dB	32-20,000 Hz	41-1/2”H x 19”W x 16”D	3	$16,000.00
Vandersteen 2Ce	86 dB	32Hz - 21kHz +/- 1.5dB, 29Hz – 29kHz +/- 3dB	39.75”H x 16”W x 10.25”D	4	$3,607.00
Totem Forest	87 dB	30 Hz – 20 kHz ± 3 dB	34.3”H x 7.7”W x 10.6”D	2	$5,200.00
Focal Theva N°2	90 dB	53-28,000 Hz	41 3/8"H x 12 5/8"W x 18 7/8"D	4	$1,800.00

Looking at the table, Sensitivities generally fall between 86 and 100 dB. Frequency responses generally reach into the 30s with the Focal being the exception, only reaching 53 Hz. The speakers are all sizable, falling between 34 and 41 inches tall. Most speakers have between 3 and 4 drivers, with the Totem Forest being the only listed speaker with 2 drivers.

2.2 Specific Loudspeakers

Klipsch Forte IV [3]

The Forte IV has a design unlike anything else I had seen before. Both the tweeter and mid have horns meant to give a wider more accurate listening position. It has a 12-inch bass driver on the front as well, and then a 15-inch passive radiator on the back. A review on The Ear gave them a glowing review in terms of sound quality, complimenting their bass response and saying they rivaled even the best electrostatic speakers in terms of transparency.[4] The speakers are also my favorite on the list visually. I really like the black face and the striking wood varnish. I was not able to find a frequency response graph from the manufacturer or a reviewer.

[3] “Forte IV Floorstanding Loudspeaker.” Klipsch
[4] “Klipsch Forte IV.” The Ear

Volti Rival – Type I[5]

The Rival has some design elements like the Forte IV. It also has a horn for its tweeter and mid. However, it has a 15-inch woofer on the front face, and no passive radiator, instead it has a front facing port. The Rival is a large speaker, being a little under four feet tall. Reviewer Ken Micallef described it as having a "sense of purposeful authority."[6] I personally love the large and striking presence of the speakers. I was not able to find a frequency response graph from the manufacturer or a reviewer.

Vandersteen 2Ce Signature II[7]

The Vandersteen Signature is unique because of its limited baffle design. It has a 1-inch tweeter, 4.5-inch mid, 8-inch woofer, and a rear facing 10-inch active acoustic coupler. Reviewer Art Dudley explains that the limited baffle that it does have is there to time align the three front facing drivers.[8] The 2Ce has a very prolific history, having sold over 100,000 pairs since they began production in 1977. With such a track record, and good reviews everywhere you look, this speaker seems to be doing something right. I was not able to find a frequency response graph from the manufacturer or a reviewer.

3.0 Technical Specifications

3.1 Initial Cabinet Design

These speakers are going to be large. There is quite a bit of room in my living room on either side of the TV stand. The current speakers that are there are 26" tall, 12" wide, and 11" deep. The front TV stand comes out 2 feet from the wall. I know I want these speakers to be taller than the current ones. My ear level at the listening position is 3 feet off the ground, so this would be a good approximate height for the drivers, with a possible total height around 36". To allow for the large front that I want, I will use 19" as an ideal width. 16" would be a good depth for their location.

[5] "The New Rival by Volti Audio." Volti Audio
[6] "Volti Audio Rival Loudspeaker." Stereophile.com
[7] "Vandersteen Model 2CE Signature III." Vandersteen Audio
[8] "Vandersteen 2CE Signature II Loudspeaker." Stereophile.com

These speakers do not need to be light as they won't be moving frequently and can be moved by a team.

Taking the dimensions of 36"H x 19"W x 16"D and removing 1.5" in each dimension for a ¾" wood thickness we get 34.5" x 17.5" x 14.5" for internal dimensions. This gives me an approximate internal volume of 5.1 cubic feet. (8,754 cubic inches, 143.5 liters)

Target Dimensions: 36"H x 19"W x 16"D

Flexibility: Height is flexible, width is flexible +/- 2 inches, and depth is flexible +/- 2 inches

Target Volume: 5.1 cubic feet, 143.5 liters

3.2 SPL

I spent time measuring the LUFS of music on several different speaker systems throughout a week to learn what volumes I like to listen to. This information helps me know what SPL I want these speakers to be capable of.

Measurements

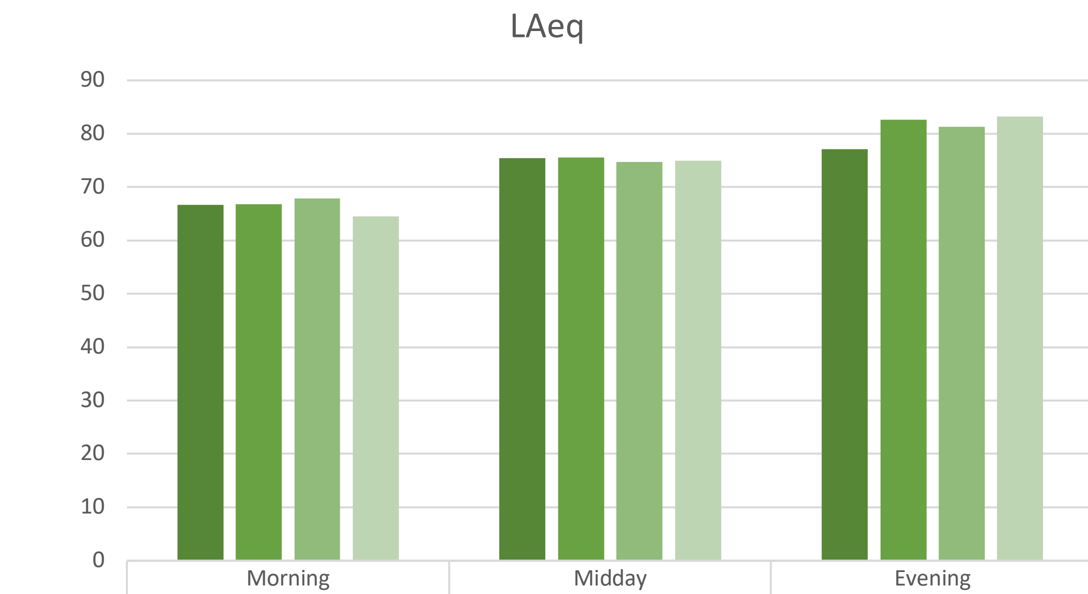
My measurements were taken using the NIOSH SLM app on my iPhone 13 Pro.

The measurements used as defined in the NIOSH app:

> **LAeq:** Equivalent (averaged every second) continuous sound level
>
> **Maximum Level:** Highest sound pressure level during a measurement period
>
> **LCpeak:** Peak sound pressure level in C-weighted decibels
>
> **Total Run Time:** Total Run time for the current measurement

LAeq Levels Throughout the Day

The following chart includes LAeq data from morning, midday, and evening listening. All these measurements are C-weighted, and were either taken at my small desktop speakers, or my larger living room speakers. I took these measurements over the course of two days.



	Morning	Midday	Evening
Series 1	66.7	75.4	77.1
Series 2	66.8	75.6	82.6
Series 3	67.9	74.7	81.3
Series 4	64.5	75	83.2

My morning listening levels tended to be at my quietest level through the day. I don't often listen to music on speakers in the morning, but I did for this lab. I found I was not looking to really be jamming, instead I just wanted to hear it a little bit.

My Midday levels were surprisingly consistent, hovering around 75 dB.

My evening levels were my loudest, ranging from 77.1 dB to 83.2 dB in this set. This is the time that I listen to music most regularly, and I typically like it to be loud as is supported with my measurements. These will be the most helpful to me in determining what levels my speakers need to be capable of.

Overall, with these levels I know that the speakers need to be capable of pushing at least 83 dB for an extended period of time.

Max. Level

The following chart contains the Max. Level from the same measurements as shown in the LAeq chart.

These levels will be useful in determining the headroom and amplifier power I will need for my speakers.

Max SPL Listening

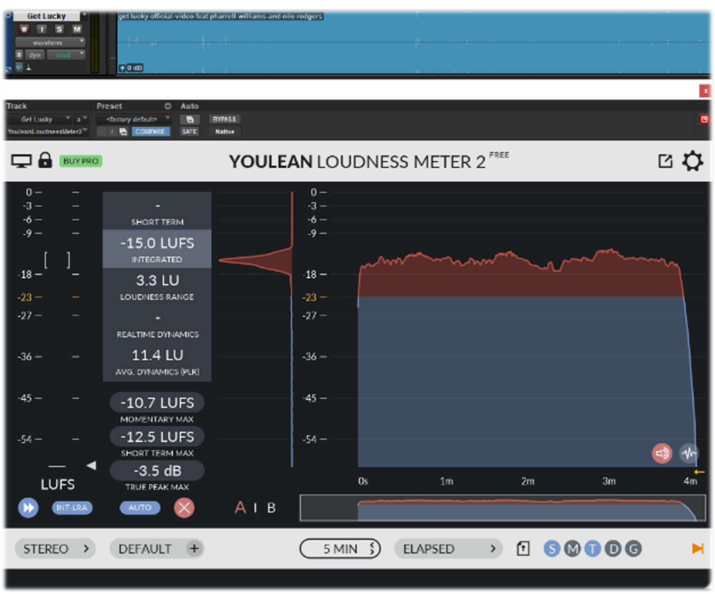
I set out to find what I thought was the loudest I want to listen to my speakers. My Max SPL was experienced at my home desk monitors. I played Get Lucky by Daft Punk, and Leave the Door Open by Silk Sonic and went to what I felt was the loudest I would want to jam to them. Using the NIOSH app, I measured each song in full using a C weighting. The data points gathered are as follows:

Song	LAeq	Max Level	LCpeak	Total Run Time
Daft Punk	86.2	94.8	111.8	3:49
Leave the Door Open	85.6	91.2	107.7	3:45

Running the files for these songs through the Youlean Loudness Meter 2 plugin provided the following data:

Leave the Door Open:

Leave the door open came to an integrated LUFS level of -18.1 with an average dynamic range of 12 LU.



Get Lucky:

Get Lucky had an integrated LUFS of -15, and an average dynamic range of 11.4 LU.

Since Daft Punk had the highest Max. Level, it will be what I base the rest of the discussion around speaker loudness on.

3.3 SPL Conclusions

Based on my listening, these speakers need to play music at a sustained level around 83 dB, and reach peaks of 95 dB. With the Apple Music headroom of 16 dB, I would be reaching peaks of 99 dB. I don't watch films at such a high volume, so I'll start at 78 dB, and if I add the Netflix headroom of 27 dB, I would need to reach peak SPLs of 105 dB.

These SPLs need to be reached 9 feet, or a little under 3 meters away, which is about 3 times the standard measuring and modeling distance of 1 meter. Using the inverse square law, I can calculate the necessary output to reach 105 dB at 3 meters. I would need around an additional 9 dB of output to account for the doubling and a half in distance. Therefore, my speakers need to be capable of 93 dB continuous, with peaks of 104 dB for music, and 87 dB continuous with peaks of 114 dB for movies.

Target SPL: 93 dB continuous with 104 dB peaks

3.4 Amplifier Considerations

Wattage Needs

From the above, I know that my speakers will need to be capable of maintaining a 93 dB average level, with up to 104 dB max levels at the listening position 9 feet away.

Many speakers have sensitivities around 89 dB at 1 watt at 1 meter. If this speaker is powered by a 100-watt amplifier (a common size) it can reach level 20 dB above its sensitivity. This is calculated in terms of dBw (which is how much louder an amplifier can push the speakers than its sensitivity) which is calculated with the following equation:

$$\text{dBw} = 10\ \text{Log10}(\text{Amplifier Size})$$

So, for that 89 dB at 1 watt at 1 meter speaker, a 100-watt amplifier would allow it to reach 109 dB at 1 watt at 1 meter. For a speaker with a sensitivity of 89 dB to reach a peak of 104 dB at almost 3 meters would take a dBw of 24, which would require a 300-watt amplifier.

Target Sensitivity: at least 89 dB

3.5 Frequency Response

Low Frequency Extension

I have already discussed in the Functional Description that bass extension will be a priority in these speakers. It is important that they have a full range for listening to films and music.

My most ideal low-frequency extension range is 20 - 35 Hz. I would be happy with 40 Hz, and I feel that 45 would be the highest acceptable.

Frequency Response Shape

As these are speakers are for listening forward, a flat frequency response is not a primary concern. A +/- 2- or 2.5-dB frequency response would be good. They need to reach above 20 kHz, with no breakup frequencies below 20 kHz.

Target Shape: +/-2.5dB

High Frequency Extension: Extends above 20K.

Low Frequency Extensions: 45 Hz minimum, 20Hz target, 35 acceptable.

4.0 Driver Selection

4.1 Subwoofer

With Bass extension being a priority, and knowing that I want large and intimidating speakers, I knew I would be looking at considering some large drivers. In my initial search I found 8 drivers I decided to collect information on. (See Appendix B) With my cabinet size considerations I decided 15-inch drivers would be my desired size. From these Drivers I found that the Dayton Audio DCS380-4, the Peerless XXLS-P830845 and the Dayton Audio RSS390HO-4 all fit into my desired budget and sensitivity range. I then took a closer look at these drivers' specifications and modeled them in WinSpeakerz. (See Appendix B) Looking at my modeling, I was most attracted to the Dayton Audio RSS390HO-4 because of its ability to extend below the other two drivers, and more comfortably as well. It is also an Aluminum cone which should provide lower distortion.

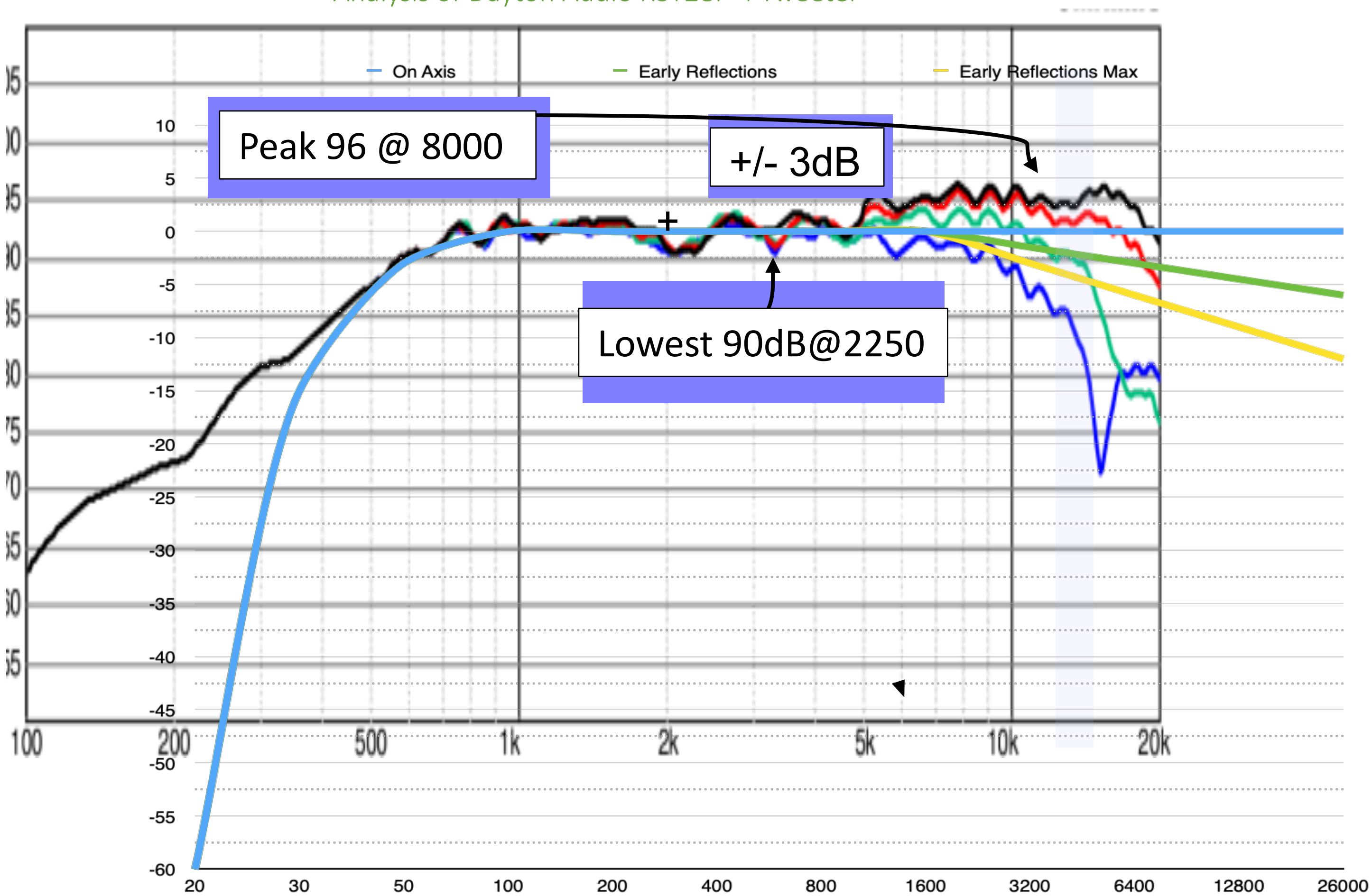
4.2 Mid

For my Midwoofer I decided to look mostly at 6-inch drivers because they often had low enough Free Resonances to cross-over with my 15-inch Subwoofer. Among the 8 drivers that I collected in my spreadsheet, I found that the Dayton Audio RS150P-4a, the SB Acoustics SB17NBAC35-4, and the SB Audience ROSSO-6MW150D all fit my desired budget and sensitivity range, so I modeled them in WinSpeakerz to get a better idea of their capabilities. (See Appendix C). I decided to purchase the SB Acoustics SB17NBAC35-4 because of its ability to extend almost flat down to 100Hz, leading me to think it will be able to pair well with the Subwoofer. Looking at its manufacturer's specifications, it also has a desirable off-axis response, and high-frequency extension, that leads me to believe it will pair well with a tweeter.

4.3 Tweeter

For my Tweeters I began by looking for tweeters with a desirable off-axis to accommodate my wide desired listening axis, and sensitivity. I found 8 to take a close look at (See Appendix D) and on the following pages are analyses of the 3 that I found most appealing.

Analysis of Dayton Audio RST28F-4 Tweeter



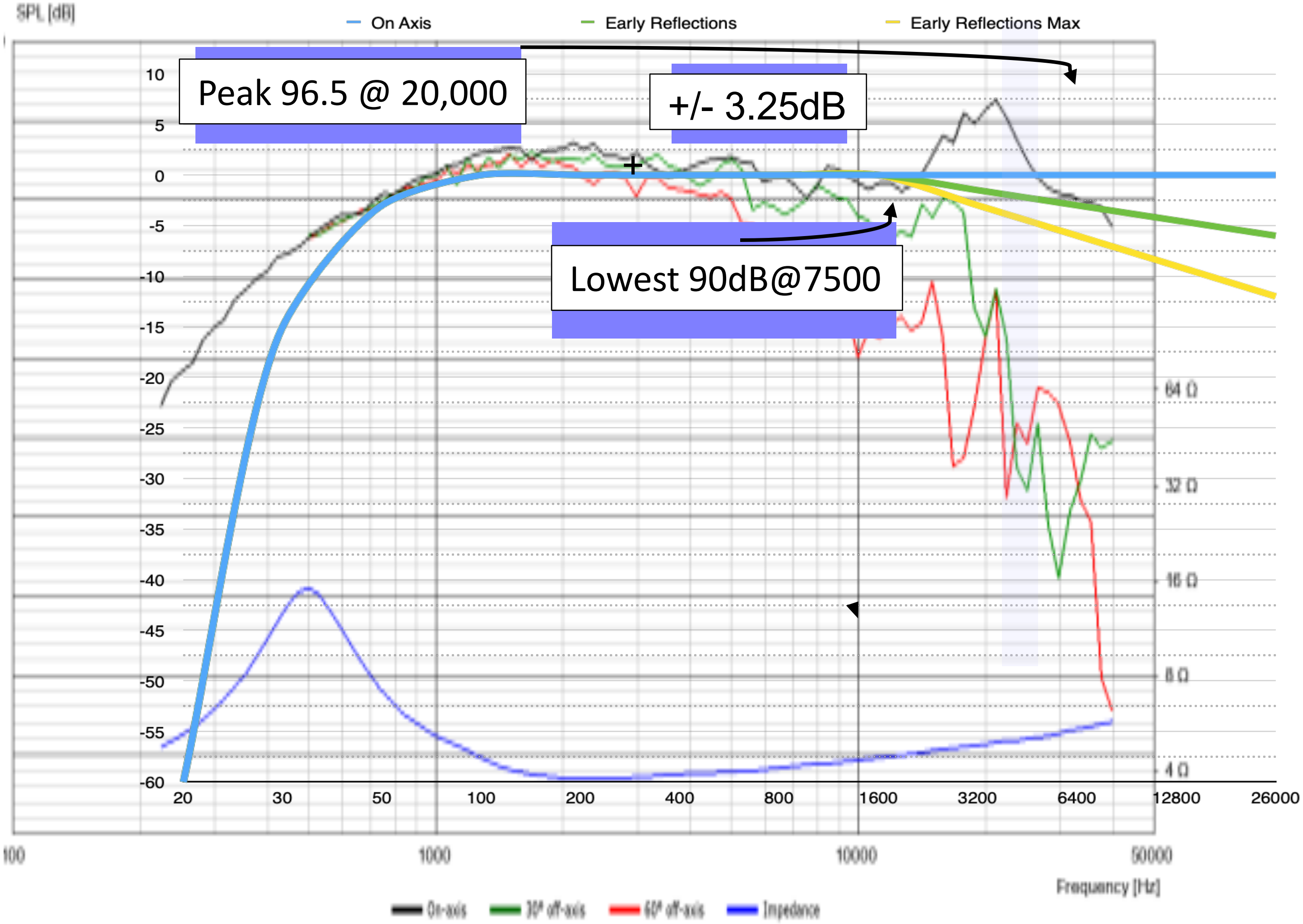
The Dayton Audio RST28F-4 Tweeter will not be used for my design. It extends up to 20k but is already rolling off at 20k. Its frequency response does not appear as flat to me as other tweeters I am looking at.

It has a sensitivity of 93.5 dB which goes above and beyond my desired SPL.

Its off-axis response seems quite smooth. It does not diverge super noticeably until, 5k, which I think is actually too high for my desired Midwoofer to match with.

The tweeter is all black which fits my design. I don't love the large dome look, however.

Analysis of ScanSpeak Discovery D2604 Tweeter



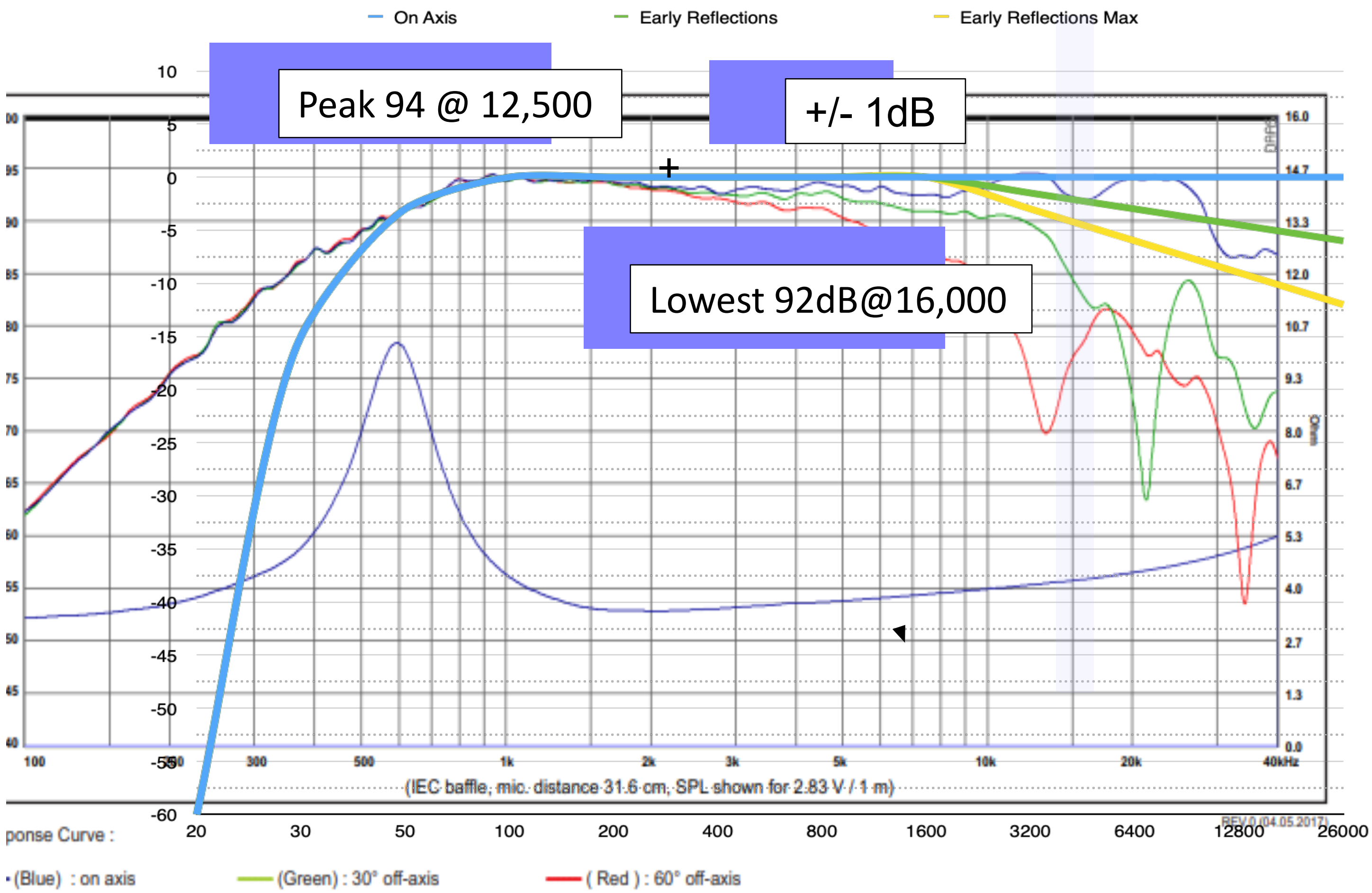
The ScanSpeak Discovery D2604 Tweeter will likely not be used for my design. While it extends past 20k, it has a large spike around 20k that makes me nervous.

It has a sensitivity of 92 dB which fits into my design goals and matches with the other drivers I have selected.

Its off-axis response is also not as smooth as the SB Acoustics SB29RDAC-C000-4 Tweeter. The off axis also seems to be noticeably diverging from the on-axis as low as 1,500, which is not what I would like.

The tweeter is all black which could fit the design, however, I do not enjoy its aesthetic design nearly as much as the SB Acoustics SB29RDAC-C000-4.

Analysis of SB Acoustics SB29RDAC-C000-4 Tweeter



The SB Acoustics SB29RDAC-C000-4 Tweeter looks incredible for my design. With its impedance curve at 600Hz, it will be more than able to crossover with my midwoofer. It extends in frequency above 20k which also fits my design goals. It is also +/- 1 dB which is extremely attractive to me.

It has a sensitivity of 93 dB which fits well into my sensitivity goals and is similar to the subwoofer and midwoofer I picked out.

The Tweeter has a good looking off-axis response that makes me feel it will fit into my wide listening environment. The off-axis also seems to diverge around 2k, which is where my selected midwoofer's off-axis begins to diverge as well.

Aesthetically, the tweeter is all black, again fitting into my design. I believe it will look nice paired with my other drivers on an all-black baffle.

4.4 Final Driver Selections

For my subwoofer I ended up buying the Dayton Audio RSS390HO-4 because of its low frequency extension, SPL output, and aesthetic design. For my midwoofer I bought the SB Acoustics SB17NBAC35-4 because I believed it would be a great pair for my subwoofer and would fit with my tweeter as well. I bought the SB Acoustics SB29RDAC-C000-4 Tweeter because of its flat and well extended frequency response as well as its aesthetic design and SPL capabilities.

5.0 Final Cabinet Design and Drafting

One of my primary cabinet design goals was for the speakers to be large and intimidating. This is a quality of several of my reference speakers, especially the Klipsch Forte IVs, that I enjoy. My target dimensions from above were 36”H x 19”W x 16”D.

5.1 Wall Dimensions

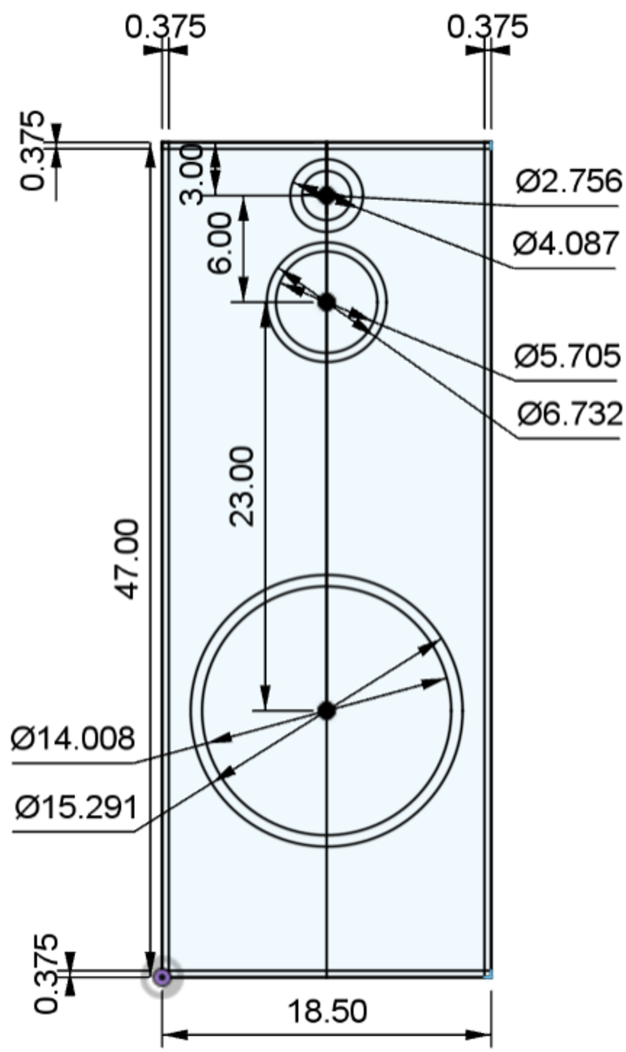
When considering how the wall of my speakers would fit on a standard piece of Medium-density fibreboard (MDF) which is 48” by 96”, I ended up changing some of my dimensions. I realized there was not much of a point in *not* getting the most out of my MDF purchase and making them as tall as possible. Their final external height came to 47” to allow them to be as tall as possible while removing the raw edges of the sheet of MDF. I used Fusion 360 to begin drafting the front face of my speaker to experiment with different widths and depths to visualize and decide on my rough preferences. I decided on an external width of 18.5”, and an external depth of 20.125” based on visual preference, and attempting to reduce resonances in the box. 18.5” and 20.125” are far enough off from half of 47” and from each other to reduce box resonances.

Final External Dimensions: 47”H x 18.5”W x 20.125”D

5.2 Driver Placement

To begin my driver placement decisions, I again took to Fusion 360 with the measurements of my drivers and began to experiment. I knew I wanted the tweeter to sit close to the top of the speaker. With the center of the tweeter 3 inches from the top of the speaker, there was about an inch of clearance from the top of the tweeter to the top of the speaker. This was enough space for the necessary rabbet joint between the front panel and the top panel and looked good. I placed the center of the Midwoofer 6 inches from the middle of the tweeter, or 9 inches from the top of the speaker. This left just less than an inch between the drivers. I decided to put my subwoofer close to the ground for visual aesthetic, weight distribution, and getting bass reinforcement with the floor and surrounding walls. My final decision was to have the center of the subwoofer 15 inches from the bottom of the speaker.

The image below shows the sketch draft of the front panel to the speakers. The sketch includes the 3/8" rabbet joints. The front panel has its rabbeting all the way around the back of the panel to allow for an entirely flat front face.



5.3 Internal Bracings and Supports

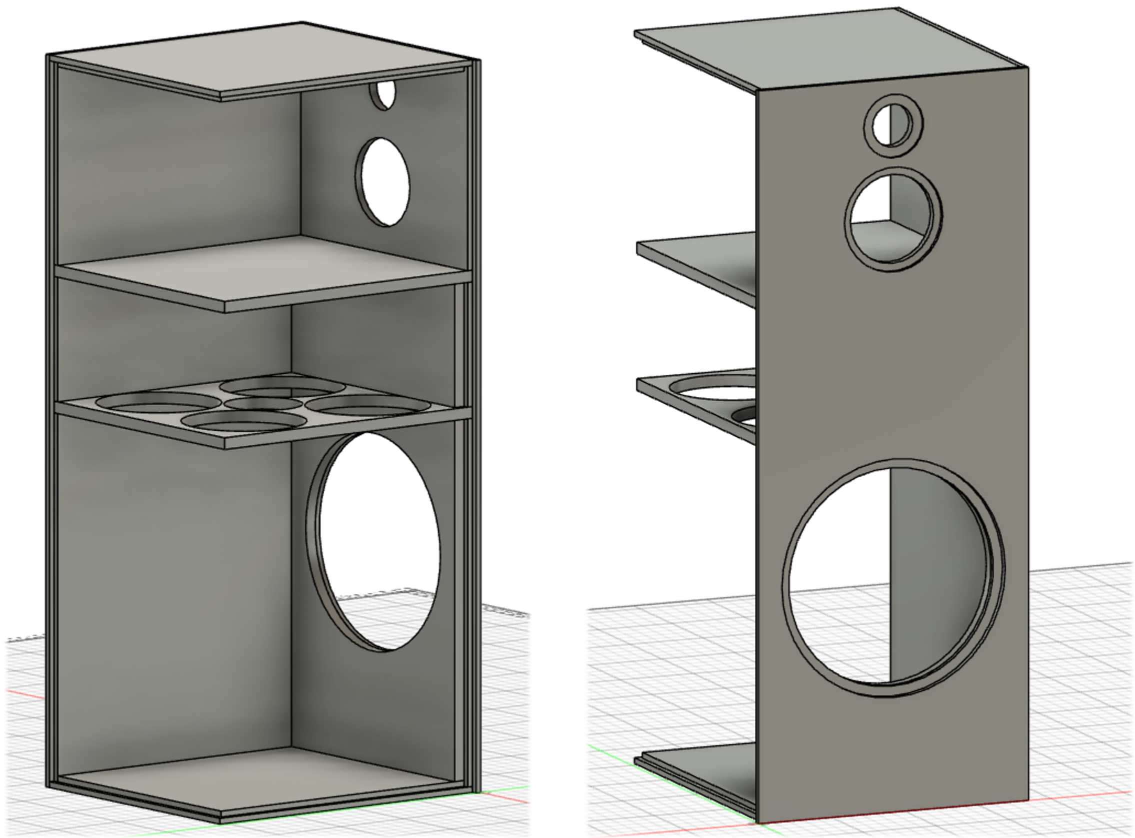
When considering internal bracing for my speakers, I began considering having a sealed box at the top of the tower for the midwoofer and tweeter, and a separate ported box for the subwoofer. This is in the end the design I went with. The sealed and smaller box provided by mid and tweeter with isolation from the woofer, which reduces excess noise that can escape from the port. It also allows my midwoofer to have more optimum operation conditions. The brace that seals off the top box was places as close as possible to the bottom of the midwoofer. I placed a second brace for additional structural support above the subwoofer. Since my enclosure was to be made from MDF which is rather soft, and my subwoofer is 30 lbs., I added a second layer of MDF on the back of the front wall in the subwoofer box. This was to allow me to use a longer screw and provide more material for my subwoofer to screw into.

Internal dimensions of the top box: 13.125”H x 17.750”W x 19.375”D

Volume of top box: 2.6 Cubic Feet, 73.6 liters

Internal dimensions of the bottom box: 23.625”H x 17.750”W x 19.375”D

Volume of bottom box: 4.7 Cubic Feet, 133.1 liters



5.4 Port

Lastly, I decided on port placement. Based on my software calculations, I would need a 4” diameter port that was about 9” long. I decided to put my port on the front of my speaker because I was not very concerned about excess noise coming through the port, and I liked the visual aesthetics. I placed the port under the subwoofer and off to the side as it would not fit perfectly below it. Initially I was frustrated that it would not be in the center, but I ended up really liking this as the speakers mirror each other and are easy to tell apart.

6.0 Construction

When planning my construction based on my design and drafting, I calculated that I needed to buy 3 sheets of MDF. I could fit a front section, two sides, a top, a bottom, and a back section on one sheet of MDF, so I would need two to make those sections for both speakers. From the third sheet I could cut all the internal bracings and supports. Mat Moore the Shop Foreman played an extremely important role in the construction of my speakers. He assisted in most steps of the construction and was an invaluable guide and advisor.

6.1 Cabinet

My first task in the shop was to process my sheets of MDF into the sizes of my cabinet walls. This was a much longer process than I had anticipated, as I had never cut or processed this size or quantity of wood before. Once my walls were cut to size using the table saw, it was time to cut out my rabbet and dado joint slots. This was again a longer process than I had anticipated, and I made some errors. When cutting the dados onto one of my back walls, I made an error and cut below my measurement instead of above, resulting in me not being able to fit the internal bracing in. Luckily this error was fixable and did not leave me needing to cut another back or buy more material. I cut the correct dado into place and my bracing fit correctly, leaving my box intact, just missing some extra material.

Next was the daunting task of routing my driver holes. After talking with other students in the class who had done this process before me, I decided to use some of my excess MDF to practice routing the driver holes. This had been recommended to me, but I was on the fence about whether to or not because I was running low on shop time. In the end I am very glad I took my peers advice and practiced, as I made a couple mistakes in my practice holes that would have been very upsetting had they happened on my actual cabinet.

After dry-fitting both speakers to be sure they fit correctly and would seal, it was time to glue.

Glueing them was no easy task because of their size. I had two people to help me, and we still found maneuvering them to be somewhat difficult. I used Titebond III to glue the cabinets. We fitted the sides, then the top and bottom to the front face, then slid in the internal braces, before fitting the back of the speaker on last. It required most of the clamps we had available to us to make sure we had pressure applied in all necessary places. I left the cabinets clamped overnight.

Once they were dry, I rounded the edges of the front face to reduce diffraction.

6.2 Internal Dampening

Once the glue had dried, it was time to apply my internal dampening. I aimed to cover every surface in the top chamber, and most surfaces in the bottom chamber. I had to leave some room in the bottom chamber for the port. I used rockwool as my dampening material. I cut the rockwool to size and then fasted it by stapling through as small piece of cardboard held to the rockwool. This gave the staple something to hold it because they could not hold the rockwool itself.

6.3 Painting

My desired paint finish was chalkboard. I started by gently sanding the entire MDF surface to prep it. Then I applied two coats of primer. Once the cabinets were primed, it was time to apply the chalkboard paint. The paint I was able to get was spray paint, which was not what I had originally wanted to use, but it ended up turning our pretty good. I do plan to eventually repaint them as through tuning and transportation they have taken a couple of scuffs.

6.4 Construction Conclusion

I was very happy with my speakers after construction. It was a labor of love that paid off. I am happy that my drivers sit very flush, and with how the paint job turned out. The look scary and huge just how I wanted them too.

7.0 Tuning

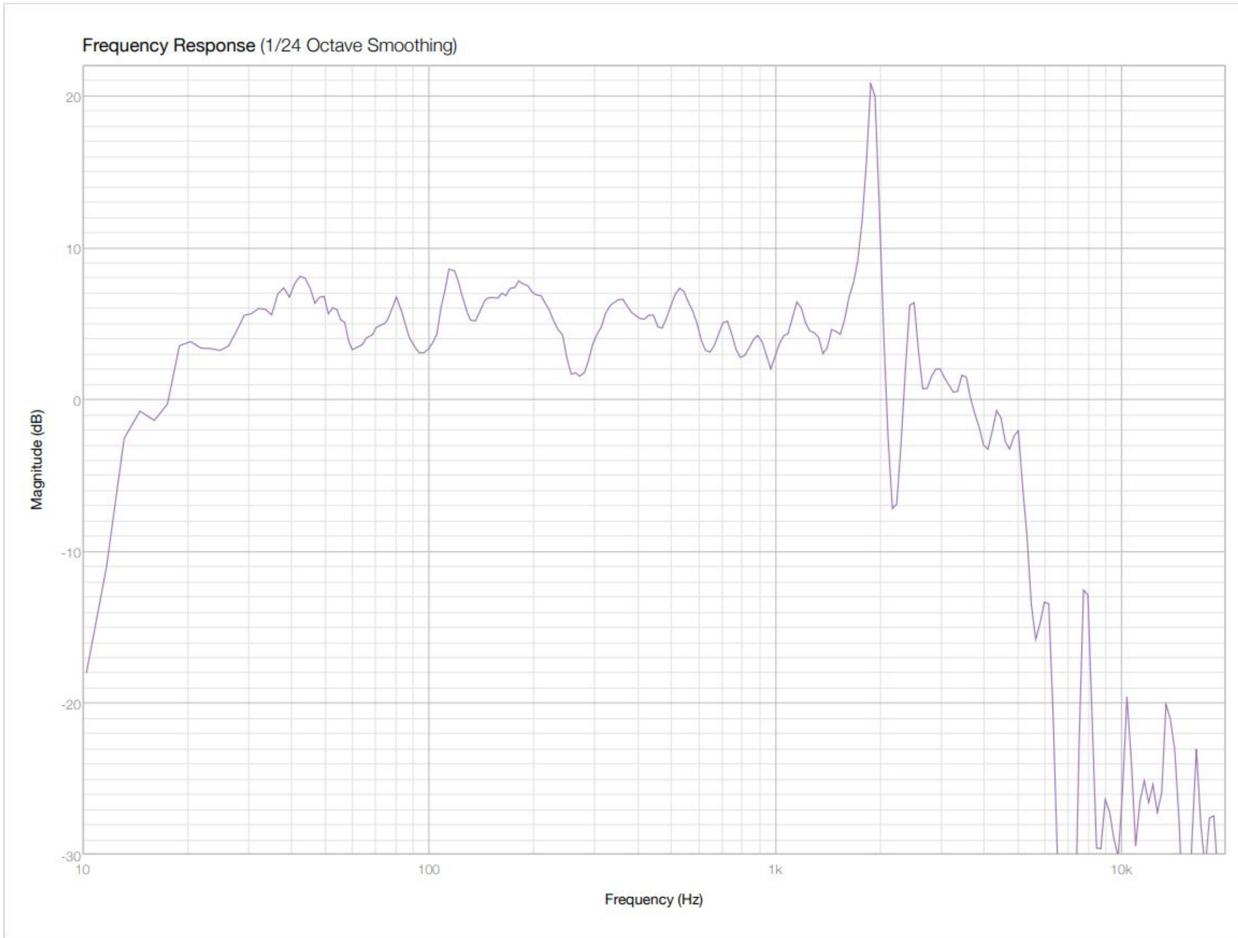
My main goals in my tuning process were to achieve smooth crossover points, get a good time alignment between drivers, and make them sound good. As they are listening forward speakers I was not the most concerned with an ultra-flat frequency response, instead I was mostly concerned with them sounding good to my ears.

I tuned mainly in the McArdle Blackbox Theater but did some final tuning and my final performance measurements on the Rozsa stage. Measurements were taken in SMAART V8 and FuzzMeasure.

7.1 Initial Driver Measurements

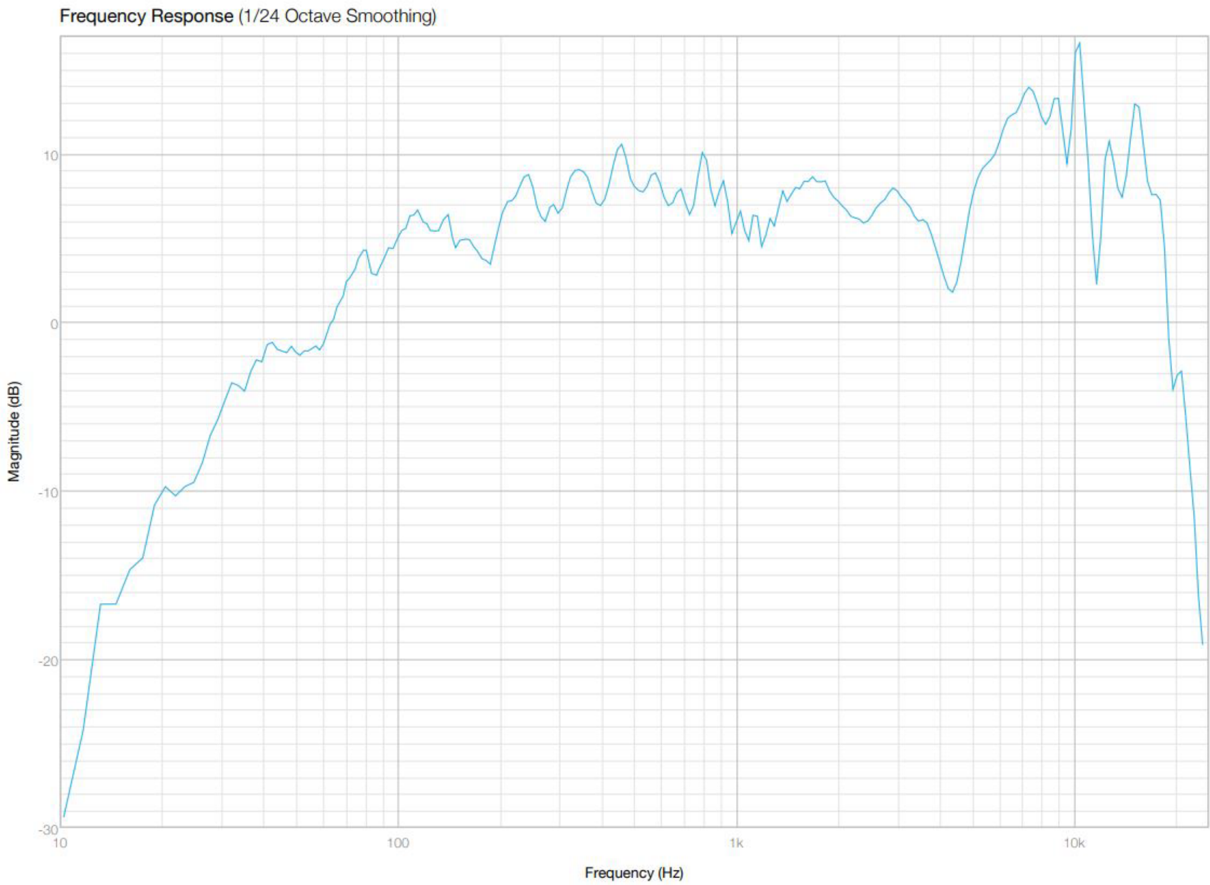
My initial driver measurements were taken at one meter out as well as about 2 inches out. They proved very promising.

My subwoofer with no port in began rolling off around 30 Hz, which I hoped to extend significantly with my port. It began to hit a nasty breakup frequency around 2k, which was easily avoidable as I knew the subwoofer would be crossed over at least by 300 Hz.



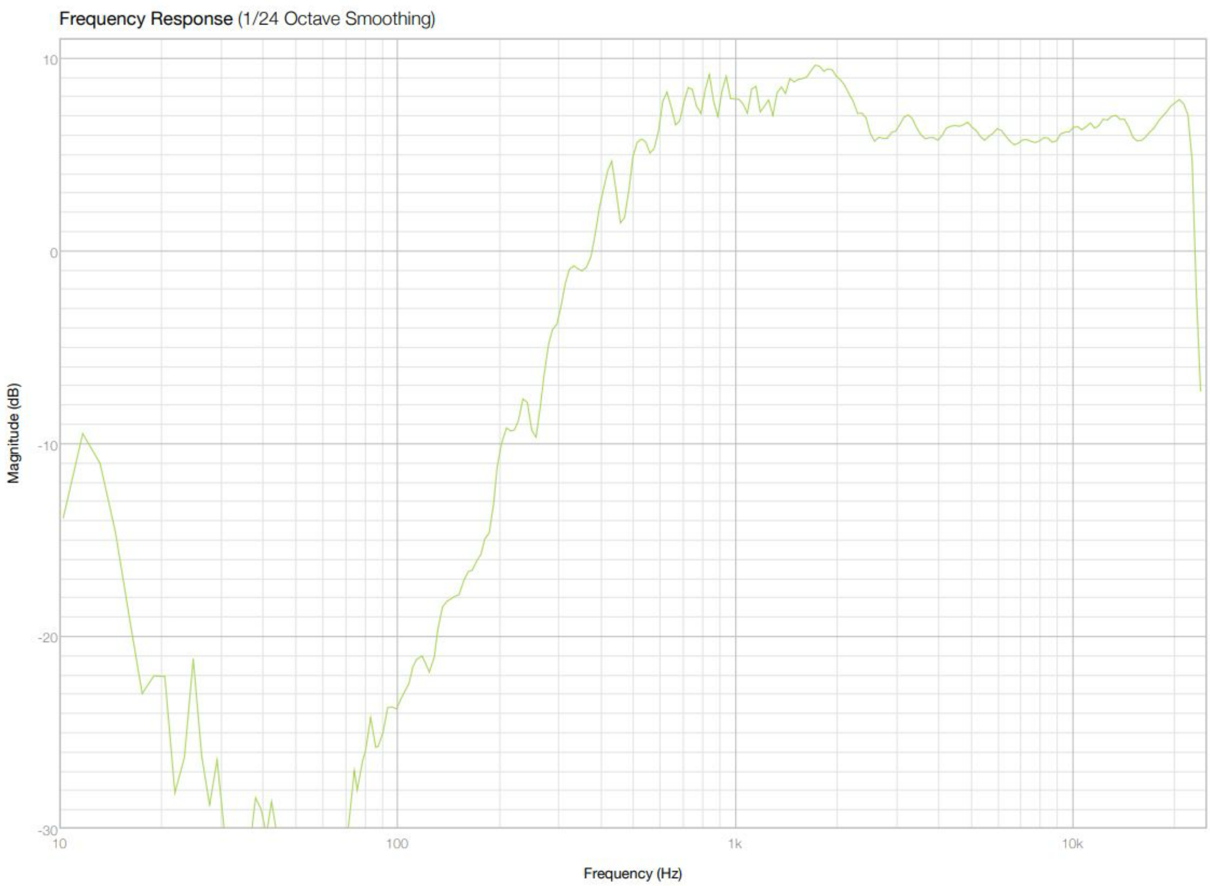
Frequency Response of Subwoofer at 1 meter without a port

My midwoofer began rolling aff around 200 Hz, which prompted me to think my crossover would be around there. There were some peaks that I thought would be easily handleable with EQ. It began to hit a breakup frequency around 5K, which I knew was much higher than I would cross over with my tweeter.



