DESK SPEAKERS

Learning to build them!

Abstract

[Trek de aandacht van uw lezer met een interessante samenvatting. Dit is meestal een kort overzicht van het document.
Wanneer u uw inhoud wilt toevoegen, klikt u hier en begint u te typen.]

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The Plan

General

The plan is to build desk speakers for casual listening during programming, working and gaming. That means it needs to sound good in a medium to small sized room. The biggest constraints of this speaker build are the budget and the size.

It's my first time building a speaker so when things go wrong I don't want to waste a lot of money. Furthermore, I don't expect them to sound extremely good; it's just for learning new things and fun.

Enclosure

Since our budget is limited a sealed enclosure would make sense; we don't need a port or passive radiator. However, the low-ends are constrained in a sealed enclosure. A passive radiator would fix this. Unfortunately they aren't cheap and it makes the crossover more complex; this increases the chance things go wrong.

Last but not least, the port. This is a nice option in between a sealed enclosure or a ported radiator; the bass response is good and the ports aren't that expensive. This does mean however, that the enclosure needs to be a little bigger to fit the port.

Crossover

There are a couple of crossover types. In a *one-way* crossover, the entire input signal is passed to one full-range speaker. With a *two-way* crossover, the input signal is split in two signals; one containing the high frequencies and one containing the low frequencies. The same goes for a *three-way*.

Since it is generally harder for one speaker to produce sound in the entire audio spectrum, it makes sense to use a *two-way* crossover. Furthermore, using a *two-way* crossover is encouraged since it is generally cheaper to use a tweeter and a woofer than using one single full-range driver.

Using a *two-way* consequently has two advantages; it's cheaper and is *likely* going to sound better. It has one more advantage for future use; one can easily swap out components from the crossover to change the *color* of the audio and frequency response. It also makes it more future-proof.

Drivers

Selection

Using our constraints we can already narrow our view by a lot of drivers. After selecting some specific goals such as frequency range, sensitivity and looks we should only have a couple left to choose from. If that's not the case we should add more constraints to narrow the selection even more.

Frequency Range

The frequencies of the tweeter and mid-woofer need to overlap. This is due to the way a crossover works. It splits the signal into two parts; one for the tweeter and one for the woofer. That means the frequency response of the woofer and tweeter need to cross each other somewhere. If that isn't the case, one should change the woofer or tweeter to complement the other driver.

Sensitivity

It is important that the tweeter and woofer have approximately the same sensitivity to make sure they sound equally as loud. If the tweeter has a higher sensitivity, the high frequencies will be much louder than the low frequencies. And vice versa.

Results

Using the above constraints I found the DS135, CF120 and TCP115 woofers. They're all roughly in the same price zone and the specs don't differ a lot either. It's just a matter finding a suiting tweeter.

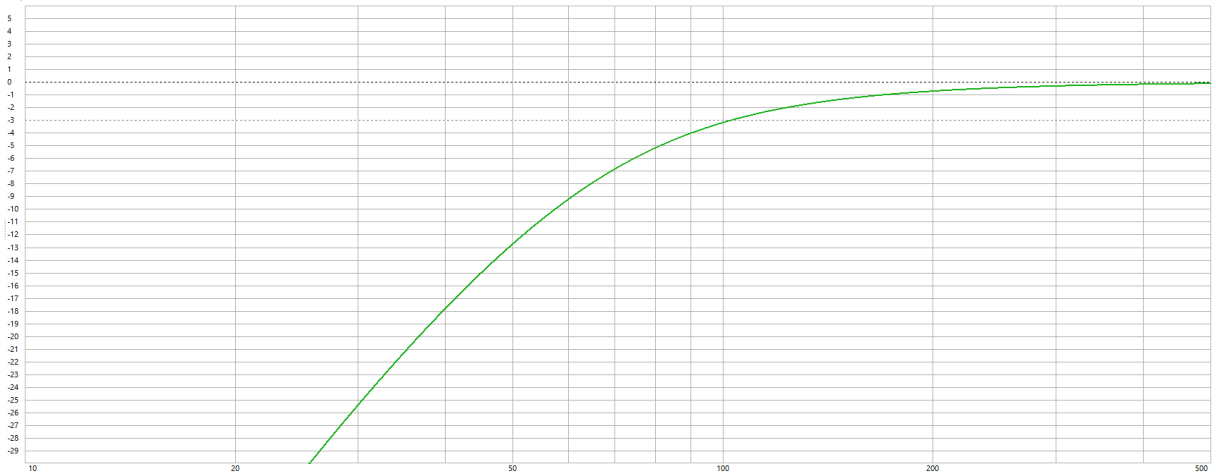
By applying the same constraints for tweeters I found the NHP25F, DSN25F and ND25FW. Since comparing the frequency ranges and checking for crossover compatibility is much easier when done visually, I'm going to simulate it using software. However, one thing is for sure; one of these is going to make it into my first build!

