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Subject: Amp for 4pi speakers

Posted by [vandevoordekoen](#) on Tue, 27 Nov 2018 09:34:47 GMT

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Hello

Thanks to Wayne, I've built a set of 4pi speakers a few years ago.  
However, the room acoustics of our living room are far from ideal.  
We have an L-shaped room and this is the best aesthetic speaker setup:

The 4pi speakers aren't toed-in, they are not on stands. Just on the floor straight forward. It's a compromise between good audio and aesthetics.

There is no acoustic treatment (it's a living room). The only possible treatment are carpets, thick curtains and two book cabinets across from the speakers.

At this moment the 4pi speakers are driven by

- Pro-Ject DAC (<https://www.project-audio.com/en/product/dac-box-s-fl/>)
- Pro-Ject pre-amp (<https://www.project-audio.com/en/product/stereo-box-s/>)
- HH MOSFET amp (from a radio studio)

It's an OK setup, but it's not really user-friendly (I don't get enough digital connections, there are multiple 'power on' buttons, and the MOSFET amp is not user-friendly at all, it's a really old amp, without soft start, that used to be always powered on)

My wife asked me for a more 'easy' setup and I can understand her.

When I connected the speakers to a Denon X2400H (I know, an AVR, some audiophiles will already roll their eyes :) ), I have to agree: it didn't sound much better.

But when I calibrated the amp with audyssey MultEQ Ext, the built-in room correction software of the AVR, we were like WOW.

What a difference. The LF sounds much cleaner now and the HF much brighter. It was like we had a new set of speakers.

This is what audyssey EQ did to the sound:

With REW software, I measured the differences (from listening position). Red is before EQ, green is after EQ:

You can clearly see the differences. You can also see that some signal is lost in the 60-100hz area. I could tweak it with the audyssey app, but I didn't purchase it yet. But overall, it just sounds better.

I know the possibilities of flanking subs to deal with the modes in the LF area, and I experimented with it (2 passive 3pi subs). But somehow, it never worked quite well. Maybe because of our L-shaped room? The asymmetrical placement of the speakers in our room?

So, is it possible?

Is a 700€ AVR the best solution here?

However, I read that an integrated amp is always better than a AVR.

But on the other hand, some people swear that one can't hear an audible difference between amps in the 500-1000\$ price range and above. They 'prove' it with blind tests.

It seems an eternal discussion to me.

I don't know. (But I do know that I don't have golden ears and I don't have a perfect listening room with good accoustics.)

At this moment the Denon x2400H with audyssey is connected and it's doing well..

This week I can test a Marantz PM6006 amp. I'm curious... :)

What are your thoughts considering my situation?

- go with the AVR?
- go with an integrated amp?
- go with an integrated amp, bump up the treble and try to do some EQ/room correction around 200hz? (does something like that is possible under 1000\$?)

We watch 75% movies, listen 25% music.

Thank you for your advice!

PS sorry for the spelling mistakes, I'm not a native english speaker.

## File Attachments

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- 3) [DSC05968.JPG](#), downloaded 1428 times
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- 6) [4PI+L%2BR+luisterpositie+geen+EQ.jpg](#), downloaded 293 times
- 7) [4PI+L%2BR+luisterpositie+Audyssey+Reference.jpg](#), downloaded

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Subject: Re: Amp for 4pi speakers

Posted by [Wayne Parham](#) on Tue, 27 Nov 2018 18:21:45 GMT

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It looks like you've done a very good job already, and I have no doubt you'll tweak your system further to make it even better still.

Congratulations!

You're "working with what you've got," which is what 90% of us have to do. High-quality uniform-directivity loudspeakers help a great deal here, but we're still hostage to room acoustics. That's what you're fighting, but you've done a great job.

I'm not particularly concerned with the amplifier you choose. It will serve you well provided it is a good quality unit that is used within its operating range, e.g. not overdriven and pushed into clipping. So choose your amplifier based on quality and features.