Frequency Response of Midwoofer at 1 meter

My tweeter was mostly flat from 1k to above 20k with noticeable high points between 1 and 2k and around 20k.



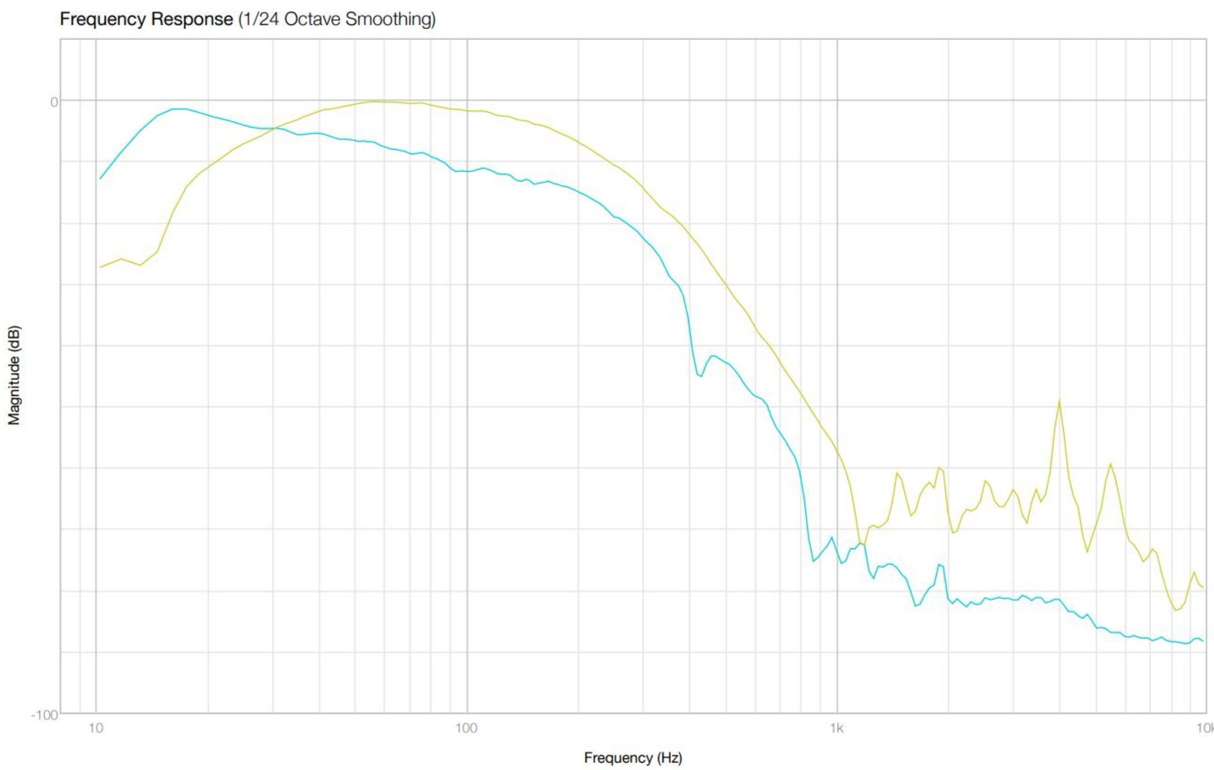
Frequency Response of Tweeter at 1 meter

7.2 Crossover Design

Based on what I found in my initial driver measurements, I ended up with 4th order crossovers at 200 Hz, and 1,250 Hz. I found I was getting good summation at these points over other frequencies I had tried. I initially tried a crossover at 250 Hz from my mid and subwoofer but was having trouble getting them to play nice. I also got advice from Chris that lowering the point will help my subwoofer not have to work as hard on trying to produce higher frequencies, allowing me to get more out of the limited power I had for them.

7.3 Port Tuning

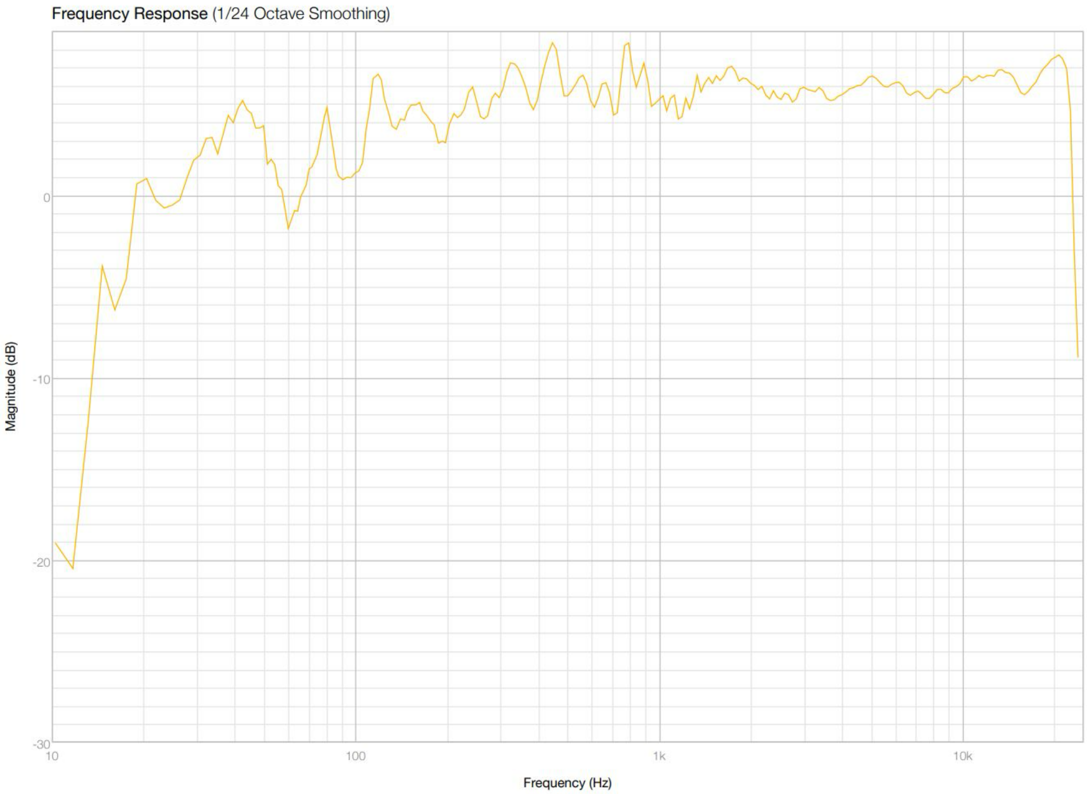
When it came time to tune my port, I got extremely lucky. The ports I bought were 4" in diameter, with a flared end, and a 17" tube. I took measurements of the port before making any cuts to it and loved what I got. The port was tuned almost perfectly to 16 Hz, and brought my F3 below 20 Hz. This had been my dream when designing my speakers which felt amazing.



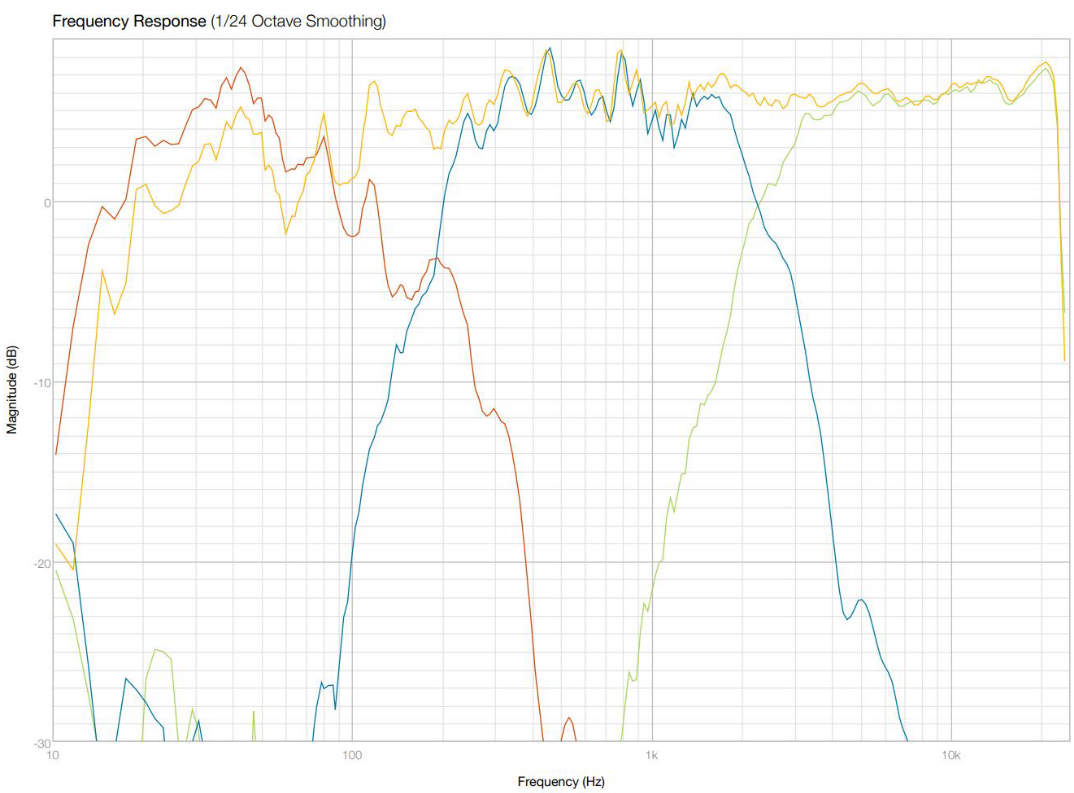
Frequency response of the port (blue) and subwoofer (yellow)

8.0 Final Performance Documentation

My final measurements were taken with an Earthworks M50 at a meter on the listening axis. The speaker was about 3 feet off the ground placed on two rehearsal blocks as that was the highest we could lift them. I used some sheets hanging below the speaker and laid around on the floor between the speaker and microphone to minimize floor reflections. These measurements were all done in FuzzMeasure with three two and a half second long sine sweeps averaged together.

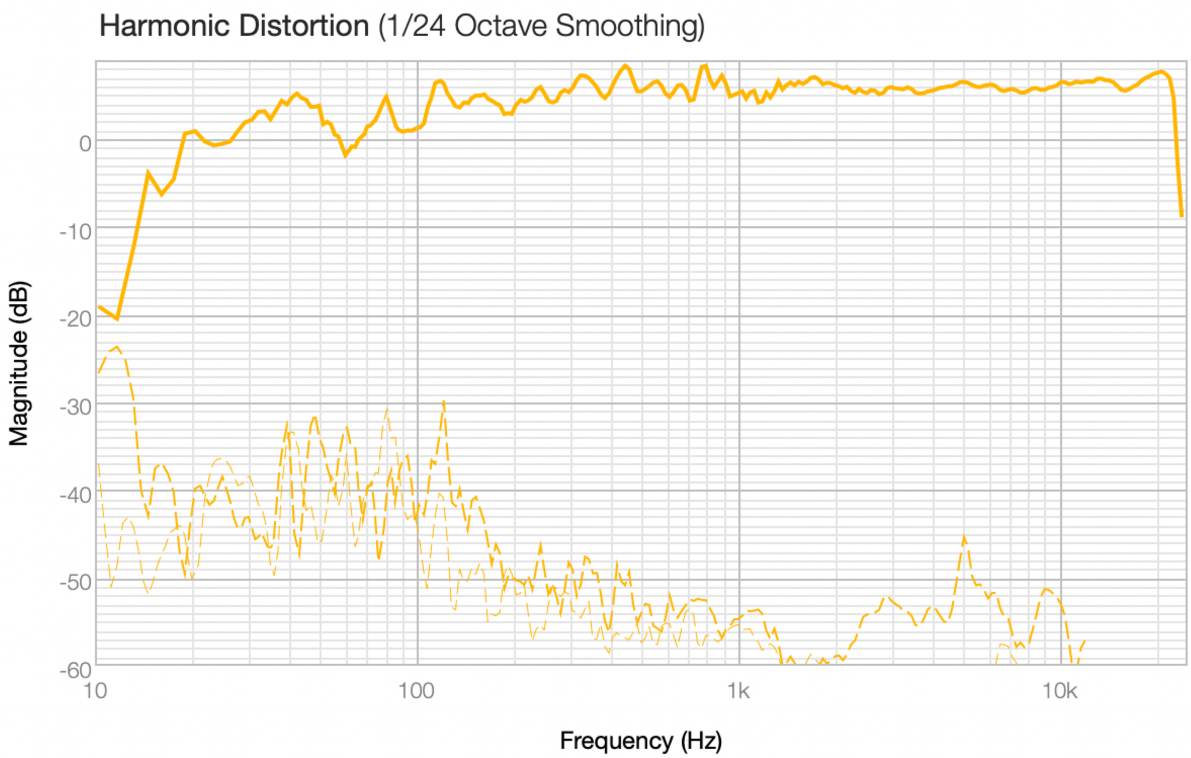


Frequency response of the full speaker at 1 meter

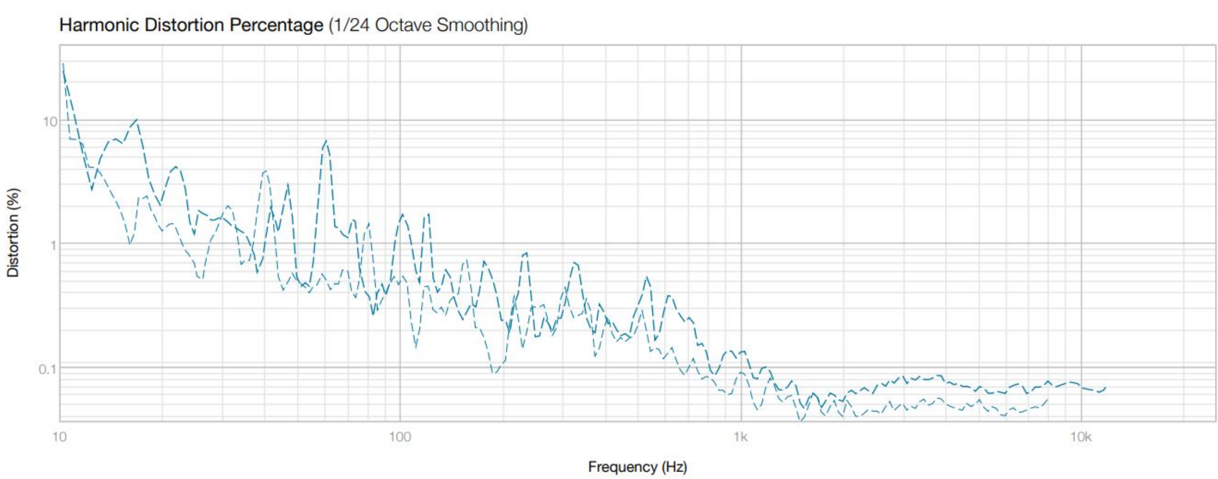


Integrated Frequency Response of the full speaker

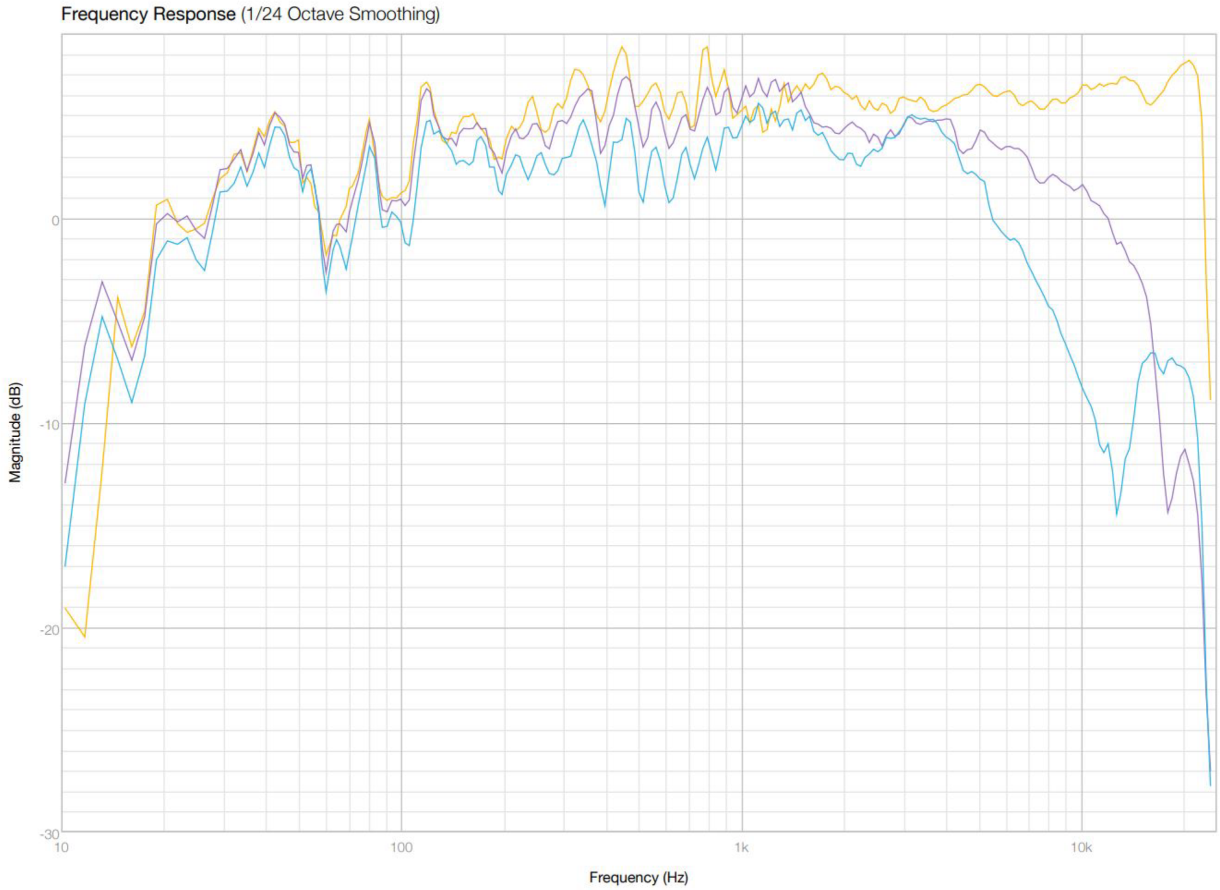
I am very happy with the overall frequency response of the speakers. The low end rolls off, but this is not of concern to me because they will be placed in relatively small rooms where the floor as well as rear wall will provide bass amplification. The crossover points are acceptably flat, and I am happy with the overall shape.



Measured Harmonic Distortion

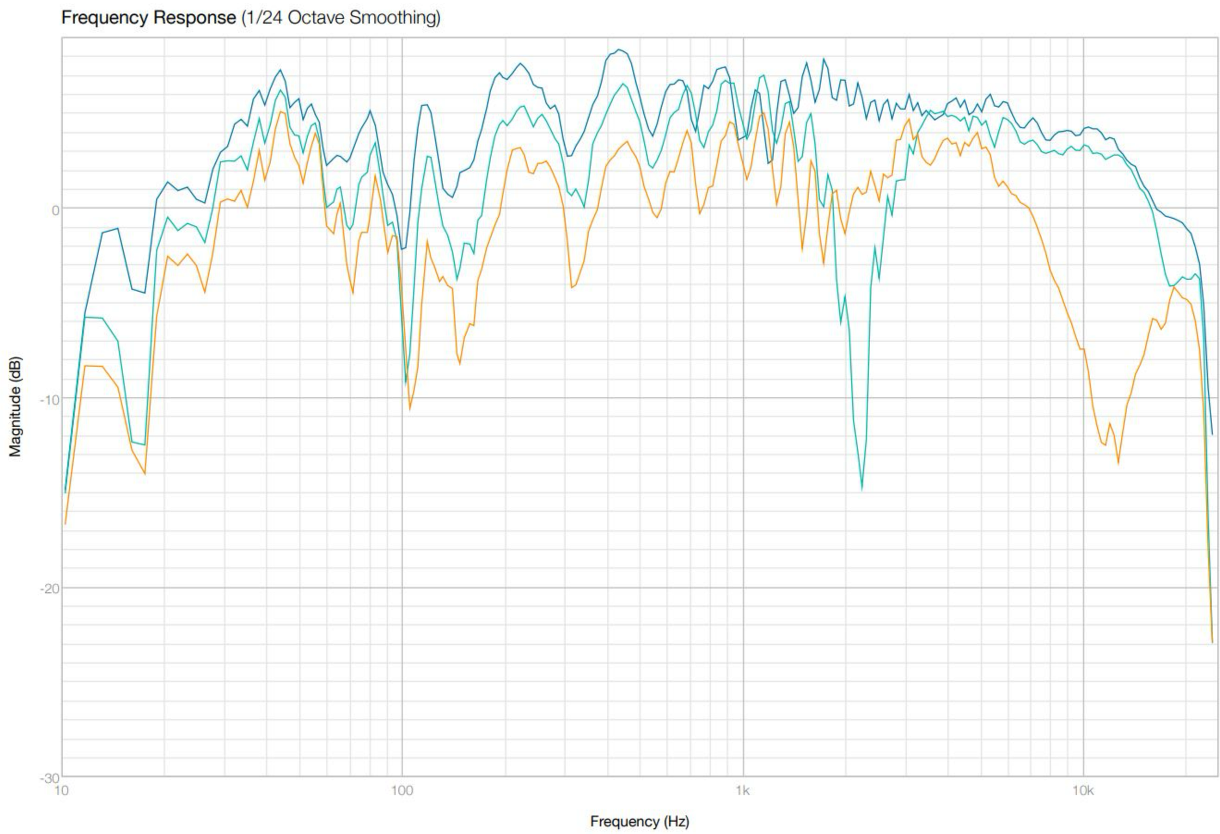


Relative Percentage of Harmonic Distortion



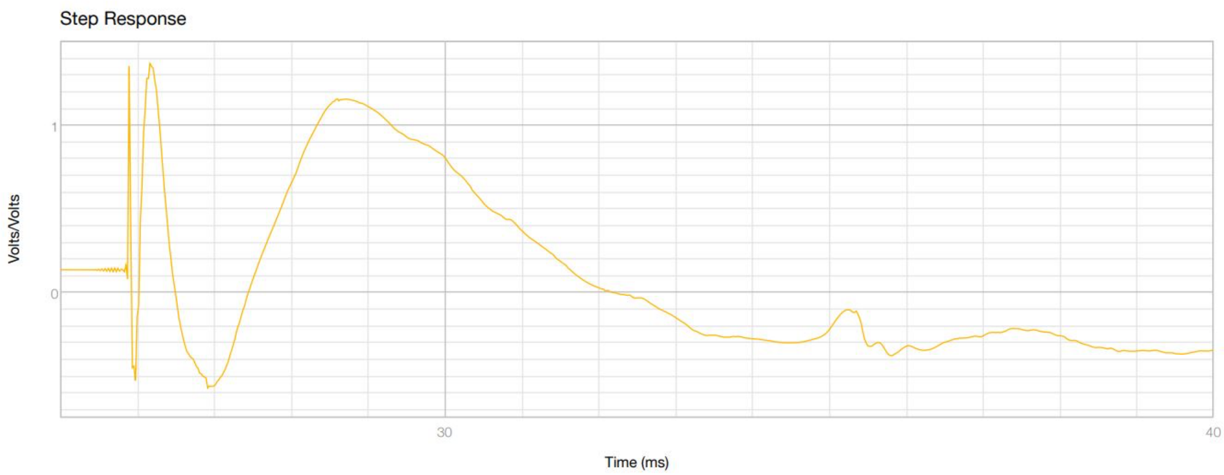
On Axis Frequency Response (Yellow) 30 Degree horizontal off axis (Purple) and 60 degree off axis (Blue)

The horizontal off axis response of the speakers is relatively smooth until 5k, when the off axis responses begin to roll off rapidly.

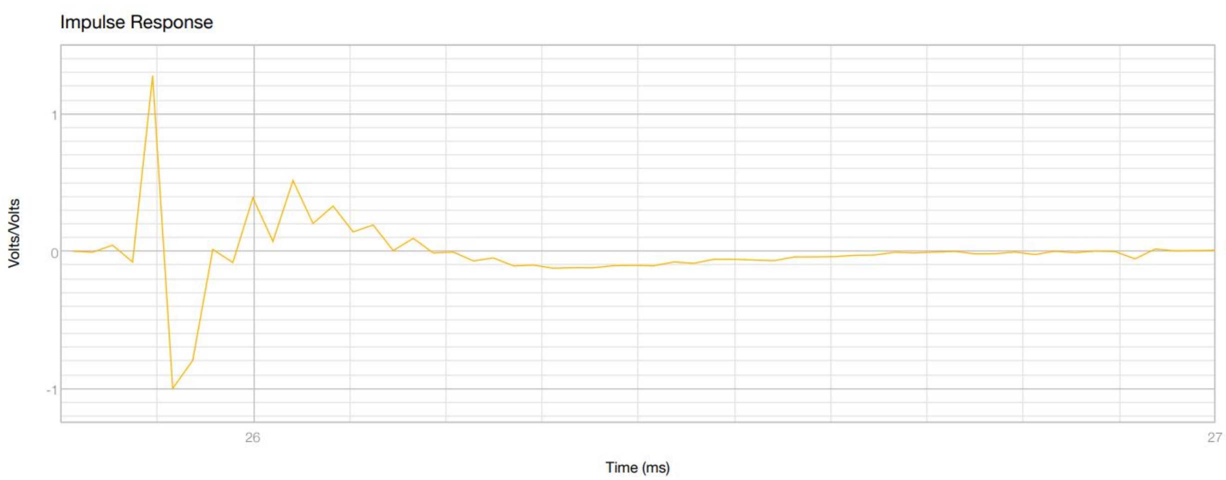


On Axis frequency response (Dark Blue) 30 degree vertical off axis (Teal) 60 degree vertical off axis (Yellow)

The vertical off axis response is pretty smooth and consistent except for a large notch in the 30 degree off axis just above 2K. This is likely due to phase cancellation happening in that exact location.



Step Response of the Speaker



Impulse Response of the Speaker

9.0 Reflection

My speakers are home in my living room now and I could not be happier with them. I get to sit in the seat I designed them for and enjoy music in a way that wasn't easily accessible to me before. They look exactly how I envisioned them in the space, and I love getting to share them with my friends and family.

In the design stage I did not do a whole lot of thinking about the labor of moving these speakers, and while this meant I was a little surprised by how hard it is… I don't believe anything could have swayed me from my initial big scary tower design. The process of moving them involves a small folding dolly, my partner, and two cars. The first time I had to take them home gave me some doubts… but we have the process down enough now for me to say that their size is worth the trouble. I just love how they look and with the chalkboard they are such a fun commodity. It makes me so happy when I have someone come over and I can invite them to listen and then leave a little piece of art with the speakers.

Someday I would still love to get amplifiers that can fully power my subwoofers, but I am not upset by my current setup. The three Fosi amps allow me more volume than I have ever wanted in the space they are in now. I can shake the whole house just fine.

I want to say thank you to Chris Plummer. I could not have made such awesome speakers without his teachings and help. Thank you so much for supporting me and my kind of crazy idea for scary four-foot-tall speakers, and helping me make them amazing. And a special thanks for the awesome photos of them too!

I also want to thank Mat Moore. So much of the construction of my speakers can be credited to the help and effort of Mat. I was endlessly consulting with him while in the shop and could not have done it without him.

9.0 Bibliography

"Forte IV Floorstanding Loudspeaker." Klipsch. Accessed September 10, 2023. https://www.klipsch.com/products/forte-iv-floorstanding-speaker#learn.

"Klipsch Forte IV." The Ear, October 3, 2022. https://the-ear.net/review-hardware/klipsch-forte-iv-floorstanding-loudspeakers/.

Moulton, David. *Total recording*. KIQ Productions, 2002.

Murphy, John L. *Introduction to loudspeaker design*. Andersonville (TN): True Audio, 2014.

Newell, P. R., & Holland , K. (n.d.). Loudspeakers: For music recording and Reproduction. Elsevier/Focal.

"The New Rival by Volti Audio." Volti Audio, July 1, 2023. https://voltiaudio.com/rival-2/.

NOVO, MxC. "Forest." Totem, April 21, 2023. https://totemacoustic.com/product/forest/.

"Theva N°2 - Balance between Finesse and Performance." Focal. Accessed September 10, 2023. https://www.focal.com/us/high-fidelity-speakers/theva/theva-n2#documentation.

"Vandersteen 2CE Signature II Loudspeaker." Stereophile.com, January 28, 2007. https://www.stereophile.com/floorloudspeakers/107vandy/index.html.

"Vandersteen Model 2CE Signature III." Vandersteen Audio. Accessed September 10, 2023. https://www.vandersteen.com/products/model-2ce-signature-iii.

"Volti Audio Rival Loudspeaker." Stereophile.com, May 18, 2017. https://www.stereophile.com/content/volti-audio-rival-loudspeaker.

10.0 Appendix

A – Tuning Data

B - Subwoofer Report

C – Midwoofer Report

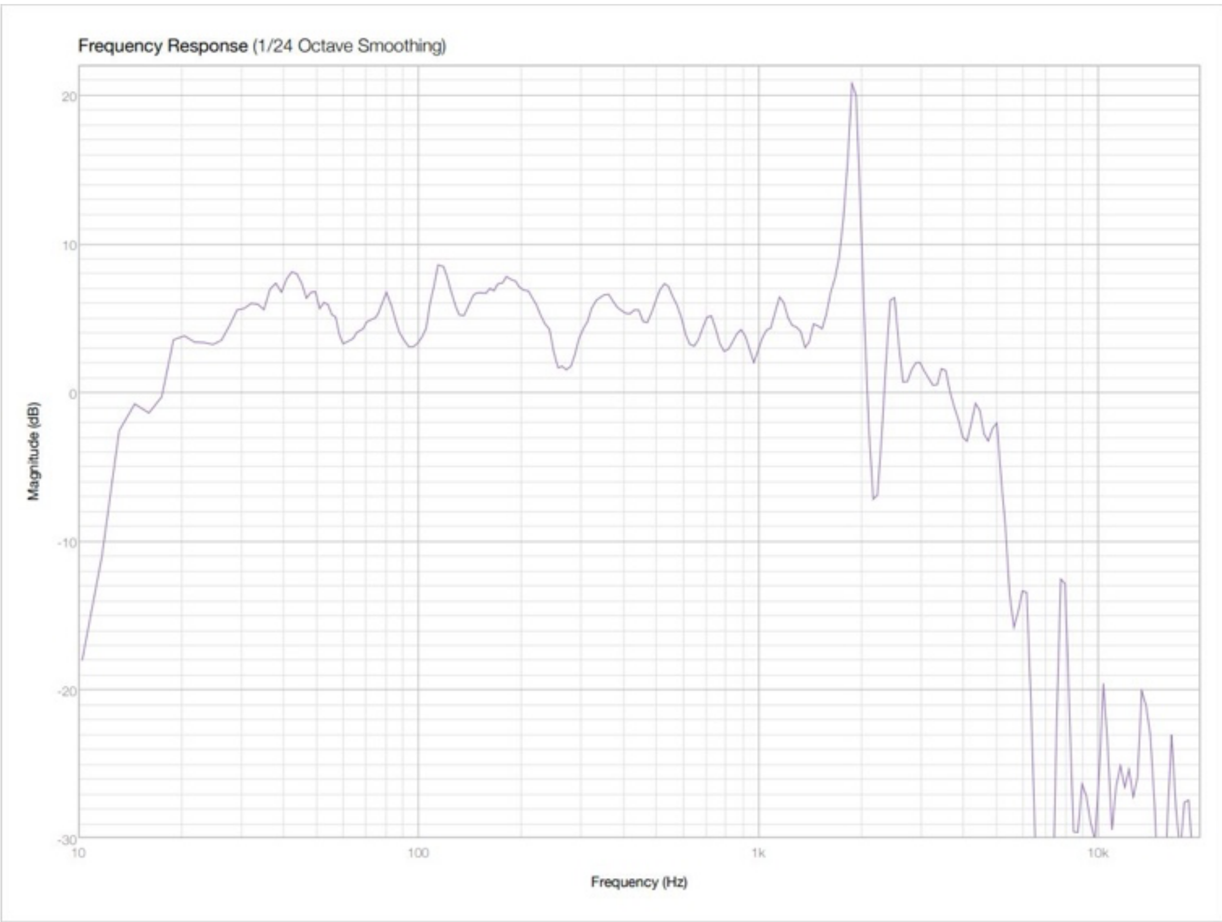
D – Tweeter Spreadsheet

10.4 Appendix A

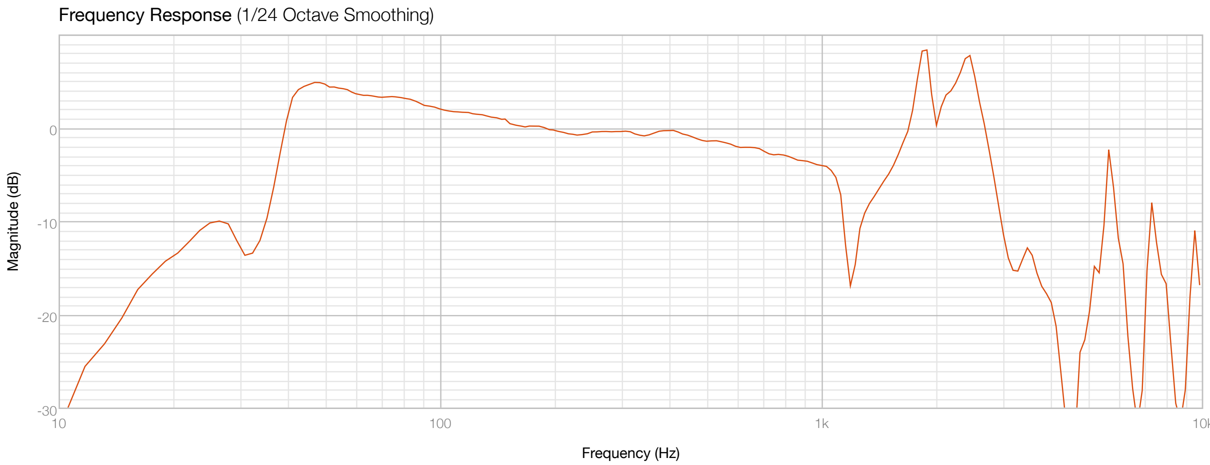
Tuning Data

Driver Responses

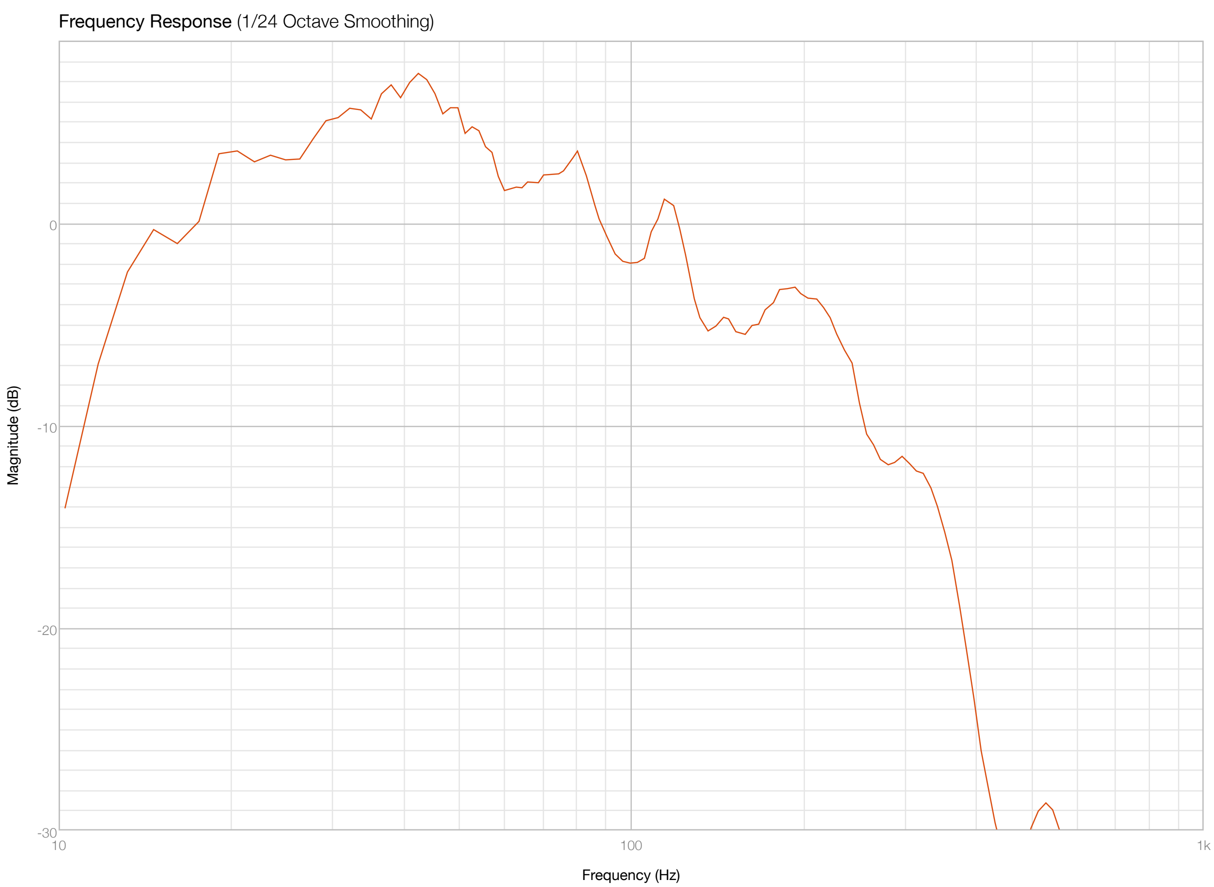
Subwoofer



Subwoofer Frequency Response at 1 Meter, no Crossover

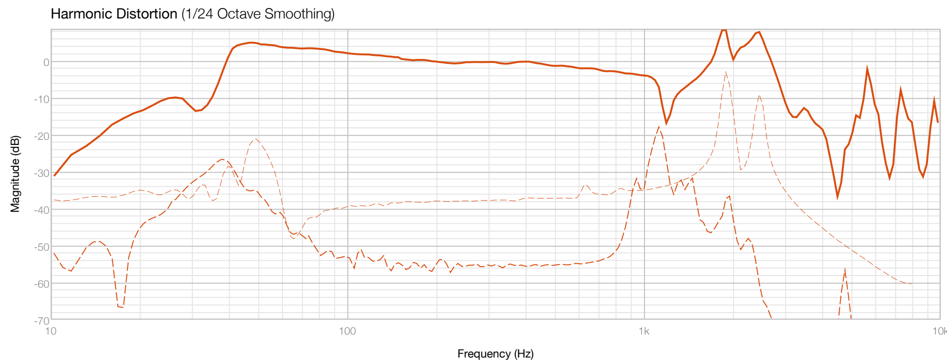


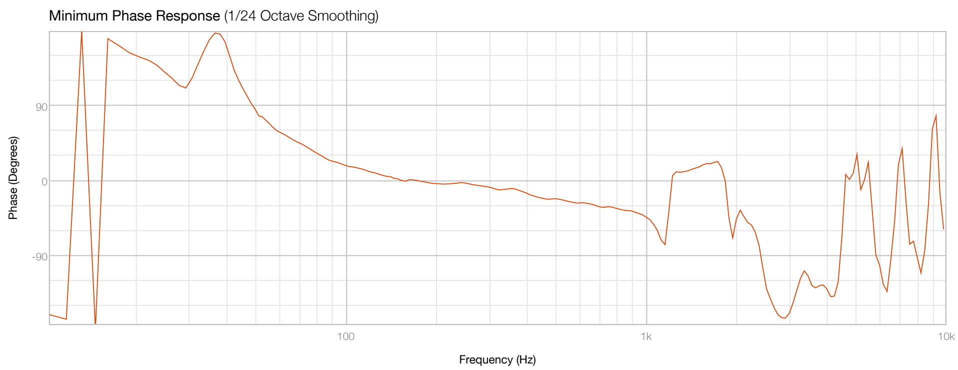
Subwoofer Frequency Response at approx. 2”, no Crossover



Subwoofer Frequency Response at 1 Meter, with 4^{th} Order Crossover at 200 Hz

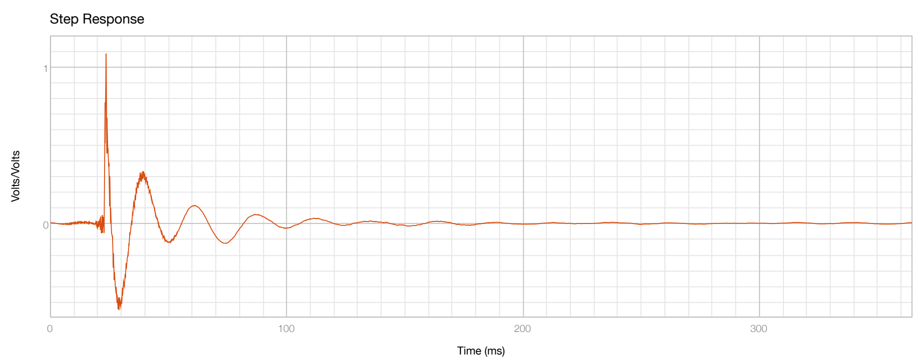
Subwoofer Harmonic Distortion

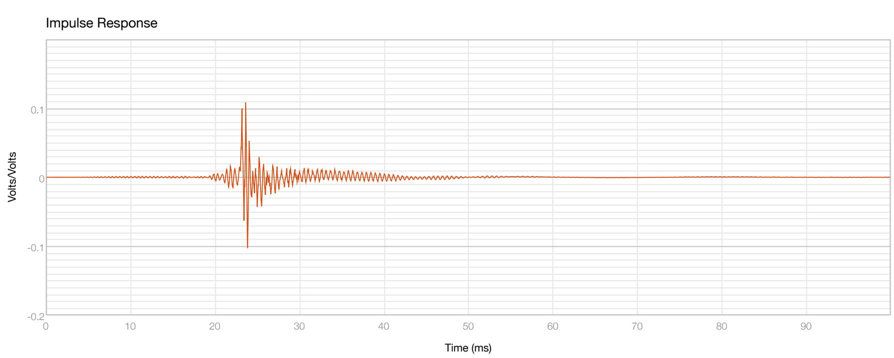




Subwoofer Minimum Phase

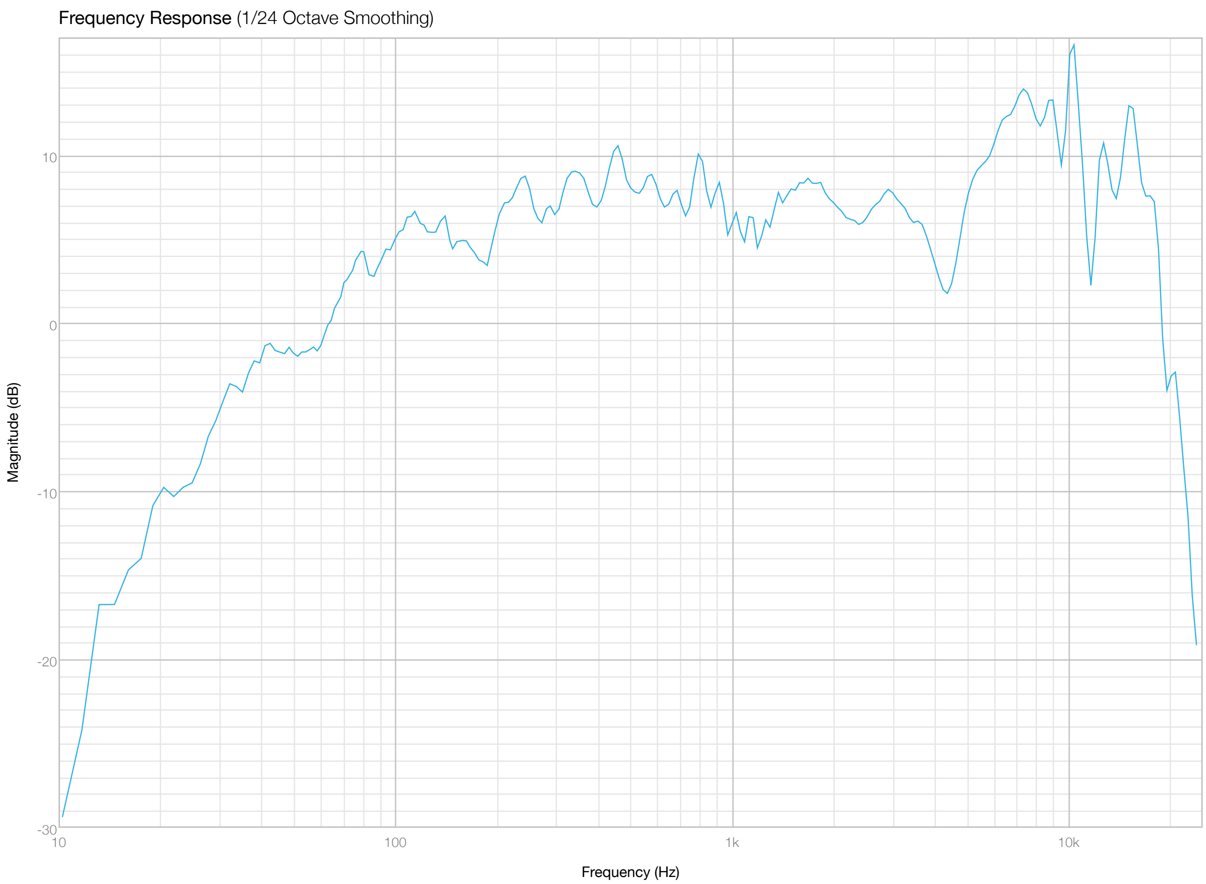
Subwoofer Step Response



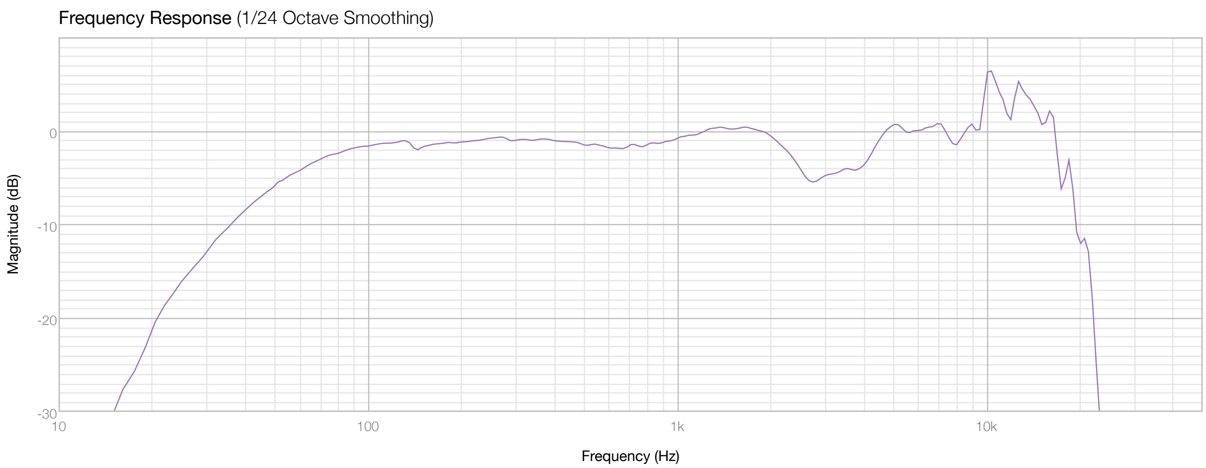


Subwoofer Impulse Response

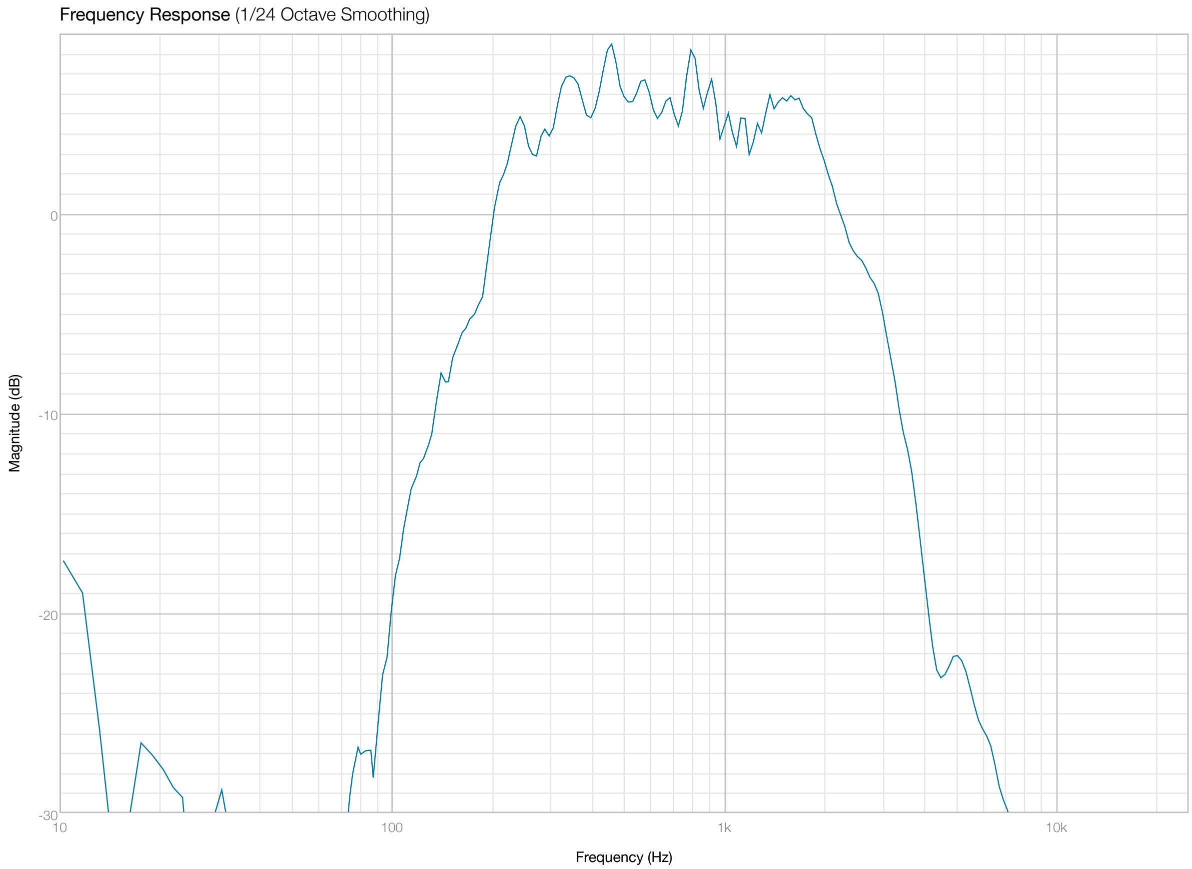
Midwoofer



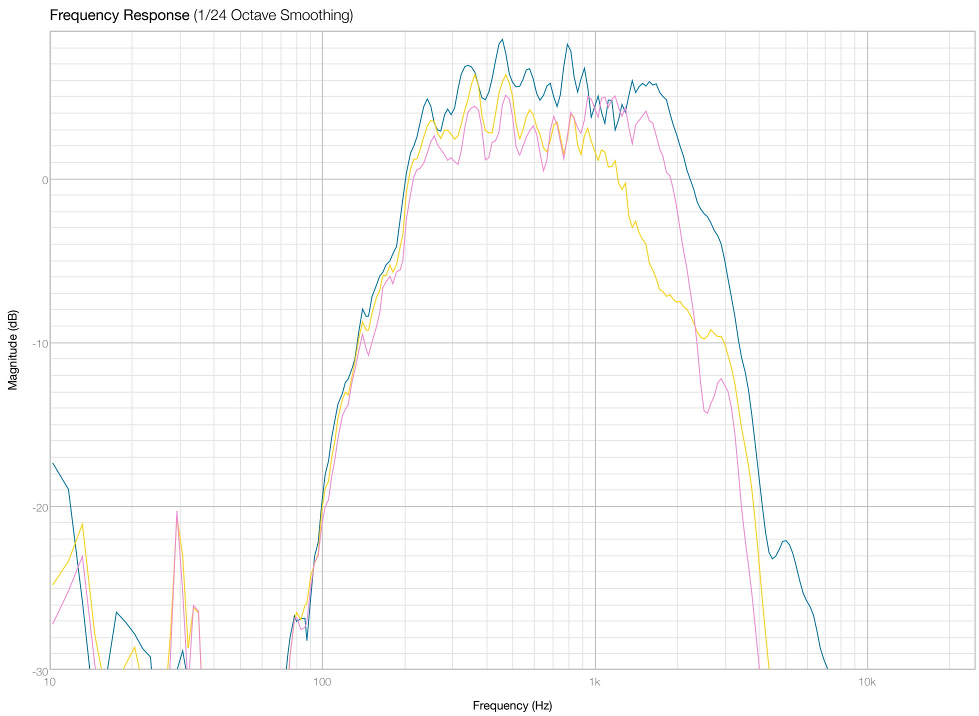
Midwoofer Frequency Response at 1 Meter, no Crossover



