
Subject: Back EMF?

Posted by [Frihed89](#) on Sat, 23 Apr 2011 05:45:06 GMT

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A local speaker guru has warned me that a 12-15" driver may produce a lot of back-EMF that amps with very poor damping factor (2A3 SET) have a hard time coping with, regardless of sensitivity.

First of all, what is back-EMF? Second, is it a problem with the 2A3 on the Four Pi?

Subject: Re: Back EMF?

Posted by [Wayne Parham](#) on Sat, 23 Apr 2011 08:05:07 GMT

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Back-EMF is the voltage produced when the mass of motor causes it to act as a generator after the drive voltage has shut off or reversed. It is a real concern in some cases, but not in high-efficiency speakers like these. The electro-mechanical properties that make it efficient also tend to reduce those kinds of side effects.

What you should watch for - an indirect measure of this - is the maximum impedance. You don't very benign impedance curves. I've called them "tube friendly" speakers in the past, because they truly are. They offer high efficiency and gentle impedance curves.

Subject: Re: Back EMF?

Posted by [Bill Epstein](#) on Wed, 27 Apr 2011 03:00:38 GMT

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My experience is limited to Parafeed amps but I have driven both Theatre 4s and the newer 4Pis with both 2A3 and 45 amps w/o bass driver anomalies. In the case of the Bottlehead 2A3 Paramours, they made Theatre 4s fill an auditorium with sound.

Amioutaline?

Subject: Re: Back EMF?

Posted by [Matts](#) on Thu, 28 Apr 2011 16:38:03 GMT

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the Pi 4's sound great with SET! I've used mine with parafeed 2A3s as well with great bass (both in quantity and quality) and no problems. Topic can get complex- with lots of factors, but not necessary here.

Subject: Re: Back EMF?

Posted by [Frihed89](#) on Fri, 29 Apr 2011 23:05:42 GMT

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Thanks. The guy who warned me is actually a very accomplished speaker designer, but tends not to like 2-way designs for high efficiency.

Subject: Re: Back EMF?

Posted by [Matts](#) on Sat, 30 Apr 2011 21:24:34 GMT

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that's why he's a "local speaker guru" and Wayne's an "international speaker guru"! haha

Subject: Re: Back EMF?

Posted by [Bill Epstein](#) on Sun, 01 May 2011 23:00:44 GMT

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Frihed89 wrote on Fri, 29 April 2011 19:05 Thanks. The guy who warned me is actually a very accomplished speaker designer, but tends not to like 2-way designs for high efficiency.

He'd love this:

... except the 2123s were "blown" and the "high efficiency" ribbons were anything but. Good intentions, high-quality drivers and a lot of plywood a good speaker does not make.

Remember these Bat-Speakers? And the giant horns attached to the XLH 1812s directly behind?

File Attachments

1) [JBL 3 Way Proto.jpg](#), downloaded 5869 times

Subject: Re: Back EMF?

Posted by [Frihed89](#) on Mon, 02 May 2011 08:34:19 GMT

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Troels Gravesen: www.troelsgravesen.dk in english

Subject: Re: Back EMF?

Posted by [Wayne Parham](#) on Mon, 02 May 2011 13:10:55 GMT

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I appreciate the nod and I hope nobody was offended.

Putting personalities aside, just looking at the facts, it really isn't accurate to say a 12" or 15" woofer is more or less likely to generate greater back-EMF than a woofer with smaller cone diameter. It isn't even the diameter that matters, it's the mass. And that's not the only thing that comes into play. There's the amount of mechanical damping verses electrical damping, and there's the strength of the motor, the magnetic strength and the voice coil impedance.

I've measured woofers that created such strong back-EMF they actually induced current sufficient to make sound in adjacent drivers connected through a passive crossover network. This is unusual, of course, but it is an extreme example of back-EMF. A driver like this has to be connected directly to an amplifier output, and the amplifier would need to have good damping factor, i.e. low output impedance. No tube amp would work well with a driver like this. Ironically, it wasn't even that large - it had a 6" diameter cone.