I see you're having the most trouble below 100Hz, and flanking subs aren't effective in that range. They can increase extension but cannot smooth room modes below 80Hz. The flanking sub configuration is intended to smooth the upper midbass and lower midrange, which is partly influenced by high-frequency modes but mostly affected by self-interference from the wall behind the speakers and side walls that are very near. Those boundaries cause a deep notch, usually in the 100Hz to 150Hz region, and this is too high for more distant multisubs to mitigate.

You may find that you do have a notch or two above 100Hz, and that a higher-resolution measurement would expose them. In fact, I think I see evidence of that in the dip around 120Hz. The measurement system likely smoothed a deep notch there, making it appear to be wider but less deep than it really is. Flanking subs would smooth that.

But for the region below 100Hz, distributed mutisubs are the best cure. You'll want to place subs far from the mains, and low-pass deep enough to prevent localization. Of course, the farther away they are, the more important it will be that low-pass be deep and steep. This, of course, limits their ability to smooth the higher-frequency room modes. You may have to limit the distributed subs to 60Hz to 80Hz, and that leaves the range above 80Hz unmitigated.

This is why I find a blended approach to be the best solution. Funny, I'm proposing a "blended approach to subwoofer blending." :lol:

Use flanking subs and distributed multisubs. The flanking subs can't smooth the modes below 100Hz by themselves, but when combined with a couple distributed subs placed some distance away, smoothing is very effective. Distributed subs are limited by localization problems, and so must be low-passed too low to smooth modes above 80Hz or so. Flanking subs are limited by close proximity to the mains, and so cannot achieve effective smoothing below 80Hz or so. But together, they can smooth the whole modal region.

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Subject: Re: Amp for 4pi speakers

Posted by [vandevoordekoen](#) on Tue, 27 Nov 2018 19:51:30 GMT

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Hi Wayne

Thank you for your quick and helpful answer!

You're right about the notch at 120hz. I always like to smooth the measurements a bit because it gives a good feeling. :blush: :d

A less smoothed image of the measurement from listening position without EQ shows clearly what you predicted:

So, generally this notches would disappear with flanking subs for the upper midbass and lower midrange whereas more distant multisubs can smooth out below 100hz?

So... Adding 4 subs. :roll: :d

Do these subs have to be big and is the position of the distant subs crucial?

The Audyssey EQ flattens/lowers the frequencies from 100hz to 300hz (which caused somewhat a muddy bass IMHO). This lowered frequencies already made a much better image in the midrange bass.

Can flanking subs/distant subs solve this acoustic problem around 200hz too or is EQ here the only cure?

Thank you, honestly.

#### File Attachments

1) [4PI L+R luisterpositie geen EQ minder smoothing.jpg](#),  
downloaded 1384 times

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Subject: Re: Amp for 4pi speakers

Posted by [Wayne Parham](#) on Tue, 27 Nov 2018 22:47:16 GMT

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In my experience, 200Hz is about the limit of the flanking sub (helper woofer) approach. But I've blended the woofer with the mid(woofer) to ~250Hz in some loudspeakers and it has worked well.

Some specialized cases, like the constant directivity cornerhorns, allow for a wide overlap band. Many 2.5-ways are designed this way too. The midwoofer and helper-woofer are in fairly close proximity, so they can overlap to fairly high frequency.

But when I've run subwoofers as "helper woofers" - in the configuration I call "flanking subs" - I generally don't run them that high. They are localizable if the rolloff is made too high. I generally

use low-pass between 90-120Hz second-order, which provides quite a bit of output in the 100Hz to 200Hz region because rolloff is so gradual.

You could try 150Hz second-order, which would definitely provide output up to 200Hz and beyond. But it might start to sound unnatural when run that high.

As for the modal smoothing below 100Hz, please do a search here for multisub setups. There are a few approaches, but most agree that if you have four subs (or more) it almost doesn't matter where you put them. Just don't cluster them together - Place them around the room.

Multisubs and Flanking Subs

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Subject: Re: Amp for 4pi speakers

Posted by [tom-m](#) on Tue, 27 Nov 2018 23:44:08 GMT

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About your amp question, you could use the AVR for the convenience, with remote and many inputs. And if your AVR has pre-out, you can use a higher quality external amp if needed.