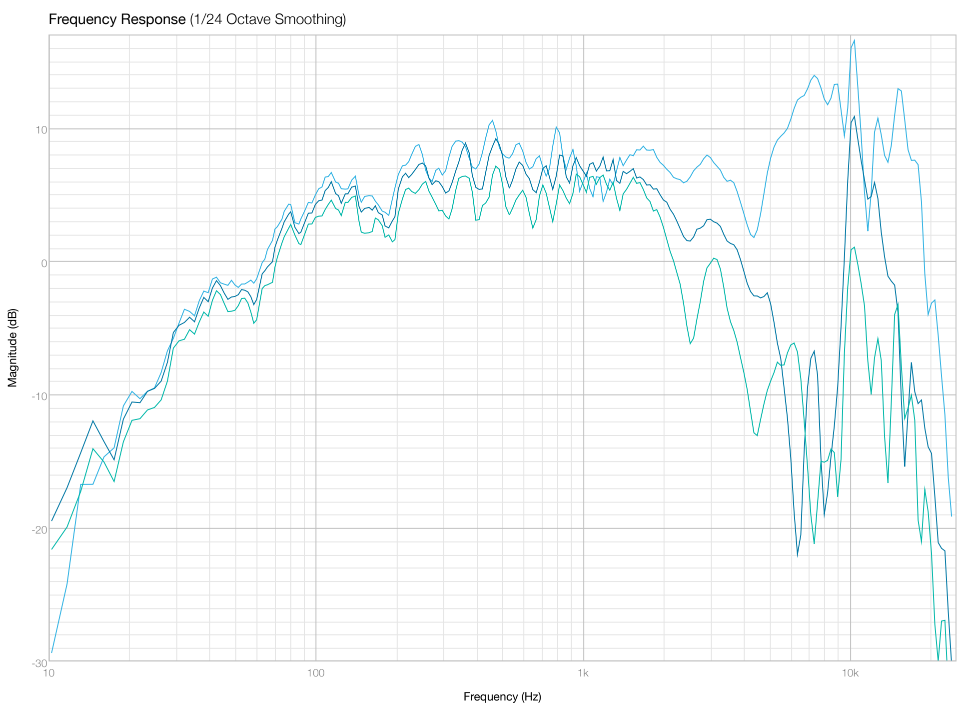
Midwoofer Frequency Response at approx. 2”, no Crossover



Midwoofer Frequency Response at 1 Meter, with 4th Order Crossovers at 200 Hz and 1,250 Hz



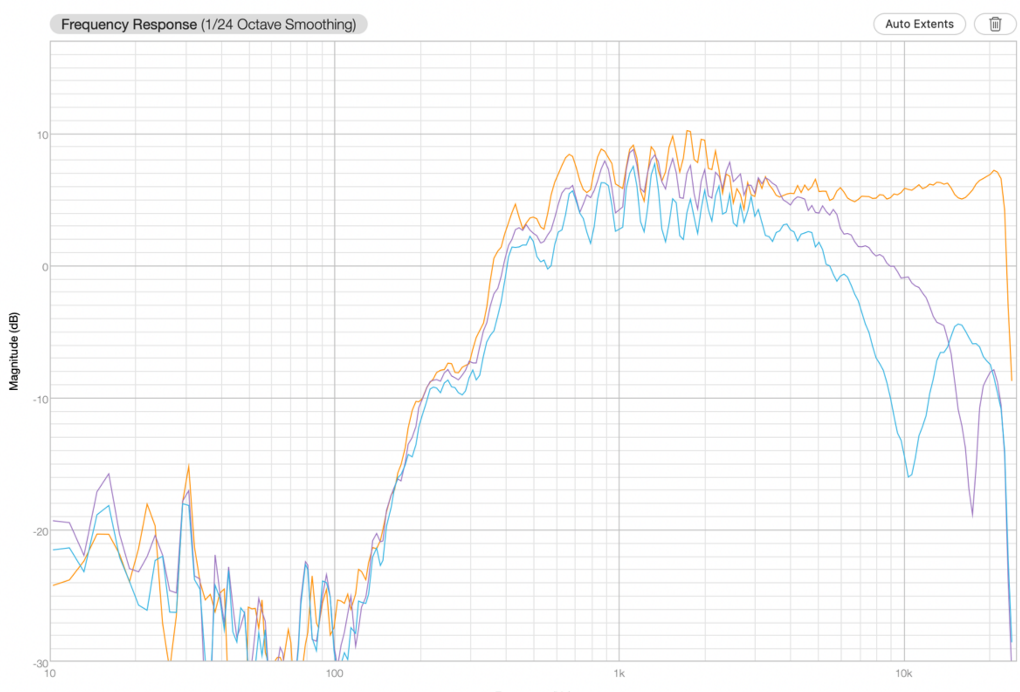
Midwoofer Horizontal Off-Axis Frequency Response at 1 Meter with Crossovers, On Axis (Blue), 30 Degree (Pink) 60 Degree (Yellow)



Midwoofer Horizontal Off-Axis Frequency Response at 1 Meter, no Crossovers, On Axis (light blue), 30 Degree (dark blue), 60 Degree (teal)

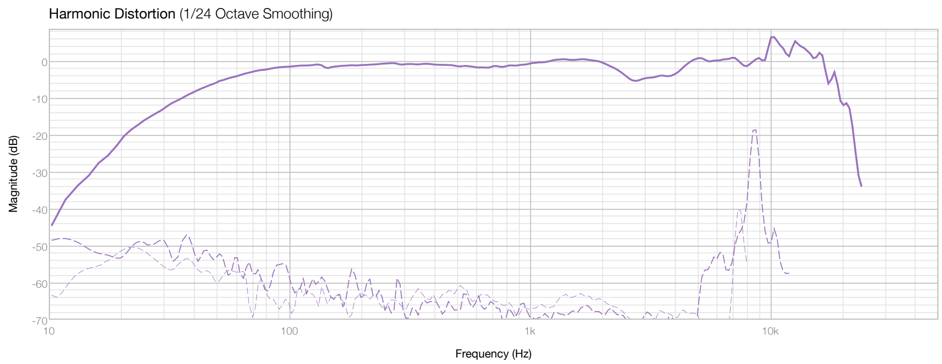
Note: My bad that they are all blue, so sorry to my colorblind homies

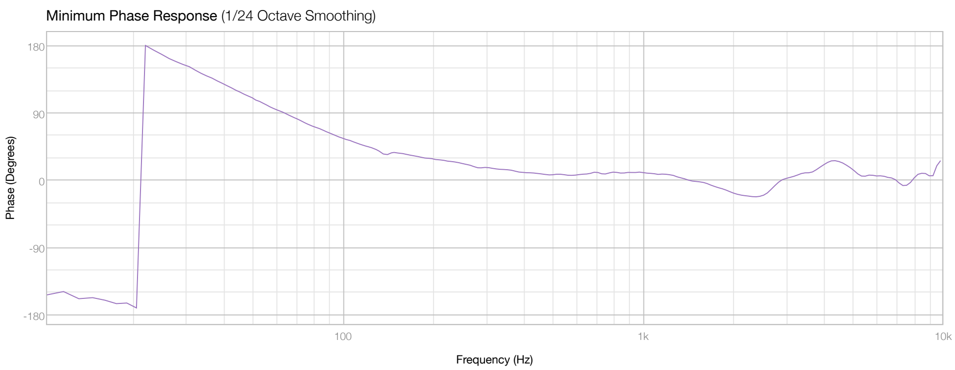
Midwoofer Vertical Off-Axis Frequency Response at 1 Meter, with Crossovers, On Axis (light pink), 30 Degree (orange), 60 Degree (magenta)



Midwoofer Vertical Off-Axis Frequency Response at 1 Meter, without Crossovers, On Axis (orange), 30 Degree (purple), 60 Degree (blue)

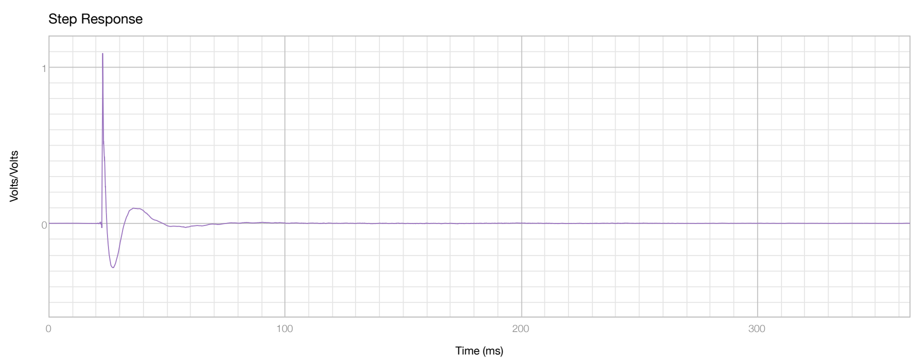
Midwoofer Harmonic Distortion

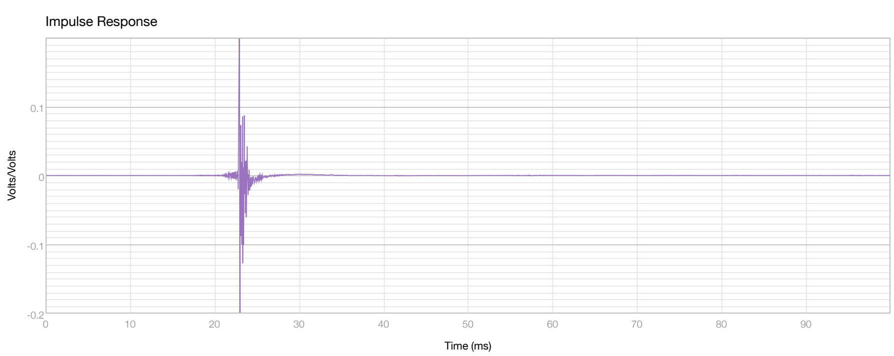




Midwoofer Minimum Phase

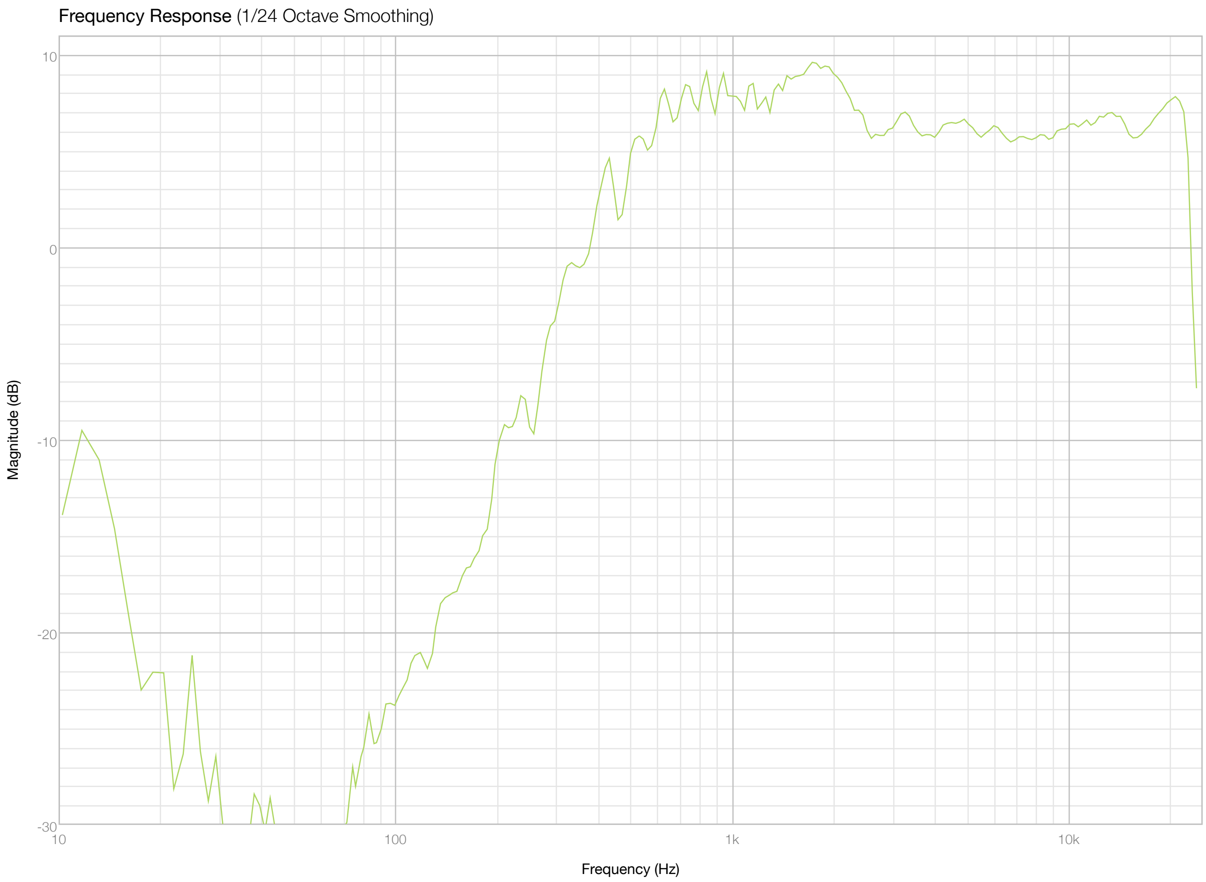
Midwoofer Step Response



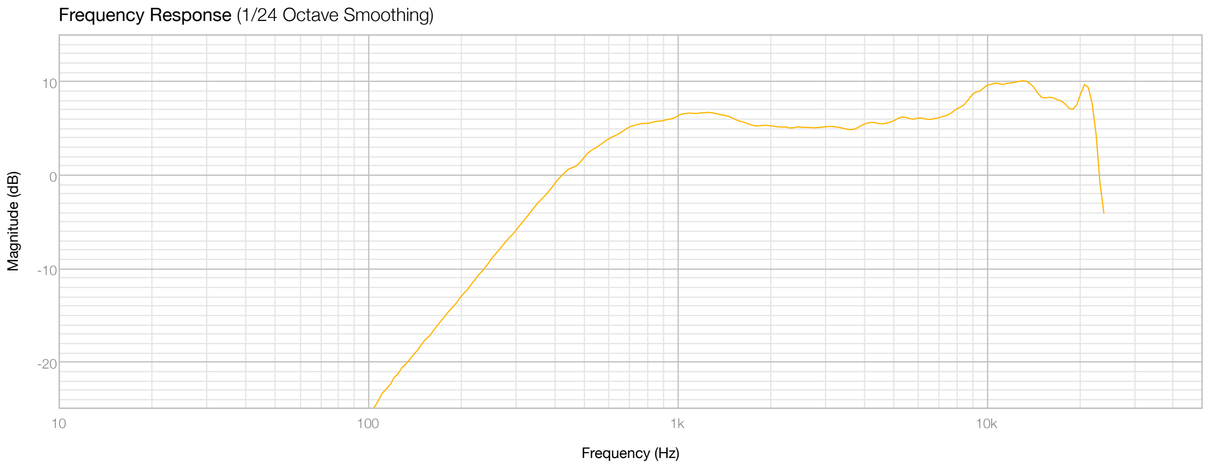


Midwoofer Impulse Response

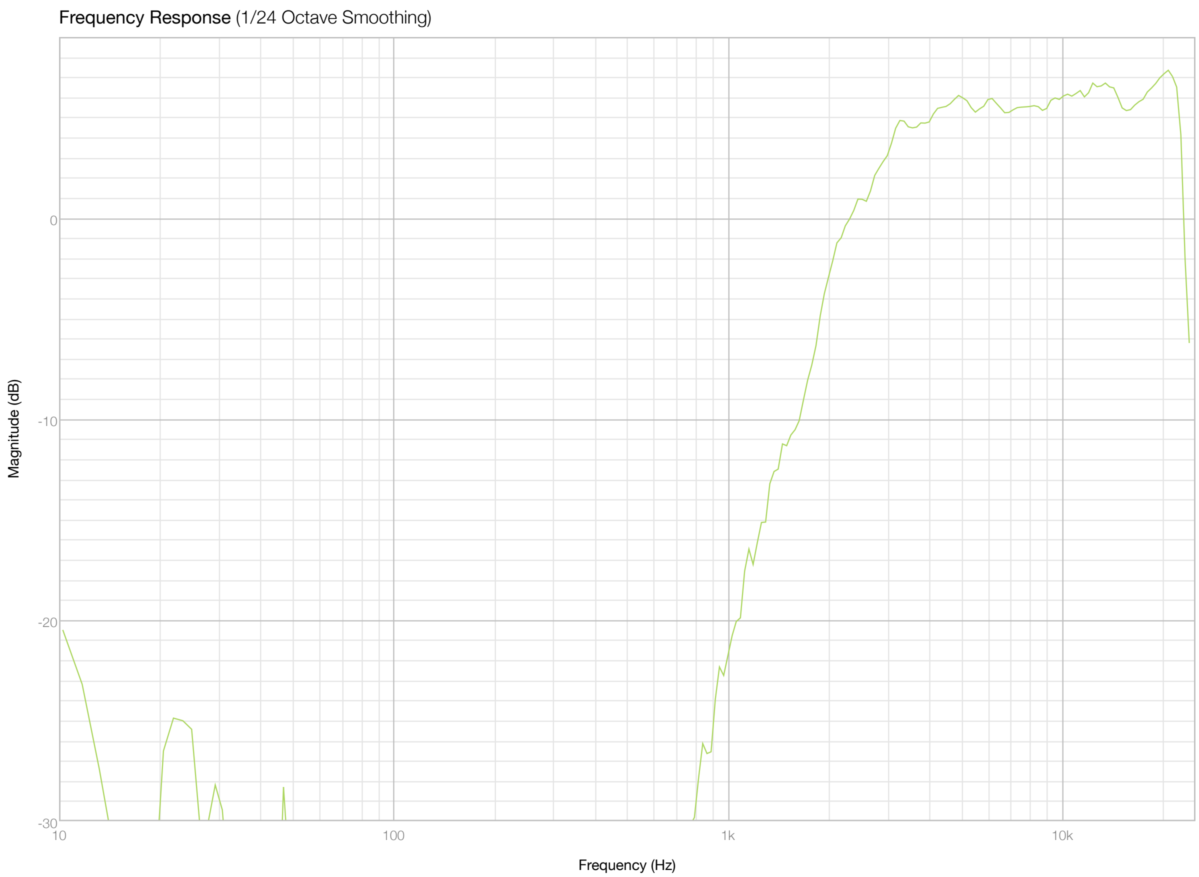
Tweeter



Tweeter Frequency Response at 1 Meter, no Crossover

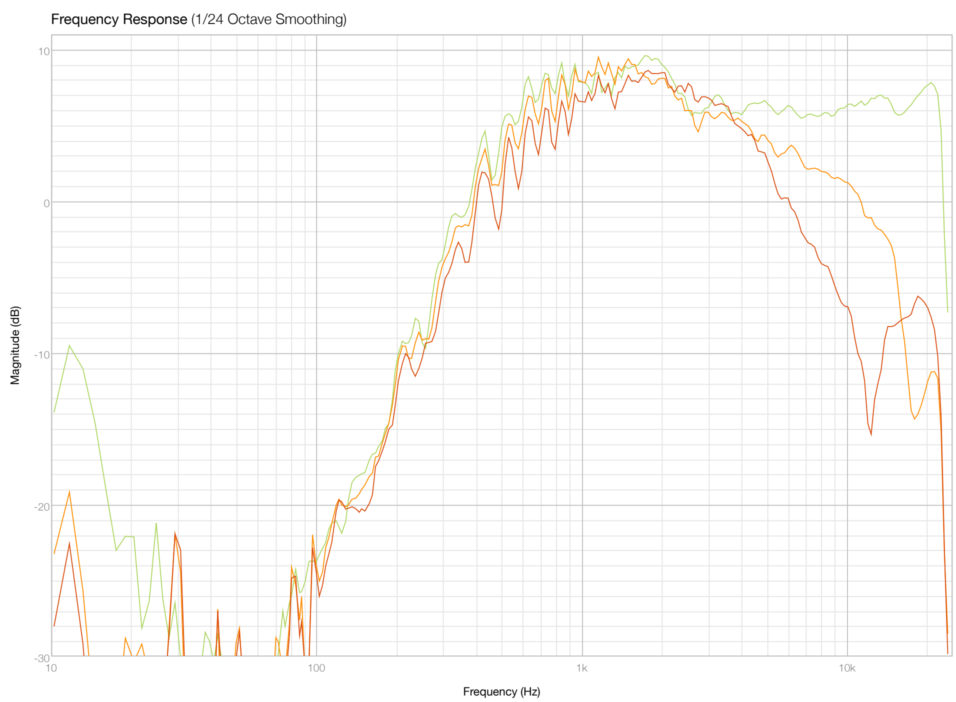


Tweeter Frequency Response at approx. 2”, no Crossover

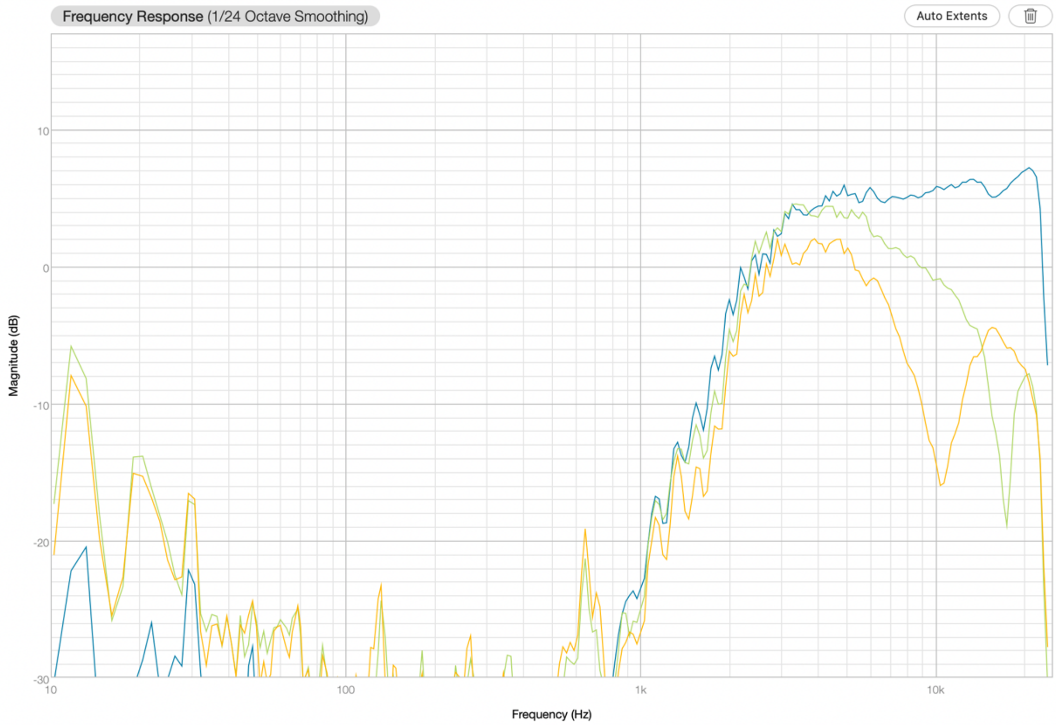


Tweeter Frequency Response at 1 Meter, 4th Order Crossover at 1,250 Hz

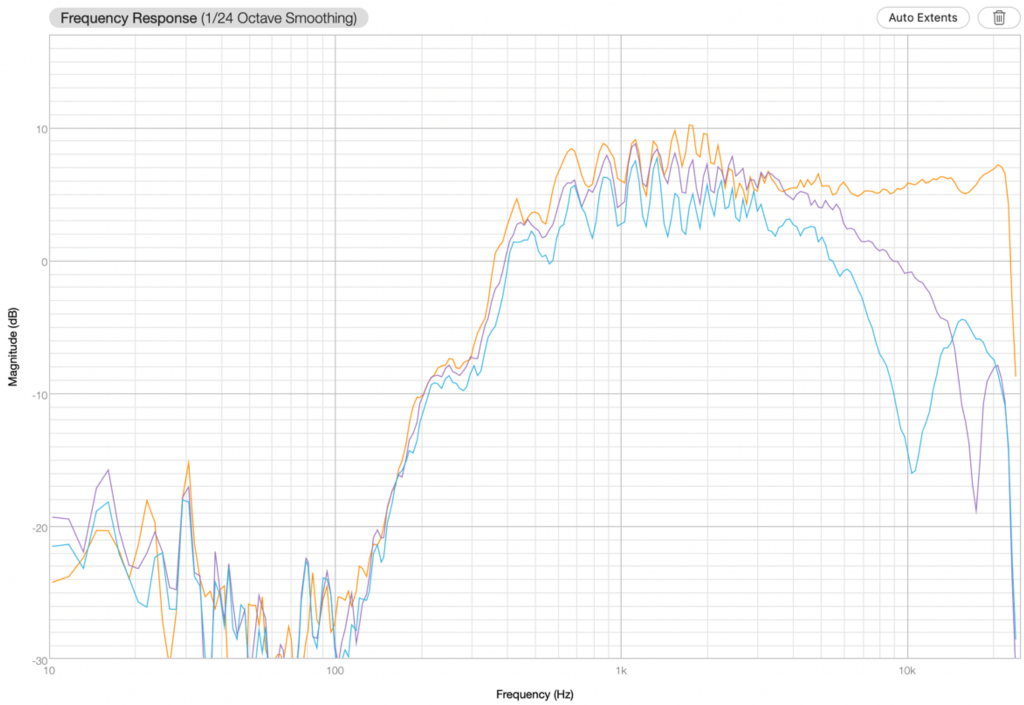
Tweeter Horizontal Off-Axis Frequency Response at 1 meter with Crossovers, On-Axis (light green), 30 Degree (blue) 60 Degree (yellow)



Tweeter Horizontal Off-Axis Frequency Response at 1 meter without Crossovers, On-Axis (light green), 30 Degree (orange) 60 Degree (red)

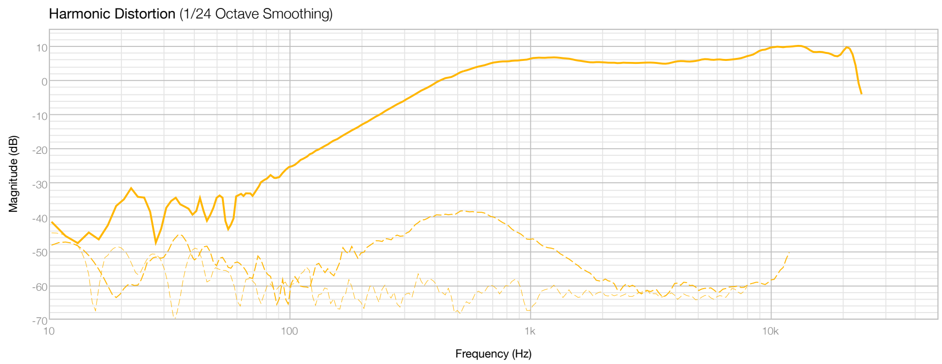


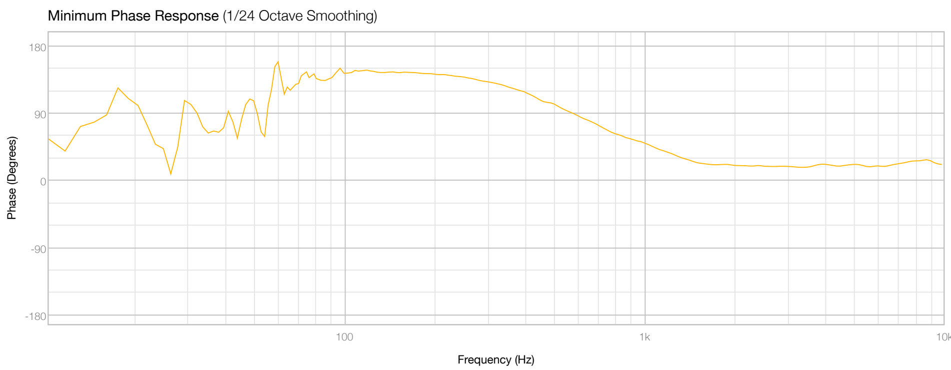
Tweeter Vertical Off-Axis Frequency Response at 1 meter with Crossovers, On-Axis (blue), 30 Degree (light green) 60 Degree (yellow)



Tweeter Vertical Off-Axis Frequency Response at 1 meter without Crossovers, On-Axis (orange), 30 Degree (purple) 60 Degree (blue)

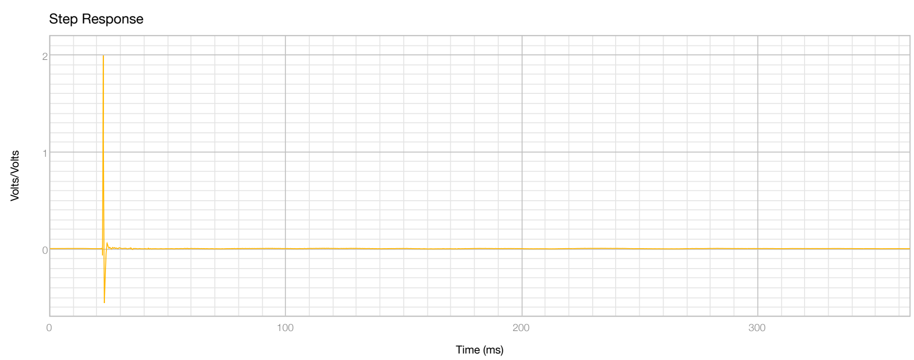
Tweeter Harmonic Distortion

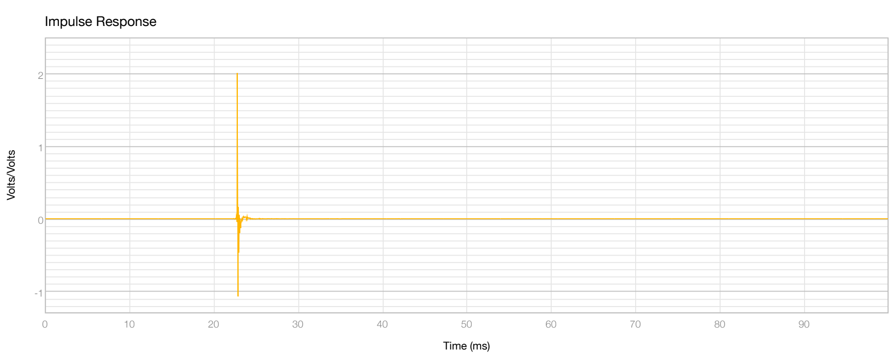




Tweeter Minimum Phase

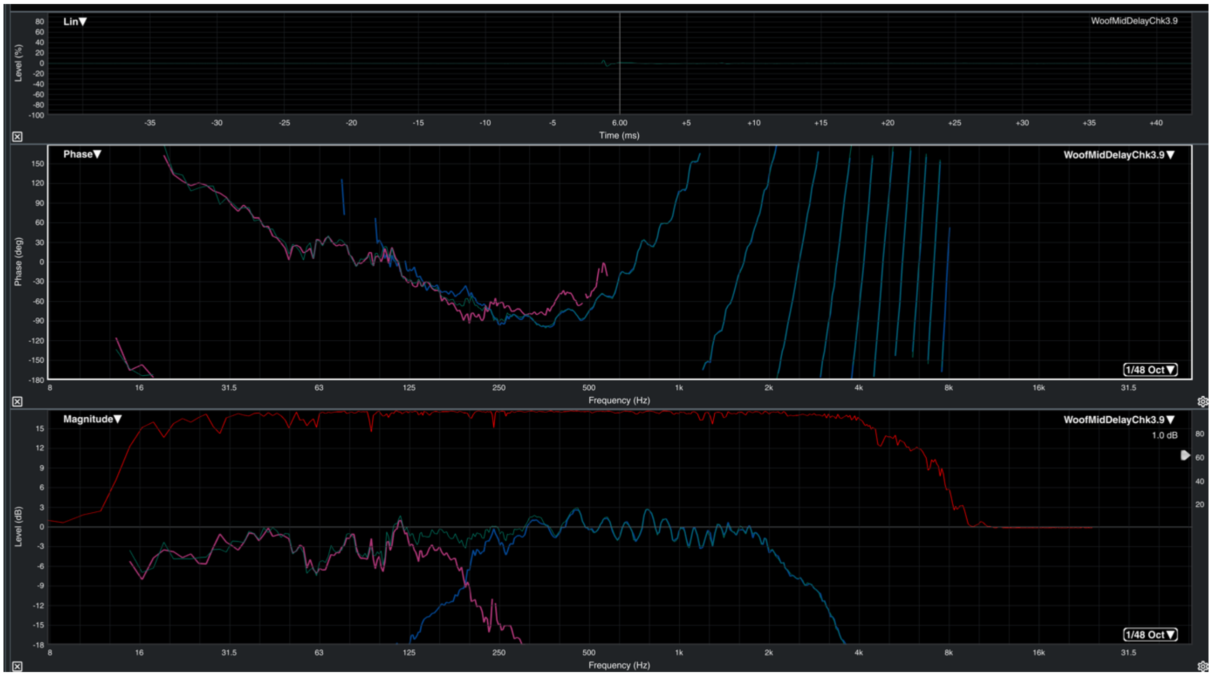
Tweeter Step Response



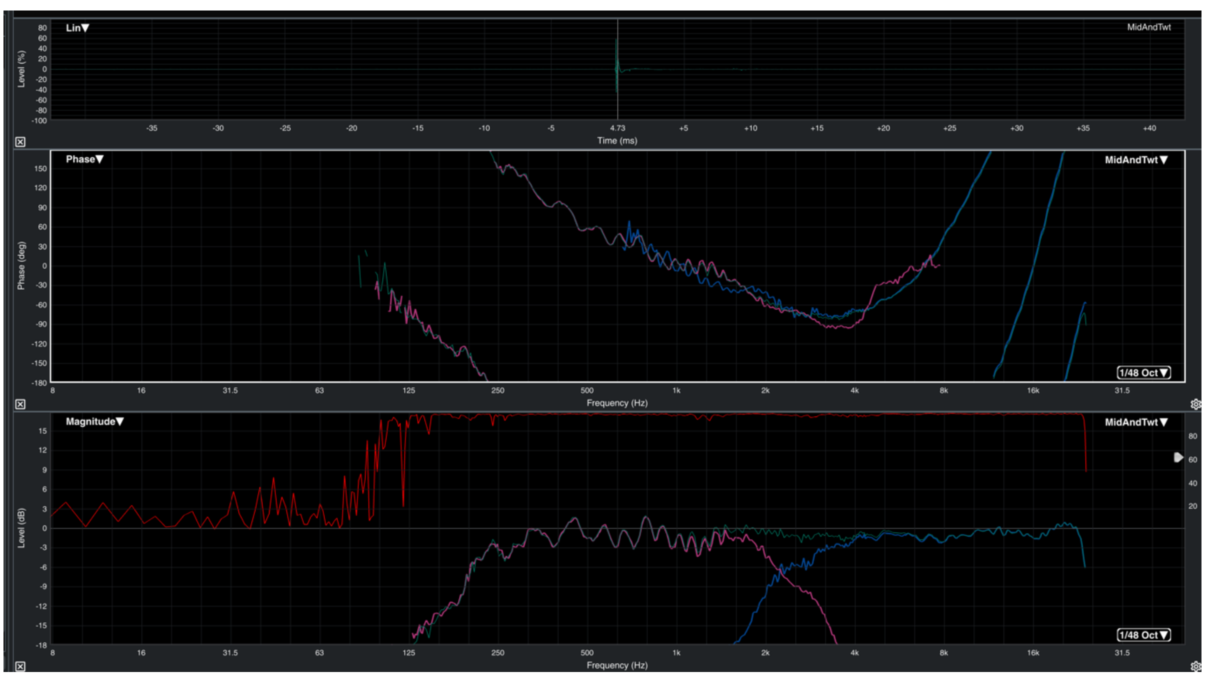


Tweeter Impulse Response

Time Alignment



SMAART Graph captured showing phase alignment between my subwoofer (pink) and midwoofer (blue). Combined frequency response of both drivers is shown in green.



SMAART graph captured showing phase alignment between my midwoofer (pink) and my tweeter (blue). Combined frequency response of both drivers is shown in green. This time alignment was done after aligning my midwoofer to my subwoofer

10.1 Appendix B

Subwoofer Report

Woofers

	Nominal Size	Cone	Price	Sensitivity	Power	Thermal SPL Limit	Mechanical SPL Limit	X-max	Sd cm2	Vas (liters)	Qts	Fs	Vb (liters)	Vb (cu feet)	Vd	F3	X-max SPL
Dayton Audio RSS315HO-4	12"	Aluminum	$237.98	90.5	700	119.0		12.3	514.7	53.7	0.31	26.2	22.52	0.80	0.0006	38.4	114.3
Dayton Audio RSS390HO-4	15"	Aluminum	$294.98	92.8	800	121.8		12	829.6	168	0.32	21.5	78.22	2.76	0.0010	30.1	114.3
Dayton Audio DCS380-4	15"	Paper	$119.98	93.6	250	117.6		8.4	819.4	267	0.44	21.5	355.58	12.56	0.0007	19.0	113.3
Dayton Audio RSS460HO-4	18"	Aluminum	$449.98	93	900	122.5		12.75	1,164	272	0.32	18.8	126.65	4.47	0.0015	26.3	114.4
SB Audience BIANCO-12MW200	12"	Paper	$105.90	99	400	125.0		6.97	543.3	62.9	0.49	51	119.49	4.22	0.0004	38.5	114.1
SB Audience BIANCO-15MW200	15"	Paper	$134.00	100	400	126.0		5.92	824.5	153.3	0.58	44	508.02	17.94	0.0005	26.0	113.7
Peerless FSL-1530R01-08	15"	Paper	$98.98	98	350	123.4		4.67	866	180	0.24	41	32.43	1.15	0.0004	87.1	115.8
Peerless XXLS-P830845	12"	Paper	$189.98	85.9	175	108.3		15.2	491	91.9	0.65	29	443.57	15.66	0.0007	14.5	112.7

Specification Sheets for Woofers Not Modeled

Dayton Audio RSS315HO-4 12” Reference HO Subwoofer 4 Ohm

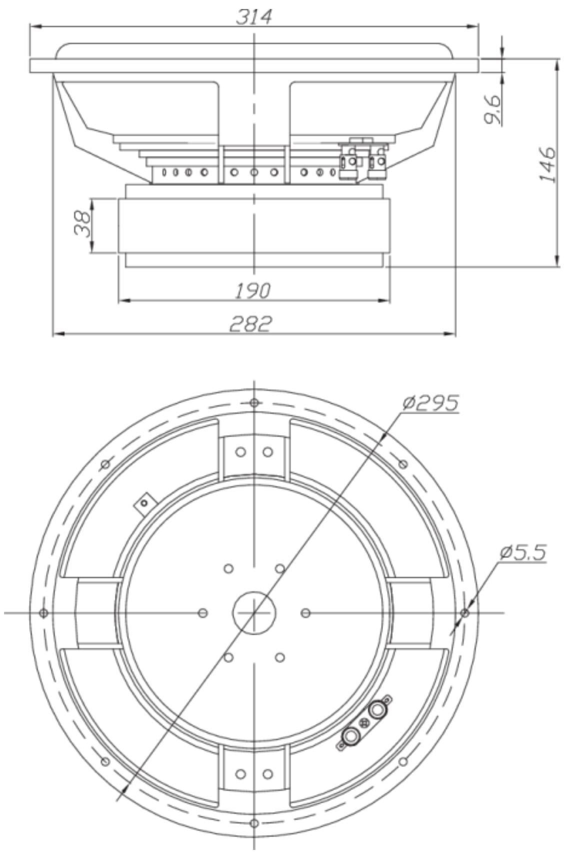
Dayton Audio RSS460HO-4 18" Reference HO Subwoofer 4 Ohm

SB Audience BIANCO-12MW200 12” Midwoofer

SB Audience DIANCO-15MW200 15” Midwoofer

RSS315HO-4 12" Reference HO Subwoofer 4 Ohm

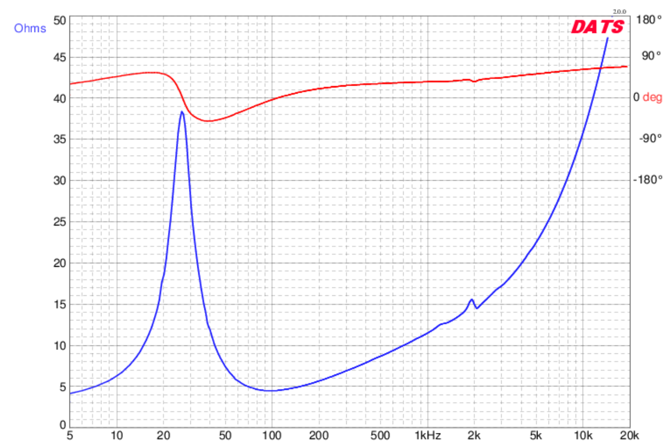
RSS315HO-4



PARAMETERS

Impedance	4 ohms
Re	3.2 ohms
Le	1.75 mH
Fs	26.2 Hz
Qms	3.63
Qes	0.33
Qts	0.31
Mms	251g
Cms	0.15 mm/N
Sd	514.7 cm²
Vd	633.1 cm³
BL	20 Tm
Vas	53.7 liters
Xmax	12.3 mm
VC Diameter	64 mm
SPL	90.5 dB @ 2.83V/1m
RMS Power Handling	700 watts
Usable Frequency Range (Hz)	26 - 600 Hz

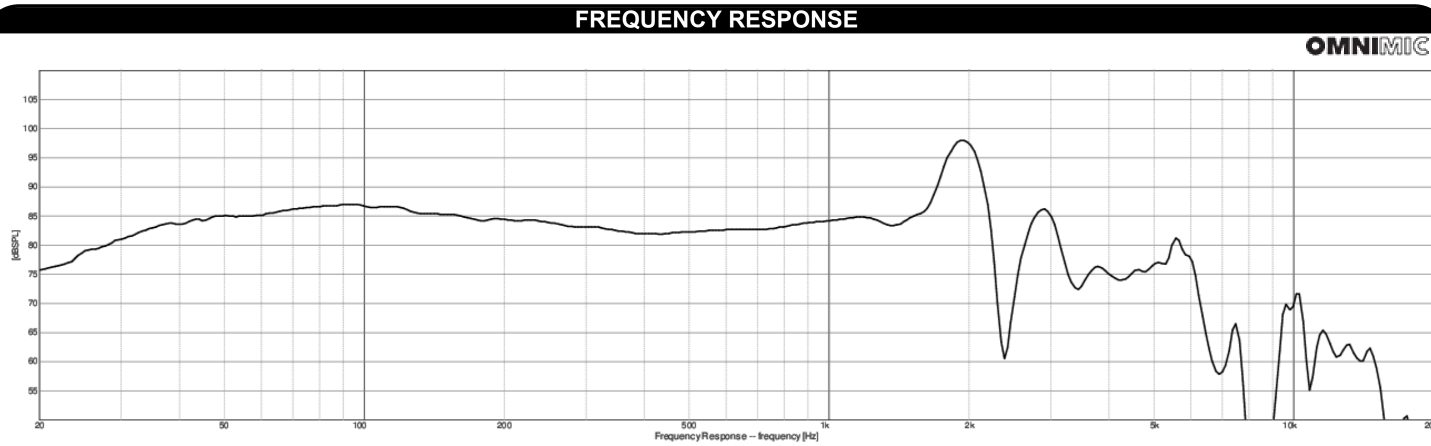
IMPEDANCE/PHASE



FEATURES

- Extensively vented motor eliminates compression and allows quiet excursion
- Extra-thick black anodized aluminum cone for maximum rigidity
- Triple shorting ring motor for ultra-low distortion
- 4-layer coil for high power handling
- Optimized parameters for small enclosures

FREQUENCY RESPONSE

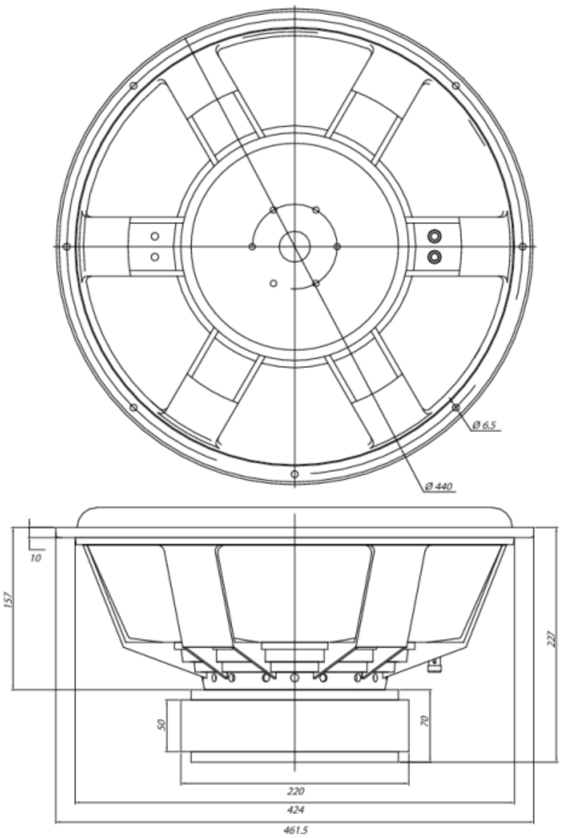


Black = 0°

Note: 1/24th octave smoothing - nearfield response included in graph below 450 Hz.

