

Hello,

Two years ago I started with the 4pi project thanks to Wayne who helped me a lot with his plans and answering my questions.

Pictures!

1. Building the 4pi speakers

2. Finishing

3. New house, made new tv furniture --> new finishing (birch)

Measurements with ecm8000 mic (listening position): very poor low-end due to room modes and resonances:

I've bought two lab12 subwoofers and made 2 testing enclosures. crossover with mini-DSP (30hz;48db/oct, 120hz;12db/oct):

A very geeky testing setup. My wife loves me when I do this kind of setups.

Much better low-end frequency response at listening position!

When I measure full range from the listening position, there is an obvious rolloff at the high frequencies. Is this something to worry about? I used the behringer ecm8000 mic, used CAL-file (which makes the rolloff even steeper) and the m-audio fast track which is also calibrated by REW.

Thank you in advance!

File Attachments

- 1) [enkel_mains.jpg](#), downloaded 7196 times
- 2) [IMG_0003.jpg](#), downloaded 7190 times

- 3) [IMG_0005.jpg](#), downloaded 7241 times
 - 4) [IMG_0007.jpg](#), downloaded 7154 times
 - 5) [IMG_0011.jpg](#), downloaded 7183 times
 - 6) [IMG_0027.jpg](#), downloaded 7074 times
 - 7) [IMG_0031.jpg](#), downloaded 7128 times
 - 8) [IMG_0159.jpg](#), downloaded 7183 times
 - 9) [IMG_0174.JPG](#), downloaded 7177 times
 - 10) [IMG_0175.JPG](#), downloaded 7054 times
 - 11) [IMG_0176.JPG](#), downloaded 7193 times
 - 12) [IMG_0309.JPG](#), downloaded 7196 times
 - 13) [IMG_0311.JPG](#), downloaded 7081 times
 - 14) [IMG_1256.JPG](#), downloaded 365 times
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 - 16) [IMG_1284.JPG](#), downloaded 7169 times
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 - 18) [mains+sub+eq_emc8000.jpg](#), downloaded 7102 times
 - 19) [mains+sub+eq_emc8000_enkel_sub_1_op_12_smoothing.jpg](#), downloaded 7119 times
 - 20) [mains+sub+eq_emc8000_enkel_sub_no_smoothing.jpg](#), downloaded 7213 times
 - 21) [meubels-008.jpg](#), downloaded 7025 times
 - 22) [meubels-009.jpg](#), downloaded 7261 times
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Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [Wayne Parham](#) on Tue, 26 May 2015 18:39:02 GMT

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Those measurements look good for the most part. But I agree with you that something is wrong above 8kHz.

To isolate the cause, try putting the microphone right in the tweeter throat and see what the response looks like. If the response above 8kHz doesn't look like what's in our published spec sheets, then something is wrong with the compression driver, crossover or measurement gear.

Normally I'd say look at the crossover first. And I suppose it wouldn't hurt to isolate it by removing the crossover. Measure the compression driver, all by itself, with just a series capacitor for protection. But honestly, if we had a crossover problem, I'd expect the response to be bad starting a couple octaves below that. This kind of rolloff looks more like a problem with the driver or the microphone.

In any case, you'll have to do a process of elimination to find the culprit.

Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements
Posted by [vandevoordekoen](#) on Tue, 26 May 2015 18:47:29 GMT
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Ok, thanks. I'll give it a try and will post the results here.

Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements
Posted by [vandevoordekoen](#) on Wed, 27 May 2015 13:05:41 GMT
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To measure the tweeter right, I've put the microphone in the tweeter throat

These are the measurements with the ecm8000 calibration file uploaded

1. Right tweeter

2. Left tweeter

Same measurements without ecm8000 calibration file

1. Right tweeter

2. Left tweeter

The measurements without calibration file look approximately like the published sheets (little more rolloff).

But what with the steeper rolloff when measured at the listening position?

And what about the measurements with calibration file (which are more accurate, no?)

Could it be possible that I made a mistake when making the crossover so the CD compensation isn't working?

Thanks in advance.