Very nice job on the speaker cabinets!  
tom

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Subject: Re: Amp for 4pi speakers

Posted by [vandevoordekoen](#) on Wed, 28 Nov 2018 21:17:15 GMT

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Wayne Parham wrote on Tue, 27 November 2018 16:47But when I've run subwoofers as "helper woofers" - in the configuration I call "flanking subs" - I generally don't run them that high. They are localizable if the rolloff is made too high. I generally use low-pass between 90-120Hz second-order, which provides quite a bit of output in the 100Hz to 200Hz region because rolloff is so gradual.

You could try 150Hz second-order, which would definitely provide output up to 200Hz and beyond. But it might start to sound unnatural when run that high.

Thank you for the answer, Wayne. I've read the post through and I realised that this was exactly what I tried to do a few years ago in our previous house! :)

This was my setup with (temporary) flanking subs:

This was the measurement with one flanking sub:

With the second flanking sub:

Bass response improved, but the 100hz-300hz was still too pronounced to me.

... which made me sell the subs. :(

I might buy new ones (but maybe smaller ones that blend aesthetically more in our living room, really "helper" woofers that won't go lower than the JBL woofers).

But I guess that those helper woofers will particularly fill the notches but won't lower the complete 100hz-300hz frequency range that is little bit too pronounced because of our room acoustics?

#### File Attachments

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- 1) [mains + sub + eq emc8000.jpg](#), downloaded 1315 times
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  - 3) [+1 sub.jpg](#), downloaded 1318 times
  - 4) [+2subs.jpg](#), downloaded 1260 times
  - 5) [mains + sub + eq emc8000 enkel sub no smoothing.jpg](#), downloaded 1318 times
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Subject: Re: Amp for 4pi speakers

Posted by [vandevoordekoen](#) on Wed, 28 Nov 2018 21:50:04 GMT

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tom-m wrote on Tue, 27 November 2018 17:44 About your amp question, you could use the AVR for the convenience, with remote and many inputs. And if your AVR has pre-out, you can use a higher quality external amp if needed.

Very nice job on the speaker cabinets!  
tom

Thank you Tom!  
They're finished with birch, I love the scandinavian look of it. :)  
About the amps, that's a good idea!

I tried it.

First I hooked up a marantz PM6006 stereo amp (not too fancy but good stereo amp) directly to

the speakers and it sounded good! Controlled and warm at the same time.

Switched then to the Denon X2400H (the AVR that I tested earlier with Audyssey room correction) and I could hear immediately a difference. With room connection and without. Without having golden ears. :)

The Marantz just "controlled" the sound more. That's the best way I can describe it.

When I hooked the Marantz up to the Denon's pre-out, it didn't sound as good as I expected. Even in direct mode on the Denon AVR, the Marantz didn't sound as good as when I connected the source directly to the Marantz.

So the stereo amp was a clear winner to me.

I'd like to connect provisionally a DSP to a stereo amp to control the 100hz-300hz frequency range, but the tested PM6006 unfortunately doesn't have a PRE OUT.

Can someone give me some advice here? I'm looking for a good stereo amp (<800\$) with digital connections (at least two opticals) and a pre-out to connect a DSP?

..until or in combination with the flanking subs/multiple subs approach. ;)

(Ah, I guess this quest for the perfect sound is a never ending story.. :o )

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Subject: Re: Amp for 4pi speakers

Posted by [Wayne Parham](#) on Fri, 30 Nov 2018 15:40:18 GMT

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vandevoordekoen wrote on Wed, 28 November 2018 15:17 But I guess that those helper woofers will particularly fill the notches but won't lower the complete 100hz-300hz frequency range that is little bit too pronounced because of our room acoustics?

The flanking subs did exactly what I would have expected, which was to reduce 15dB ripple in the 100-200Hz region to 6dB ripple. That's a "textbook case" of what to expect. Flanking subs can smooth the range a little lower than 100Hz - usually down to 80Hz and sometimes as low as 60Hz - but below 60-80Hz is where distributed multisubs work best.