RSS460HO-4 18" Reference HO Subwoofer 4 Ohm

RSS460HO-4



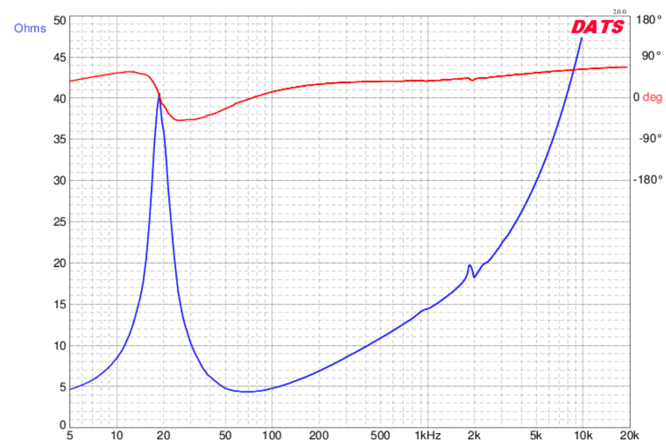
PARAMETERS

Impedance	4 ohms
Re	3.2 ohms
Le	2.24 mH @ 1 kHz
Fs	18.8 Hz
Qms	4.05
Qes	0.35
Qts	0.32
Mms	499g
Cms	0.14 mm/N
Sd	1,164.0 cm²
Vd	1,484.1 cm³
BL	23.4 Tm
Vas	272 liters
Xmax	12.75 mm
VC Diameter	76.2 mm
SPL	93 dB @ 2.83V/1m
RMS Power Handling	900 watts
Usable Frequency Range (Hz)	20 - 500 Hz

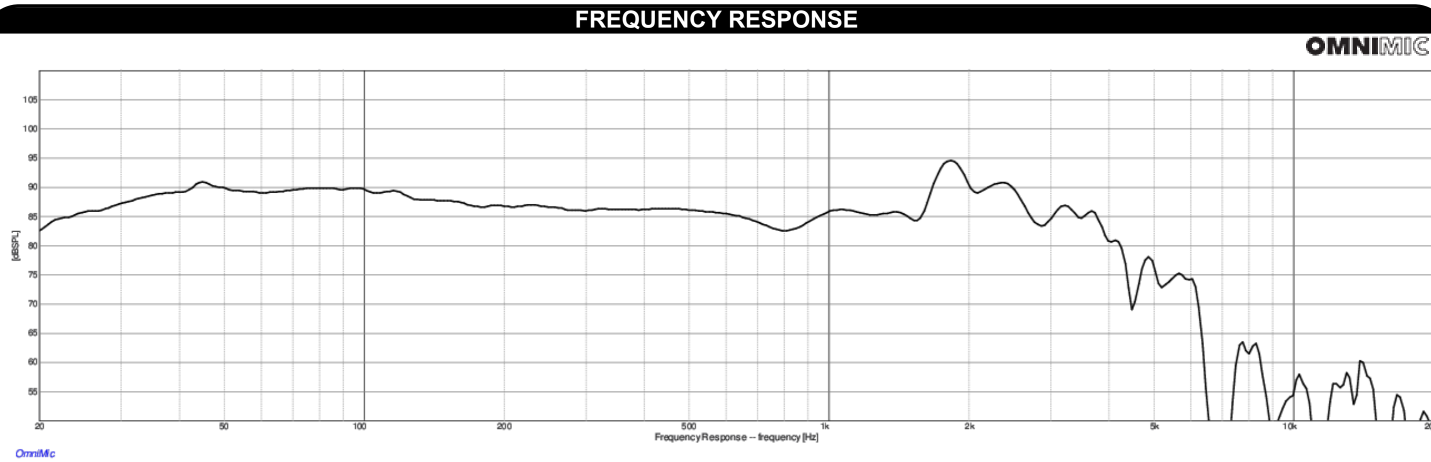
FEATURES

- Extensively vented motor eliminates compression and allows quiet excursion
- Extra-thick black anodized aluminum cone for maximum rigidity
- Triple shorting ring motor for ultra-low distortion
- 4-layer coil for high power handling
- Optimized parameters for small enclosures

IMPEDANCE/PHASE



FREQUENCY RESPONSE



Note: 1/24th octave smoothing - nearfield response included in graph below 450 Hz.

Black = 0°

BIANCO-12MW200

SB AUDIENCE

12" - Midwoofer - 400W - 99dB

- Proprietary cone paper material with silk cotton tree and manila pulp
- 2.4" voice coil with APC (Advanced Polymer Coating)
- Vented pole piece for reduced compression
- Minimum damping fiber glass voice coil former
- Long life silver lead wires
- Weather-proof coated cone paper

Dimensions & Weight

Overall Diameter	306 mm (12.05 in)
Bolt Circle Diameter	295 mm (11.61 in)
Baffle Cutout Diameter	278 mm (10.94 in)
Mounting Depth	126 mm (4.96 in)
Flange and Gasket Thickness	9.2 mm (0.36 in)
Net Weight	5.05 Kg (12.12 lb)
Shipping Box	354 x 354 x 182 mm (13.93 x 13.93 x 7.16 in)
Gross Weight	6.59 Kg (14.52 lb)

Recone Kit

N/A

NOTES :

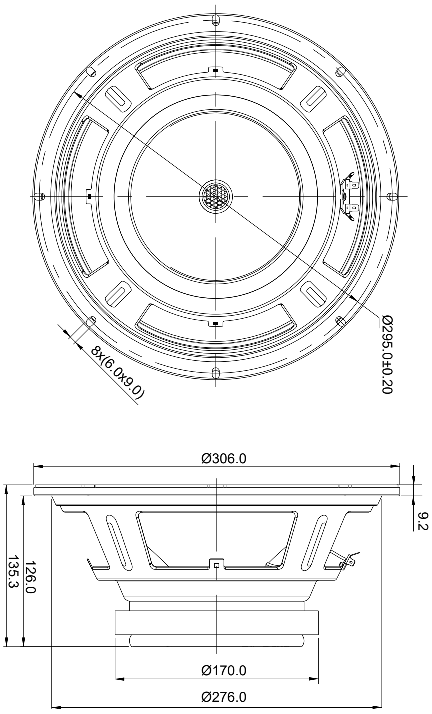
(1) AES standard, test mode with continuous pink noise signal (6 dB crest factor; 2 hours) within the Fo to 10Fo power calculated on rated nominal impedance. Loudspeaker in free air
(2) Maximum power is defined as 3dB greater than nominal power.
(3) Xmax= ((Winding depth - magnetic gap depth)/2) +(magnetic gap depth/3)
(4) Maximum excursion (p-p) before permanent damage
(5) T/S parameters measured on drive units that are broken in using Klippel LPM Measurement System.

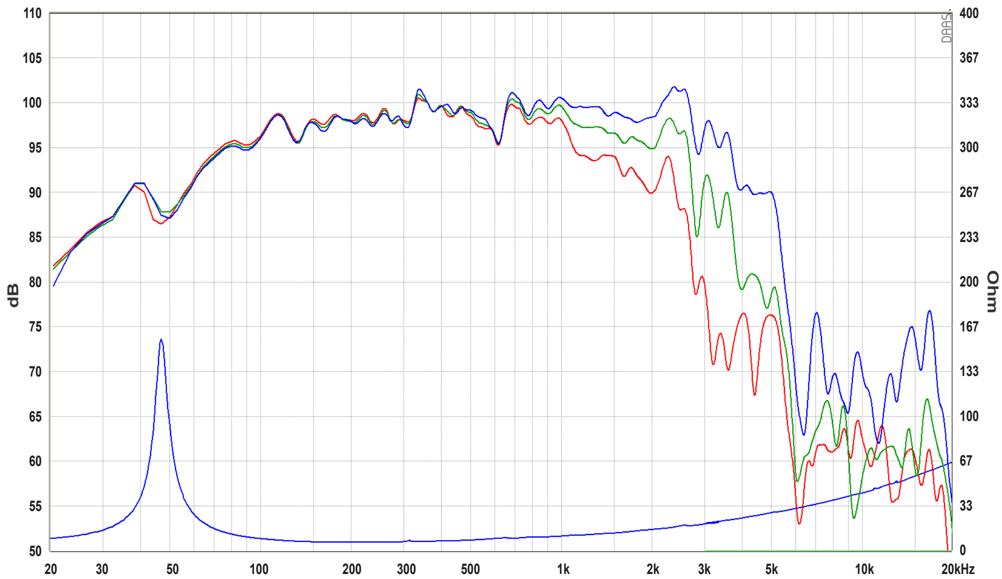
Specs :

Nominal Impedance	8 Ohm
Minimum Impedance	5.2 Ohm
AES Power Handling (1)	200 W
Maximum Power Handling (2)	400 W
Sensitivity (1W/1m)	99 dB
Frequency Range	51 - 5350 Hz
Voice Coil Diameter	60.5 mm (2.4 in)
Winding Material	Copper
Former Material	Till
Winding Depth	16.6 mm
Magnetic Gap Depth	8 mm (0.31 in)
Flux Density	1.23 T
Magnet	Ferrite
Basket Material	Stamped steel
Demodulation	-
Cone Surround	Double half roll with damping glue
NET Air Volume filled by driver	3.33 liters
Spider Profile	Single constant height waves
Weather Resistant	Yes

Thiele Small Parameters

Fs	51 Hz
Re	5.3 Ohm
Qes	0.51
Qms	14.33
Qts	0.49
Vas	62.9 liters
Sd	543.3 cm²
Xmax (3)	6.97 mm
Xdamage (4)	20 mm
Mms	65.2 gr
Bl	14.7 Tm
Le	0.83 mH
Cms	0.15 mm/N
Rms	1.45 Kg/s
Eta Zero	1.56 %
EBP	100





(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

R.4 / 28.04.2023

BIANCO-15MW200

15″ - Midwoofer - 400W - 100dB

SB AUDIENCE

- Proprietary cone paper material made in-house
- Vented pole piece for reduced compression
- Corrugation conepaper for improved durability
- Minimum damping fiber glass voice coil former
- 2.4" voice coil
- Weather-proof coated cone paper

Dimensions & Weight

Overall Diameter	384 mm (15.11 in)
Bolt Circle Diameter	371.5 mm (14.62 in)
Baffle Cutout Diameter	350 mm (13.77 in)
Mounting Depth	146.5 mm (5.76 in)
Flange and Gasket Thickness	9.7 mm (0.38 in)
Net Weight	5.12 Kg (11.28 lb)
Shipping Box	428 x 428 x 209 mm (16.85 x 16.85 x 8.22 in)
Gross Weight	6.91 Kg (15.23 lb)

Recone Kit

N/A

Specs :

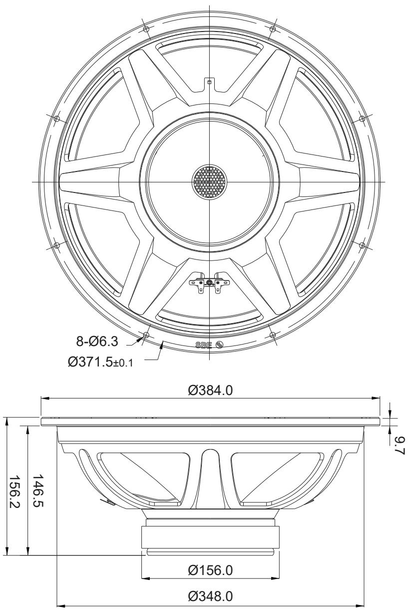
Nominal Impedance	8 Ohm
Minimum Impedance	6.8 Ohm
AES Power Handling (1)	200 W
Maximum Power Handling (2)	400 W
Sensitivity (1W/1m)	100 dB
Frequency Range	44 - 4250 Hz
Voice Coil Diameter	60.5 mm (2.4 in)
Winding Material	Copper
Former Material	Till
Winding Depth	14.5 mm
Magnetic Gap Depth	8 mm (0.31 in)
Flux Density	1.15 T
Magnet	Ferrite
Basket Material	Stamped steel
Demodulation	-
Cone Surround	Double half roll
NET Air Volume filled by driver	3.54 liters
Spider Profile	Constant height waves
Weather Resistant	Yes

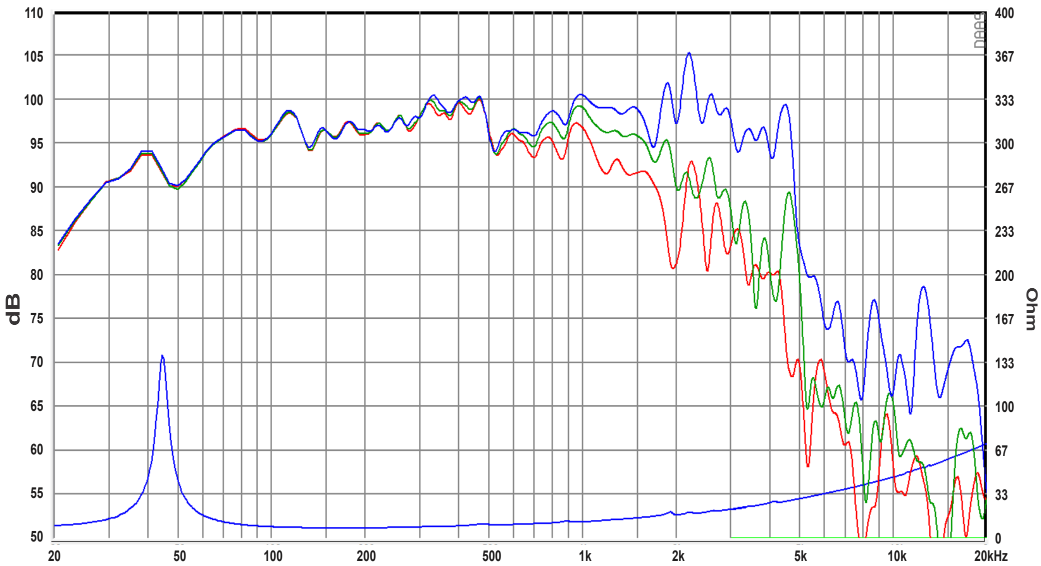
Thiele Small Parameters

Fs	44 Hz
Re	6.8 Ohm
Qes	0.61
Qms	15.19
Qts	0.58
Vas	153.3 liters
Sd	824.5 cm²
Xmax (3)	5.92 mm
Xdamage (4)	20 mm
Mms	80.9 g
Bl	15.9 Tm
Le	1.02 mH
Cms	0.16 mm/N
Rms	1.48 Kg/s
Eta Zero	2.11 %
EBP	72

NOTES :

(1) AES standard, test mode with continuous pink noise signal (6 dB crest factor; 2 hours) within the Fo to 10Fo power calculated on rated nominal impedance. Loudspeaker in free air
(2) Maximum power is defined as 3dB greater than nominal power.
(3) Xmax= ((Winding depth - magnetic gap depth)/2) +(magnetic gap depth/3)
(4) Maximum excursion (p-p) before permanent damage
(5) T/S parameters measured on drive units that are broken in using Klippel LPM Measurement System.





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

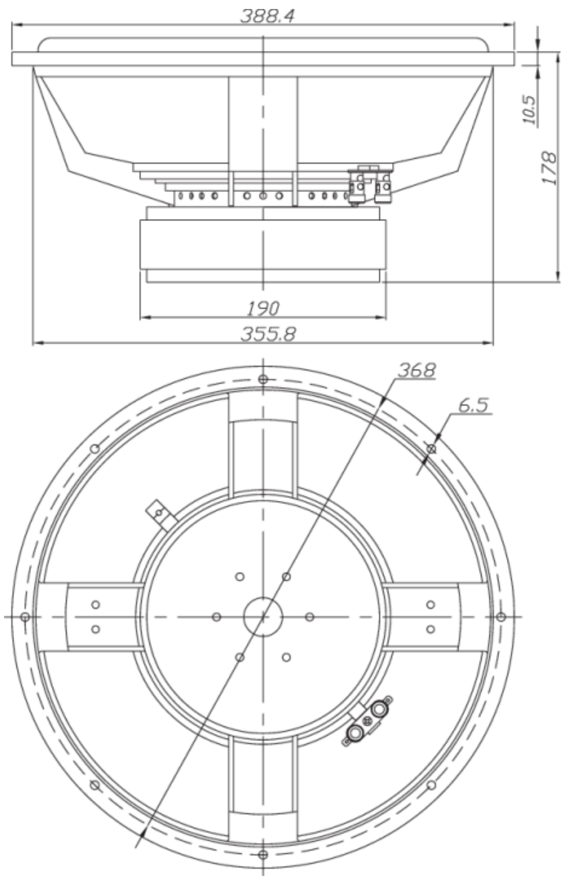
Response Curve :
------ (Blue) : on axis ------ (Green) : 30° off-axis ------ (Red) : 60° off-axis

Specifications and Modeling of the Dayton Audio RSS390HO-4 15" Reference HO Subwoofer 4 Ohm

DAYTONAUDIO

RSS390HO-4 15" Reference HO Subwoofer 4 Ohm

RSS390HO-4



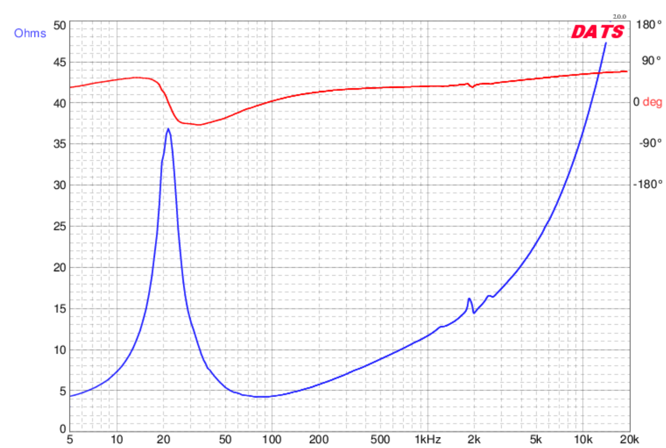
PARAMETERS

Impedance	4 ohms
Re	3.2 ohms
Le	1.79 mH @ 1 kHz
Fs	21.5 Hz
Qms	3.69
Qes	0.35
Qts	0.32
Mms	319g
Cms	0.17 mm/N
Sd	829.6 cm²
Vd	995.5 cm³
BL	19.8 Tm
Vas	168 liters
Xmax	12.0 mm
VC Diameter	64 mm
SPL	92.8 dB @ 2.83V/1m
RMS Power Handling	800 watts
Usable Frequency Range (Hz)	21 - 600 Hz

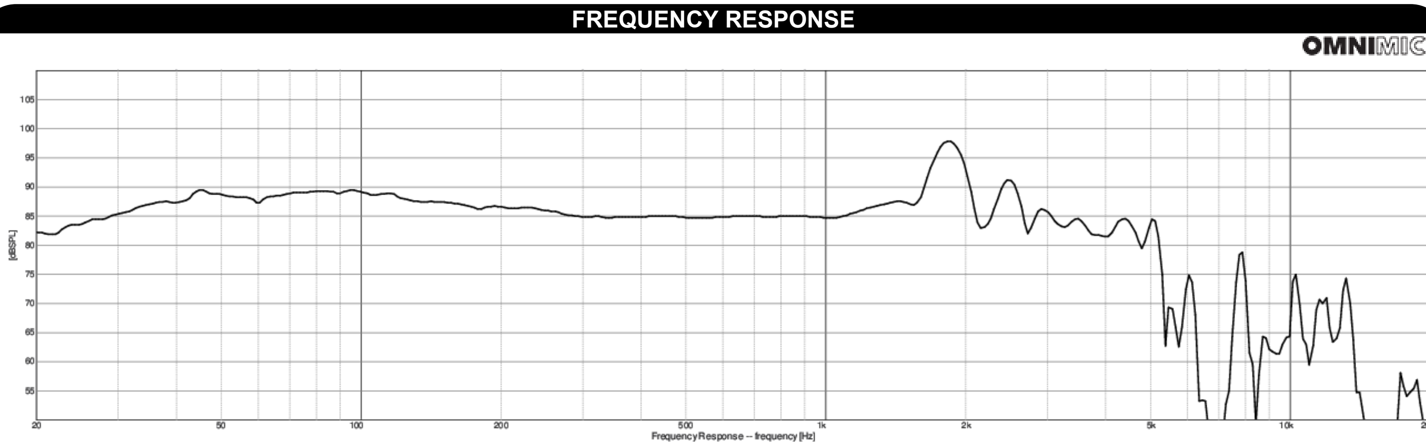
FEATURES

- Extensively vented motor eliminates compression and allows quiet excursion
- Lightweight black anodized aluminum cone for rigidity and lower moving mass
- Triple shorting ring motor for ultra-low distortion
- 2-layer coil for reduced back EMF
- Suitable for sealed or vented enclosures

IMPEDANCE/PHASE

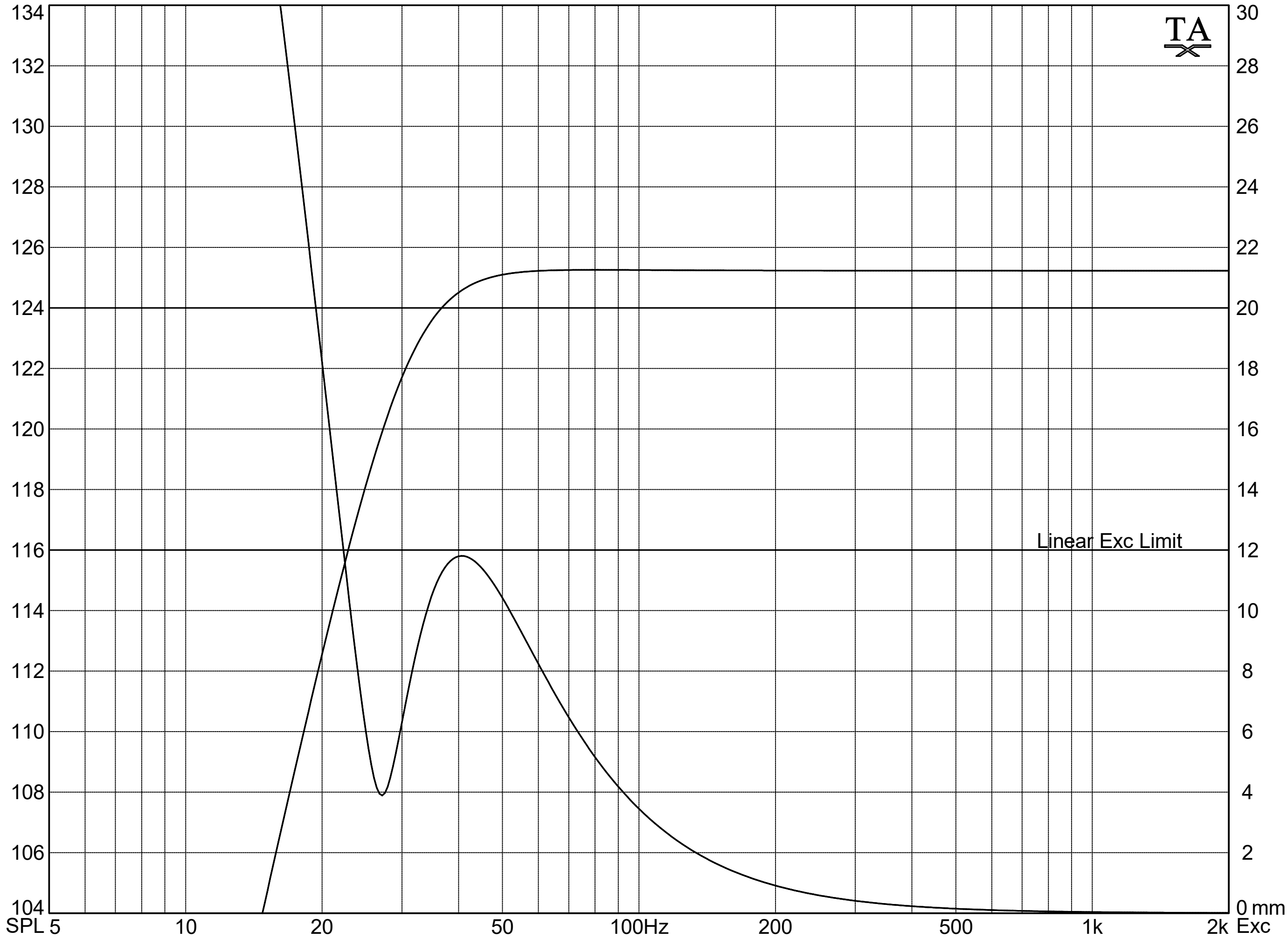


FREQUENCY RESPONSE



Note: 1/24th octave smoothing - nearfield response included in graph below 450 Hz.

Black = 0°



Driver Parameters

Driver: **Dayton Audio RSS390HO-4**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	92.8	dB SPL
Free Air Resonance	f(s) =	21.5	Hz
Total Q	Q(ts) =	0.32	
Electrical Q	Q(es) =	0.35	
Mechanical Q	Q(ms) =	3.69	
Equivalent Volume	V(as) =	5.933	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	800	Watts
Max Linear Excursion	X(max) =	12	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	2.49	cu ft
Closed Box Q	Q(tc) =	0.5886	
Box Frequency	F(B) =	27	Hz
Min Rec Vent Area	S(vMin) =	3.333E+005	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	2.383	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	1750	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

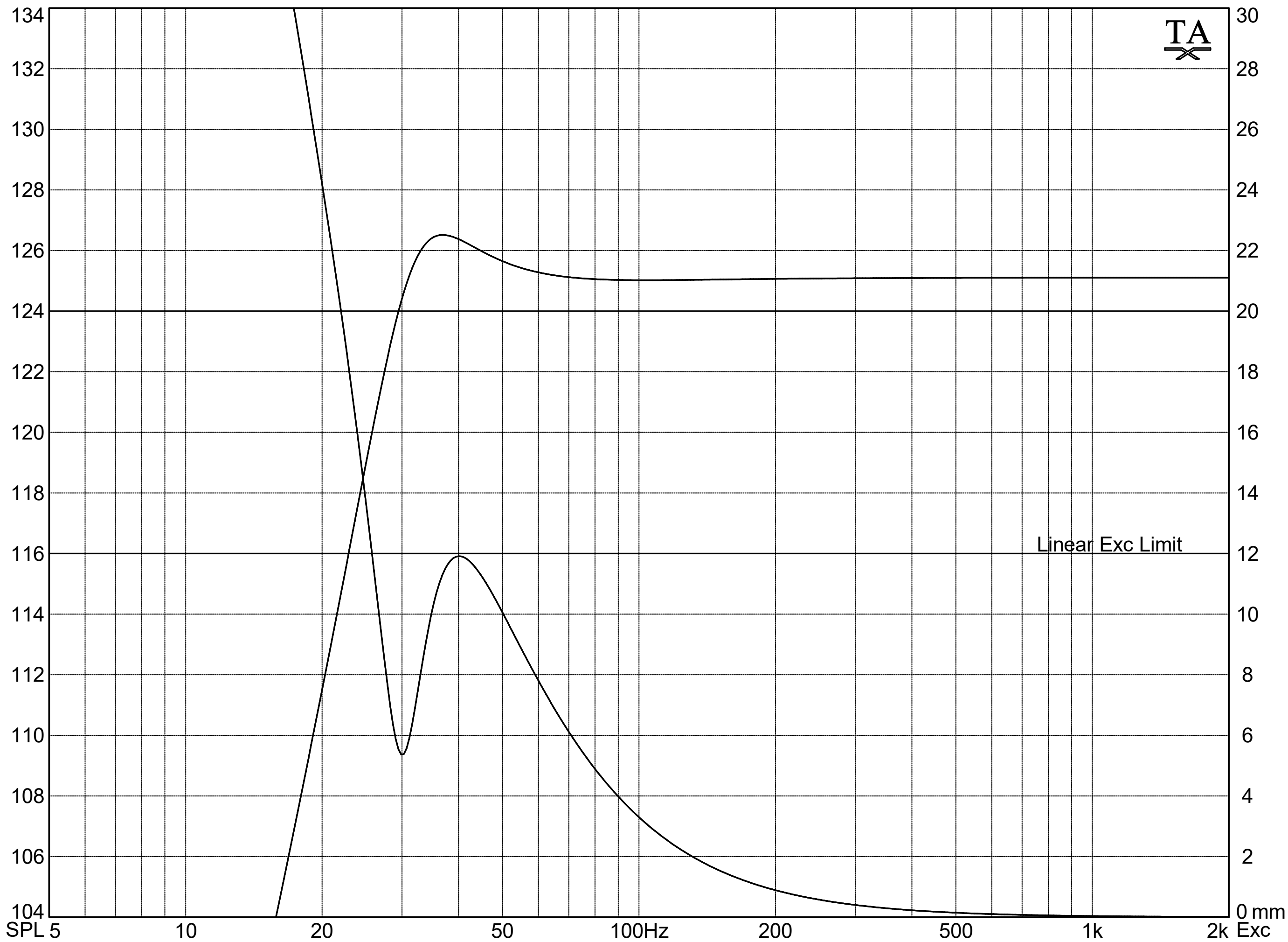
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **Dayton Audio RSS390HO-4**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	92.8	dB SPL
Free Air Resonance	f(s) =	21.5	Hz
Total Q	Q(ts) =	0.32	
Electrical Q	Q(es) =	0.35	
Mechanical Q	Q(ms) =	3.69	
Equivalent Volume	V(as) =	5.933	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	800	Watts
Max Linear Excursion	X(max) =	12	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	4	cu ft
Closed Box Q	Q(tc) =	0.5043	
Box Frequency	F(B) =	30	Hz
Min Rec Vent Area	S(vMin) =	3.703E+005	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	1.483	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	1700	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

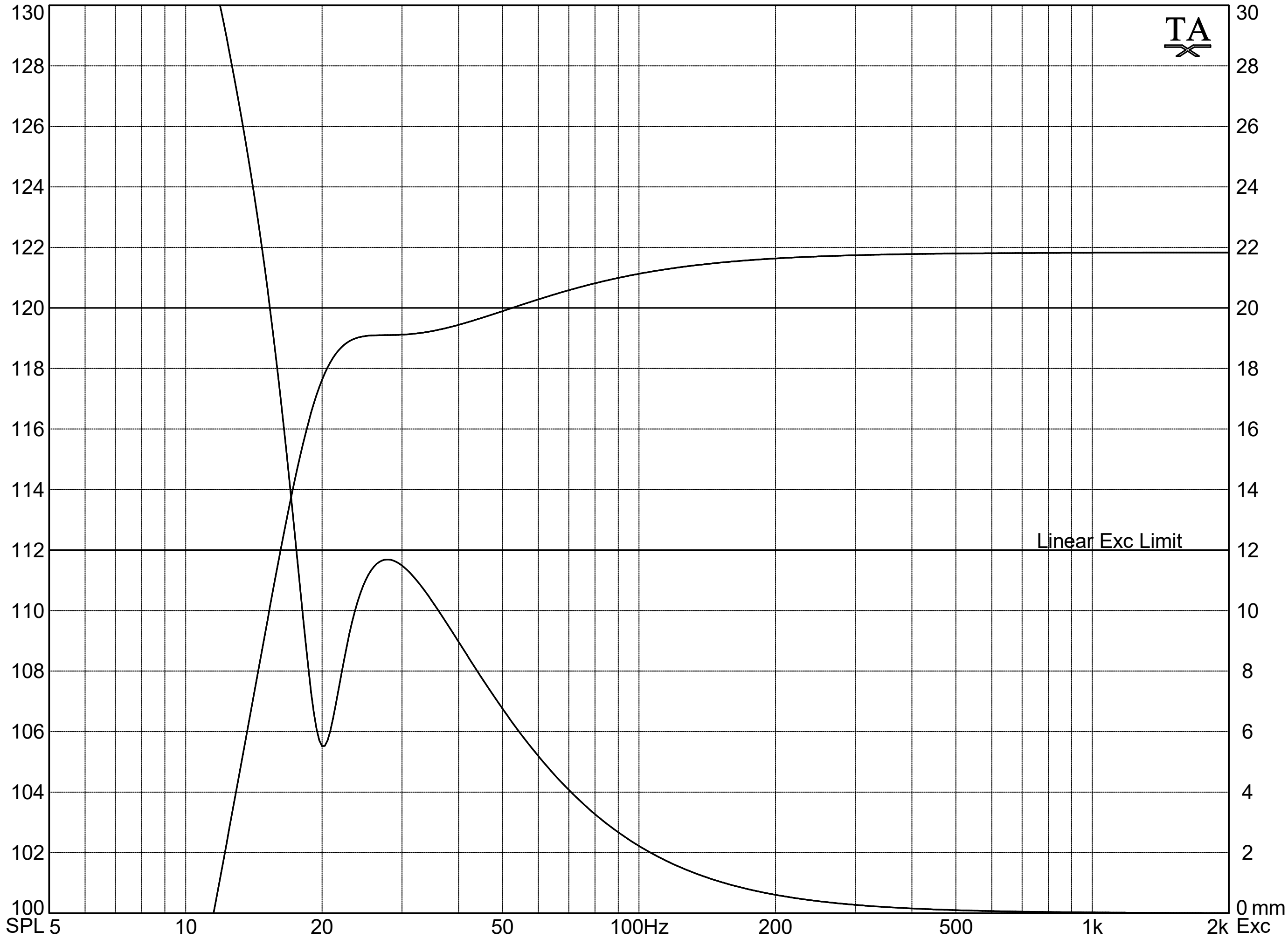
System Name:

4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date: Rev:



Driver Parameters

Driver: **Dayton Audio RSS390HO-4**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	92.8	dB SPL
Free Air Resonance	f(s) =	21.5	Hz
Total Q	Q(ts) =	0.32	
Electrical Q	Q(es) =	0.35	
Mechanical Q	Q(ms) =	3.69	
Equivalent Volume	V(as) =	5.933	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	800	Watts
Max Linear Excursion	X(max) =	12	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	6	cu ft
Closed Box Q	Q(tc) =	0.4513	
Box Frequency	F(B) =	20	Hz
Min Rec Vent Area	S(vMin) =	24.7	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	0.9888	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	800	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

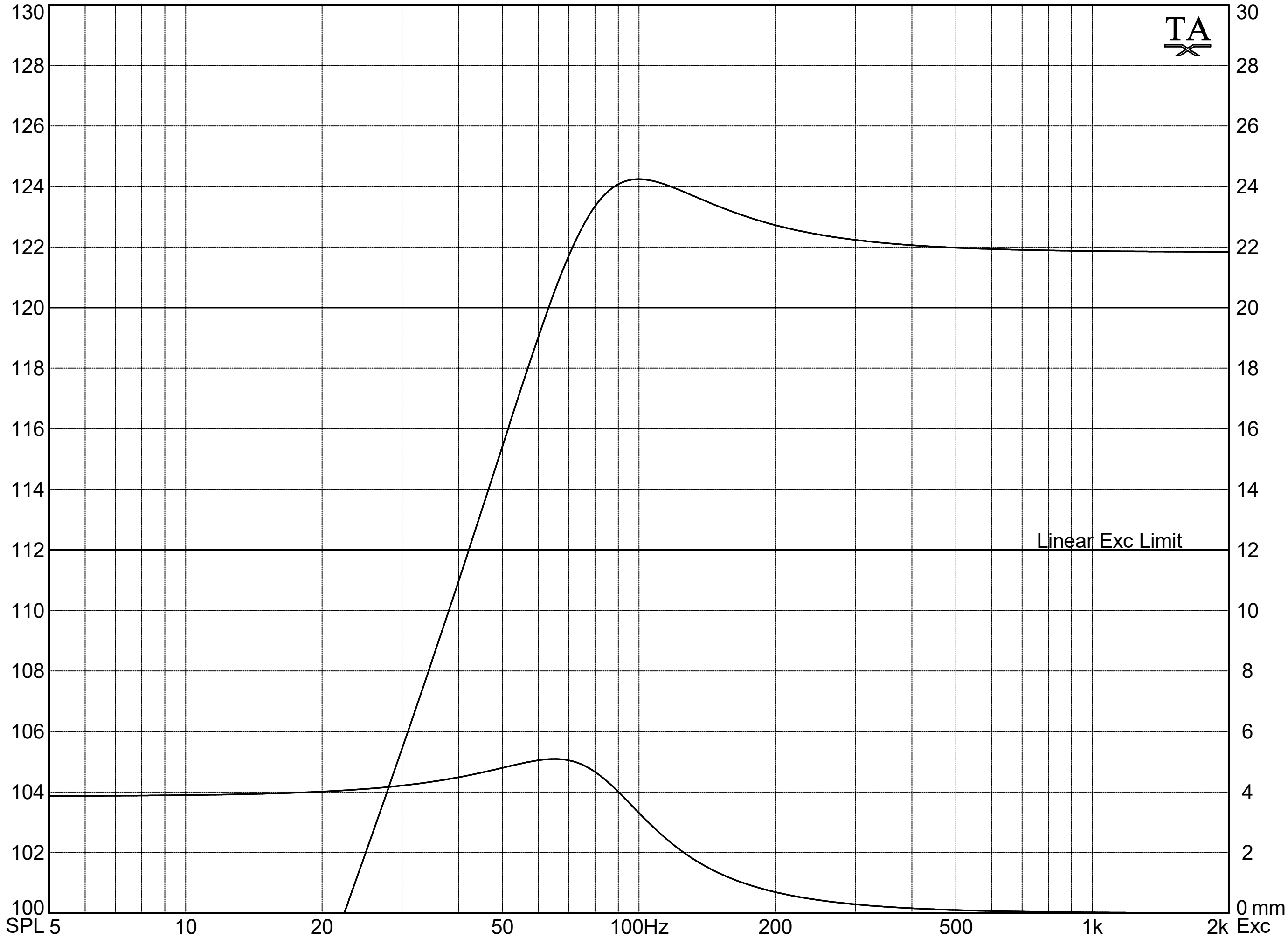
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **Dayton Audio RSS390HO-4**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	92.8	dB SPL
Free Air Resonance	f(s) =	21.5	Hz
Total Q	Q(ts) =	0.32	
Electrical Q	Q(es) =	0.35	
Mechanical Q	Q(ms) =	3.69	
Equivalent Volume	V(as) =	5.933	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	800	Watts
Max Linear Excursion	X(max) =	12	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **2nd Order Closed Box**

Box Volume	V(B) =	0.4542	cu ft
Closed Box Q	Q(tc) =	1.2	
System Resonance	F(sc) =	80.63	Hz
Compliance Ratio	alpha =	13.06	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	800	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

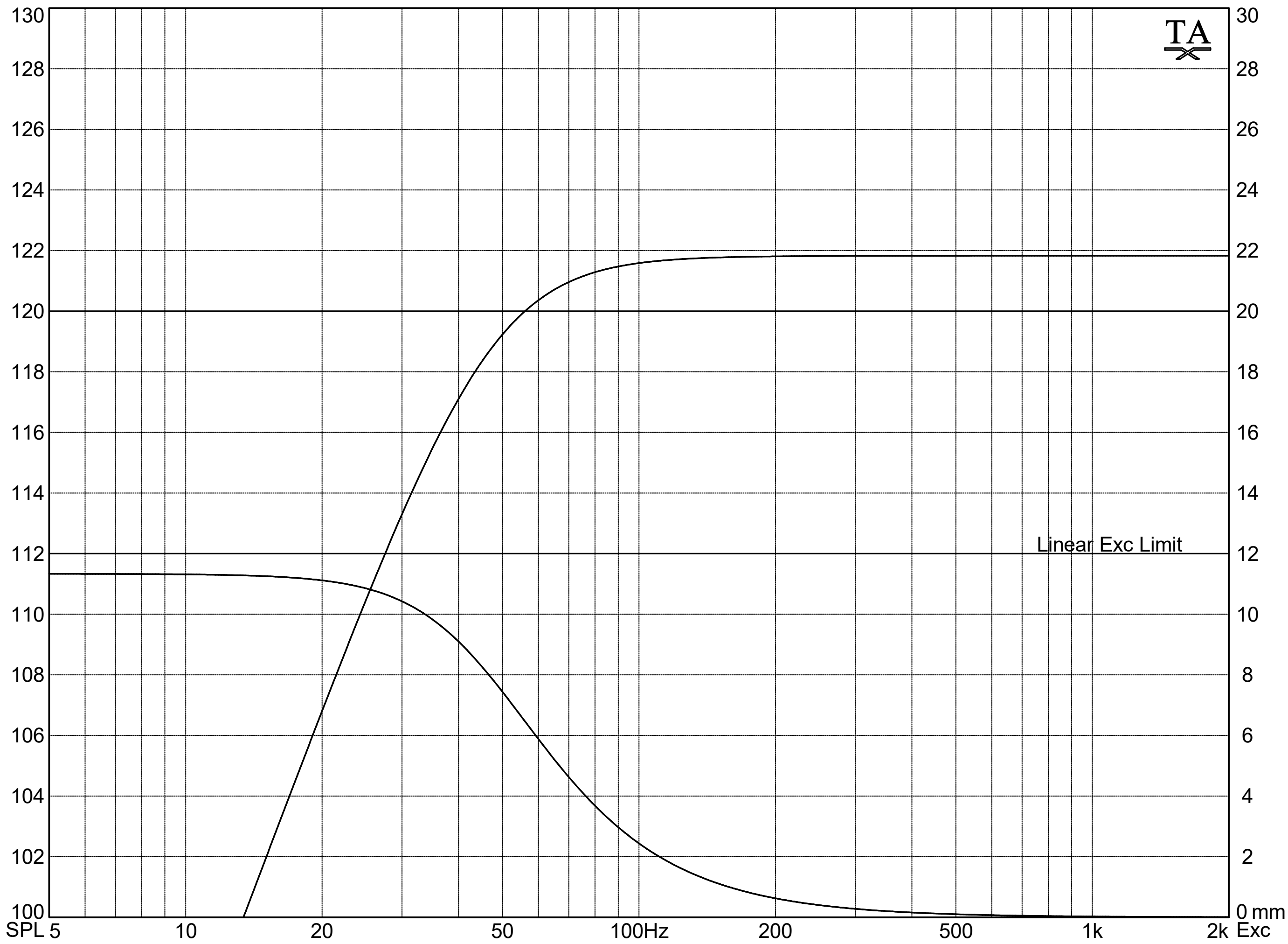
2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: Dayton Audio RSS390HO-4

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	92.8	dB SPL
Free Air Resonance	f(s) =	21.5	Hz
Total Q	Q(ts) =	0.32	
Electrical Q	Q(es) =	0.35	
Mechanical Q	Q(ms) =	3.69	
Equivalent Volume	V(as) =	5.933	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	800	Watts
Max Linear Excursion	X(max) =	12	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 2nd Order Closed Box

Box Volume	V(B) =	1.567	cu ft
Closed Box Q	Q(tc) =	0.7	
System Resonance	F(sc) =	47.03	Hz
Compliance Ratio	alpha =	3.785	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	800	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

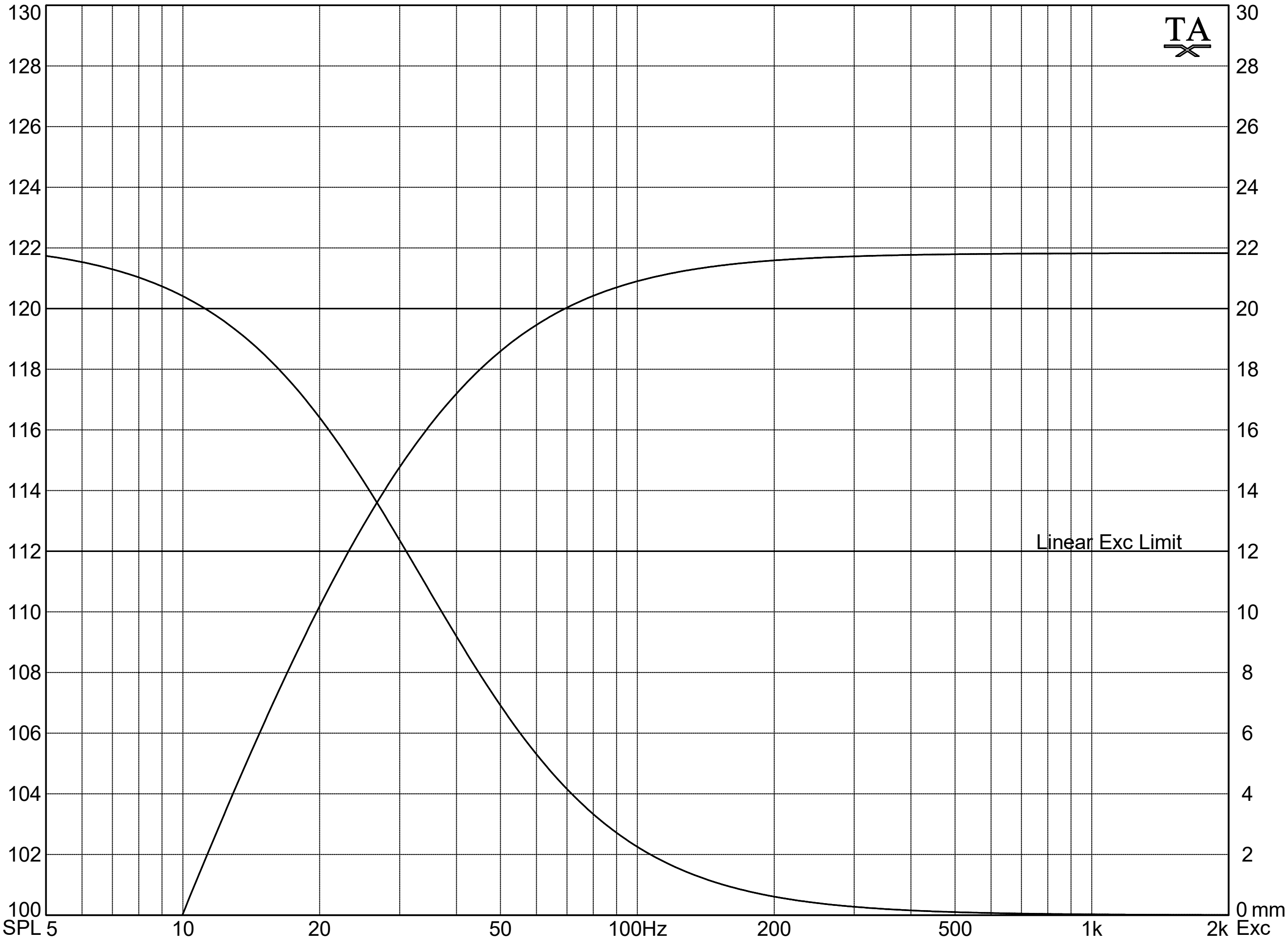
2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: Dayton Audio RSS390HO-4

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	92.8	dB SPL
Free Air Resonance	f(s) =	21.5	Hz
Total Q	Q(ts) =	0.32	
Electrical Q	Q(es) =	0.35	
Mechanical Q	Q(ms) =	3.69	
Equivalent Volume	V(as) =	5.933	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	800	Watts
Max Linear Excursion	X(max) =	12	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 2nd Order Closed Box