File Attachments

- 1) [IMG_2035.JPG](#), downloaded 6900 times
 - 2) [tweeter_left_no_cal_file.jpg](#), downloaded 6762 times
 - 3) [tweeter_left_with_cal_file.jpg](#), downloaded 6881 times
 - 4) [tweeter_right_no_cal_file.jpg](#), downloaded 6823 times
 - 5) [tweeter_right_with_cal_file.jpg](#), downloaded 12252 times
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Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [Wayne Parham](#) on Wed, 27 May 2015 16:04:50 GMT

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I cannot help but wonder if the calibration file is wrong. One must make the inference that the microphone used to create the calibration file has rising response, so the conjugate was to reduce HF by the same amount to compensate. But from what I'm seeing in the response curves, that doesn't appear to be the case. The raw measurements look closer to what I would expect, just like you said. So I lack confidence in the measurements.

I suppose you could have done something in the crossover that would cause this, because the response droops about 10dB through the decade of operation, e.g. 1kHz to 10kHz. That's what mass-rolloff looks like generally, although it is usually flat to about 4kHz and we're seeing falloff around 2.5kHz. So that makes me wonder about the compression drivers.

If you want to isolate crossover from driver, just disconnect the crossover and measure without it, using a direct connection to the compression driver.

In any case, I think we should be suspicious of the measurements and refrain from making too many judgement calls based on them. We're just not sure if the measurements are valid.

Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [vandevoordekoen](#) on Wed, 27 May 2015 21:23:52 GMT

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Disconnecting the tweeter is something for tomorrow or the weekend. I measured the right tweeter (still connected to the crossover) with another mic.

This is the result:

The mic that was used for this measurement isn't perfect, but compared to the measurement with the ecm8000 mic + CAL-file, the same rolloff appears...

earlier measurement with ecm8000 and CAL-file

I guess measuring the tweeter disconnected will give a better image of the sound. To be continued...

File Attachments

1) [tweeter_right_no_cal_file_other_mic.jpg](#), downloaded 6647 times

Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [Wayne Parham](#) on Thu, 28 May 2015 16:19:57 GMT

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I agree with you that using the second microphone tends to confirm the original measurements. The trend shows in both measurements. The second microphone isn't as flat, but the trend is still evident. I would consider this to be corroboration and it gives me more confidence in the tests, or at least in the microphone. I'm still not 100% confident the rolloff isn't from something else besides the compression driver and/or crossover, but I'm becoming more convinced that it is.

It will be interesting to see the measurements sans crossover. That will narrow this down further.

Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [chrisR](#) on Thu, 28 May 2015 16:32:53 GMT

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Wayne, I bought a calibrated PE mic from these guys:

http://www.cross-spectrum.com/measurement/calibrated_dayton.html

Assuming we trust their calibration, I also get similar measurements in the upper octave (10K-20K), where there's a roll-off at ~17KHz. I'll try to figure out how to post the plots.

Chris

Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [vandevoordekoen](#) on Thu, 28 May 2015 17:59:59 GMT

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Here are the measurements of the tweeter directly connected to the amp. ECM8000 mic with calibration file was used.

Frequency response with horn

Frequency response without horn

Same rolloff...

I guess the mic is the problem and the similar rolloff with the other mic is coincidence?

File Attachments

- 1) [driver.jpg](#), downloaded 6657 times
 - 2) [tweeter.jpg](#), downloaded 6727 times
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Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [Wayne Parham](#) on Thu, 28 May 2015 19:36:50 GMT

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I think we can rule out the microphones, because two different ones show the same trend. And I think we can rule out the waveguide, both because its properties are known and also because measurements show it hasn't modified response. We would expect no response change from a waveguide or CD horn. But that still leaves the compression drivers and the measurement system.

The DE250/H290C driver/waveguide combination has less rolloff up high than what I would expect, which is why the crossover has no capacitor in position C1. Traditionally, one would expect to have compensation for mass-rolloff in the form of a first-order high-pass filter in the crossover's tweeter circuit. But not all drivers are like that.

Mass-rolloff is expected, and it's really more unusual to not have it on a CD horn or waveguide. So the DE250/H290C combination is unusual.

Which leads me to this question: Is the driver you're testing a DE250? If not, you might consider installing a capacitor in position C1 to provide mass-rolloff compensation. The response curve shown looks like it could use it. So if the driver isn't a DE250, this may be all that needs to be done.

Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [vandevoordekoen](#) on Sat, 30 May 2015 16:28:22 GMT

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Hello Wayne,

Both compression drivers are B&C DE250 drivers with H290C horns bought on the 4PI-webshop. Both drivers show the same unusual roll-off.

According to your previous post, I understand that the DE250/H290C combination doesn't need extra CD compensation (with an extra C1) because the crossover-design on its own already compensates enough for this CD/horn combination?