Enclosure Design

I use WinISD to figure out what drivers work best for me. Using the Loudspeakerdatabase it's easy to download the specifications of the speakers in a format that allows WinISD to read and use them. In WinISD I select that I want to use a vented enclosure. This results in the following graphs.

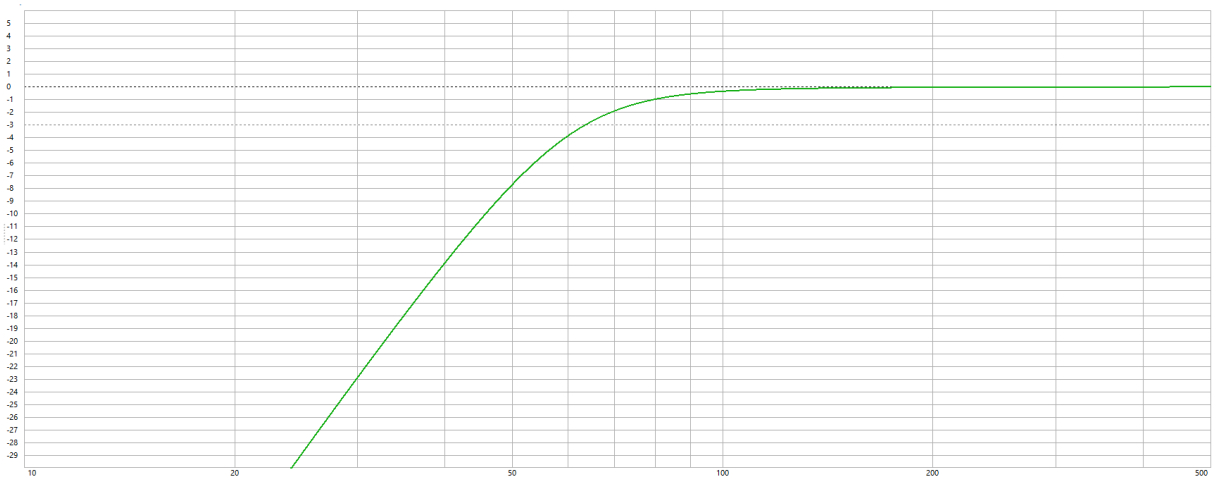
Drivers

CF120



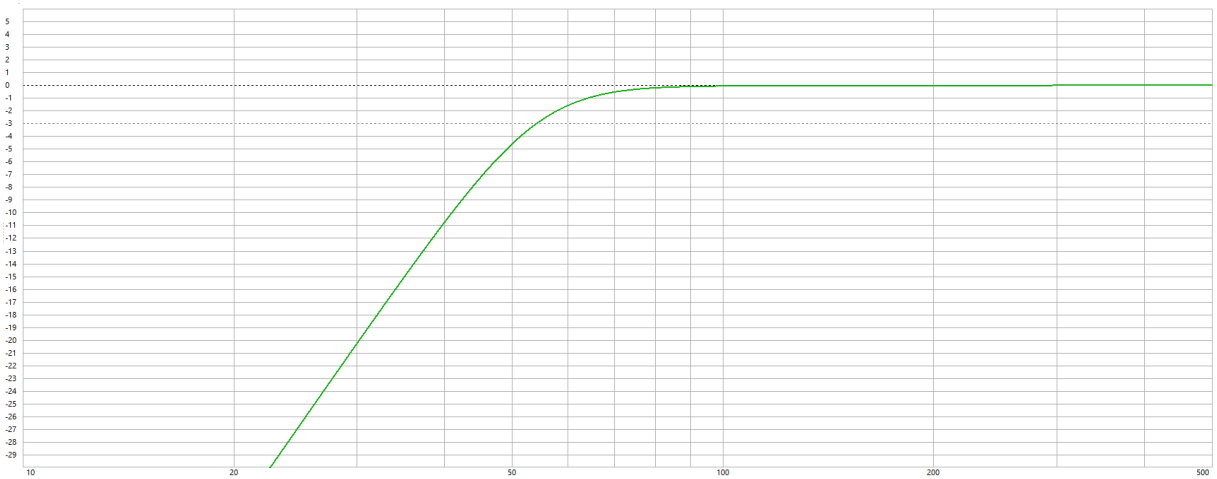
As we can see, the lowest frequency possible is 103Hz. That isn't desirable since we don't want to use a subwoofer; that means an increase in cost. That means this driver is ruled out.

TCP115



This driver seems a lot more suitable at 63Hz. To add to that, the driver only costs €15,-. It tops out at 6000Hz however.

DS135



This driver performs even better at 54Hz and it tops out at 7000Hz instead of 6000Hz. This means there is a wider range of tweeters available. It is however more expensive; €23,- at the time of writing. These €8,- extra deliver a 9Hz lower frequency. For me, that's worth it.

Conclusion

According to the graphs WinISD generated, I'm going to pick the DS135's since they have lower frequencies and they only cost €8,- extra.

Size