Box Volume	V(B) =	4.116	cu ft
Closed Box Q	Q(tc) =	0.4999	
System Resonance	F(sc) =	33.59	Hz
Compliance Ratio	alpha =	1.441	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	800	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

2nd Order Closed Box

Designer: Rowan Parsons

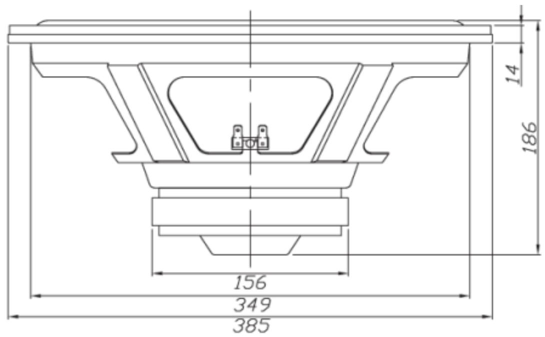
Title:

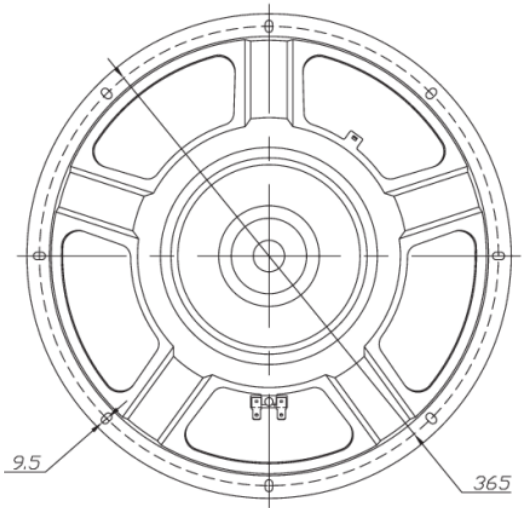
Rev Date: Rev:

Specifications and Modeling of the Dayton Audio DCS380-4 15" Classic Subwoofer 4 Ohm

DCS380-4 15" Classic Subwoofer 4 Ohm

DCS380-4





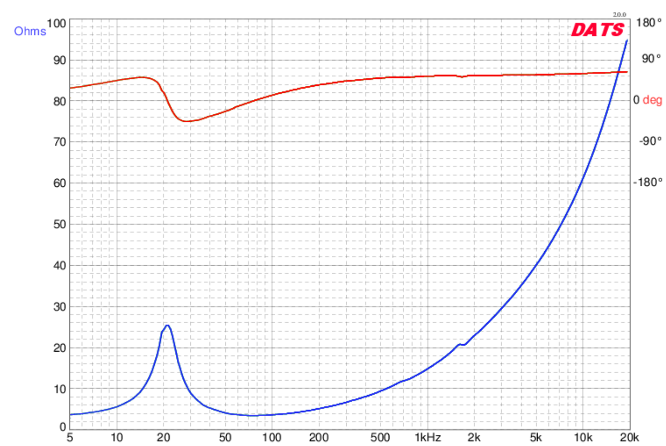
PARAMETERS

Impedance	4 ohms
Re	2.9 ohms
Le	2.31 mH @ 1 kHz
Fs	21.5 Hz
Qms	3.79
Qes	0.49
Qts	0.44
Mms	190g
Cms	0.29 mm/N
Sd	819.4 cm²
Vd	688.3 cm³
BL	12.4 Tm
Vas	267 liters
Xmax	8.4 mm
VC Diameter	51 mm
SPL	93.6 dB @ 2.83V/1m
RMS Power Handling	250 watts
Usable Frequency Range (Hz)	20 - 500 Hz

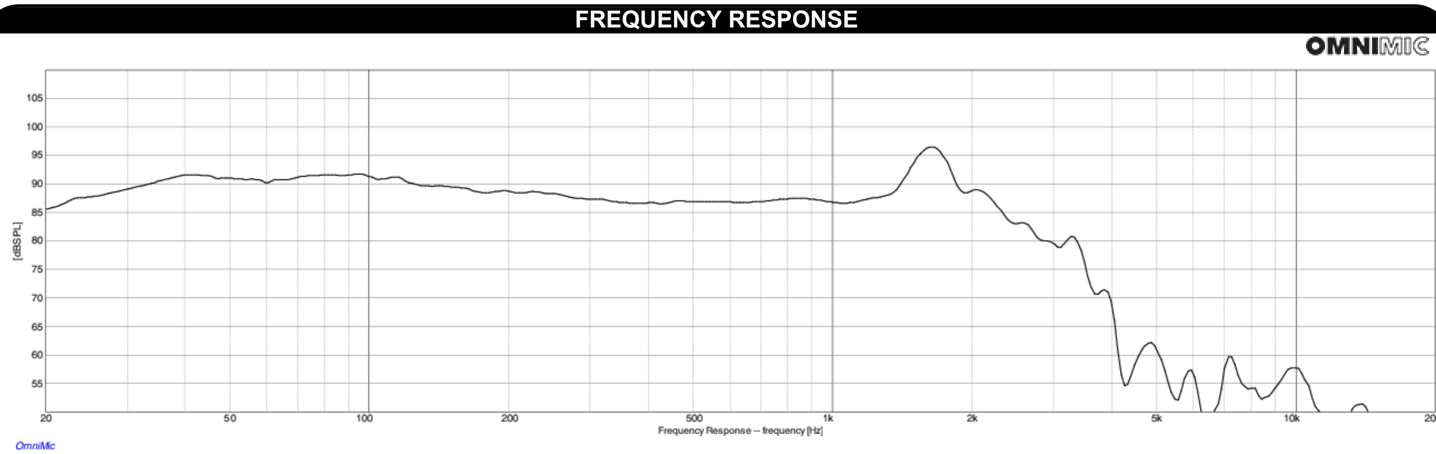
FEATURES

- Heavy-duty treated paper cone for high stiffness-to-weight ratio
- 2" aluminum former, 4-layer voice coil, and large vented pole piece for high power handling
- Large diameter flat spider and healthy Xmax for clean bass

IMPEDANCE/PHASE

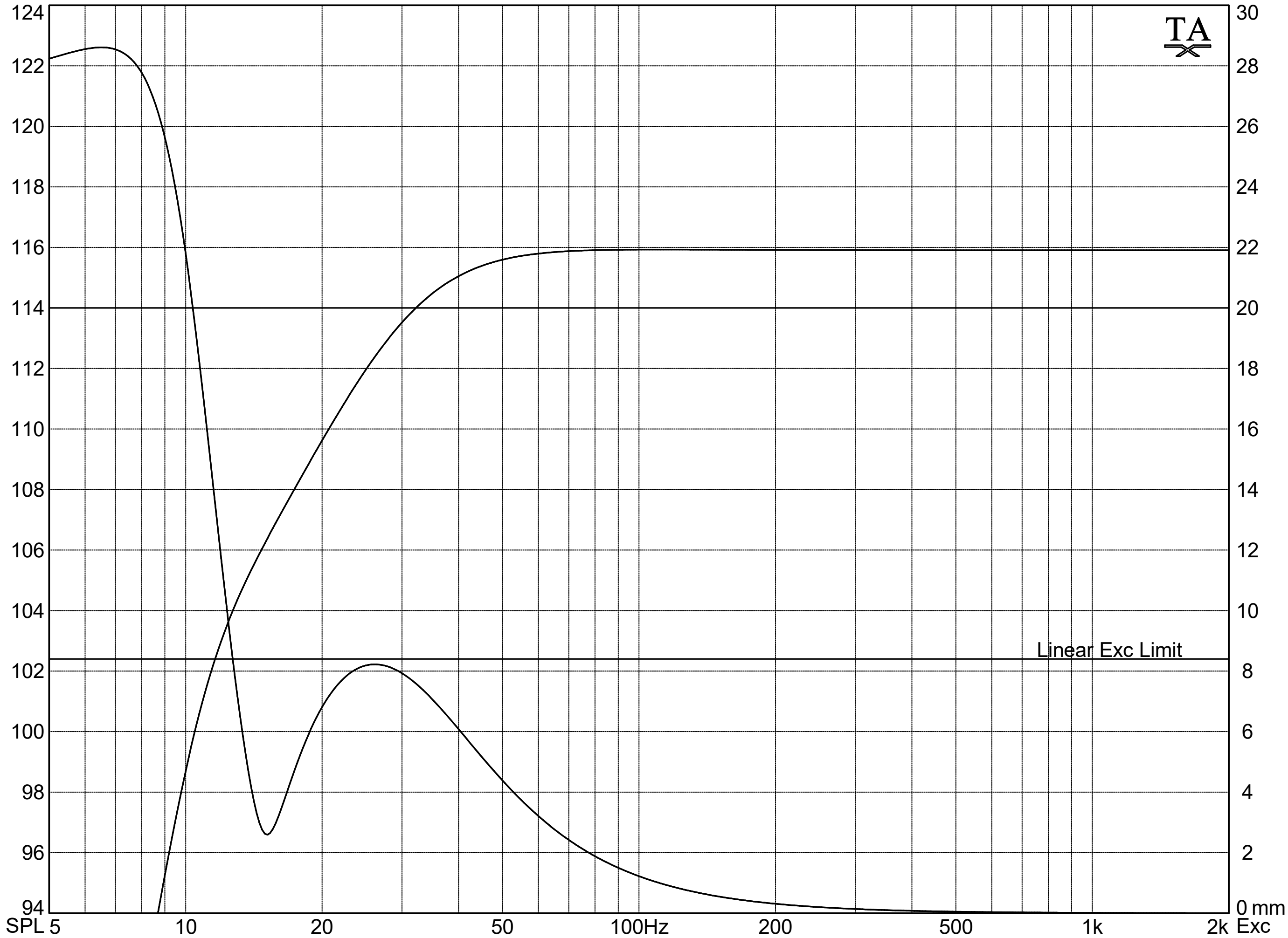


FREQUENCY RESPONSE



Note: 1/12th octave smoothing - nearfield response included in graph below 450 Hz.

Black = 0°



Driver Parameters

Driver: **Dayton Audio DCS380-4**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	93.6	dB SPL
Free Air Resonance	f(s) =	21.5	Hz
Total Q	Q(ts) =	0.44	
Electrical Q	Q(es) =	0.49	
Mechanical Q	Q(ms) =	3.79	
Equivalent Volume	V(as) =	9.429	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	500	Watts
Max Linear Excursion	X(max) =	8.4	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	7.55	cu ft
Closed Box Q	Q(tc) =	0.6598	
Box Frequency	F(B) =	15	Hz
Min Rec Vent Area	S(vMin) =	12.8	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	1.249	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	170	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

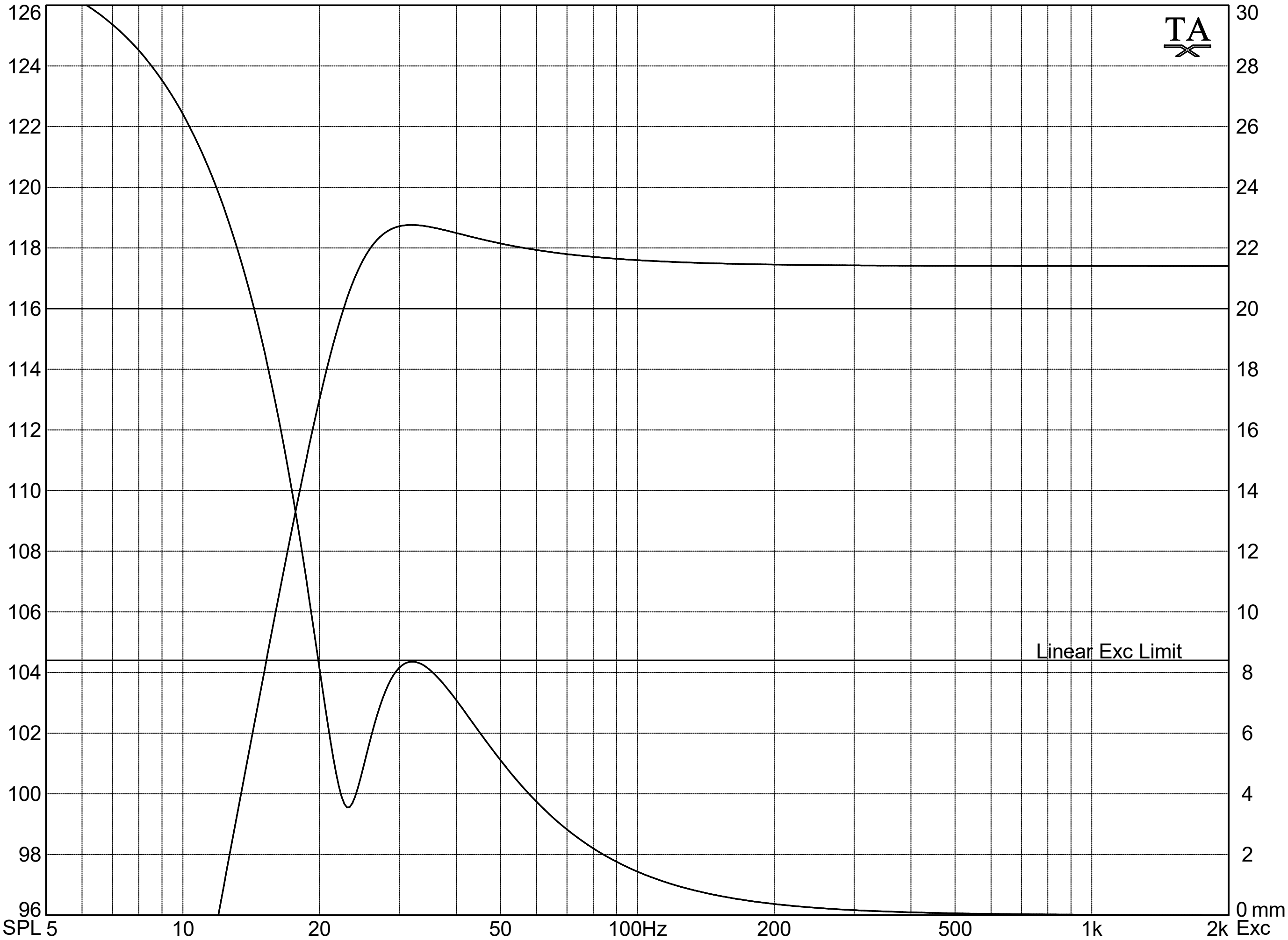
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **Dayton Audio DCS380-4**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	93.6	dB SPL
Free Air Resonance	f(s) =	21.5	Hz
Total Q	Q(ts) =	0.44	
Electrical Q	Q(es) =	0.49	
Mechanical Q	Q(ms) =	3.79	
Equivalent Volume	V(as) =	9.429	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	500	Watts
Max Linear Excursion	X(max) =	8.4	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	10	cu ft
Closed Box Q	Q(tc) =	0.6133	
Box Frequency	F(B) =	23	Hz
Min Rec Vent Area	S(vMin) =	19.6	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	0.9429	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	240	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

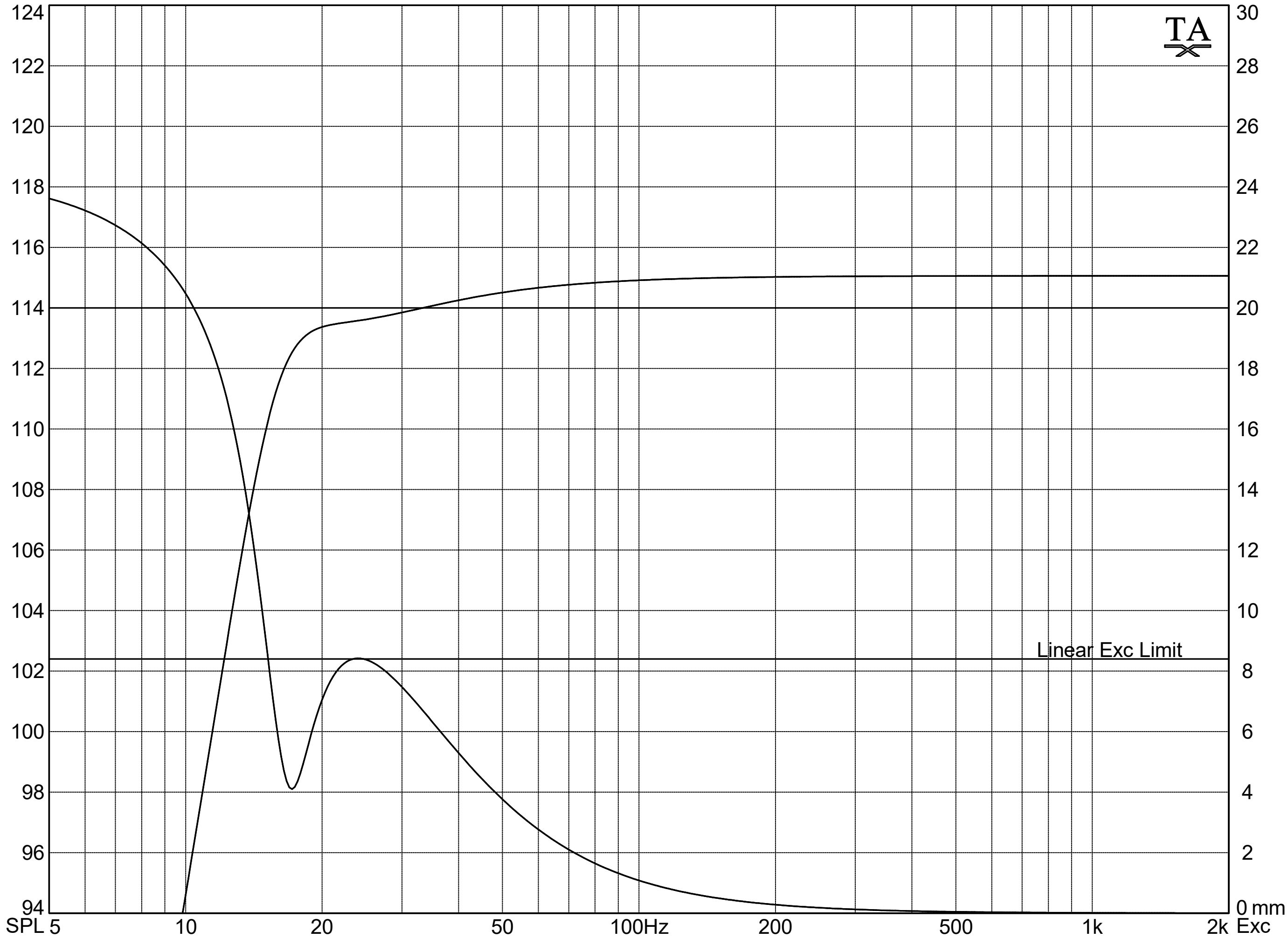
System Name:

4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date: Rev:



Driver Parameters

Driver: **Dayton Audio DCS380-4**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	93.6	dB SPL
Free Air Resonance	f(s) =	21.5	Hz
Total Q	Q(ts) =	0.44	
Electrical Q	Q(es) =	0.49	
Mechanical Q	Q(ms) =	3.79	
Equivalent Volume	V(as) =	9.429	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	500	Watts
Max Linear Excursion	X(max) =	8.4	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	16	cu ft
Closed Box Q	Q(tc) =	0.5547	
Box Frequency	F(B) =	17	Hz
Min Rec Vent Area	S(vMin) =	14.5	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	0.5893	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	140	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

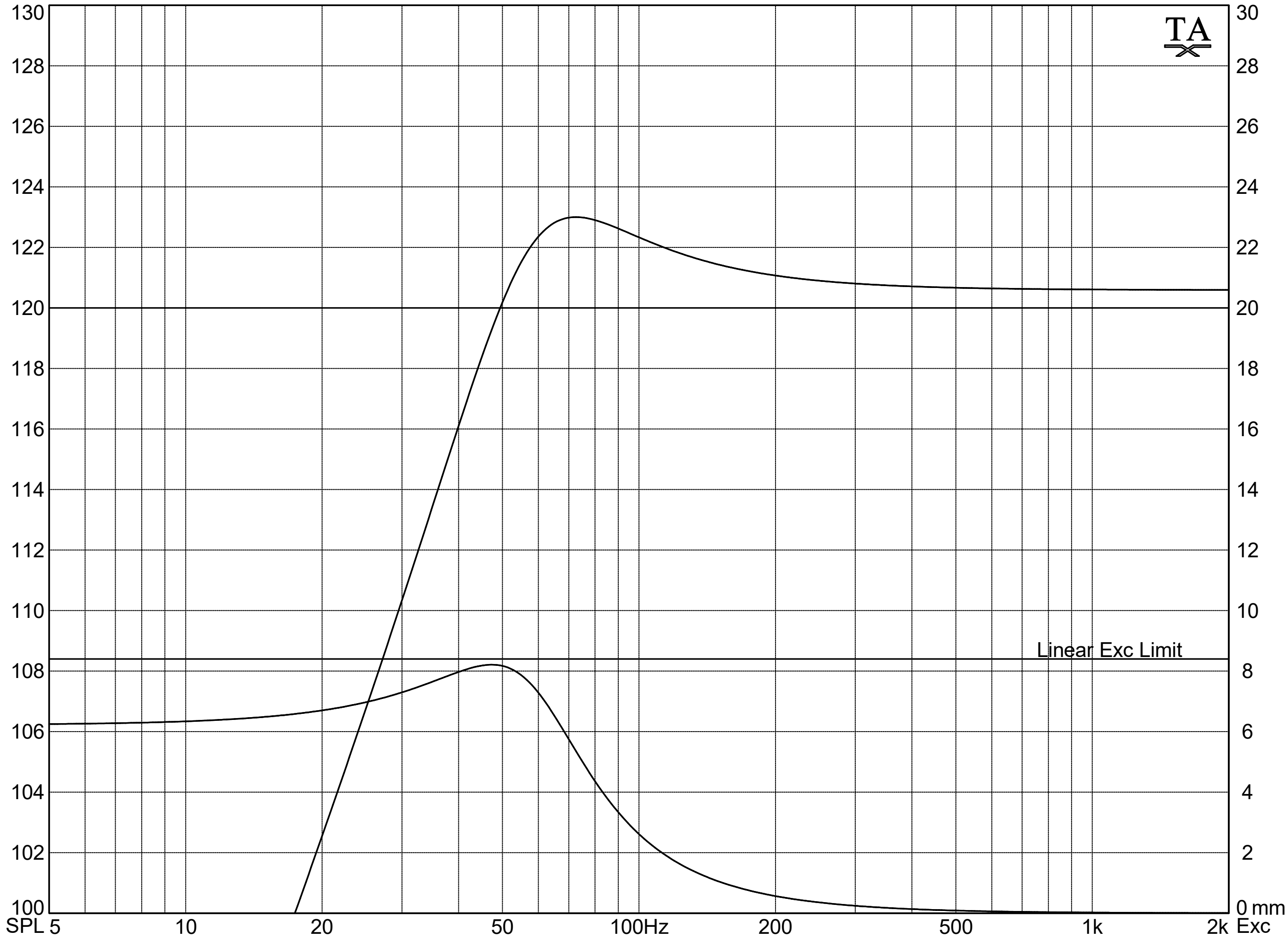
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **Dayton Audio DCS380-4**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	93.6	dB SPL
Free Air Resonance	f(s) =	21.5	Hz
Total Q	Q(ts) =	0.44	
Electrical Q	Q(es) =	0.49	
Mechanical Q	Q(ms) =	3.79	
Equivalent Volume	V(as) =	9.429	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	500	Watts
Max Linear Excursion	X(max) =	8.4	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **2nd Order Closed Box**

Box Volume	V(B) =	1.465	cu ft
Closed Box Q	Q(tc) =	1.2	
System Resonance	F(sc) =	58.64	Hz
Compliance Ratio	alpha =	6.438	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	500	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

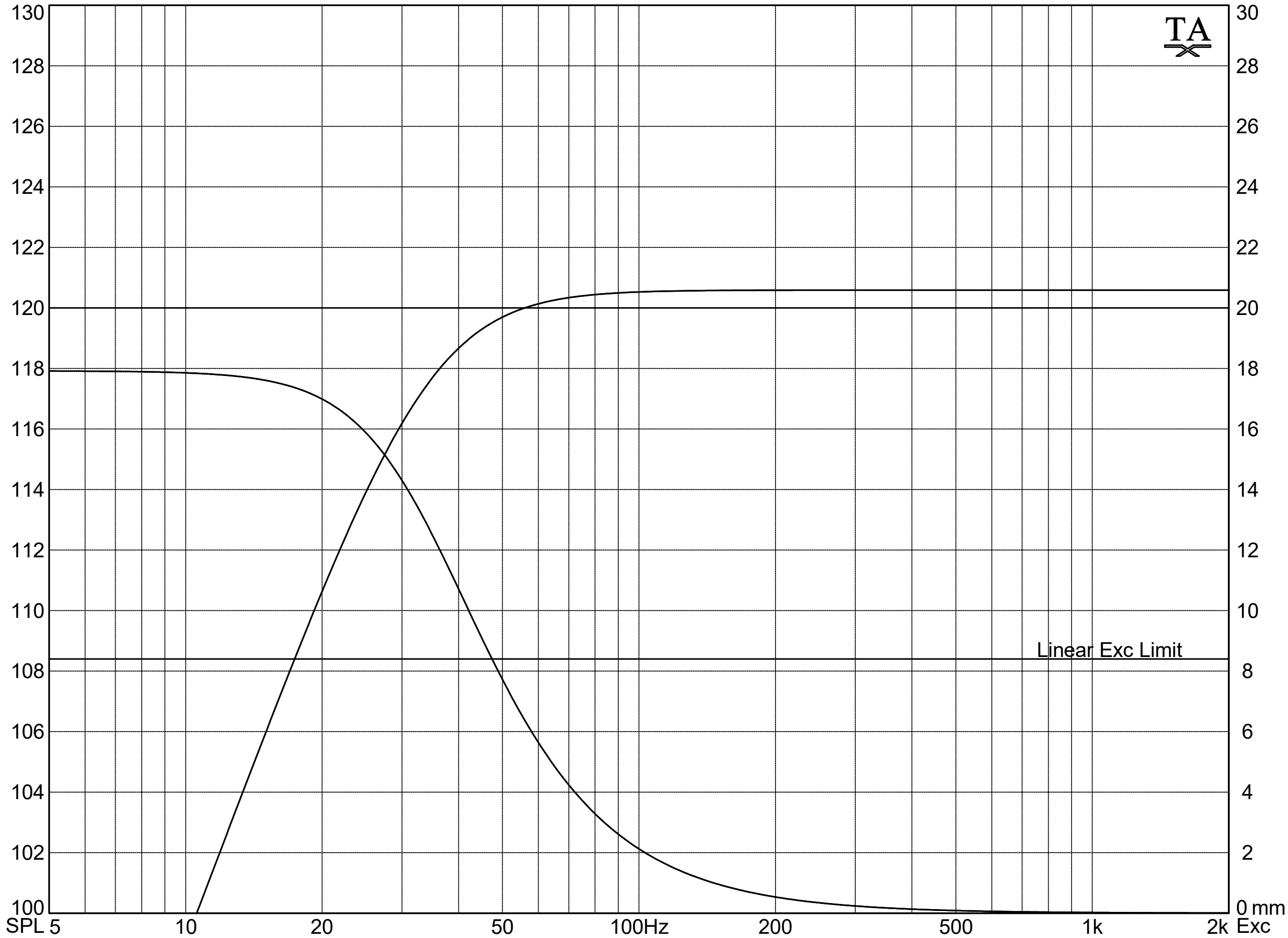
2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **Dayton Audio DCS380-4**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	93.6	dB SPL
Free Air Resonance	f(s) =	21.5	Hz
Total Q	Q(ts) =	0.44	
Electrical Q	Q(es) =	0.49	
Mechanical Q	Q(ms) =	3.79	
Equivalent Volume	V(as) =	9.429	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	500	Watts
Max Linear Excursion	X(max) =	8.4	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **2nd Order Closed Box**

Box Volume	V(B) =	5.961	cu ft
Closed Box Q	Q(tc) =	0.707	
System Resonance	F(sc) =	34.55	Hz
Compliance Ratio	alpha =	1.582	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	500	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

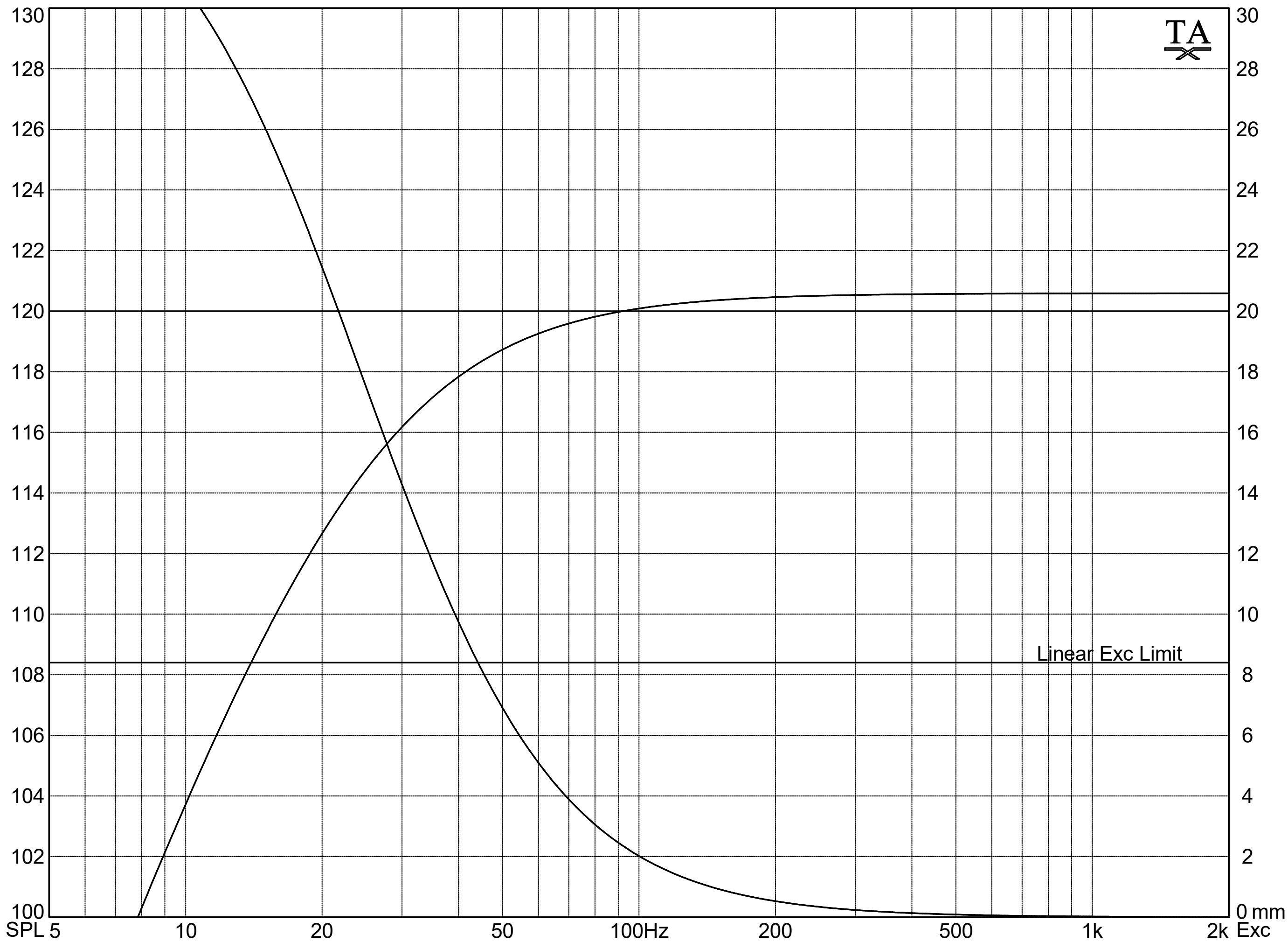
2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **Dayton Audio DCS380-4**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	93.6	dB SPL
Free Air Resonance	f(s) =	21.5	Hz
Total Q	Q(ts) =	0.44	
Electrical Q	Q(es) =	0.49	
Mechanical Q	Q(ms) =	3.79	
Equivalent Volume	V(as) =	9.429	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	500	Watts
Max Linear Excursion	X(max) =	8.4	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **2nd Order Closed Box**

Box Volume	V(B) =	32.37	cu ft
Closed Box Q	Q(tc) =	0.5	
System Resonance	F(sc) =	24.43	Hz
Compliance Ratio	alpha =	0.2913	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	500	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:

Specifications and Modeling of the Peerless FSL-1530R01-08

Driver Specification Sheet

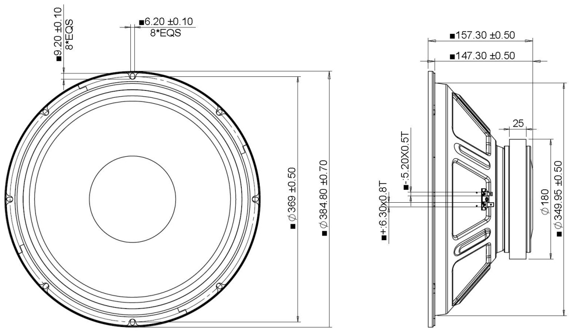
Peerless by TYMPHANY

Model No:	FSL-1530R01-08	Rev:	1
Product Line:	Tymphany	Last Update:	2017-04-21 12:39:42

Product Description

This 15 inch 8 ohm speaker features a FEA optimized ferrite magnet motor, 2.5inch voice coil, cloth surround, paper cone, a vented yoke for motor cooling, and a high strength stamped steel frame. Kevlar loaded non-pressed paper cone to help dampen and control cone resonance. The multi-roll surround and spider have been optimized to reduce distortion over the excursion range of this transducer.

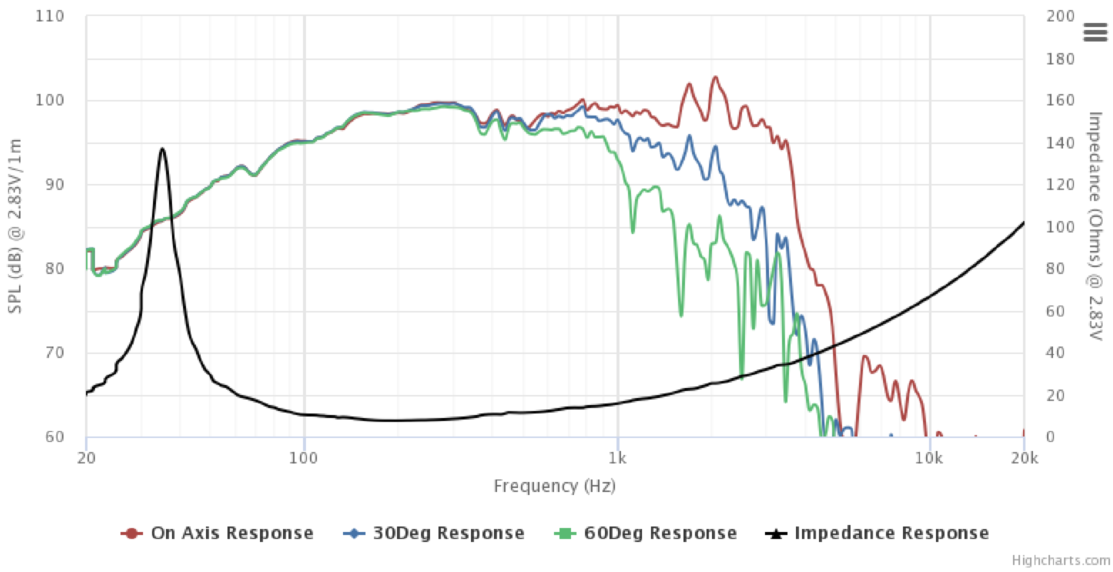
Mechanical Drawing



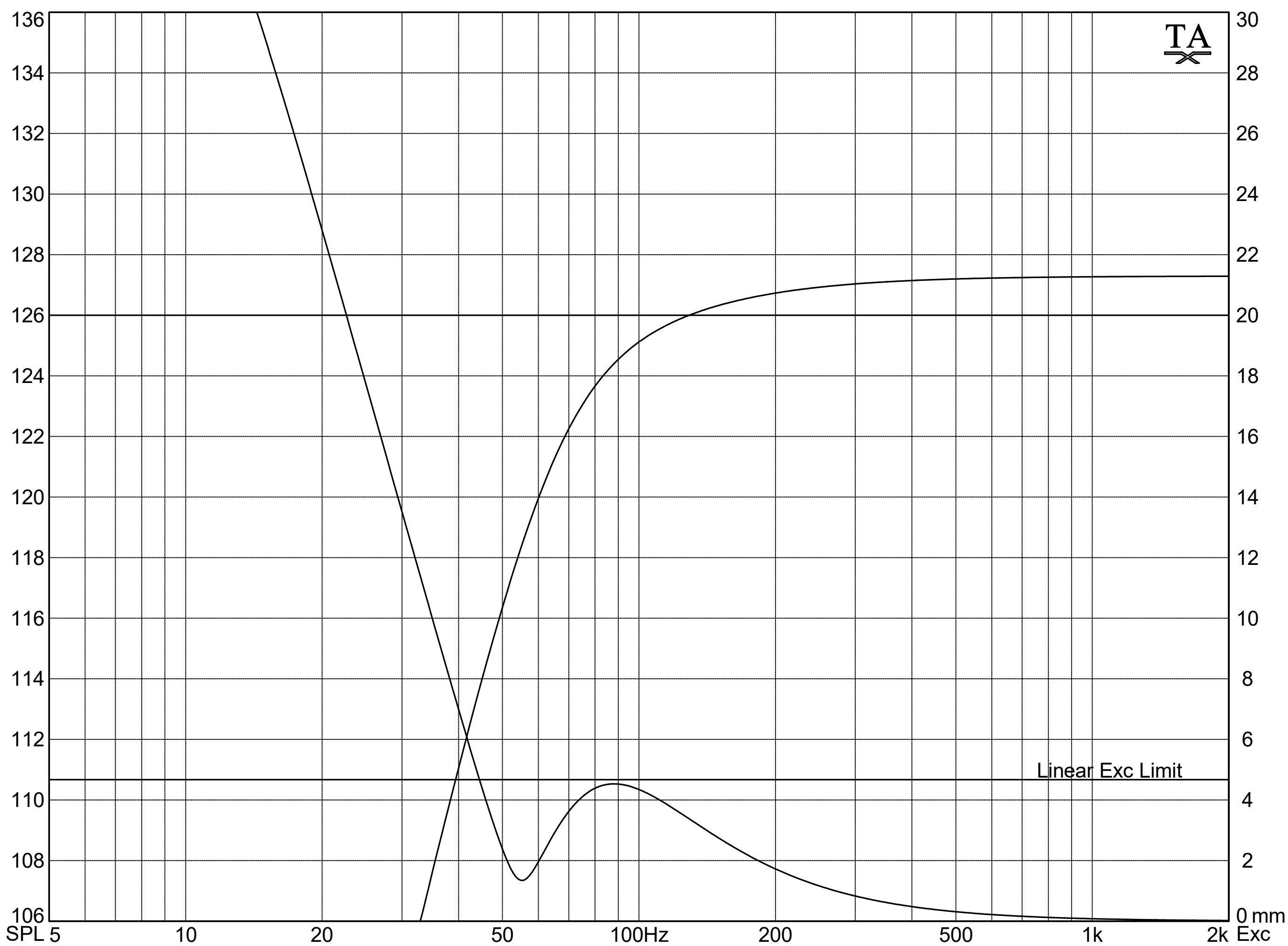
Specifications

DC Resistance	Revc	Ohms	5.23	5.0%	Energy Bandwidth Product	EBP	(1/Qes)*fs	
Minimum Impedance	Zmin	Ohms	7.51	7.5%	Moving Mass	Mms	g	86.9
Voice Coil Inductance	Le	mH	1.16		Suspension Compliance	Cms	um/N	178.3
Resonant Frequency	Fs	Hz	40.43	15%	Effective Cone diameter	D	cm	33.2
Mechanical Q Factor	Qms		5.85		Effective Piston Area	Sd	cm^2	865.7
Electrical Q Factor	Qes	0.25			Effective Volume	Vas	L	187.7
Total Q Factor	Qts		0.24		Motor Force Factor	BL	Tm	21.5
Ratio Fs/Qts	F	Fs/Qts	168.46		Motor Efficiency Factor	ß	(T*M^2)/Ohms	88.3
Half Space Sensitivity @2.83V	db@2.83V/1M	dB	98.4	+/- 1.0db	Voice coil former Material	VCfm		GSV
Half Space Sensitivity @1W/1M	db@1W/1M	dB	98.1	+/- 1.0db	Voice coil inner diameter	VCd	mm	75.75
Gap Height	Gh	mm	8		Rated Noise Power	P	W	450
Maximum Linear Excursion	Xmax	mm	2.2		Test Spectrum Bandwidth	40Hz-400Hz		
Ferrofluid Type	FF				Driver Size	Inch	15 in	
Driver Mass	Kg	6.3						

Frequency and Impedance Response



Tymphany HK LTD
Address : Room 1307-8 Dominion Centre, 43-59 Queens Rd East, Wanchai, Hong Kong
E-mail: sales@tymphany.com



Driver Parameters

Driver: **Peerless FSL-1530R01-08**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	98	dB SPL
Free Air Resonance	f(s) =	41	Hz
Total Q	Q(ts) =	0.24	
Electrical Q	Q(es) =	0.252	
Mechanical Q	Q(ms) =	4.98	
Equivalent Volume	V(as) =	6.357	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	350	Watts
Max Linear Excursion	X(max) =	4.67	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	1.5	cu ft
Closed Box Q	Q(tc) =	0.5493	
Box Frequency	F(B) =	55	Hz
Min Rec Vent Area	S(vMin) =	27.6	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	4.238	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	850	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

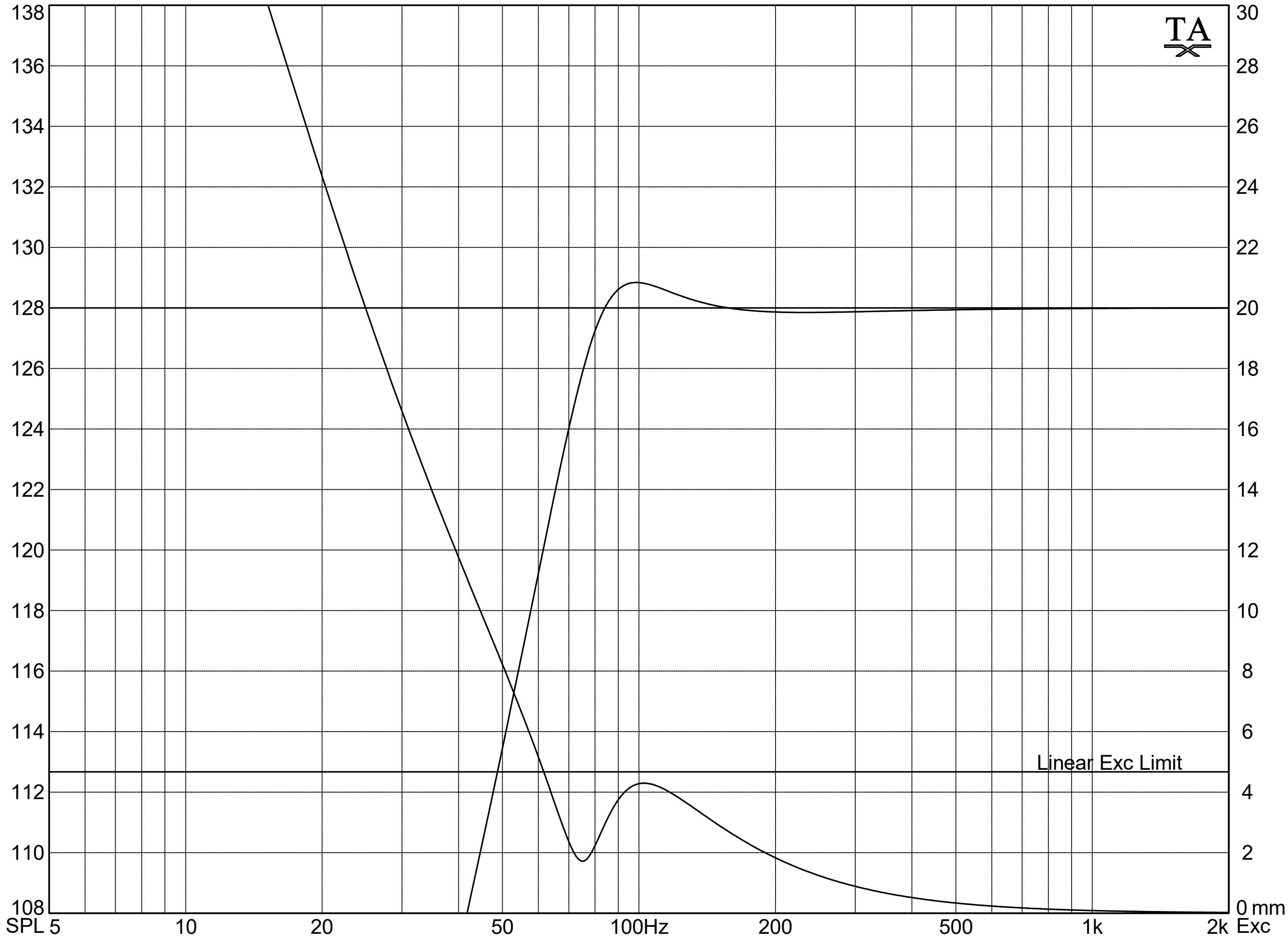
System Name:

4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date: Rev:



Driver Parameters

Driver: **Peerless FSL-1530R01-08**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	98	dB SPL
Free Air Resonance	f(s) =	41	Hz
Total Q	Q(ts) =	0.24	
Electrical Q	Q(es) =	0.252	
Mechanical Q	Q(ms) =	4.98	
Equivalent Volume	V(as) =	6.357	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	350	Watts
Max Linear Excursion	X(max) =	4.67	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	2	cu ft
Closed Box Q	Q(tc) =	0.4906	
Box Frequency	F(B) =	75	Hz
Min Rec Vent Area	S(vMin) =	37.6	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	3.178	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	1000	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

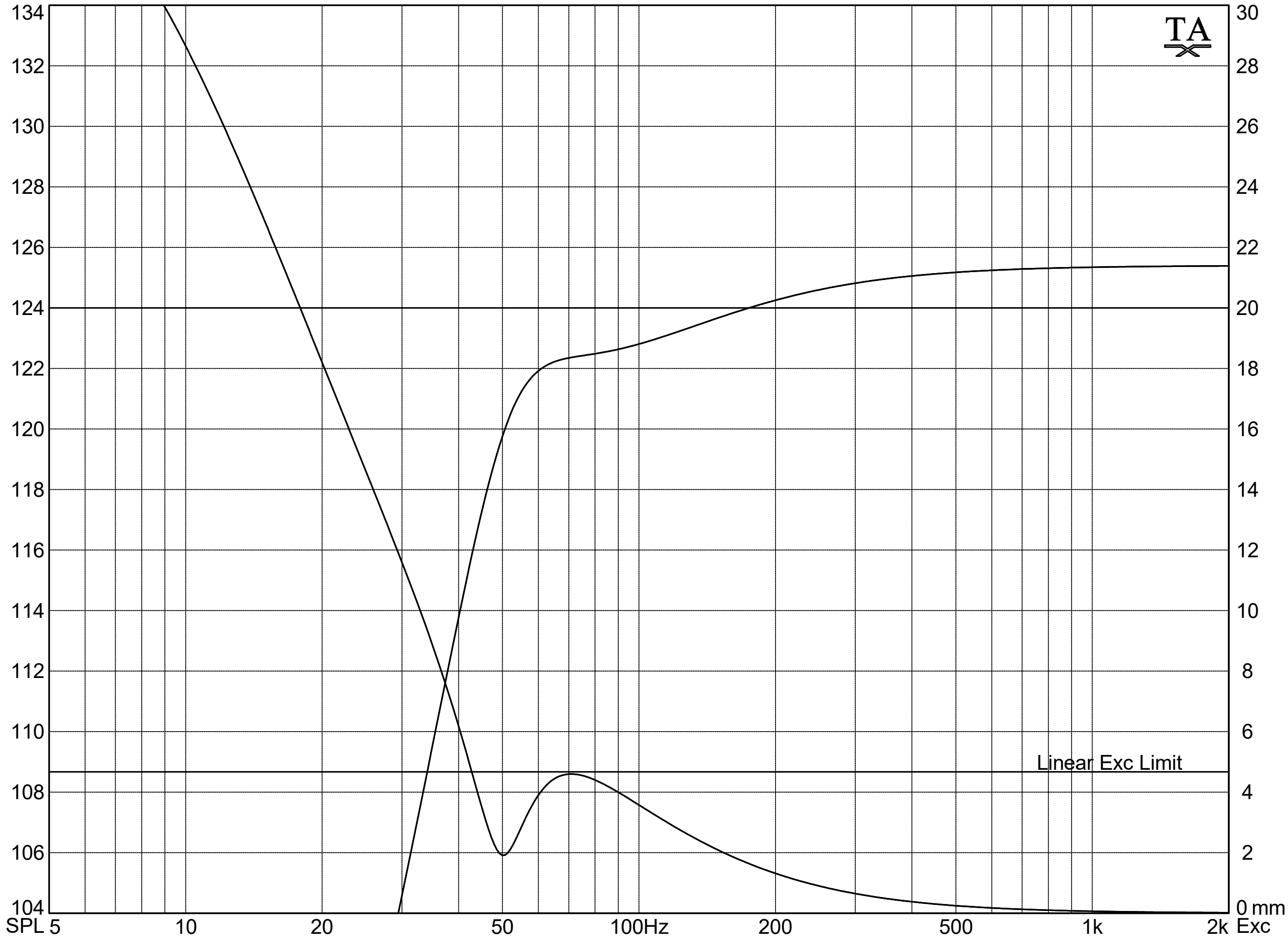
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **Peerless FSL-1530R01-08**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	98	dB SPL
Free Air Resonance	f(s) =	41	Hz
Total Q	Q(ts) =	0.24	
Electrical Q	Q(es) =	0.252	
Mechanical Q	Q(ms) =	4.98	
Equivalent Volume	V(as) =	6.357	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	350	Watts
Max Linear Excursion	X(max) =	4.67	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	3	cu ft
Closed Box Q	Q(tc) =	0.4238	
Box Frequency	F(B) =	50	Hz
Min Rec Vent Area	S(vMin) =	25.1	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	2.119	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	550	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