This is a picture of the crossover:

1. No C1 is installed
2. An extra resistor (over the tweeter) is installed (to reduce the possible peak at 1.6khz with the H290C horn).
3. R3 (the Zobel) isn't a large silver block (as seen often in the 4pi crossover pictures), but two 15ohm/50W resistors connected parallel.

Nothing of this should cause problems, should it? Or do I overlook something?

Maybe it is an incredible coincidence that both mics show the same roll-off?

Thanks in advance.

File Attachments

1) [IMG_0174.JPG](#), downloaded 3801 times

Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [Wayne Parham](#) on Sun, 31 May 2015 14:48:07 GMT

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The waveguide is ours, I knew that. We're the only ones that make it. But I wasn't sure about the driver or crossover. Now that I know the driver is the DE250, in my mind, that leaves only crossover and measurement system. And I doubt the crossover is doing it. It looks like you have it right. You can always double-check it, but I'm sure you've already done that.

My guess is the measurement system is at fault. Not the microphones, but the system, itself.

Seeing two microphones show the same trend tells me it's probably not the microphones. The only thing that's really left is the system. The input circuitry could cause this, or any number of other things internal to the system.

How does it sound? If there is as much rolloff as would seem to be shown in the measurements, it would sound very muddy and dull, almost like no tweeter was connected. Does it sound that way?

Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [tom-m](#) on Wed, 03 Jun 2015 23:12:21 GMT

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Hi Wayne,

In his crossover, the coils are not positioned on the board in the recommended way. Would this be the cause of his issue?

Tom

Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [Wayne Parham](#) on Thu, 04 Jun 2015 15:19:04 GMT

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You're right, there's more mutual inductance when they're positioned that way, close together and in the same plane. They are coupled together, and act sort of like a transformer. This causes the HF crossover to shift some, and even causes some of the energy from the woofer circuit to bleed into the tweeter circuit, and vice versa. But this would be most evident in the crossover range, and even worst case, it's a fairly small effect. I wouldn't say it's trivial, but the coupling isn't so strong that it could create a 10dB boost or drop.

What we're seeing is HF rolloff, and by a pretty significant amount. I think it's probably the measurement system, and that the charts aren't giving an accurate picture. If they are, if there is something wrong with the crossover or drivers, then the HF is so low that these speakers would sound very dull, almost like no tweeter is connected at all.

Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [vandevoordekoen](#) on Thu, 04 Jun 2015 15:53:42 GMT

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Hello,

I can't say the speakers sound like there is no tweeter at all. Neither can I say that the HF are "sparkling", but maybe that's not necessary.

To test the measurement system, I measured the HF signal 3 times: with and without USB audio card + using 2 different mics (ECM8000 and TASCAM DR-1 (TASCAM is not great but no garbage either)). The following overlap gives an idea:

Red line = TASCAM mic directly connected with laptop (mic-in)
Green line = TASCAM mic connected to the USB audio card (M-audio Fast Track)
Blue line = ECM8000 mic connected to the USB audio card (M-audio Fast Track) WITHOUT .cal-file

Red and Green line are approximately the same. The Fast track isn't the weak link. The ECM8000 measurement without .cal file gives approximately the same result. So the .cal file is corrupted IMHO.

Just to give an idea, these are the same measurements, WITH .cal file applied for the ECM8000 mic

Looking at the first overlap, I see a 5db to 10db roll-off. But this might be normal? Aaaargh, it's driving me a little crazy, honestly.

Would it be the amp?

File Attachments

- 1) [vergelijking.jpg](#), downloaded 3508 times
 - 2) [vergelijking_met_cal.jpg](#), downloaded 3642 times
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Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [Wayne Parham](#) on Fri, 05 Jun 2015 22:37:23 GMT

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I see the rolloff is consistent, so it has to be something common to all measurements. The thing is, a 10dB drop above 10kHz is pretty noticeable, and sounds like a 1970s tape deck that's totally missing the top octave. So if the rolloff is real, the sound you'll hear is pretty dull. If you were around in the 1970s, think under-dash 8-track tape player.

Subject: Re: 4 pi speakers + 3 pi subwoofers, pics & measurements

Posted by [tom-m](#) on Sat, 06 Jun 2015 03:09:49 GMT

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To help narrow down where the problem is, I would ask if you have a set of speakers other than the Pi4. If so, measure another set of speakers. If they show the same HF roll off, then it would be in your measurement gear, or audio gear. If no roll off, then it is in the Pi4 speakers.

Tom