Your measurements show a perfect example of what the flanking sub configuration does:

Without flanking subs:

With flanking subs:

As for over-representation in the 100-300Hz range, that's not really something the flanking sub

configuration can address. Flanking subs don't usually go that high and even if they did, they will generally add energy rather than cancel it.

There are some situations where peaks will be partially cancelled, but it's really better suited to "fill in the holes." And as frequency rises above 200Hz, sound becomes more statistical - a reverberent field - so it tends to become more of an average sound level and not distinct modes. That's where the EQ will become more effective.

vandevoordekoen wrote on Wed, 28 November 2018 15:17I might buy new ones (but maybe smaller ones that blend aesthetically more in our living room, really "helper" woofers that won't go lower than the JBL woofers).

That's perfect. Probably the biggest objection and hardest problem for people to solve is where to put all the subs. It's better to have a number of small subs than one big one. But flanking subs don't have to dig deep, they just have to blend with the mains in the 80-200Hz range. So they don't necessarily need to be large. And distributed multisubs - placed further away - can be small and relatively inefficient because the fact that you are using several tends to increase SPL. So you can use relatively small boxes, and that helps when trying to work with the room decor.

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Subject: Re: Amp for 4pi speakers

Posted by [vandevoordekoen](#) on Fri, 30 Nov 2018 16:47:33 GMT

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Wayne Parham wrote on Fri, 30 November 2018 09:40The flanking subs did exactly what I would have expected, which was to reduce 15dB ripple in the 100-200Hz region to 6dB ripple. That's a "textbook case" of what to expect. Flanking subs can smooth the range a little lower than 100Hz - usually down to 80Hz and sometimes as low as 60Hz - but below 60-80Hz is where distributed multisubs work best.

Nice to read that I (and the room) did things right there. :)

Quote:As for over-representation in the 100-300Hz range, that's not really something the flanking sub configuration can address. Flanking subs don't usually go that high and even if they did, they will generally add energy rather than cancel it.

I guess my expectations were wrong here. Should have read your paper better. :roll:

Quote:And as frequency rises above 200Hz, sound becomes more statistical - a reverberent field - so it tends to become more of an average sound level and not distinct modes. That's where the EQ will become more effective.

Can I get good EQ with 200\$ budget for EQ? If so, any advise?  
Any thoughts about MiniDSP 2x4?

Quote:...flanking subs don't have to dig deep, they just have to blend with the mains in the



80-200Hz range. So they don't necessarily need to be large. And distributed multisubs - placed further away - can be small and relatively inefficient because the fact that you are using several tends to increase SPL. So you can use relatively small boxes, and that helps when trying to work with the room decor.

OK, interesting. I have 3 more questions here...

- what small woofer would you advice as helper-woofer in 80-200hz range?
- what small woofers would you advice in multiple sub config?
- Is passive low-pass crossover possible with an external amp or is it better to use plate-amps with active crossover?

What is the budget I have to keep in mind for flanking subs/multiple subs? 8)

All the best.

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Subject: Re: Amp for 4pi speakers

Posted by [Wayne Parham](#) on Fri, 30 Nov 2018 18:48:22 GMT

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vandevoordekoen wrote on Fri, 30 November 2018 10:47 Can I get good EQ with 200\$ budget for EQ? If so, any advise?

Any thoughts about MiniDSP 2x4?

Equalizers aren't terribly expensive. I'm not a big fan of the old analog graphic equalizers but do like parametric and digital equalizers. The MiniDSP is fine.

vandevoordekoen wrote on Fri, 30 November 2018 10:47- what small woofer would you advice as helper-woofer in 80-200hz range?

- what small woofers would you advice in multiple sub config?
- Is passive low-pass crossover possible with an external amp or is it better to use plate-amps with active crossover?

I must admit that all the drivers I use need pretty large boxes. So I'm not sure my suggestions will work for you, since all need at least 50 liters boxes and most need closer to 75 or 100 liters.

But in that class - for "helper woofers" - I'd use JBL 2226H, Eminence Definimax 4012 or Eminence LAB12. Of those, the first two are actually midwoofers. You could probably use a midwoofer like the Alpha 10 in a smaller box and it would cost less. Any of the before-mentioned woofers work well as "helper woofers" flanking the mains.