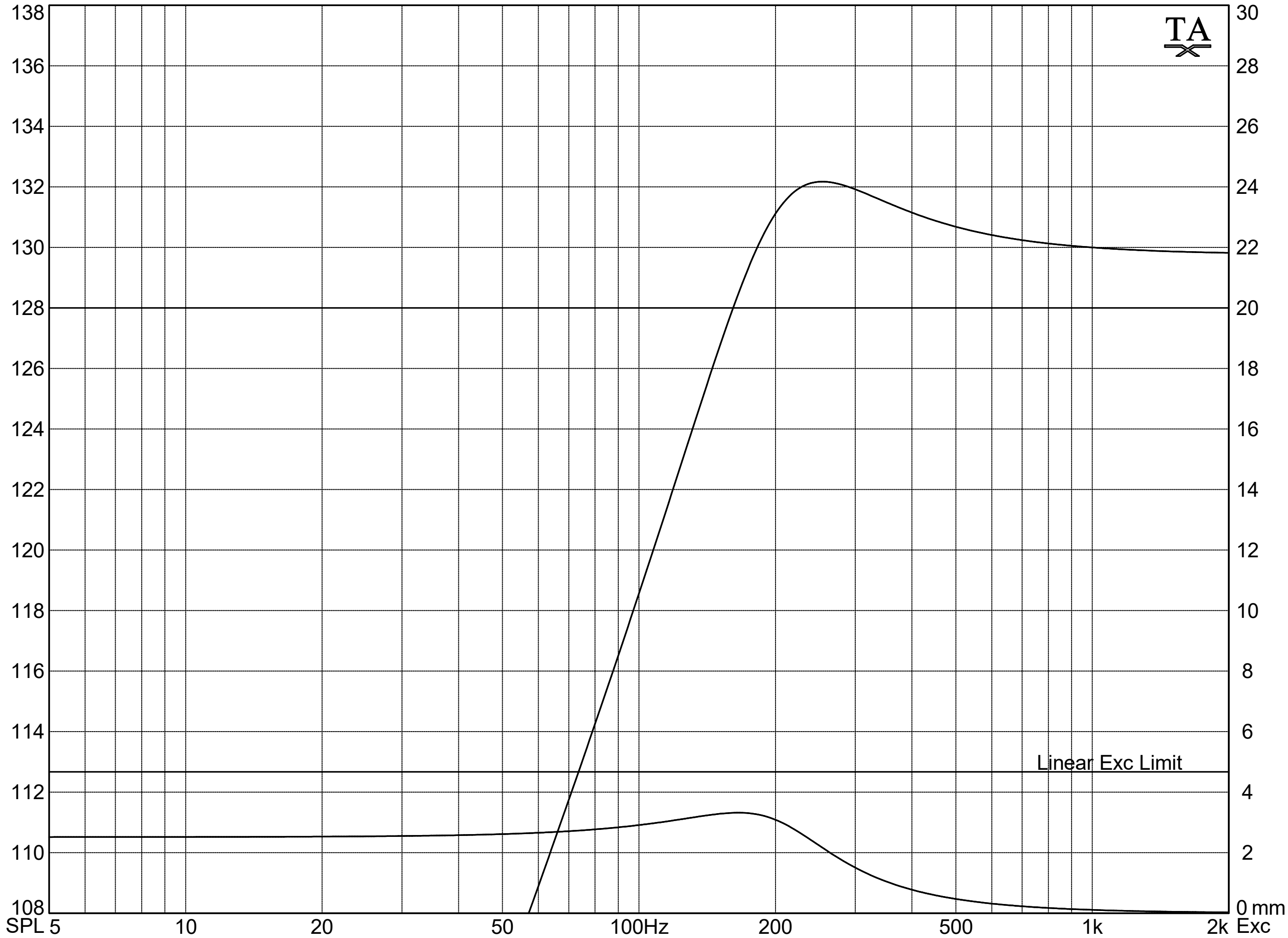
System Name:

4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date: Rev:



Driver Parameters

Driver: Peerless FSL-1530R01-08

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	98	dB SPL
Free Air Resonance	f(s) =	41	Hz
Total Q	Q(ts) =	0.24	
Electrical Q	Q(es) =	0.252	
Mechanical Q	Q(ms) =	4.98	
Equivalent Volume	V(as) =	6.357	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	350	Watts
Max Linear Excursion	X(max) =	4.67	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 2nd Order Closed Box

Box Volume	V(B) =	0.2649	cu ft
Closed Box Q	Q(tc) =	1.2	
System Resonance	F(sc) =	205	Hz
Compliance Ratio	alpha =	24	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	1500	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

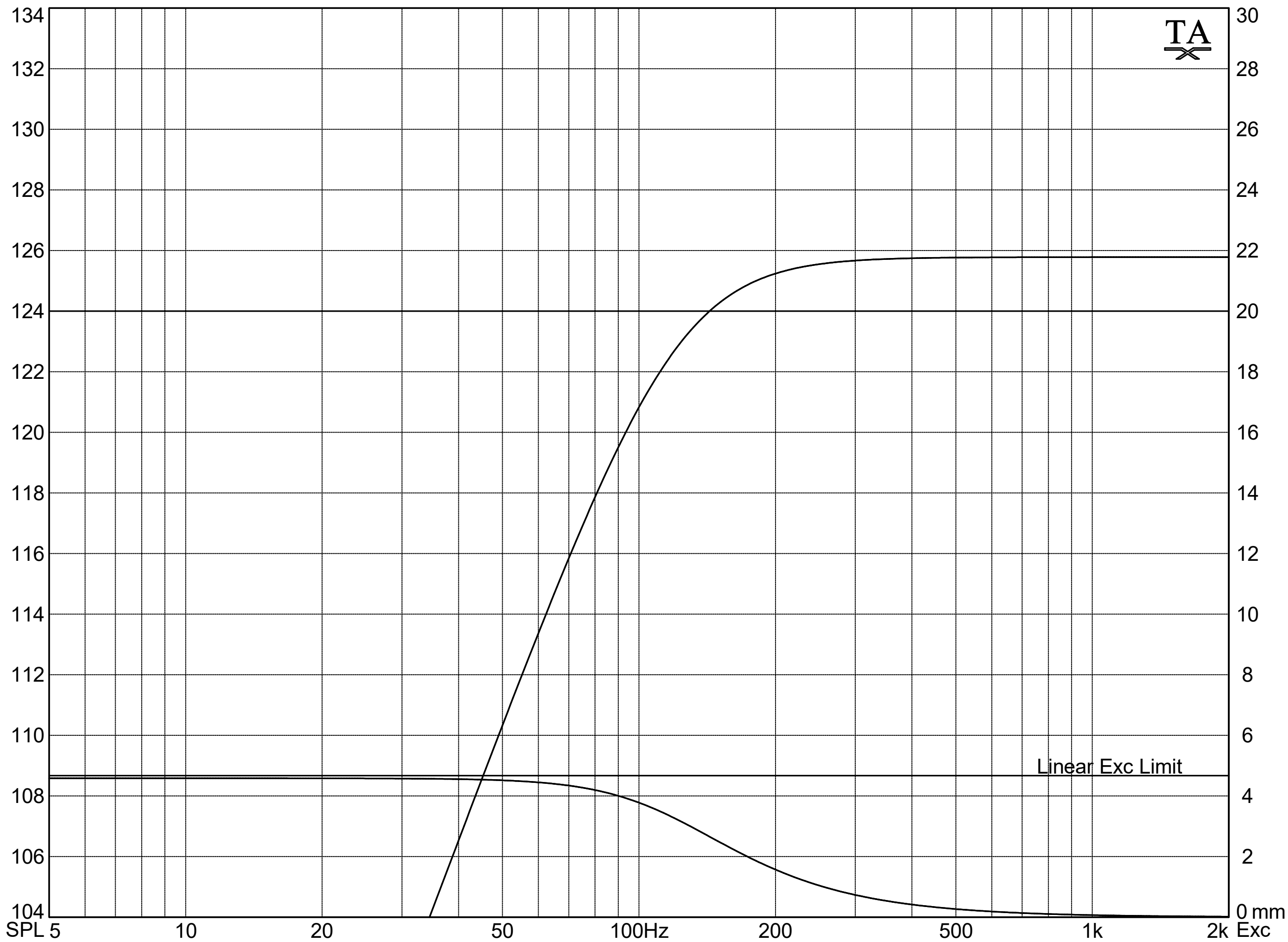
2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **Peerless FSL-1530R01-08**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	98	dB SPL
Free Air Resonance	f(s) =	41	Hz
Total Q	Q(ts) =	0.24	
Electrical Q	Q(es) =	0.252	
Mechanical Q	Q(ms) =	4.98	
Equivalent Volume	V(as) =	6.357	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	350	Watts
Max Linear Excursion	X(max) =	4.67	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **2nd Order Closed Box**

Box Volume	V(B) =	0.8279	cu ft
Closed Box Q	Q(tc) =	0.707	
System Resonance	F(sc) =	120.8	Hz
Compliance Ratio	alpha =	7.679	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	600	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

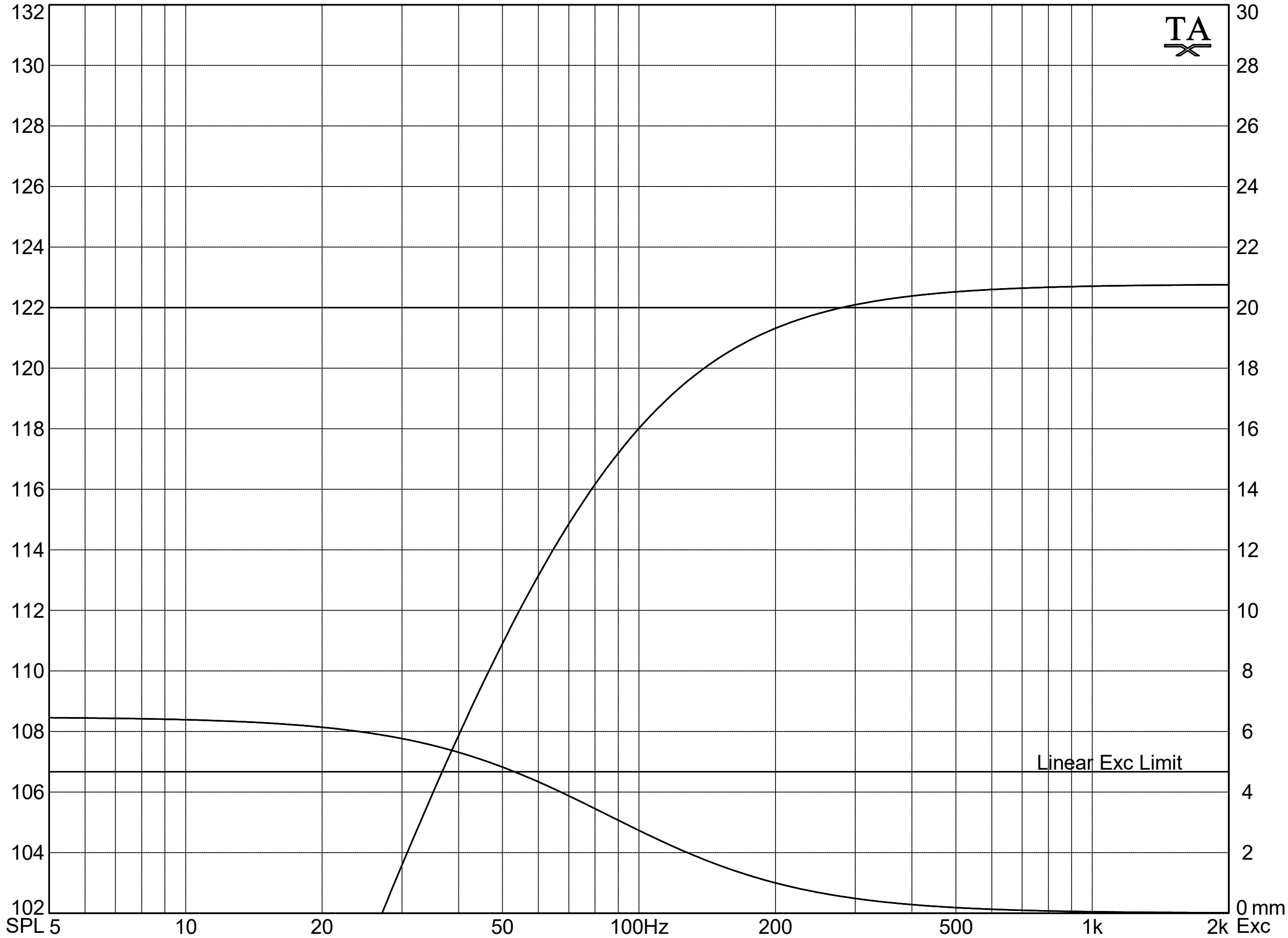
2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **Peerless FSL-1530R01-08**

Nominal Diameter	D =	15	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	98	dB SPL
Free Air Resonance	f(s) =	41	Hz
Total Q	Q(ts) =	0.24	
Electrical Q	Q(es) =	0.252	
Mechanical Q	Q(ms) =	4.98	
Equivalent Volume	V(as) =	6.357	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	350	Watts
Max Linear Excursion	X(max) =	4.67	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **2nd Order Closed Box**

Box Volume	V(B) =	1.903	cu ft
Closed Box Q	Q(tc) =	0.5	
System Resonance	F(sc) =	85.42	Hz
Compliance Ratio	alpha =	3.34	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	300	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date: Rev:

10.2 Appendix C

Midwoofer Report

	Nominal Size	Cone	Price	Sensitivity	Power	Thermal SPL Limit	Mechanical SPL Limit	X-max	Sd cm2	Vas (liters)	Qts	Fs	Vb (liters)	Vb (cu feet)	Vd	F3	X-max SPL
Dayton Audio RS150-4	6"	Aluminum	$49.98	91.8	40	107.8		4.4	85	16.4	0.33	45.1	8.45	0.30	0.0000	60.4	113.1
Dayton Audio RS125-4	5"	Aluminum	$44.98	89.9	30	104.7		4	52.8	5.29	0.37	57.2	3.98	0.14	0.0000	64.9	112.8
Dayton Audio RS150P-4A	6"	Paper	$52.98	90.3	40	106.3		4.4	85	15.7	0.34	43.7	8.93	0.32	0.0000	56.0	113.0
SB Acoustics SB17MFC35-4	6"	Polypropylene	$70.60	90	60	107.8		11	118	45	0.28	30	13.49	0.48	0.0001	51.0	113.5
SB Acoustics SB17NBAC35-4	6"	Aluminum	$84.80	90	60	107.8		11	118	42.6	0.29	30	14.33	0.51	0.0001	48.4	113.4
SB Audience ROSSO-6MW150D	6"	Paper	$65.00	94	150	115.8		5.24	145.3	8.8	0.32	66	4.10	0.14	0.0001	92.4	114.4
SB Audience BIANCO-8MW125	8"	Paper	$50.70	97	125	118.0		6.42	224.3	10.1	0.55	89	28.09	0.99	0.0001	56.7	114.0
SEAS H1217-08 CA18RLY	6.5"	Paper	$109.80	90	80	109.0		10	136	32	0.47	42	52.98	1.87	0.0001	33.6	112.9

Specification Sheets for MidWoofers Not Modeled

SB Acoustics SB17MFC35-4 6”

Dayton Audio RS125-4 5" Reference Woofer 4 Ohm

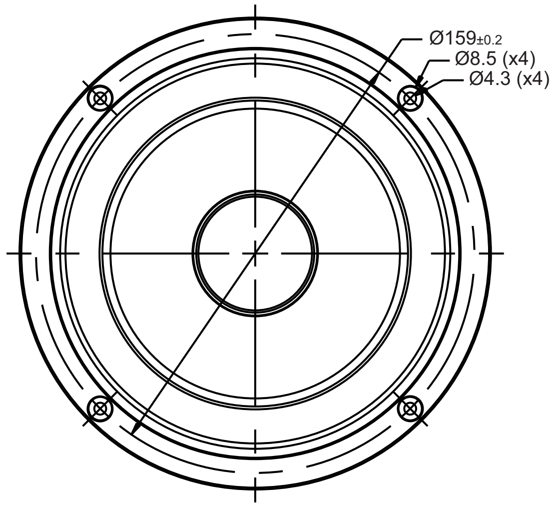
Dayton Audio RS150-4 6" Reference Woofer 4 Ohm

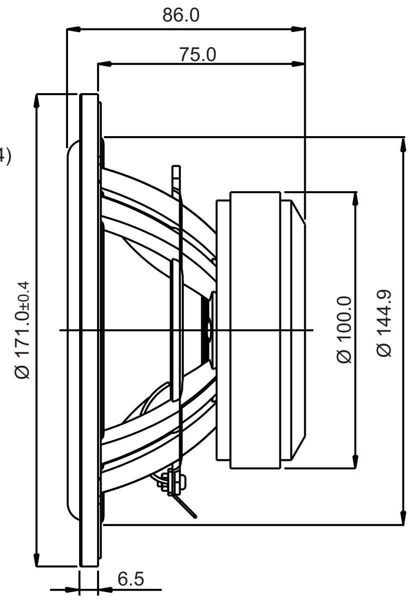
SB Audience BIANCO-8MW125 8” Midwoofer

Seas Prestige CA18RLY H1217 6.5”

SB ACOUSTICS

6” SB17MFC35-4





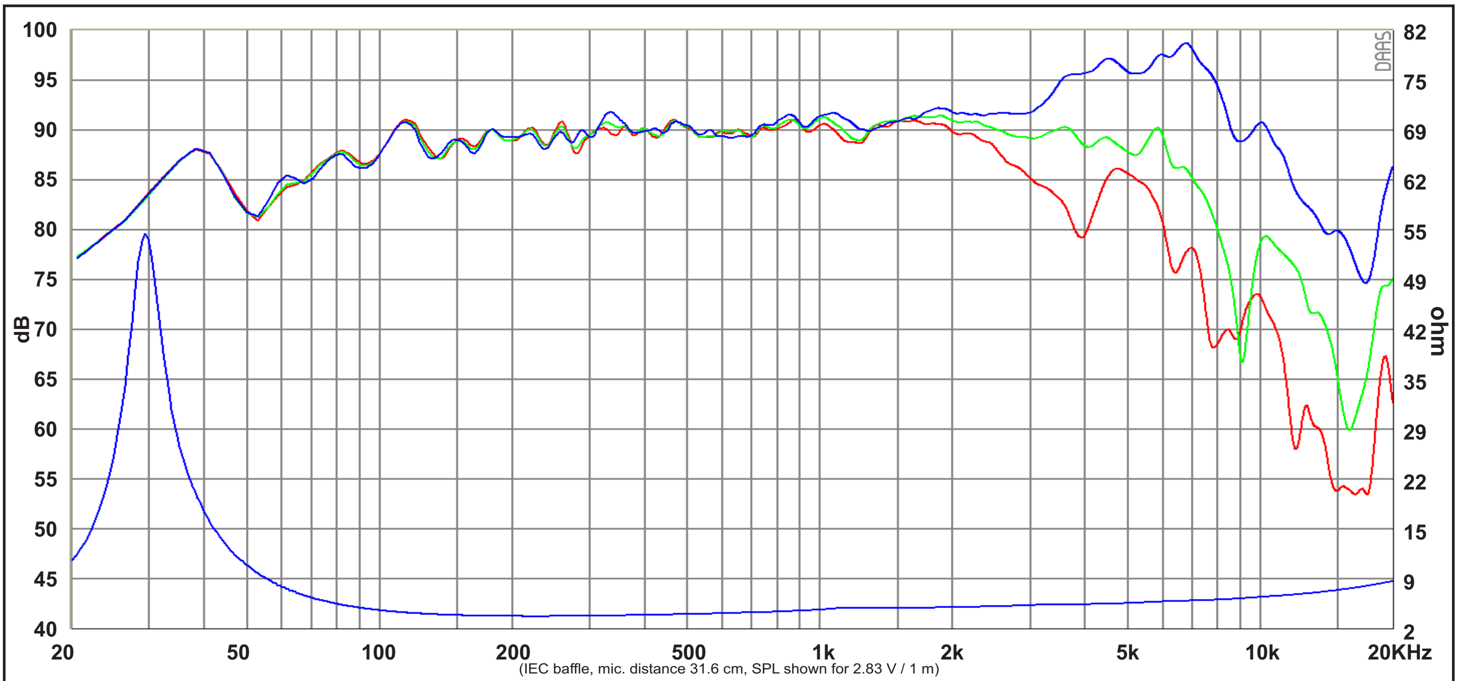
FEATURES

- Vented cast aluminium chassis for optimum strength and low compression
- Mineral filled PP-cone made in-house
- Soft low damping rubber surround for improved transient response
- Non-conducting fibre 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	4 Ω	Free air resonance, Fs	30 Hz
DC resistance, Re	3.1 Ω	Sensitivity (2.83 V / 1 m)	90 dB
Voice coil inductance, Le	0.13 mH	Mechanical Q-factor, Qms	5.2
Effective piston area, Sd	118 cm²	Electrical Q-factor, Qes	0.30
Voice coil diameter	35.5 mm	Total Q-factor, Qts	0.28
Voice coil height	16 mm	Moving mass incl.air, Mms	12.3 g
Air gap height	5 mm	Force factor, Bl	4.9 Tm
Linear coil travel (p-p)	11 mm	Equivalent volume, Vas	45 liters
Magnetic flux density	1.0 T	Compliance, Cms	2.29 mm/N
Magnet weight	0.54 kg	Mechanical loss, Rms	0.45 kg/s
Net weight	1.55 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)

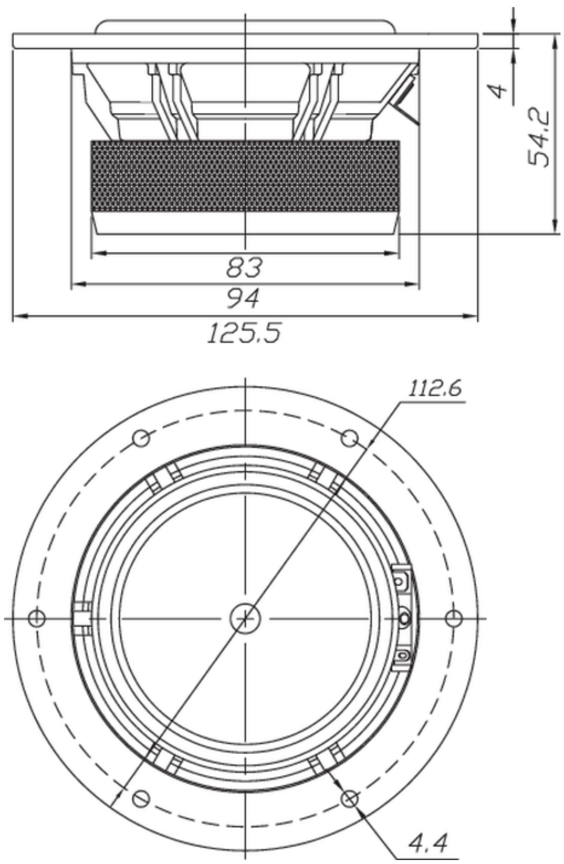
Response Curve :

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

REV.1 (16.02.2016)

RS125-4 5" Reference Woofer 4 Ohm

RS125-4



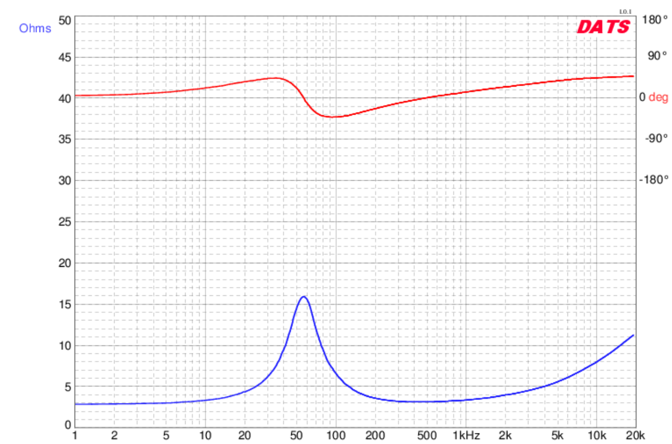
PARAMETERS

Impedance	4 ohms
Re	2.9 ohms
Le	0.28 mH @ 1 kHz
Fs	57.2 Hz
Qms	2.04
Qes	0.45
Qts	0.37
Mms	5.7g
Cms	1.35 mm/N
Sd	52.8 cm²
Vd	21.1 cm³
BL	3.63 Tm
Vas	5.29 liters
Xmax	4.0 mm
VC Diameter	25 mm
SPL	89.9 dB @ 2.83V/1m
RMS Power Handling	30 watts
Usable Frequency Range (Hz)	65 - 5,400 Hz

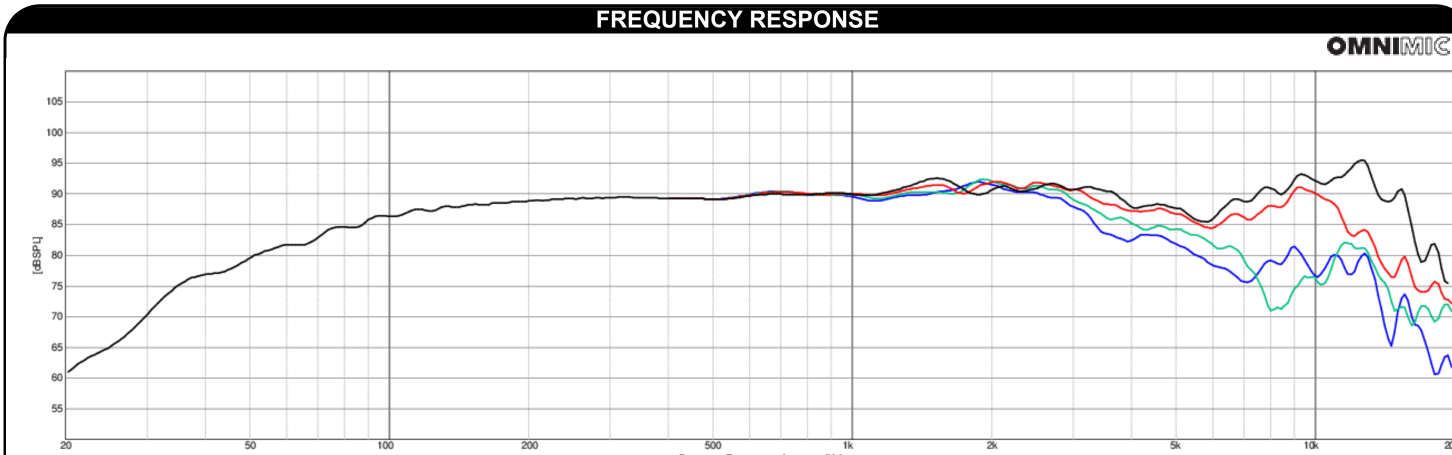
FEATURES

- 4 ohm impedance is perfect for series pairs in MTMs and center channel speakers
- Excellent car audio midrange/midbass
- High-end low-distortion motor with two shorting paths to reduce inductance

IMPEDANCE/PHASE



FREQUENCY RESPONSE

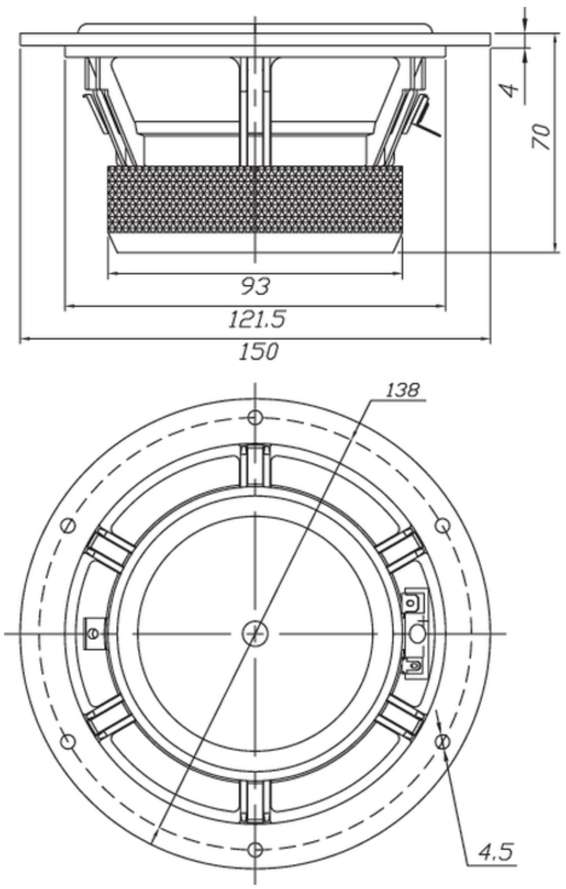


Note: 1/24th octave smoothing - nearfield response included in graph below 450 Hz.

Black = 0°
Red = 15°
Green = 30°
Blue = 45°

RS150-4 6" Reference Woofer 4 Ohm

RS150-4



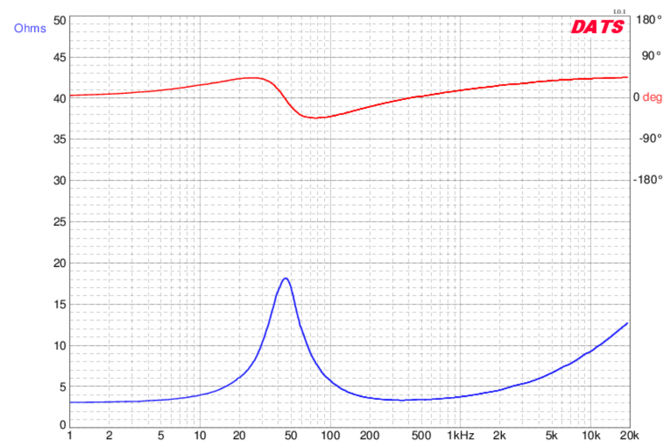
PARAMETERS

Impedance	4 ohms
Re	3.1 ohms
Le	0.34 mH @ 1 kHz
Fs	45.1 Hz
Qms	1.96
Qes	0.40
Qts	0.33
Mms	7.7g
Cms	1.62 mm/N
Sd	85 cm²
Vd	37.4 cm³
BL	4.1 Tm
Vas	16.4 liters
Xmax	4.4 mm
VC Diameter	25 mm
SPL	91.8 dB @ 2.83V/1m
RMS Power Handling	40 watts
Usable Frequency Range (Hz)	48 - 4,000 Hz

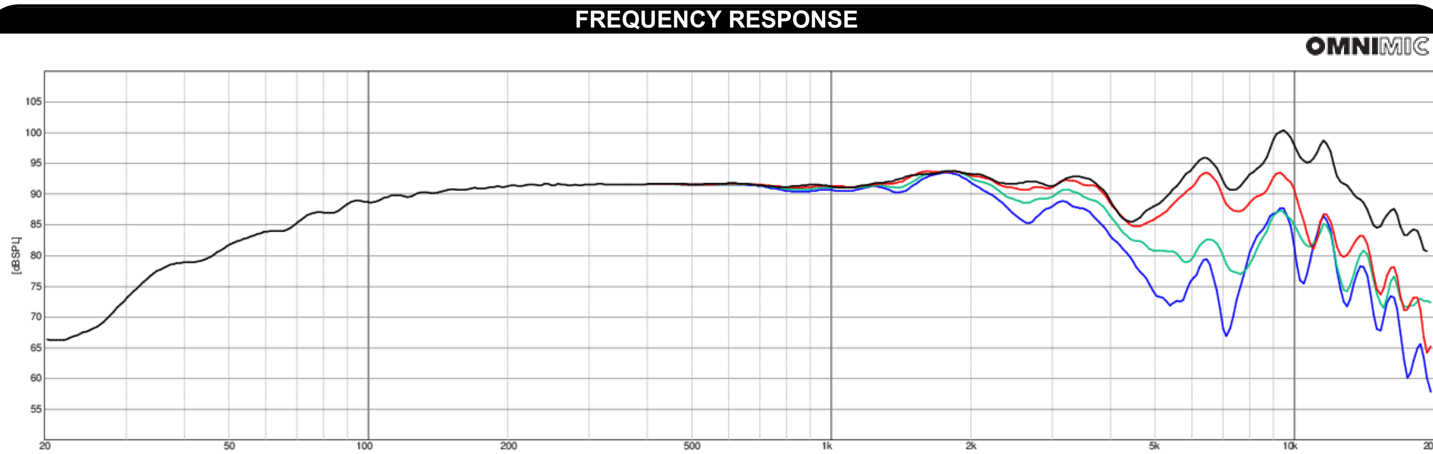
FEATURES

- Great replacement for the Dayton RS150S-8 6" Reference Shielded Woofer 8 Ohm
- 4 ohm impedance is perfect for series pairs in MTMs and center channel speakers
- Excellent car audio midrange/midbass
- High-end low-distortion motor with two shorting paths to reduce inductance

IMPEDANCE/PHASE



FREQUENCY RESPONSE



Note: 1/24th octave smoothing - nearfield response included in graph below 450 Hz.

Black = 0°
Red = 15°
Green = 30°
Blue = 45°

BIANCO-8MW125

8" - Midwoofer - 250W - 97dB

SB AUDIENCE

- Proprietary cone paper material made in-house
- 2" voice coil with APC (Advanced Polymer Coating)
- Vented pole piece for reduced compression
- CCAW voice coil wire for reduced moving mass
- Minimum damping fiber glass voice coil former
- Long life silver lead wires

Dimensions & Weight

Overall Diameter	205.6 mm (8.09 in)
Bolt Circle Diameter	195.0 mm (7.68 in)
Baffle Cutout Diameter	179.6 mm (7.07 in)
Mounting Depth	99 mm (3.89 in)
Flange and Gasket Thickness	9.15 mm (0.36 in)
Net Weight	3.47 Kg (7.65 lb)
Shipping Box	233 x 233 x 140 mm (9.17 x 9.17 x 5.51 in)
Gross Weight	3.92 Kg (8.64 lb)

Recone Kit

N/A

NOTES :

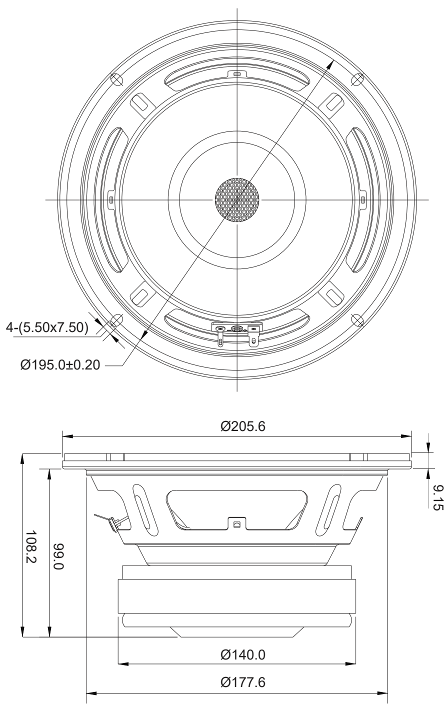
(1) AES standard, test mode with continuous pink noise signal (6 dB crest factor; 2 hours) within the Fo to 10Fo power calculated on rated nominal impedance. Loudspeaker in free air
(2) Maximum power is defined as 3dB greater than nominal power.
(3) Xmax= ((Winding depth - magnetic gap depth)/2) +(magnetic gap depth/3)
(4) Maximum excursion (p-p) before permanent damage
(5) T/S parameters measured on drive units that are broken in using Klippel LPM Measurement System.

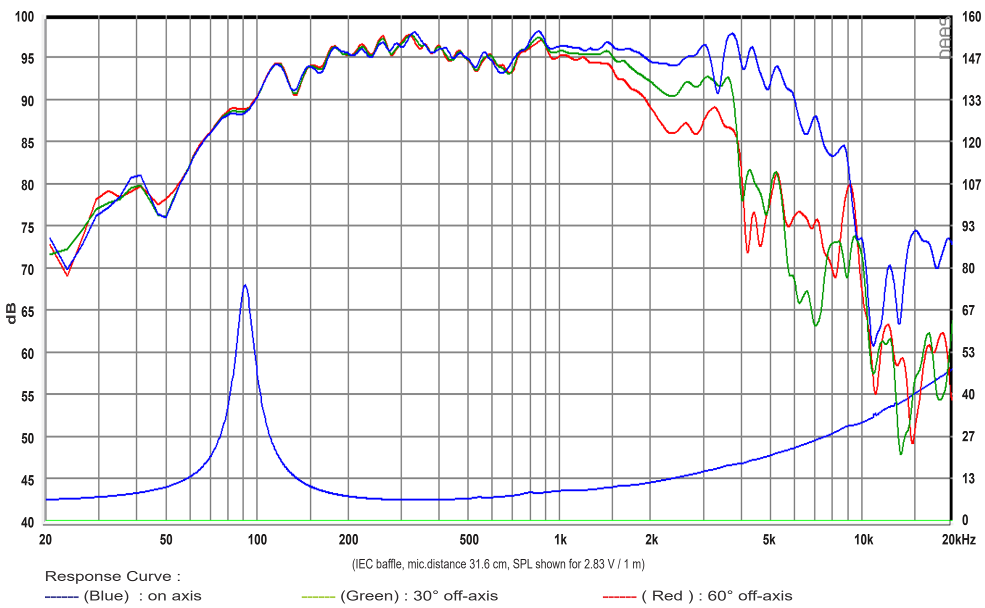
Specs :

Nominal Impedance	8 Ohm
Minimum Impedance	5.6 Ohm
AES Power Handling (1)	125 W
Maximum Power Handling (2)	250 W
Sensitivity (1W/1m)	97 dB
Frequency Range	89 - 7400 Hz
Voice Coil Diameter	49.5 mm (2 in)
Winding Material	Copper clad aluminium
Former Material	Till
Winding Depth	15.5 mm
Magnetic Gap Depth	8 mm (0.31 in)
Flux Density	1.23 T
Magnet	Ferrite
Basket Material	Stamped steel
Demodulation	-
Cone Surround	Double half roll with damping glue
NET Air Volume filled by driver	1.54 liters
Spider Profile	Single constant height waves
Weather Resistant	Yes

Thiele Small Parameters

Fs	89 Hz
Re	5.8 Ohm
Qes	0.57
Qms	14.63
Qts	0.55
Vas	10.1 liters
Sd	224.3 cm²
Xmax (3)	6.42 mm
Xdamage (4)	16 mm
Mms	22.8 g
Bl	11.3 Tm
Le	0.5 mH
Cms	0.14 mm/N
Rms	0.87 Kg/s
Eta Zero	1.19 %
EBP	156





R.4 / 28.04.2023

SEAS PRESTIGE

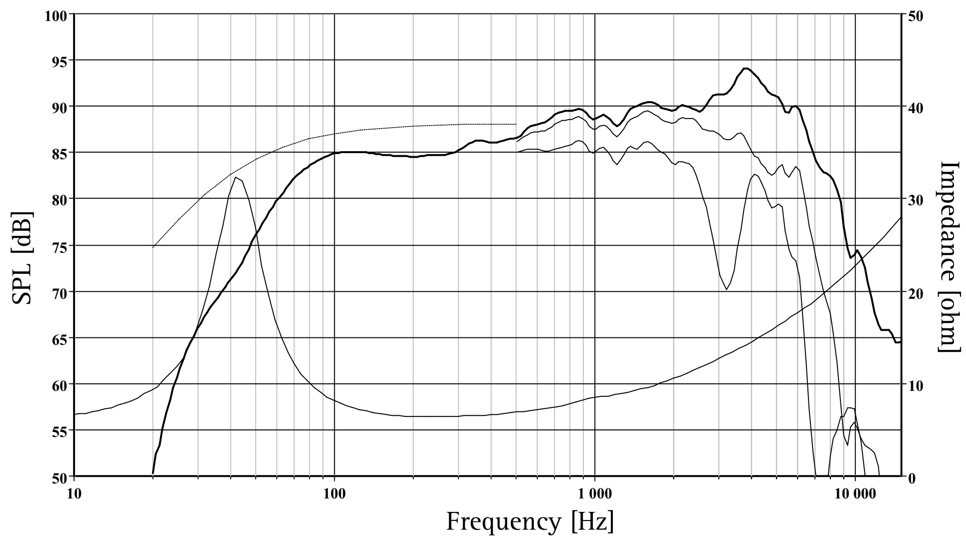
CA18RLY
H1217

6,5” High Fidelity cone driver, developed for use as a high quality woofer or woofer/midrange unit.

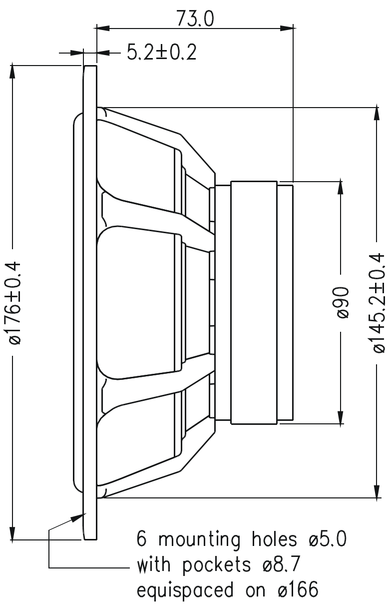
Classical coated paper cone gives a smooth extended frequency response with a controlled roll off.

High temperature, light weight, CCAW voice coil wound on an aluminium voice coil former gives a high power handling capacity. The extremely stiff and stable injection moulded metal basket, keeps the critical components in perfect alignment.

Large windows in the basket both above and below the spider reduce sound reflection, air flow noise and cavity resonance to a minimum. The large magnet system provides high efficiency and low Q.



The frequency responses above show measured free field sound pressure in 0, 30, and 60 degrees angle using a 12L closed box. Input 2.83 VRMS, microphone distance 0.5m, normalized to SPL 1m.The dotted line is a calculated response in infinite baffle based on the parameters given for this specific driver. The impedance is measured in free air without baffle using a 2V sine signal.



Nominal Impedance	8 Ohms	Voice Coil Resistance	5.8 Ohms
Recommended Frequency Range	35 - 3000 Hz	Voice Coil Inductance	1.05 mH
Short Term Power Handling *	250 W	Force Factor	5.6 N/A
Long Term Power Handling *	80 W	Free Air Resonance	42 Hz
Characteristic Sensitivity (2,83V, 1m)	90.0 dB	Moving Mass	10.6 g
Voice Coil Diameter	26 mm	Air Load Mass In IEC Baffle	0.92 g
Voice Coil Height	16 mm	Suspension Compliance	1.4 mm/N
Air Gap Height	6 mm	Suspension Mechanical Resistance	1.04 Ns/m
Linear Coil Travel (p-p)	10 mm	Effective Piston Area	136 cm²
Maximum Coil Travel (p-p)	20 mm	VAS	32 Litres
Magnetic Gap Flux Density	1.1 T	QMS	2.92
Magnet Weight	0.42 kg	QES	0.56
Total Weight	1.41 kg	QTS	0.47

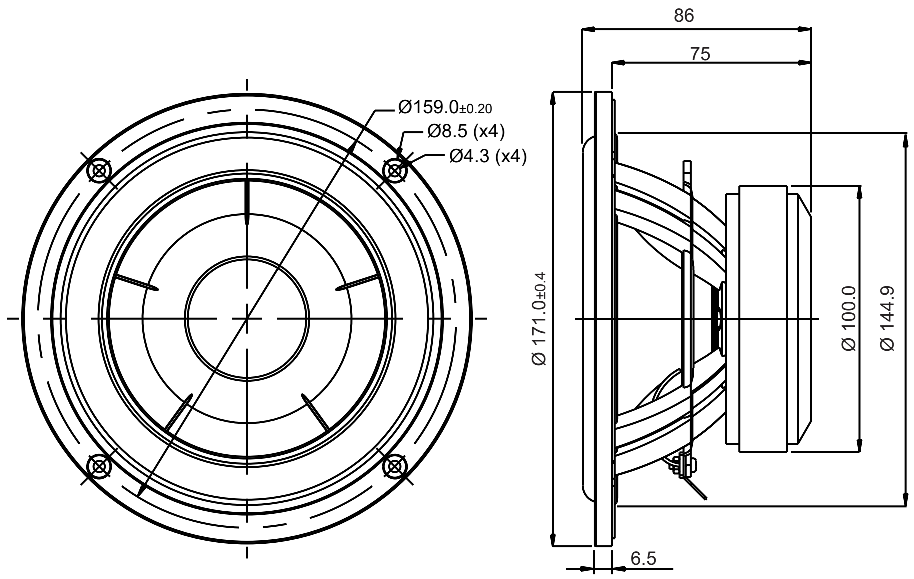
Jul 2007-1 *IEC 268-5 W18-101

SEAS reserves the right to change technical data

RoHS compliant product

Specifications and Modeling of the SB Acoustics SB17MFC35-4

6" SB17NBAC35-4



FEATURES

- Vented cast aluminum chassis for optimum strength and low compression
- Geometrically reinforced aluminum cone for optimum piston operation and reduced break-up.
- Soft low damping rubber surround for improved transient response
- Non-conducting fibre 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	4 Ω	Free air resonance, Fs	30 Hz
DC resistance, Re	3.1 Ω	Sensitivity (2.83 V / 1 m)	90 dB
Voice coil inductance, Le	0.13 mH	Mechanical Q-factor, Qms	4.3
Effective piston area, Sd	118 cm2	Electrical Q-factor, Qes	0.31
Voice coil diameter	35.5 mm	Total Q-factor, Qts	0.29
Voice coil height	16 mm	Moving mass incl.air, Mms	12.4 g
Air gap height	5 mm	Force factor, Bl	4.9 Tm
Linear coil travel (p-p)	11 mm	Equivalent volume, Vas	42.6 liters
Magnetic flux density	1.0 T	Compliance, Cms	2.16 mm/N
Magnet weight	0.54 kg	Mechanical loss, Rms	0.6 kg/s
Net weight	1.56 kg	Rated power handling*	60 W

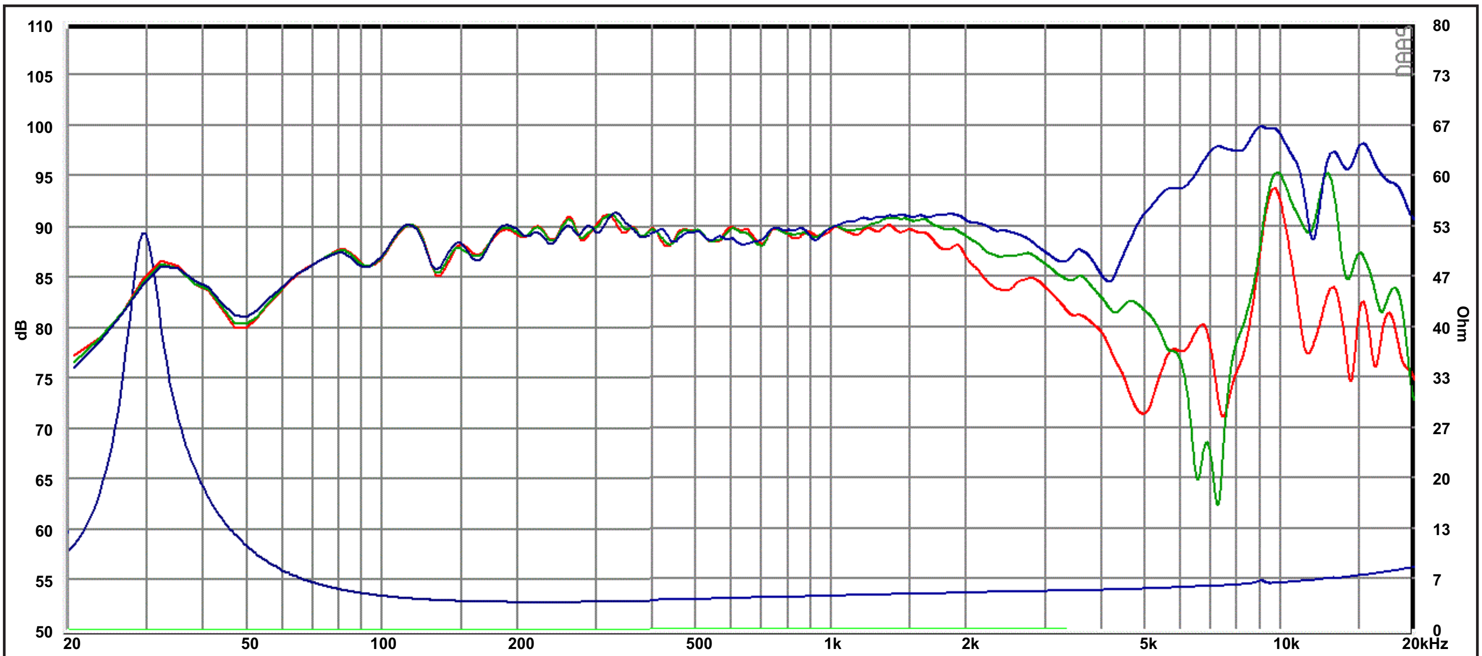
* IEC 268-5, T/S parameters measured on drive units that are broken in.