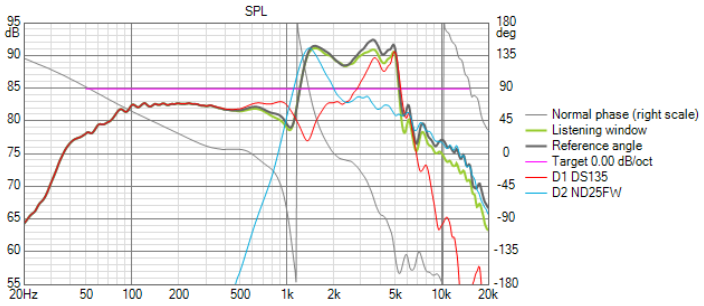
WinISD recommends an internal volume of 6,11 Liters which is equal to 0.215 cubic feet. Since the speakers are meant as desktop speakers, I want them to be as small as possible.

When using 0.5 inch MDF and the DS135 the speaker needs to be at least 7 inches wide. To give some room for error I'm going to pick 7.5 inches as width. I don't really care about depth and height as long as it fits on my desk and doesn't look too big.

When playing with a volume calculator I ended up with 7.5 inches as width, 11 inches as height and 9.5 inches as depth. This results in an interior volume of 0.2148 cubic feet which is close enough to 0.215 cubic feet.

Crossover

To come up with a crossover I'm going to use VituixCAD since it's easy to use but very powerful. To illustrate the need of a crossover, I simulated the speakers connected in series.



The peak in the high frequency range exists because the tweeter has a resistance of 4Ω while the woofer has a resistance of 8Ω. This has to be levelled out with a resistor.

After playing with it for a long time, I ended up with the following frequency response graph. The drivers are crossed over at 3800Hz.