The kind of woofer I expect to have the most trouble with is the one with a fairly heavy cone and very loose suspension. It's designed to be used as a subwoofer. That kind of woofer often generates a lot of back-EMF. The truth is, that kind of tuning is popular in car subwoofers, and there are a lot of them with cones from 6" to 10". The problem isn't limited to drivers larger than 12", in fact, I'd say the ones most likely to be a problem are the little ones with real heavy cones. Nothing to damp them but the amp.

High-efficiency drivers tend to have lighter cones and stronger motors. That's not to say they are all immune to back-EMF - I've seen a few with fairly high impedance at resonance (Z_{max}), which is an indirect indicator of back-EMF. And that's really the problem, in most cases, because you're not usually dealing with back-EMF at the extreme of the example I gave above. Usually, it's the impedance fluctuation interacting with the tube amplifier's output impedance that is the problem. This creates a voltage divider that varies with frequency, which is another way of saying it creates a filter. The amplitude response is adversely affected as a result.

More information:

Back-EMF

Z_{max}

Subject: Re: Back EMF?

Posted by [spkrman57](#) on Wed, 04 May 2011 16:57:18 GMT

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I have used the following small tubed amps on my 4-Pi spkrs utilizing 8 and 16 ohm 2226 drivers with no problems:

45/2A3/300B/Triode strapped EL34

I will re-iterate what Wayne has said in the past concerning the 2226 liking more wattage than what the little amps put out for max performance (10 % of max or 60 wpc).

I agree with that, but I will say that the dropoff in performance using little tubed amps under 10 wpc is not really that drastic. I don't know too many other 15" drivers that would work as well for me!!!

Just my 2 cents worth of course!

Regards, Ron

Subject: Re: Back EMF?

Posted by [Frihed89](#) on Wed, 04 May 2011 17:24:58 GMT

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No problem. Troels has made some nice speakers. I simply showed him a pic of the Pi-4s, so he didn't have much to go on.

I am going to make these. My step son has agreed to make the cabinets. I'll do the rest, slowly, culminating in the purchase of the cross-over. Probably in the fall.

My new amps (2A3) don't get here until July or August.

Subject: Re: Back EMF?

Posted by [Matt](#)s on Wed, 04 May 2011 23:43:47 GMT

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What amps are you using? I think the parafeed design typically has a little better damping than the classic single end, and also a better quality output xfmr is nicer, but you'd be fine either way with a well-designed amp. I also think that the "honest" xover design and the fact that there's no drastic dip in the impedance curve in Pi 4's is helpful with smaller tube amps. No offense meant with guru comment- I didn't know anything about the other guy- just kidding around. Hope that was clear by the smiley! You'll be quite happy with the Pi 4's.

Subject: Re: Back EMF?

Posted by [Frihed89](#) on Thu, 05 May 2011 01:33:24 GMT

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Fi 2A3 monos. They are DC coupled but not parafeed.

Subject: Re: Back EMF?

Posted by [Wayne Parham](#) on Thu, 05 May 2011 15:12:54 GMT

as speakers come - very efficient and benign with respect to impedance load. Seriously, there are few other speakers that are as easy to drive.

This back-EMF thing has actually been a topic of several discussions, a particular focus of mine many years ago. It's a big issue for tube amps, and it's one of the things that my loudspeakers are particularly good at. Look back through the links from my earlier post, if you're interested. Seriously, we've got this covered.

Subject: Re: Back EMF?

Posted by [Frihed89](#) on Thu, 05 May 2011 15:34:24 GMT

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Thanks Wayne,

I will.

I take it that you think the JBL drivers are worth the extra €?

Also, I see you think that the smallest sonic improvement comes from better caps. But I wonder if someone hasn't fitted out the entire crossover in a way that might give additional benefits?

Subject: Re: Back EMF?