For distributed multisubs, you really need a driver tuned to be used as a subwoofer, like the LAB12. There are lots of drivers in that class - You could even use a small diameter car subwoofer. The main thing to consider here - if you need to put it in a small box - is that its electro-mechanical characteristics allow it to be used in a small box and still give good bass

extension. This kind of tuning will be inefficient, but again, using several will help generate the SPL required as well as provide modal smoothing.

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Subject: Re: Amp for 4pi speakers

Posted by [vandevoordekoen](#) on Mon, 03 Dec 2018 20:18:10 GMT

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Thank you, Wayne, for the helpful answer.

Would bass improve (100hz-300hz) when the 4pi speakers would be on a speaker stand?

And I was thinking, do the helper woofers really have to be in a separate enclosure? (just playing with this idea of making a 2-pi tower with built-in helper woofers). :roll:

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Subject: Re: Amp for 4pi speakers

Posted by [Wayne Parham](#) on Mon, 03 Dec 2018 23:29:54 GMT

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I would describe 100-300Hz as midrange. The fundamentals of human vocals are there; Middle C on the piano is in this range. So it isn't bass at all - It's midrange. And, yes, I think having the speakers on stands will modify the sound in this range. Most people prefer sounds in this range to originate at or near "ear level" because it sounds more natural. But it isn't really caused by a perceived (or even measured) difference in tonal characteristics - It's a position/directional thing.

About the placement of the "helper woofer" - You really need it to be in a separate enclosure for best results. It has to be offset a half-meter to a full meter in all three dimensions; The flanking sub should be placed below, beside and behind the main speaker it is flanking. This is what provides the smoothing of self-interference anomalies from nearest boundaries.

As an aside, I developed the flanking sub approach from three influences, one of which was the 2.5-way configuration. A 2.5-way loudspeaker has a helper woofer in the same cabinet as the main woofer, and it is usually low-passed somewhere close to the baffle-step frequency. The expected benefit of the 2.5-way design is to mitigate the on-axis drop called the "baffle step" when the pattern widens to omnidirectional at low frequencies. At higher frequencies, there is baffle-enforced forward directivity, which increases on-axis SPL. The "helper-woofer" in a 2.5-way increases SPL at frequencies below the baffle step. This benefit is also provided by the flanking sub configuration, because it works essentially the same way except that the "helper woofer" placement is offset in all three dimensions. This gives an added benefit: It smoothes the self-interference anomalies from nearby reflections.

The flanking sub arrangement was also influenced by line arrays and by the multisub

configuration. Line arrays mitigate floor and ceiling notches because of differing path-length differences between the listener and each element of the array. A 2.5-way loudspeaker is a truncated array, and it does tend to reduce the size of the floor-bounce provided it is measured in a position that places the notch in the overlap band. From this I reasoned that a helper woofer placed behind the main speaker might mitigate the self-interference notch that results from the reflection from the wall behind the speaker. Placing it a small distance from the mains in all three dimensions reduces self-interference anomalies from any nearby boundary and additionally provides modal smoothing for the higher-frequency room modes.

So the short version of all this is you can put a "helper woofer" in the same cabinet as the main woofer, but then you have a 2.5-way loudspeaker and you will not gain all the benefits provided by the flanking sub configuration.

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Subject: Re: Amp for 4pi speakers

Posted by [vandevoordekoen](#) on Wed, 05 Dec 2018 19:44:38 GMT

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So this is not a good idea, I guess (apart from the questionable photoshop skills)?

The helper woofer acts as a stand at the same time :d

#### File Attachments

1) [4pi + helper woofer integrated.jpg](#), downloaded 701 times

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Subject: Re: Amp for 4pi speakers

Posted by [Wayne Parham](#) on Thu, 06 Dec 2018 14:36:59 GMT

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That won't provide all the benefits of a flanking sub, no.

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Subject: Re: Amp for 4pi speakers

Posted by [vandevoordekoen](#) on Fri, 07 Dec 2018 10:52:54 GMT

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My wife saw the sketch, no worries, it will not happen! :d

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