Box recommendations :

Sealed box : -
Vented box : -

Conditions:

-

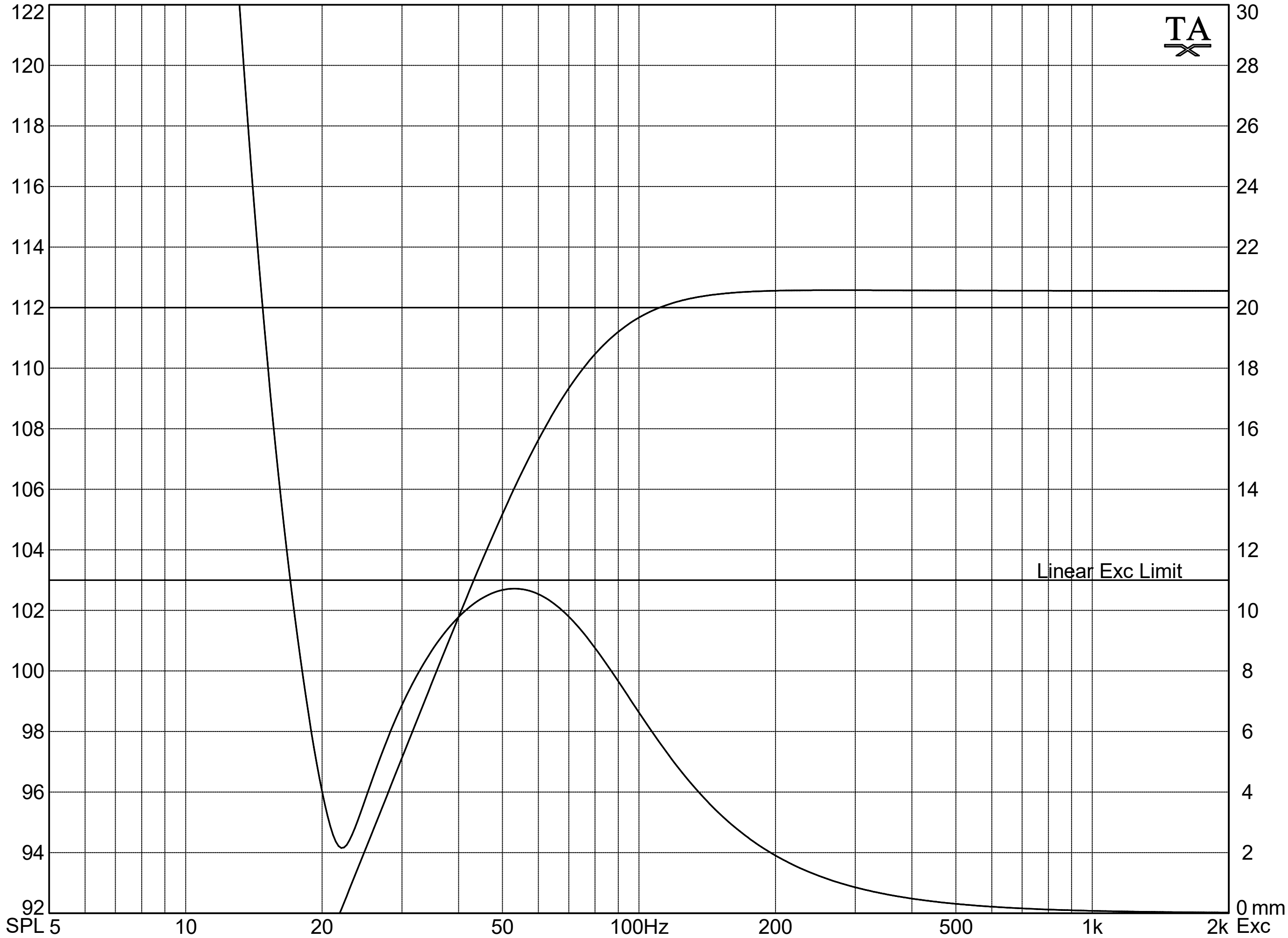


(IEC baffle, mic. distance 31.6 cm, SPL shown for 2.83 V / 1 m)

Response Curve :

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

REV.4 (16.02.2016)



Driver Parameters

Driver: **SB Acoustics SB17MFC35-4**

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	90	dB SPL
Free Air Resonance	f(s) =	30	Hz
Total Q	Q(ts) =	0.28	
Electrical Q	Q(es) =	0.3	
Mechanical Q	Q(ms) =	5.2	
Equivalent Volume	V(as) =	1.589	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	60	Watts
Max Linear Excursion	X(max) =	11	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	0.3	cu ft
Closed Box Q	Q(tc) =	0.7026	
Box Frequency	F(B) =	22	Hz
Min Rec Vent Area	S(vMin) =	3.54	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	5.297	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	180	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

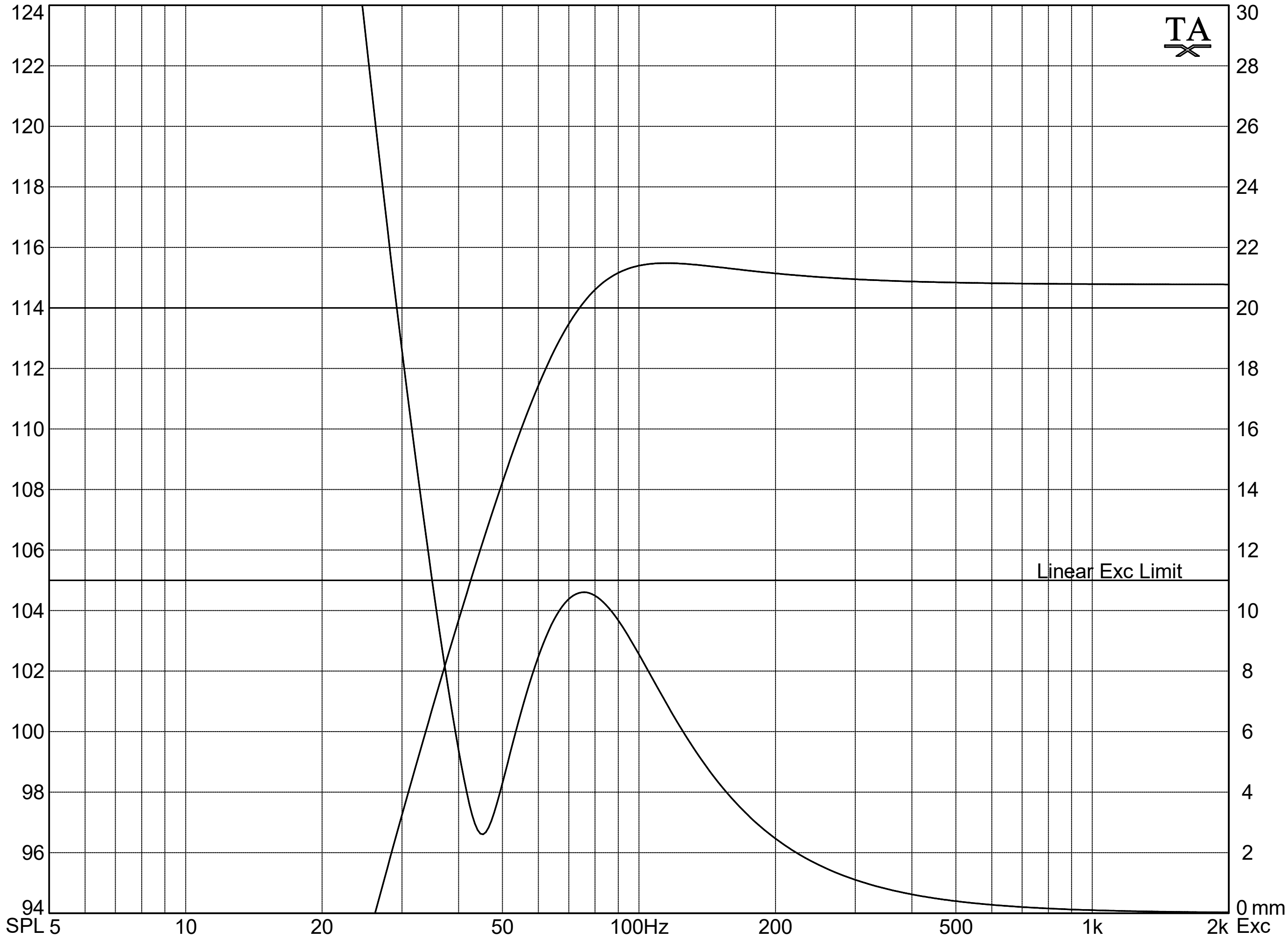
System Name:

4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date: Rev:



Driver Parameters

Driver: SB Acoustics SB17MFC35-4

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	90	dB SPL
Free Air Resonance	f(s) =	30	Hz
Total Q	Q(ts) =	0.28	
Electrical Q	Q(es) =	0.3	
Mechanical Q	Q(ms) =	5.2	
Equivalent Volume	V(as) =	1.589	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	60	Watts
Max Linear Excursion	X(max) =	11	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 4th Order Vented Box

Box Volume	V(B) =	0.3	cu ft
Closed Box Q	Q(tc) =	0.7026	
Box Frequency	F(B) =	45	Hz
Min Rec Vent Area	S(vMin) =	7.24	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	5.297	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	300	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

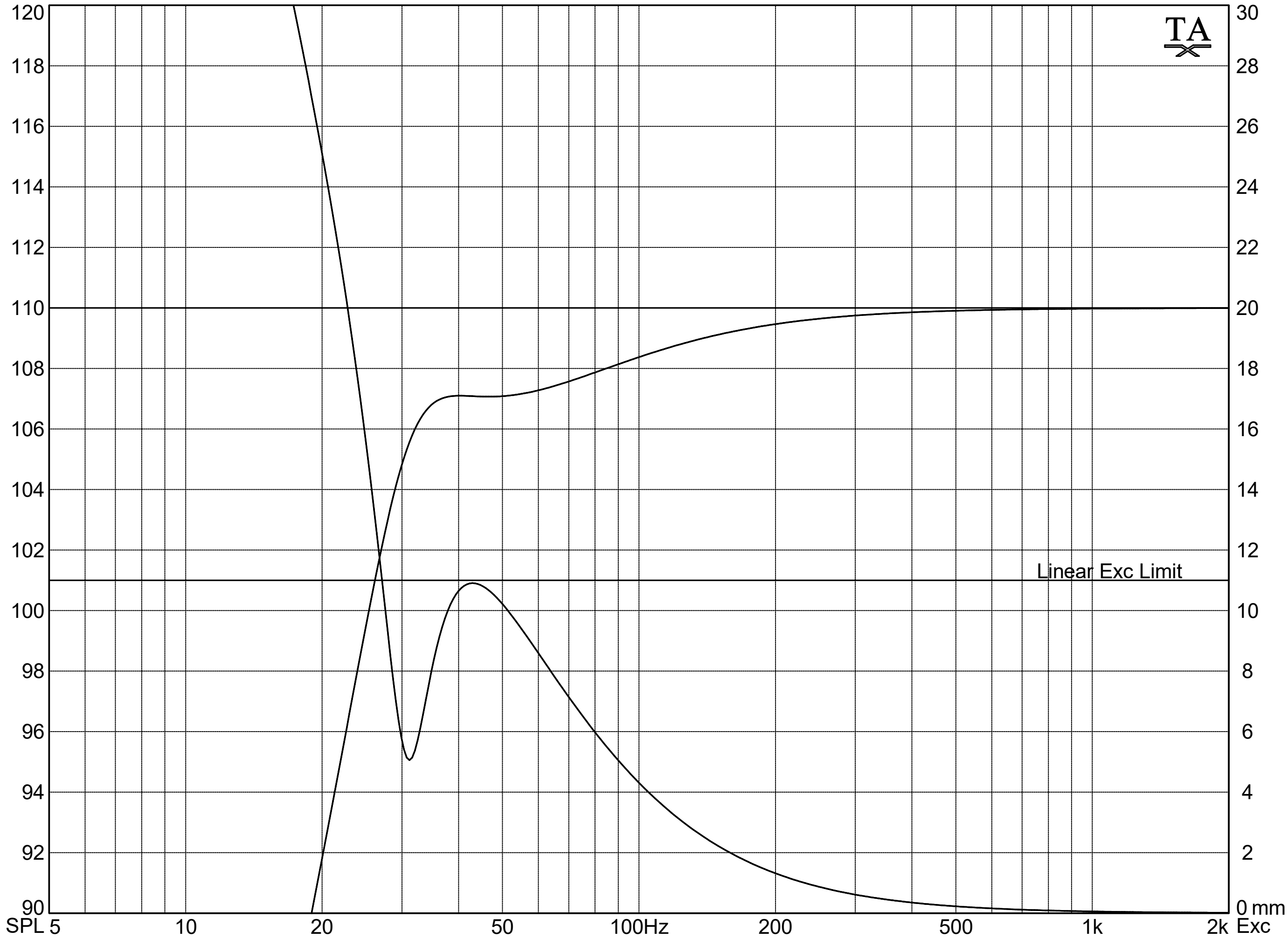
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: SB Acoustics SB17MFC35-4

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	90	dB SPL
Free Air Resonance	f(s) =	30	Hz
Total Q	Q(ts) =	0.28	
Electrical Q	Q(es) =	0.3	
Mechanical Q	Q(ms) =	5.2	
Equivalent Volume	V(as) =	1.589	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	60	Watts
Max Linear Excursion	X(max) =	11	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 4th Order Vented Box

Box Volume	V(B) =	1.25	cu ft
Closed Box Q	Q(tc) =	0.422	
Box Frequency	F(B) =	31	Hz
Min Rec Vent Area	S(vMin) =	4.99	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	1.271	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	100	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

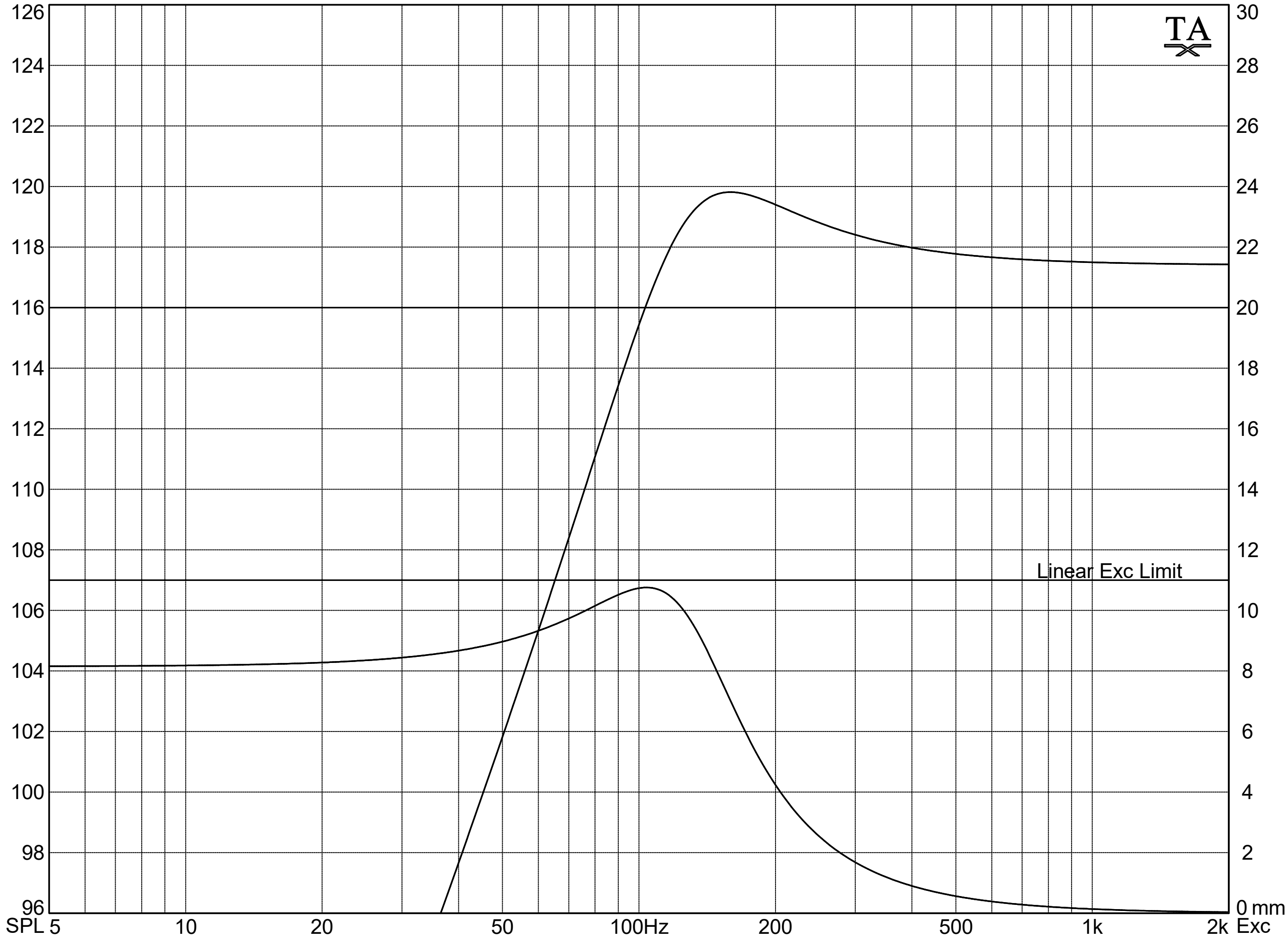
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **SB Acoustics SB17MFC35-4**

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	90	dB SPL
Free Air Resonance	f(s) =	30	Hz
Total Q	Q(ts) =	0.28	
Electrical Q	Q(es) =	0.3	
Mechanical Q	Q(ms) =	5.2	
Equivalent Volume	V(as) =	1.589	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	60	Watts
Max Linear Excursion	X(max) =	11	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **2nd Order Closed Box**

Box Volume	V(B) =	0.0915	cu ft
Closed Box Q	Q(tc) =	1.2	
System Resonance	F(sc) =	128.6	Hz
Compliance Ratio	alpha =	17.37	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	550	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

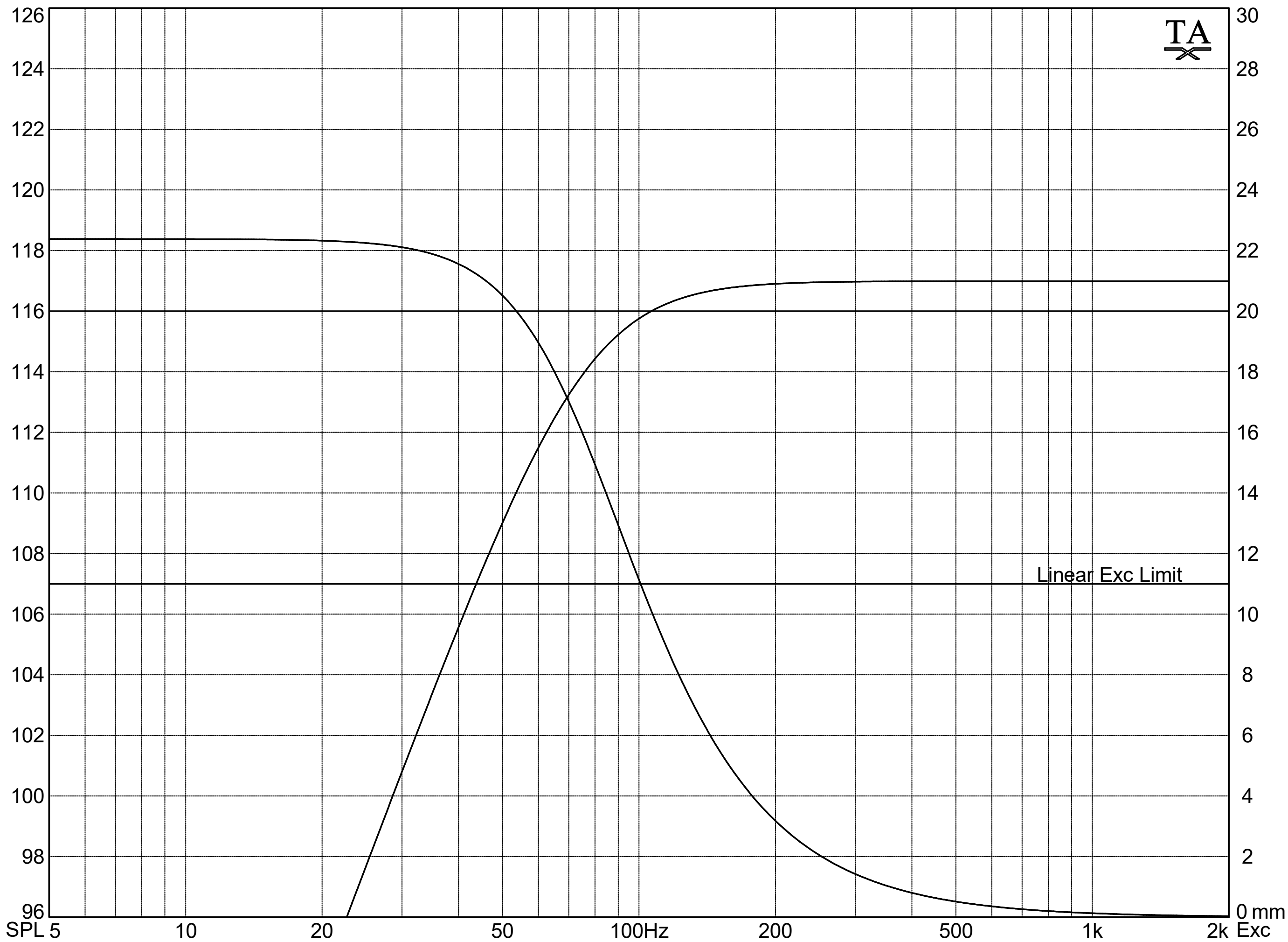
2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: SB Acoustics SB17MFC35-4

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	90	dB SPL
Free Air Resonance	f(s) =	30	Hz
Total Q	Q(ts) =	0.28	
Electrical Q	Q(es) =	0.3	
Mechanical Q	Q(ms) =	5.2	
Equivalent Volume	V(as) =	1.589	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	60	Watts
Max Linear Excursion	X(max) =	11	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 2nd Order Closed Box

Box Volume	V(B) =	0.2956	cu ft
Closed Box Q	Q(tc) =	0.707	
System Resonance	F(sc) =	75.75	Hz
Compliance Ratio	alpha =	5.376	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	500	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

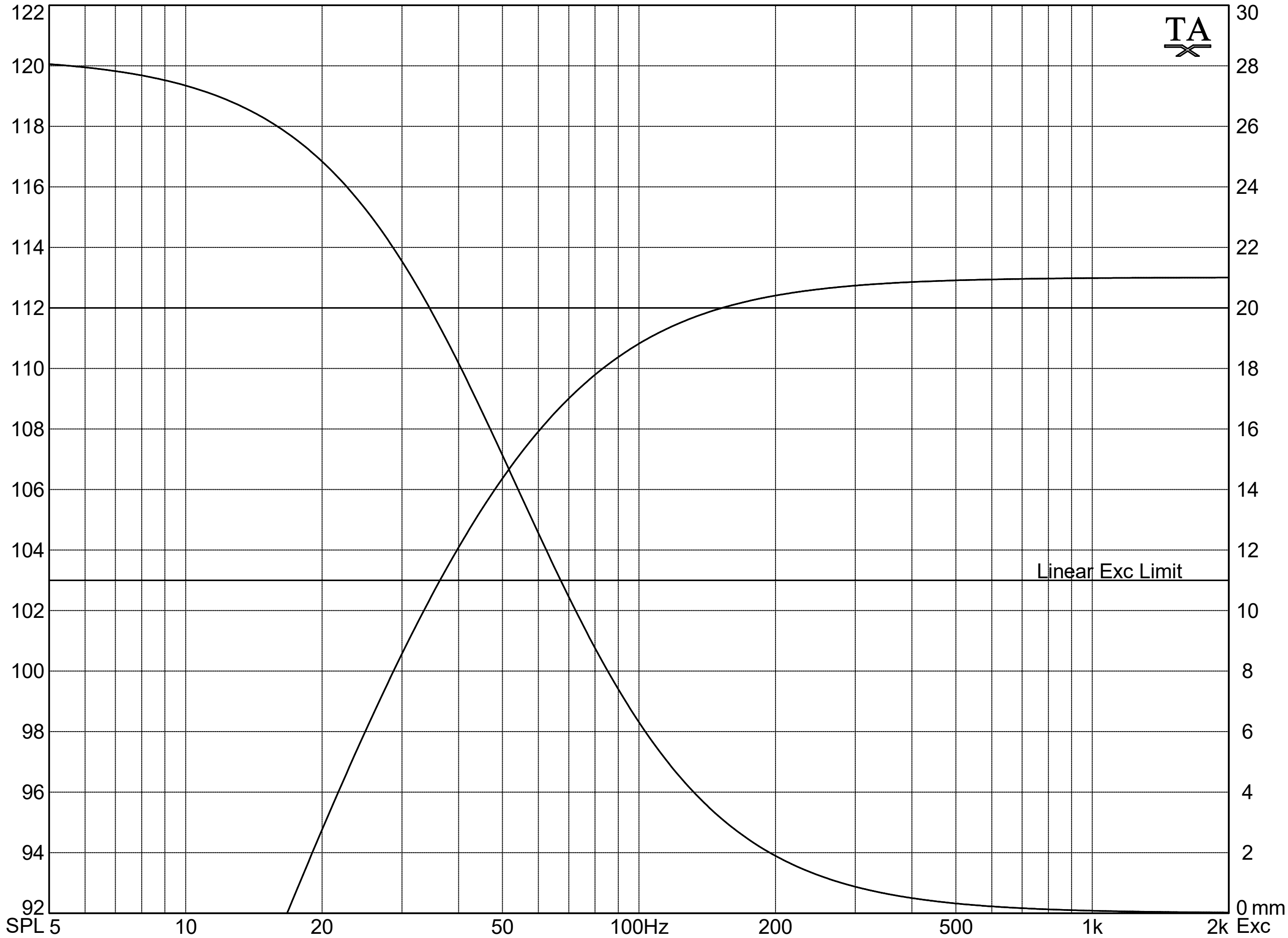
2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: SB Acoustics SB17MFC35-4

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	90	dB SPL
Free Air Resonance	f(s) =	30	Hz
Total Q	Q(ts) =	0.28	
Electrical Q	Q(es) =	0.3	
Mechanical Q	Q(ms) =	5.2	
Equivalent Volume	V(as) =	1.589	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	60	Watts
Max Linear Excursion	X(max) =	11	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 2nd Order Closed Box

Box Volume	V(B) =	0.726	cu ft
Closed Box Q	Q(tc) =	0.5	
System Resonance	F(sc) =	53.57	Hz
Compliance Ratio	alpha =	2.189	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	200	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

2nd Order Closed Box

Designer: Rowan Parsons

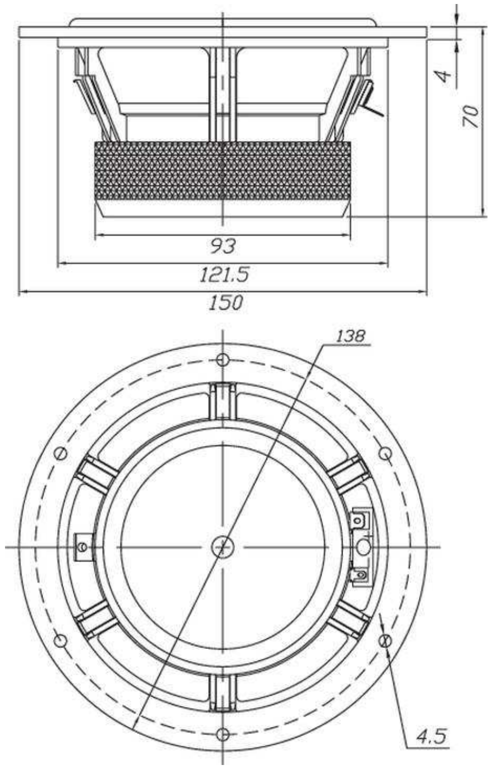
Title:

Rev Date:

Rev:

Specifications and Modeling of the Dayton Audio RS150P-4A Reference Paper Woofer

RS150P-4A 6" Reference Paper Woofer 4 Ohm



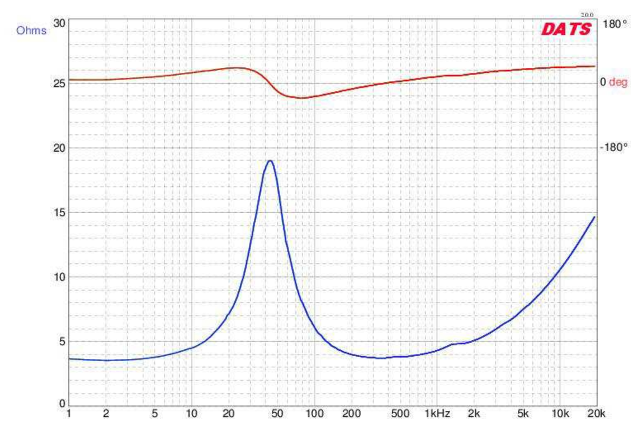
PARAMETERS

Impedance	4 ohms
Re	3.5 ohms
Le	0.39 mH @ 1 kHz
Fs	43.7 Hz
Qms	1.85
Qes	0.42
Qts	0.34
Mms	8.6g
Cms	1.54 mm/N
Sd	85.0 cm²
Vd	37.4 cm³
BL	4.4 Tm
Vas	15.7 liters
Xmax	4.4 mm
VC Diameter	25 mm
SPL	90.3 dB @ 2.83V/1m
RMS Power Handling	40 watts
Usable Frequency Range (Hz)	45 - 10,000 Hz

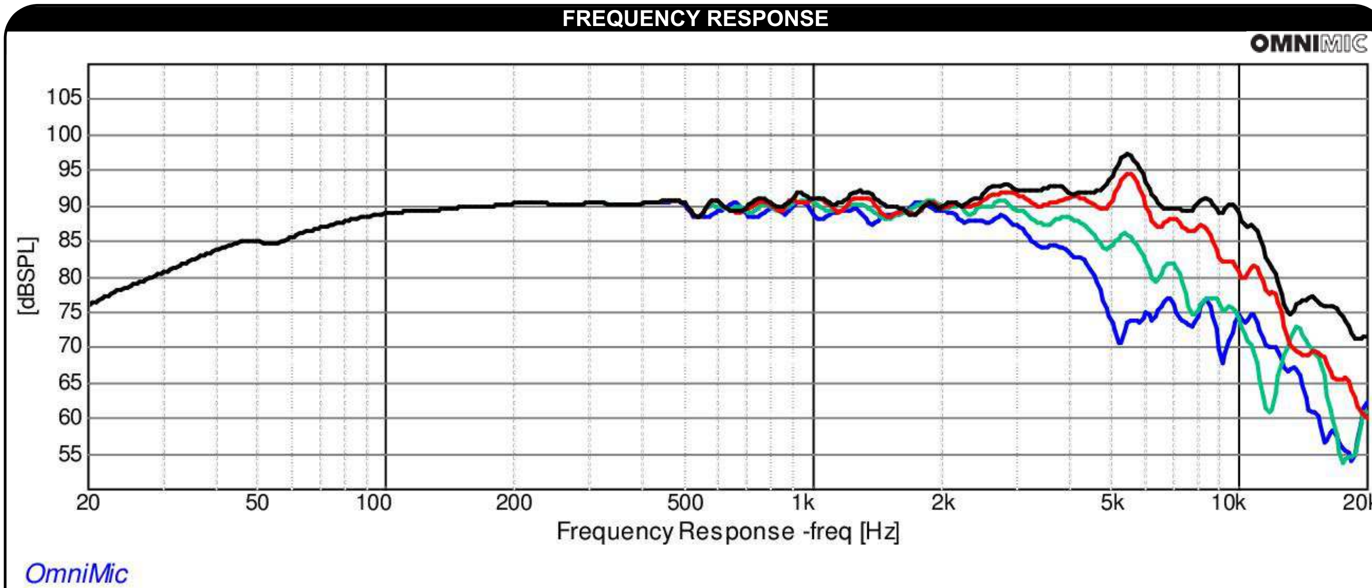
FEATURES

- Now with improved frequency response for easier crossover integration
- Three-part paper composite diaphragm featuring paper, Kevlar, and glass fibers
- Low-distortion motor, 6-hole cast frame, rubber surround, and solid aluminum phase plug
- Perfect for use as a woofer, midwoofer, or dedicated midrange driver
- 90.3 dB sensitivity and 4.4 mm of excursion

IMPEDANCE/PHASE

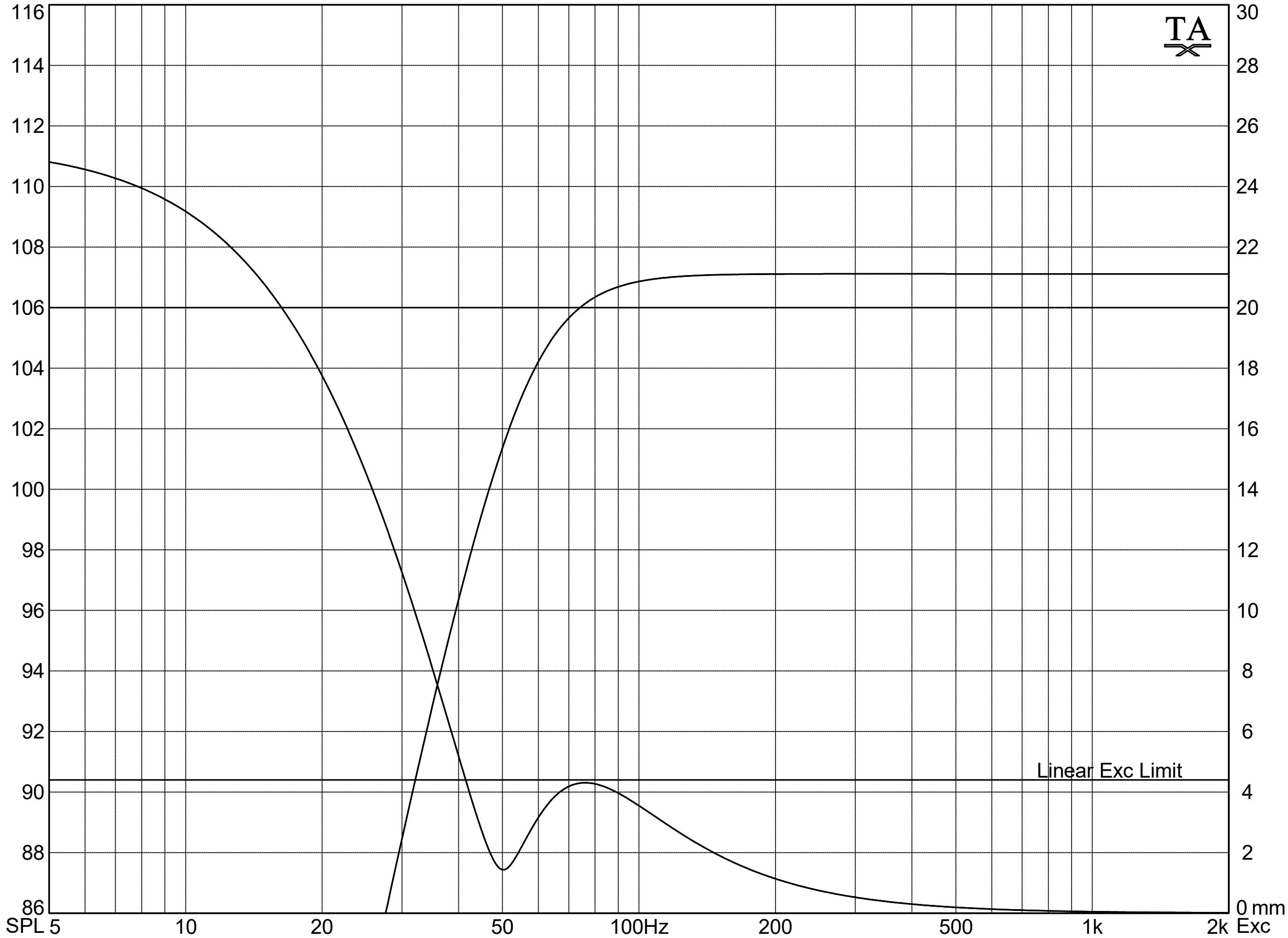


FREQUENCY RESPONSE



Note: 1/24th octave smoothing - nearfield response included in graph below 450 Hz.

Black = 0°
Red = 15°
Green = 30°
Blue = 45°



Driver Parameters

Driver: **Dayton Audio RS150P-4A**

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	90.3	dB SPL
Free Air Resonance	f(s) =	43.7	Hz
Total Q	Q(ts) =	0.34	
Electrical Q	Q(es) =	0.42	
Mechanical Q	Q(ms) =	1.85	
Equivalent Volume	V(as) =	0.5544	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	40	Watts
Max Linear Excursion	X(max) =	4.4	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	0.27	cu ft
Closed Box Q	Q(tc) =	0.5941	
Box Frequency	F(B) =	50	Hz
Min Rec Vent Area	S(vMin) =	2.32	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	2.053	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	48	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

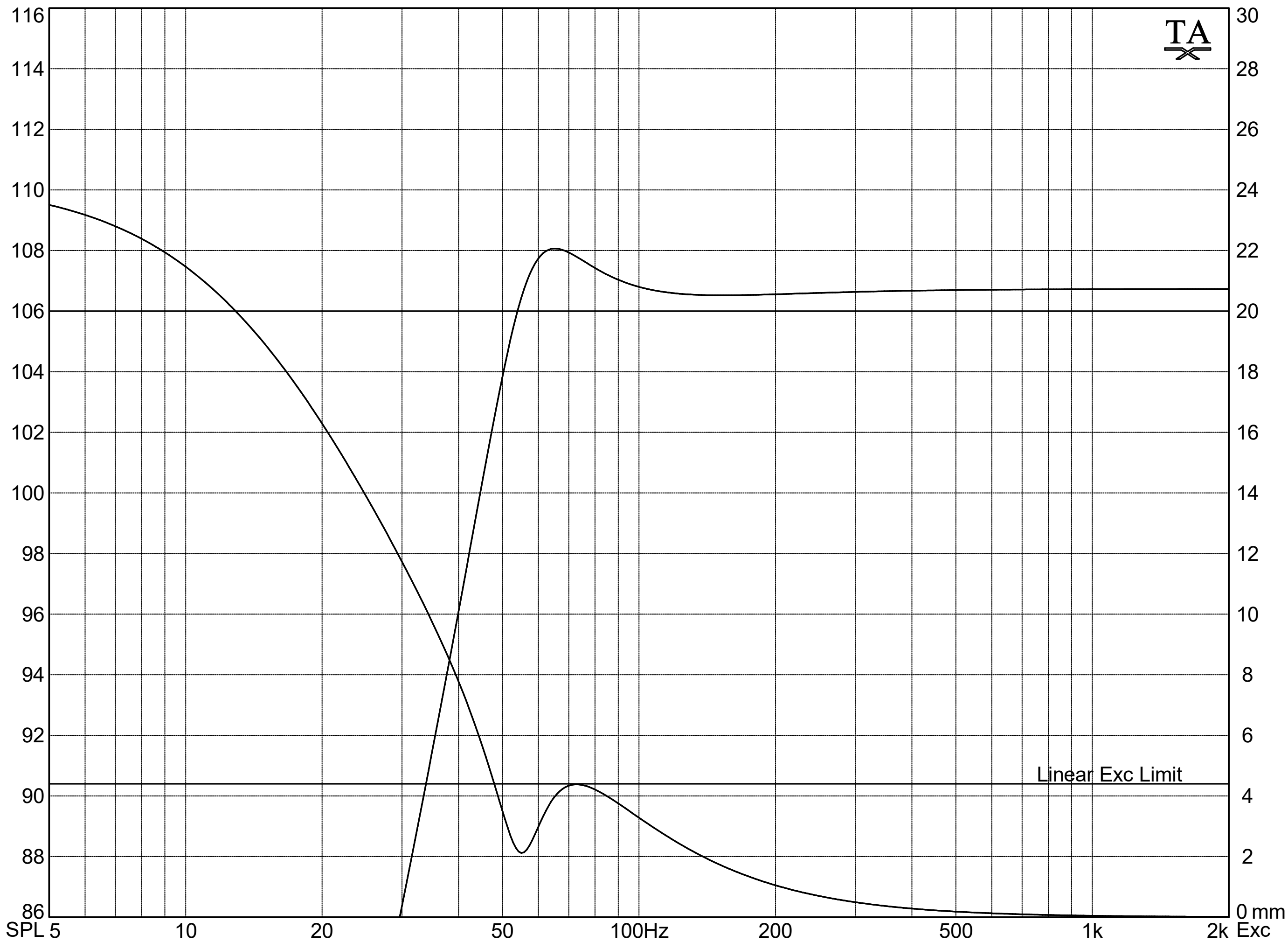
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **Dayton Audio RS150P-4A**

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	90.3	dB SPL
Free Air Resonance	f(s) =	43.7	Hz
Total Q	Q(ts) =	0.34	
Electrical Q	Q(es) =	0.42	
Mechanical Q	Q(ms) =	1.85	
Equivalent Volume	V(as) =	0.5544	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	40	Watts
Max Linear Excursion	X(max) =	4.4	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	0.5	cu ft
Closed Box Q	Q(tc) =	0.4938	
Box Frequency	F(B) =	55	Hz
Min Rec Vent Area	S(vMin) =	2.55	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	1.109	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	44	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

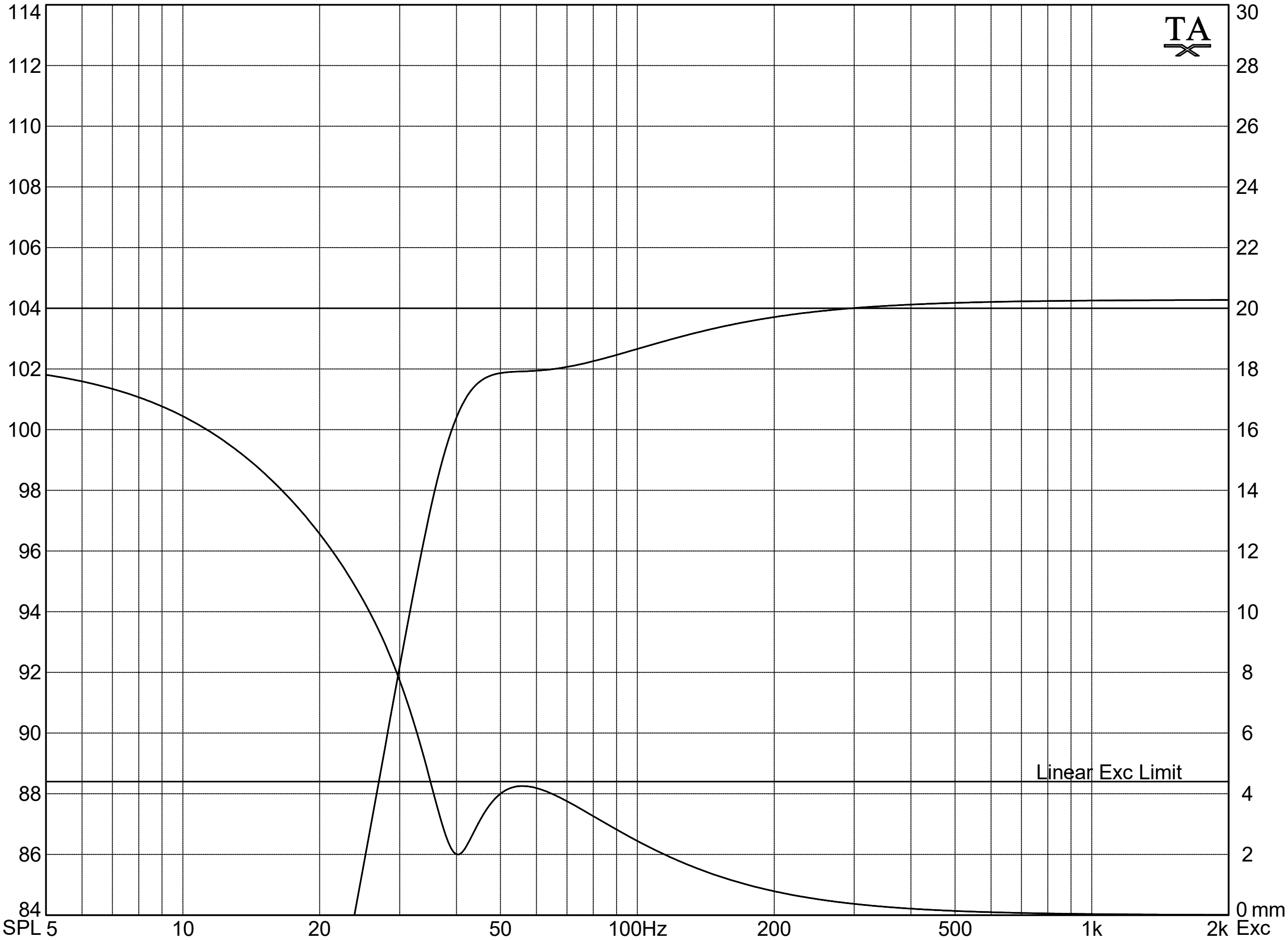
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: Dayton Audio RS150P-4A

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	90.3	dB SPL
Free Air Resonance	f(s) =	43.7	Hz
Total Q	Q(ts) =	0.34	
Electrical Q	Q(es) =	0.42	
Mechanical Q	Q(ms) =	1.85	
Equivalent Volume	V(as) =	0.5544	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	40	Watts
Max Linear Excursion	X(max) =	4.4	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 4th Order Vented Box

Box Volume	V(B) =	0.6	cu ft
Closed Box Q	Q(tc) =	0.4716	
Box Frequency	F(B) =	40	Hz
Min Rec Vent Area	S(vMin) =	1.86	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	0.9241	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	25	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

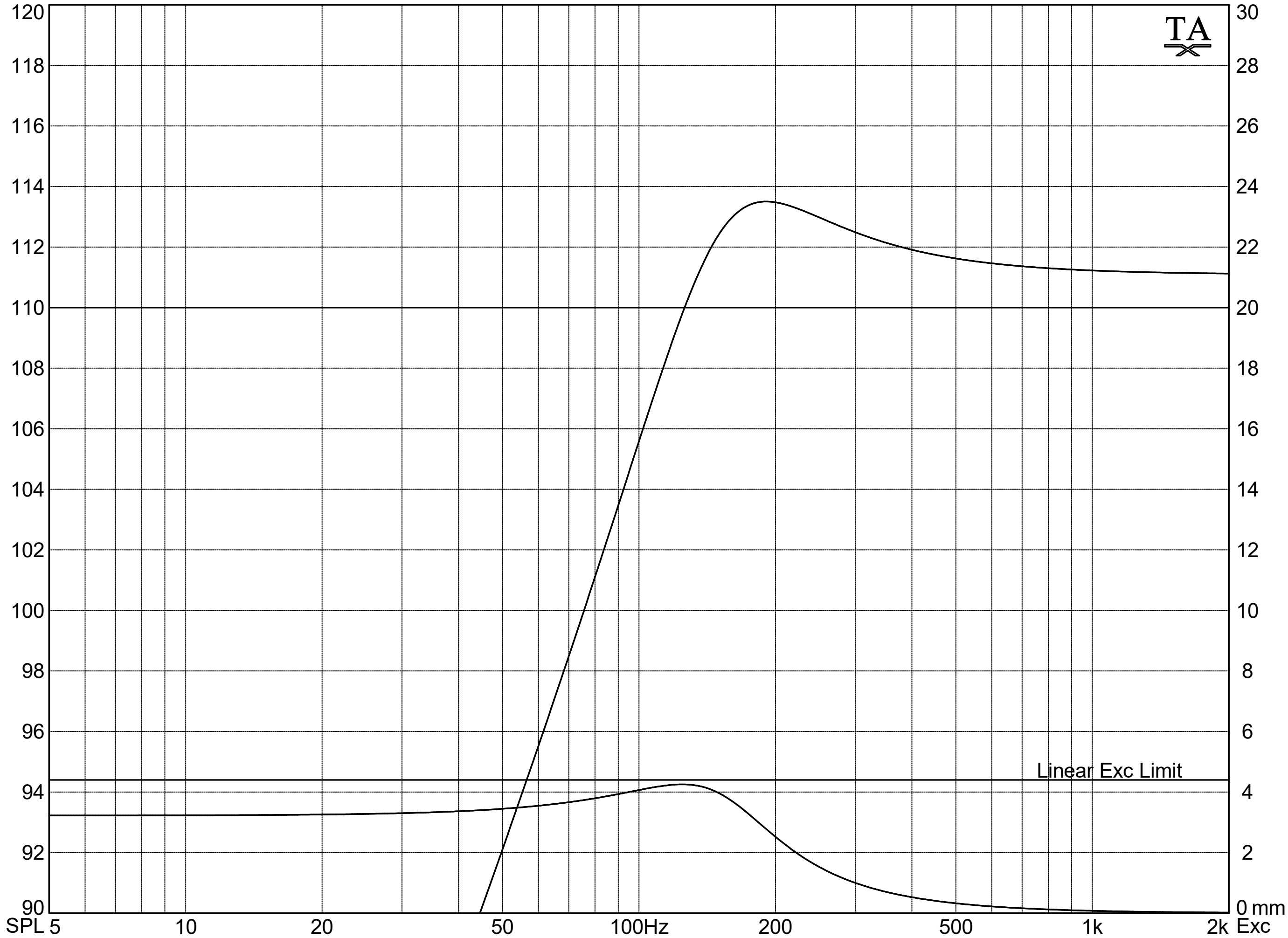
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **Dayton Audio RS150P-4A**

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	90.3	dB SPL
Free Air Resonance	f(s) =	43.7	Hz
Total Q	Q(ts) =	0.34	
Electrical Q	Q(es) =	0.42	
Mechanical Q	Q(ms) =	1.85	
Equivalent Volume	V(as) =	0.5544	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	40	Watts
Max Linear Excursion	X(max) =	4.4	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **2nd Order Closed Box**

Box Volume	V(B) =	0.04839	cu ft
Closed Box Q	Q(tc) =	1.2	
System Resonance	F(sc) =	154.3	Hz
Compliance Ratio	alpha =	11.46	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	120	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

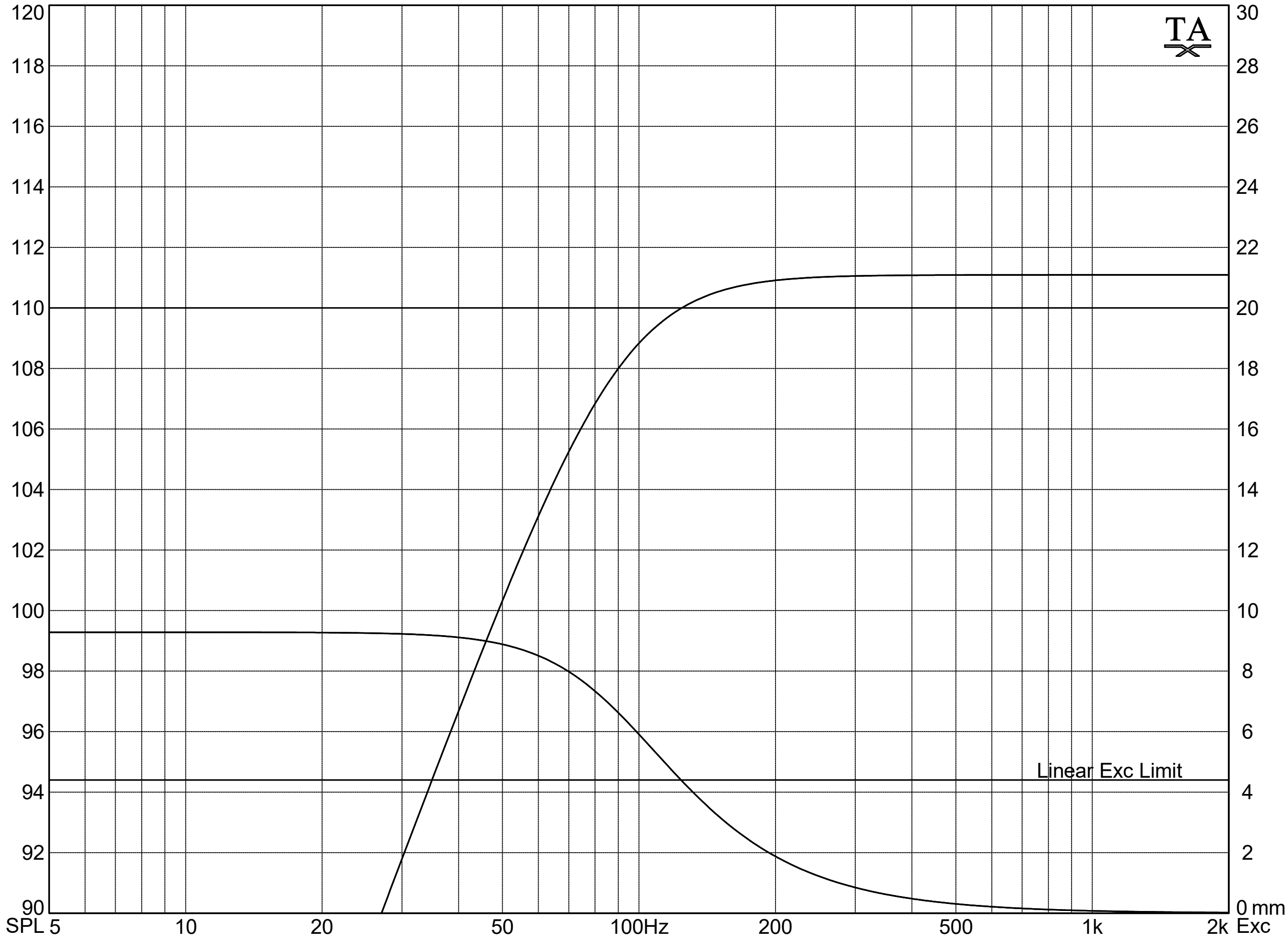
System Name:

2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date: Rev:



Driver Parameters

Driver: Dayton Audio RS150P-4A

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	90.3	dB SPL
Free Air Resonance	f(s) =	43.7	Hz
Total Q	Q(ts) =	0.34	
Electrical Q	Q(es) =	0.42	
Mechanical Q	Q(ms) =	1.85	
Equivalent Volume	V(as) =	0.5544	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	40	Watts
Max Linear Excursion	X(max) =	4.4	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 2nd Order Closed Box

Box Volume	V(B) =	0.1668	cu ft
Closed Box Q	Q(tc) =	0.707	
System Resonance	F(sc) =	90.87	Hz
Compliance Ratio	alpha =	3.324	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	120	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

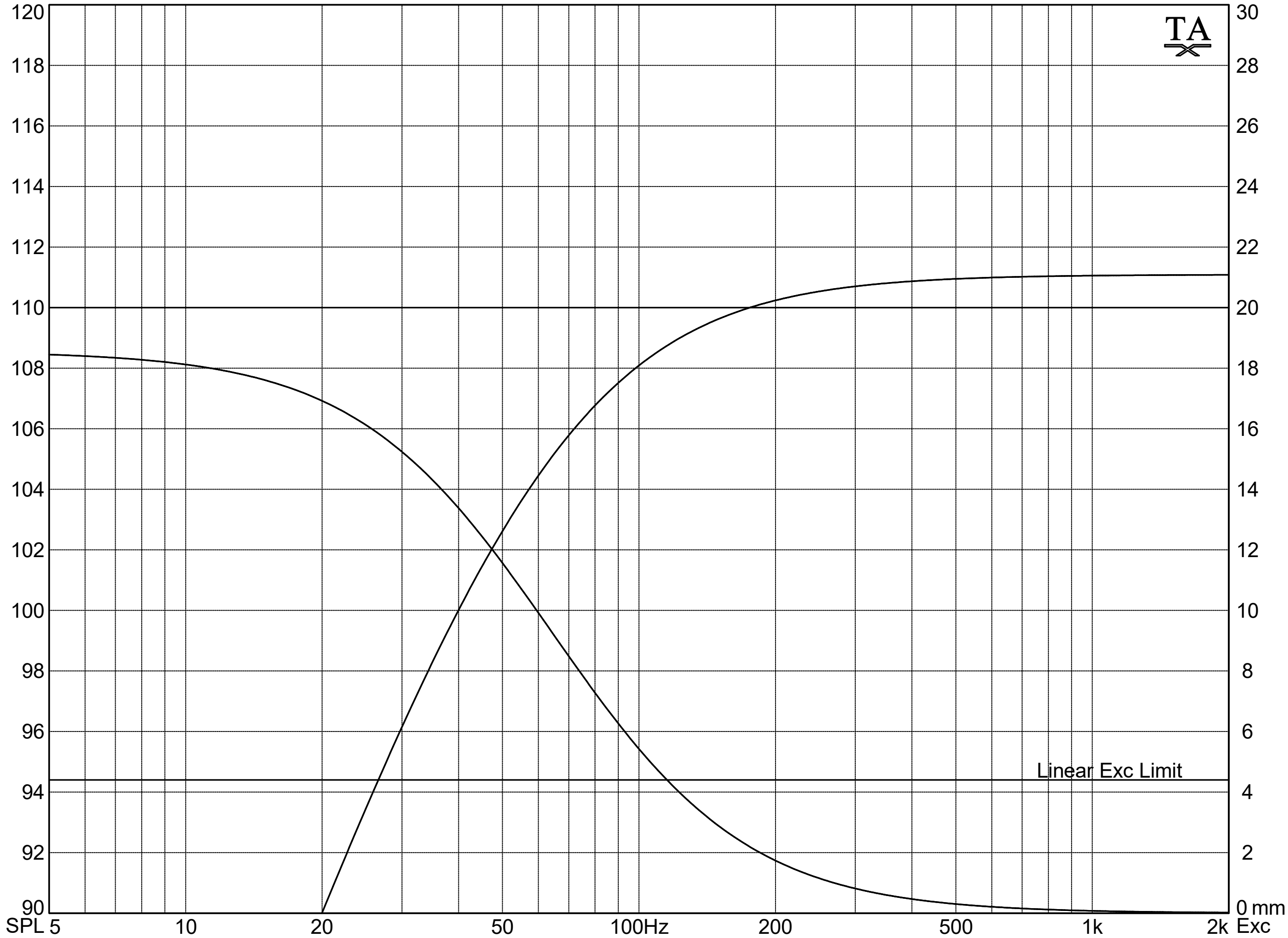
2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **Dayton Audio RS150P-4A**

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	90.3	dB SPL
Free Air Resonance	f(s) =	43.7	Hz
Total Q	Q(ts) =	0.34	
Electrical Q	Q(es) =	0.42	
Mechanical Q	Q(ms) =	1.85	
Equivalent Volume	V(as) =	0.5544	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	40	Watts
Max Linear Excursion	X(max) =	4.4	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **2nd Order Closed Box**

Box Volume	V(B) =	0.4769	cu ft
Closed Box Q	Q(tc) =	0.5	
System Resonance	F(sc) =	64.27	Hz
Compliance Ratio	alpha =	1.163	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	120	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date: Rev:

Specifications and Modeling of the SB Audience ROSSO-6MW150D 6" Midwoofer

ROSSO-6MW150D

6" - Midwoofer - 300W - 94dB

SB AUDIENCE

- Proprietary cone paper material with manila pulp and graphite
- Proprietary cone coating for controlled breakup
- Extended midrange performance
- Shorting ring in motor system for reduced distortion
- Minimum damping fiber glass voice coil former
- Cast aluminium chassis

Dimensions & Weight

Overall Diameter	162.7 mm (6.40 in)
Bolt Circle Diameter	168.5 mm (6.63 in)
Baffle Cutout Diameter	147.5 mm (5.8 in)
Mounting Depth	84 mm (3.30 in)
Flange and Gasket Thickness	5.5 mm (0.21 in)
Net Weight	2.62 Kg (5.77 lb)
Shipping Box	178 x 178 x 135 mm (7.0 x7.0 x 5.31 in)
Gross Weight	2.92 Kg (6.43 lb)

Recone Kit

N/A

Specs :

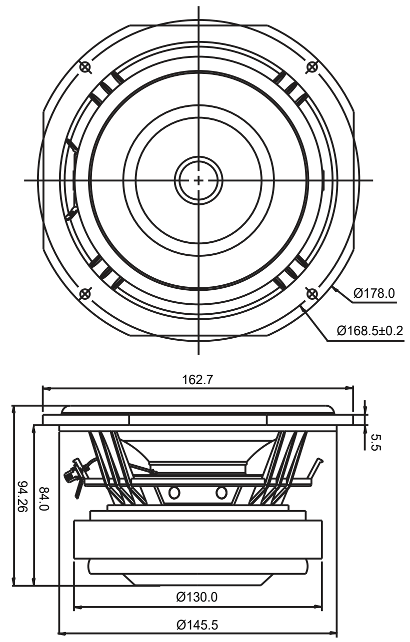
Nominal Impedance	8 Ohm
Minimum Impedance	5.4 Ohm
AES Power Handling (1)	150 W
Maximum Power Handling (2)	300 W
Sensitivity (1W/1m)	94 dB
Frequency Range	66 - 5000 Hz
Voice Coil Diameter	49.5 mm (2 in)
Winding Material	Copper
Former Material	Till
Winding Depth	12.15 mm
Magnetic Gap Depth	5 mm (0.19 in)
Flux Density	1.31 T
Magnet	Ferrite
Basket Material	Aluminium die cast
Demodulation	Aluminium shorting ring
Cone Surround	Rubber single half roll
NET Air Volume filled by driver	0.92 liters
Spider Profile	Single constant height waves
Weather Resistant	Yes

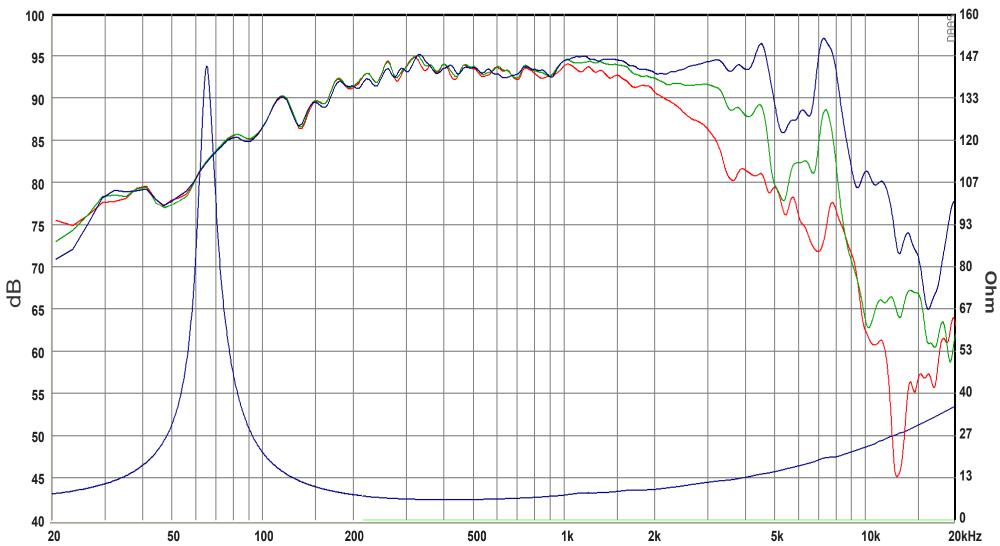
Thiele Small Parameters

Fs	66 Hz
Re	5.4 Ohm
Qes	0.33
Qms	9.24
Qts	0.32
Vas	8.8 liters
Sd	145.3 cm²
Xmax (3)	5.24 mm
Xdamage (4)	16 mm
Mms	19.4 g
Bl	11.6 Tm
Le	0.39 mH
Cms	0.3 mm/N
Rms	0.88 Kg/s
Eta Zero	0.76 %
EBP	200

NOTES :

(1) AES standard, test mode with continuous pink noise signal (6 dB crest factor; 2 hours) within the Fo to 10Fo power calculated on rated nominal impedance. Loudspeaker in free air
(2) Maximum power is defined as 3dB greater than nominal power.
(3) Xmax= ((Winding depth - magnetic gap depth)/2) +(magnetic gap depth/3)
(4) Maximum excursion (p-p) before permanent damage
(5) T/S parameters measured on drive units that are broken in

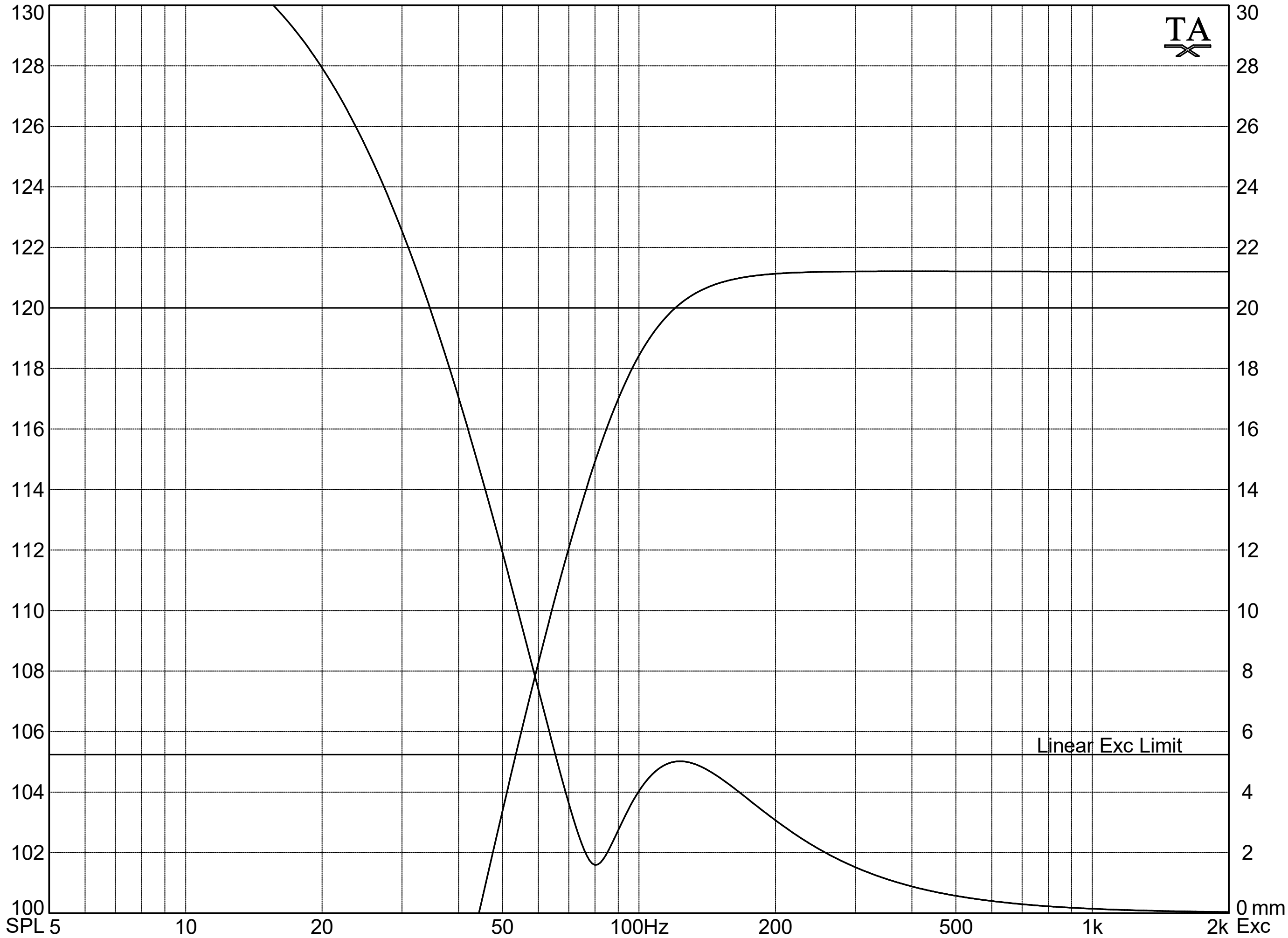




(IEC baffle, mic.distance 31.6 cm, SPL shown for 2.83 V / 1 m)

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

R.1 / 28.04.2023



Driver Parameters

Driver: SB Audience ROSSO-6MW150D

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	94	dB SPL
Free Air Resonance	f(s) =	66	Hz
Total Q	Q(ts) =	0.32	
Electrical Q	Q(es) =	0.33	
Mechanical Q	Q(ms) =	9.24	
Equivalent Volume	V(as) =	0.3108	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	150	Watts
Max Linear Excursion	X(max) =	5.24	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 4th Order Vented Box

Box Volume	V(B) =	0.125	cu ft
Closed Box Q	Q(tc) =	0.5975	
Box Frequency	F(B) =	80	Hz
Min Rec Vent Area	S(vMin) =	7.55	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	2.486	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	525	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

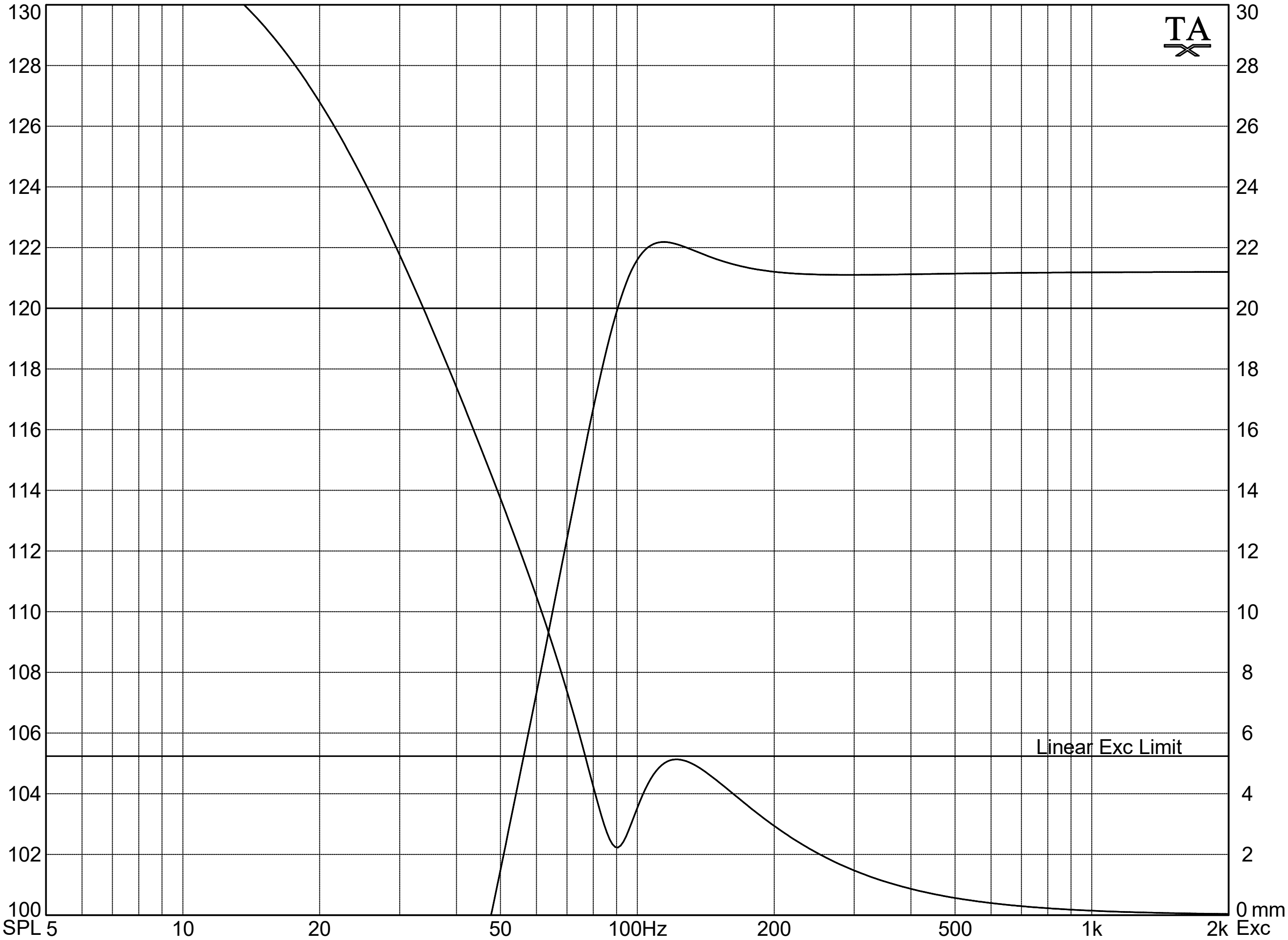
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: SB Audience ROSSO-6MW150D

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	94	dB SPL
Free Air Resonance	f(s) =	66	Hz
Total Q	Q(ts) =	0.32	
Electrical Q	Q(es) =	0.33	
Mechanical Q	Q(ms) =	9.24	
Equivalent Volume	V(as) =	0.3108	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	150	Watts
Max Linear Excursion	X(max) =	5.24	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 4th Order Vented Box

Box Volume	V(B) =	0.2	cu ft
Closed Box Q	Q(tc) =	0.5114	
Box Frequency	F(B) =	90	Hz
Min Rec Vent Area	S(vMin) =	8.5	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	1.554	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	525	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

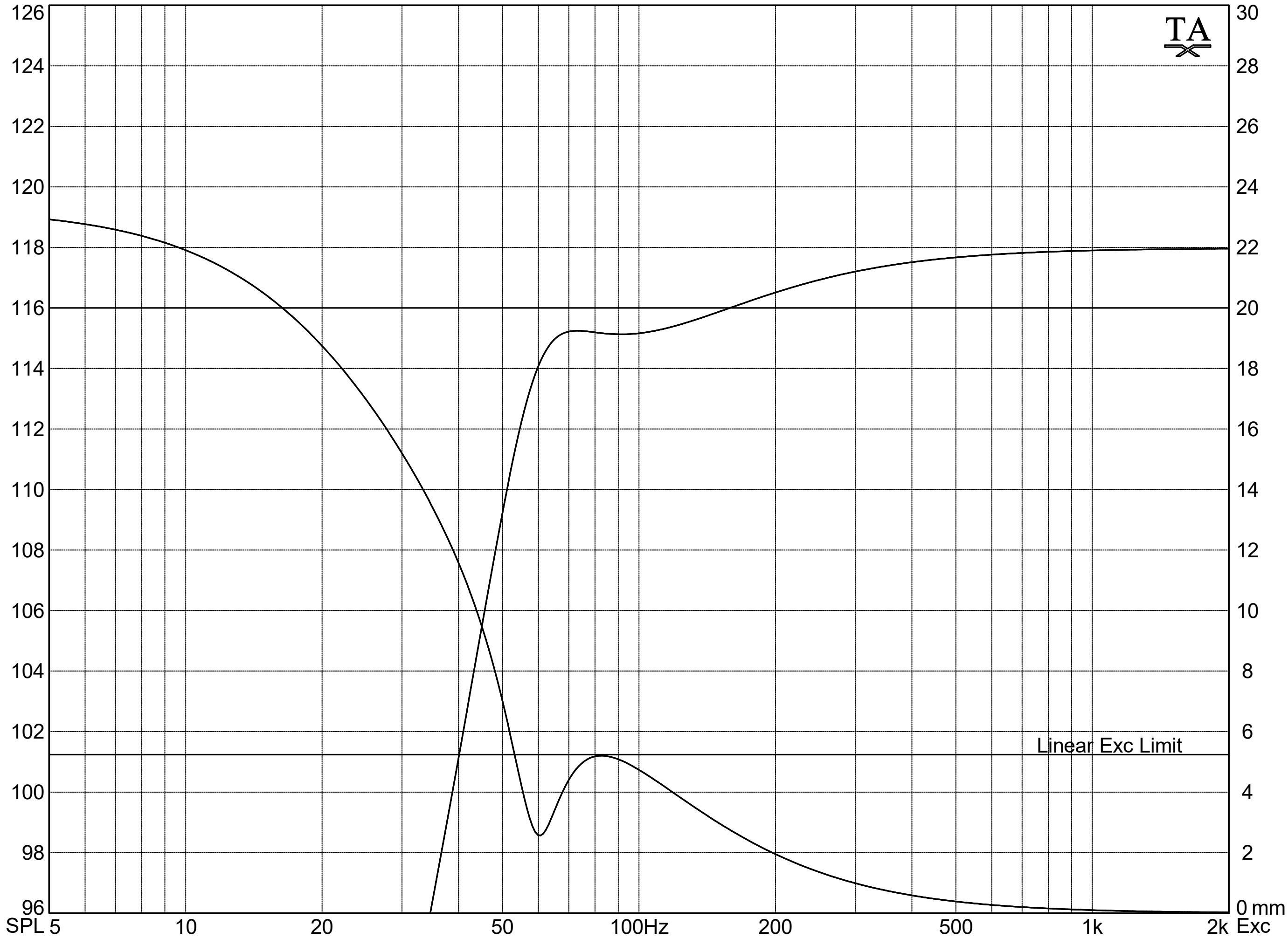
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **SB Audience ROSSO-6MW150D**

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	94	dB SPL
Free Air Resonance	f(s) =	66	Hz
Total Q	Q(ts) =	0.32	
Electrical Q	Q(es) =	0.33	
Mechanical Q	Q(ms) =	9.24	
Equivalent Volume	V(as) =	0.3108	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	150	Watts
Max Linear Excursion	X(max) =	5.24	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **4th Order Vented Box**

Box Volume	V(B) =	0.35	cu ft
Closed Box Q	Q(tc) =	0.4397	
Box Frequency	F(B) =	60	Hz
Min Rec Vent Area	S(vMin) =	5.66	sq in
Vent Surface Area	S(v) =	0	sq in
Vent Length	L(v) =	0	in
Compliance Ratio	alpha =	0.8879	
Box Loss Q	Q(B) =	7	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	250	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

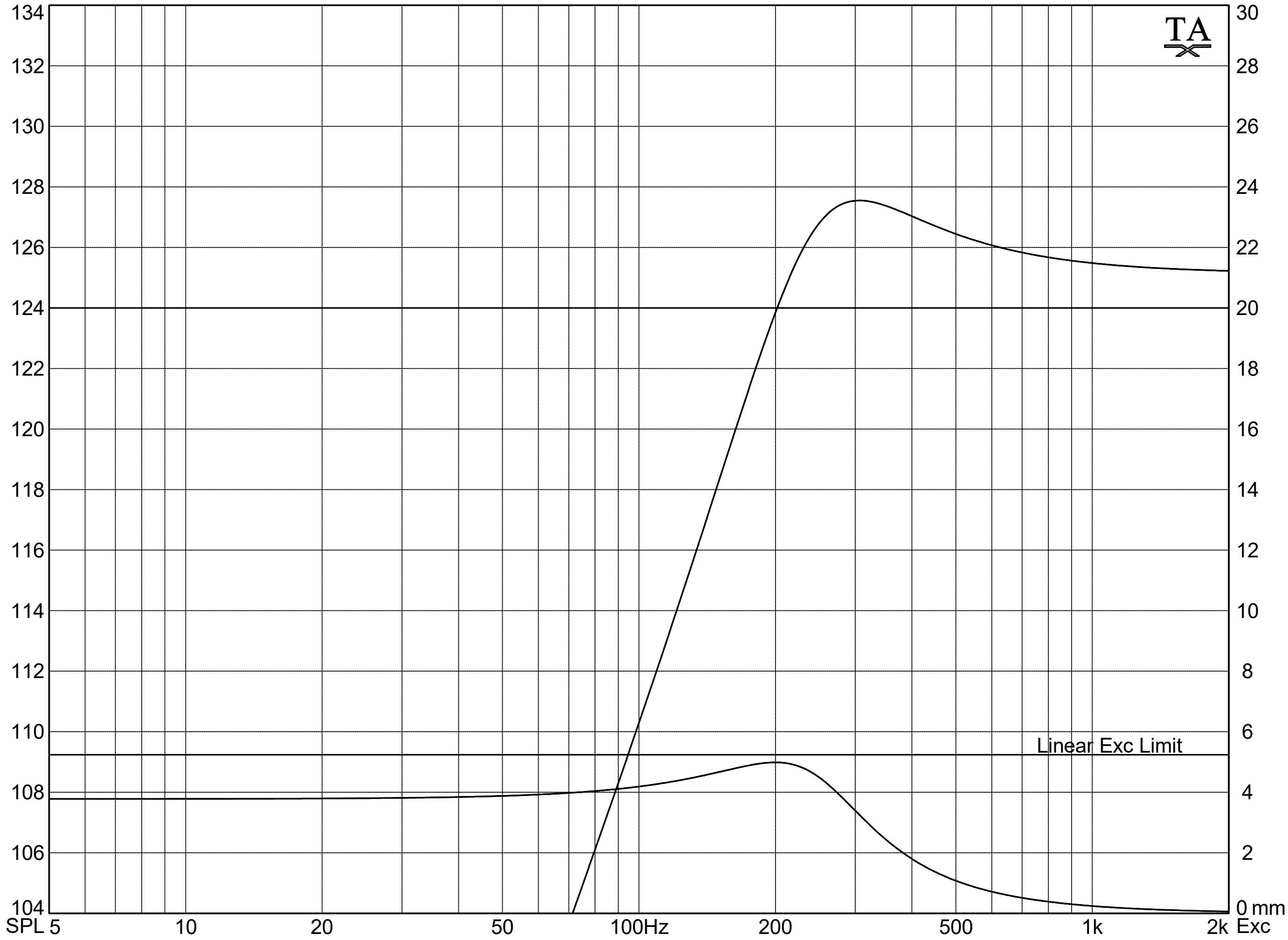
4th Order Vented Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: **SB Audience ROSSO-6MW150D**

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	94	dB SPL
Free Air Resonance	f(s) =	66	Hz
Total Q	Q(ts) =	0.32	
Electrical Q	Q(es) =	0.33	
Mechanical Q	Q(ms) =	9.24	
Equivalent Volume	V(as) =	0.3108	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	150	Watts
Max Linear Excursion	X(max) =	5.24	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: **2nd Order Closed Box**

Box Volume	V(B) =	0.02379	cu ft
Closed Box Q	Q(tc) =	1.2	
System Resonance	F(sc) =	247.5	Hz
Compliance Ratio	alpha =	13.06	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	1300	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

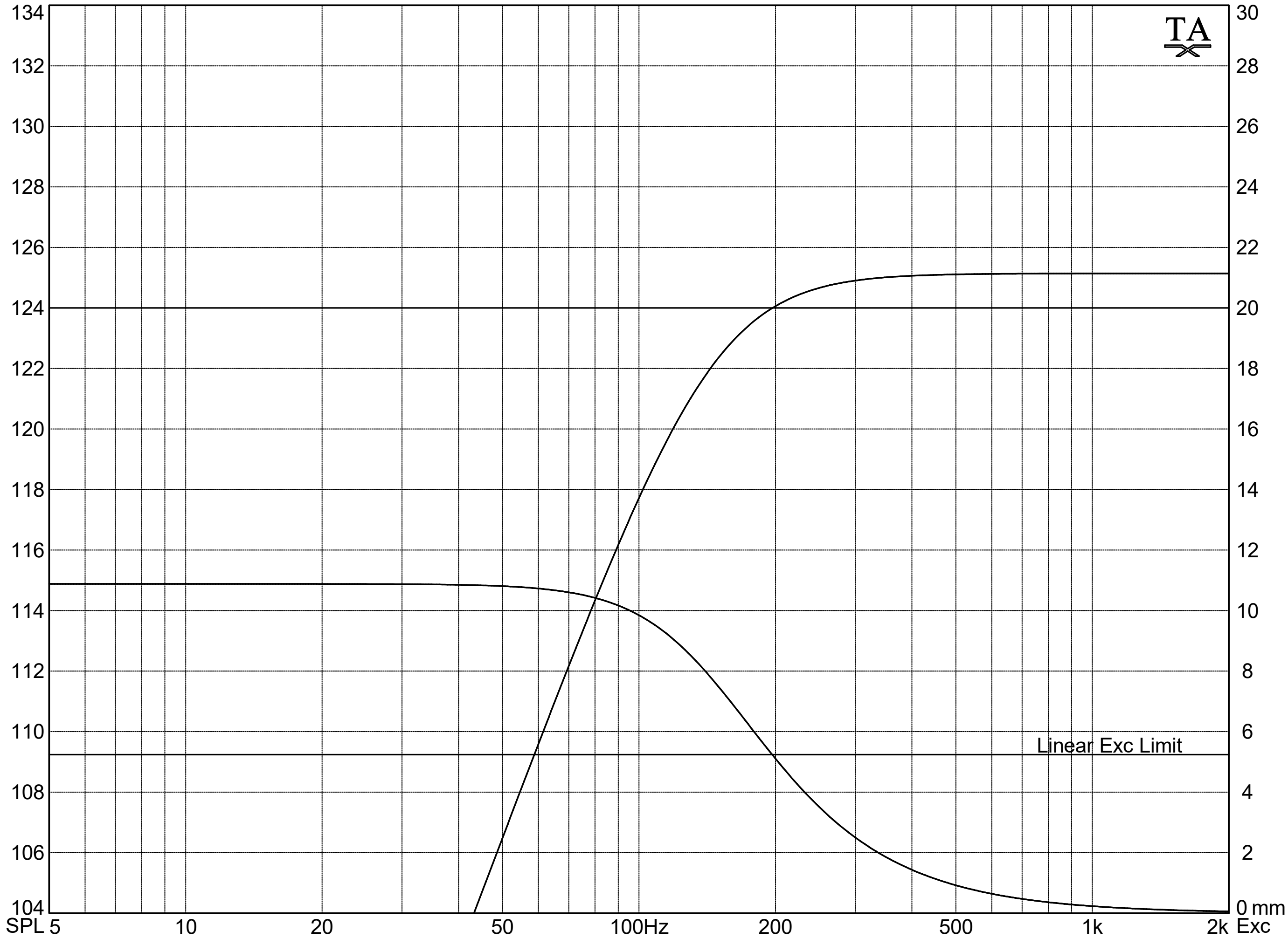
2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: SB Audience ROSSO-6MW150D

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	94	dB SPL
Free Air Resonance	f(s) =	66	Hz
Total Q	Q(ts) =	0.32	
Electrical Q	Q(es) =	0.33	
Mechanical Q	Q(ms) =	9.24	
Equivalent Volume	V(as) =	0.3108	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	150	Watts
Max Linear Excursion	X(max) =	5.24	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 2nd Order Closed Box

Box Volume	V(B) =	0.08007	cu ft
Closed Box Q	Q(tc) =	0.707	
System Resonance	F(sc) =	145.8	Hz
Compliance Ratio	alpha =	3.882	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	1300	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

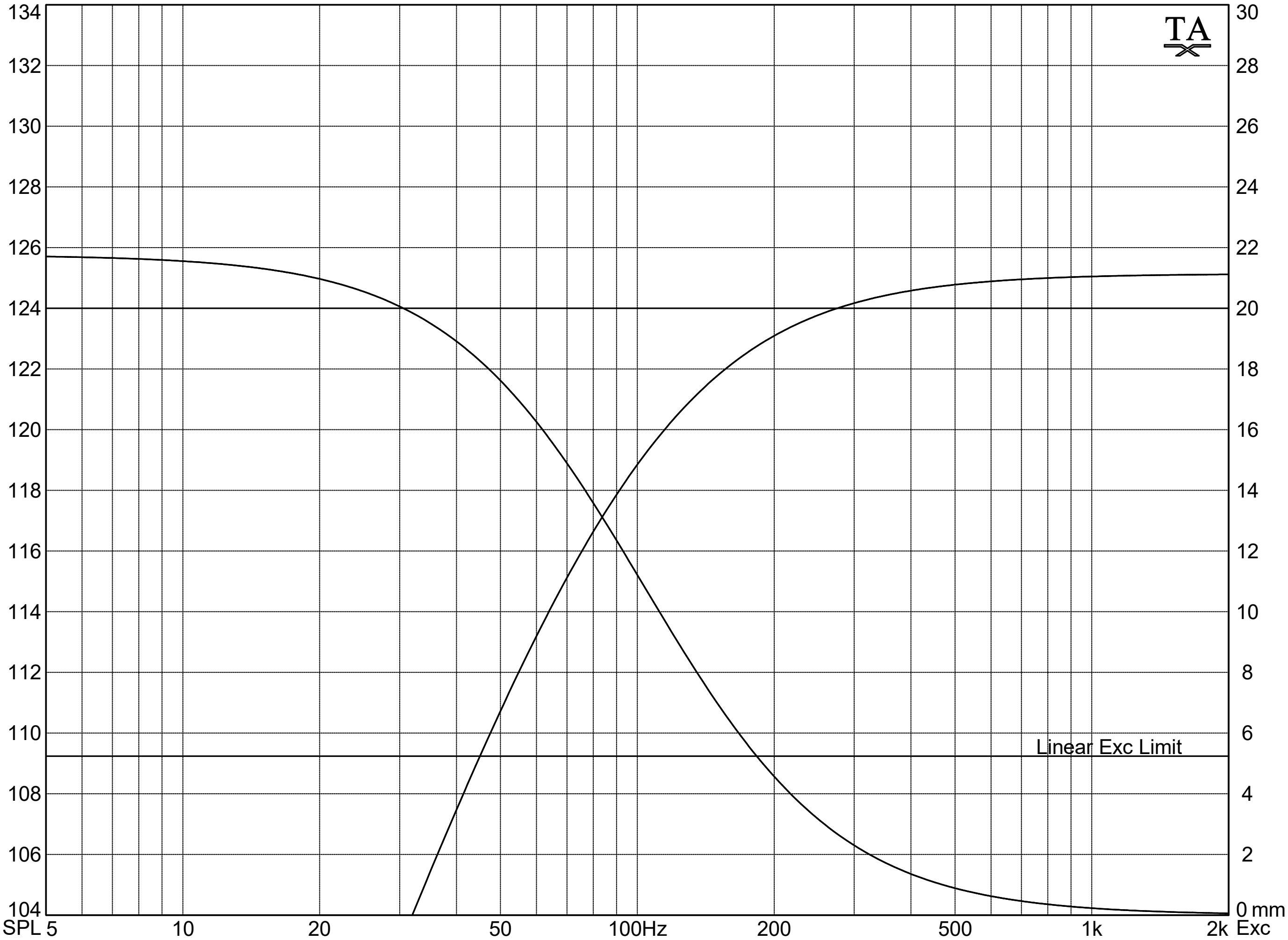
2nd Order Closed Box

Designer: Rowan Parsons

Title:

Rev Date:

Rev:



Driver Parameters

Driver: SB Audience ROSSO-6MW150D

Nominal Diameter	D =	6	in
Nominal Power	P =	0	Watts
Sensitivity (1W/1m)	SPL =	94	dB SPL
Free Air Resonance	f(s) =	66	Hz
Total Q	Q(ts) =	0.32	
Electrical Q	Q(es) =	0.33	
Mechanical Q	Q(ms) =	9.24	
Equivalent Volume	V(as) =	0.3108	cu ft
Nominal Impedance	Z =	0	Ohms
DC Resistance	R(e) =	0	Ohms
Max Thermal Power	P(t) =	150	Watts
Max Linear Excursion	X(max) =	5.24	mm
Max Excursion	X(lim) =	0	mm
Voice Coil Diam.	D(vc) =	0	mm

Driver Notes:

NOTE: Reference Efficiency was calculated based on the 1W/1m sensitivity.

System Notes:

Box Parameters

System Type: 2nd Order Closed Box

Box Volume	V(B) =	0.2156	cu ft
Closed Box Q	Q(tc) =	0.5	
System Resonance	F(sc) =	103.1	Hz
Compliance Ratio	alpha =	1.441	

System Parameters

No. of Drivers	N =	1	
Isobaric Factor	I =	1	(1=normal, 2=iso)
Input Power	P(in) =	1300	Watts
SPL Distance	D =	1	m

Michigan Technological University

269-270-1114

System Name:

2nd Order Closed Box

Designer: Rowan Parsons

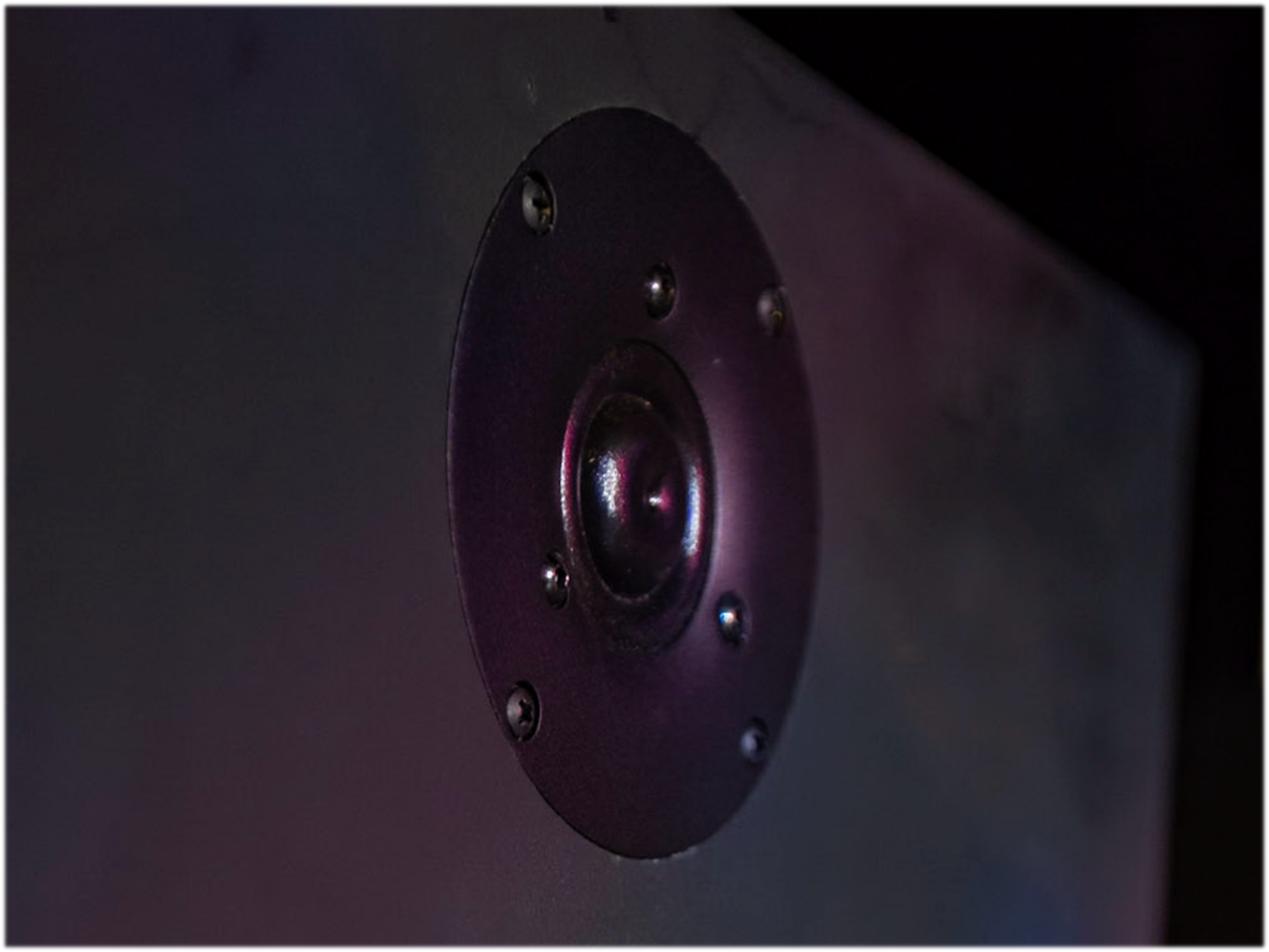
Title:

Rev Date:

Rev:

10.3 Appendix D

Tweeter Spreadsheet



	Nominal Size	Design	Price	Fs	Sensitivity	Short Term Power	Long Term Power	Thermal SPL Limit	Peak SPL Limit
Fountek NeoCd3.5H Horn Tweeter	3"	Ribbon	$106.50	500	95.5	25	12	106.3	109.5
SB Acoustics SB26CDC-C000-4	1"	Aluminum/Ceramic Dome	$61.40	690	89		100	109.0	
SB Acoustics SB19ST-C000-4	.75"	Fabric Dome	$23.60	980	88.5		30	103.3	
Dayton Audio PTMini-6		Planar Ribbon	$15.98	4461	90	30	15	101.8	
Dayton Audio RST28F-4	1 1/8"	Fabric Dome	$37.98	710	93.5		80	112.5	
Dayton Audio ND25TA-4	1"	Titanium Dome	$22.49	1470	91	40	20	104.0	
Scan-Speak D2604/833000	1"	Dome	$50.70	475	93	240	100	113.0	
SB Acoustics SB29RDAC-C000-4		Ring Dome	$64.40	600	93		100	113.0	