Posted by [Wayne Parham](#) on Thu, 05 May 2011 15:36:36 GMT

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spkrman57 wrote on Wed, 04 May 2011 11:57I have used the following small tubed amps on my 4-Pi spkrs utilizing 8 and 16 ohm 2226 drivers with no problems:

45/2A3/300B/Triode strapped EL34

I will re-iterate what Wayne has said in the past concerning the 2226 liking more wattage than what the little amps put out for max performance (10 % of max or 60 wpc).

I agree with that, but I will say that the dropoff in performance using little tubed amps under 10 wpc is not really that drastic. I don't know too many other 15" drivers that would work as well for me!!!

Just my 2 cents worth of course!

Regards, Ron

Absolutely, I agree. I use mine with 10-watters and have been very happy with them on 2A3-based 2-watters too. They're fine, sound great and are quite loud.

The thing about the 2226 at low power levels is not related to Zmax or back-EMF in any way. It's the fact that the driver was designed to handle a lot more power, and the electro-mechanical parameters shift at moderate levels. So at flea-power, the tuning of the system makes it lack bass a little bit. It will actually shift to have more bass at higher power levels. But the speaker was design with this shift in mind, and it never shifts into an underdamped (peaky) condition. It is always slightly overdamped, and shifts a bit under the curve, but never anywhere close to an underdamped condition. This is a very friendly alignment, tolerant of shifts.

Subject: Re: Back EMF?

Posted by [Wayne Parham](#) on Thu, 05 May 2011 15:46:32 GMT

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Frihed89 wrote on Thu, 05 May 2011 10:34I take it that you think the JBL drivers are worth the extra €?

Absolutely. They have shorting rings that provide flux modulation control. The improvement from that feature is huge.

Frihed89 wrote on Thu, 05 May 2011 10:34Also, I see you think that the smallest sonic improvement comes from better caps. But I wonder if someone hasn't fitted out the entire crossover in a way that might give additional benefits?

Not sure what you mean. The crossovers are highly optimized and have a nice clean forward lobe. Even the stock build uses great parts, or you can substitute with upgraded premium parts. Honestly, this is a price-no-object solution, even though it's not particularly expensive. I don't think there are any "additional benefits" possible, this is a no-compromise solution.

loudspeakers. Upgrade them with the premium drivers and you have the best you're going to get as far as mains are concerned. Where you can improve the system is by adding subs. Drive them with a separate amplifier and let them provide solid foundation and smooth room modes. See the last few pages of the whitepaper below for more information:
High-Fidelity Uniform-Directivity Loudspeakers

Subject: Re: Back EMF?

Posted by [Frihed89](#) on Thu, 05 May 2011 18:31:38 GMT

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I intend to buy the higher price mid-range drivers and tweeters from Germany or the UK. Is that what you mean? I don't particularly relish spending a lot of money on cross-over caps. (The 2A3 that I am getting has no film caps at all. It is a single stage DC amp). Since I'll buy the cross-over units from you, already populated, I'll take whatever you give me. What are the standard grade caps ? Sonic-caps or something like that?

My amps are: 12W Class A PP triode made by Jef Larsen, a 10W 300B integrated made by Audio Note (UK) and 3.5 W 2A3 made by Don Garber (Fi).

Subject: Re: Back EMF?

Posted by [Wayne Parham](#) on Thu, 05 May 2011 19:38:08 GMT

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Frihed89 wrote on Thu, 05 May 2011 13:31 I intend to buy the higher price mid-range drivers and tweeters from Germany or the UK. Is that what you mean?

Yes, the most important parts to upgrade are the midwoofer and tweeter compression driver.

Frihed89 wrote on Thu, 05 May 2011 13:31 I don't particularly relish spending a lot of money on cross-over caps. (The 2A3 that I am getting has no film caps at all. It is a single stage DC amp). Since I'll buy the cross-over units from you, already populated, I'll take whatever you give me. What are the standard grade caps ? Sonic-caps or something like that?

We maintain inventory of Erse, Solen, Jantzen (Cross-Cap and Z-Cap) and Auricaps. All are polys. When I get an order that specifies a particular brand, then I use them of course. But if not, I just use whatever I have most stock of. They're usually Erse or Jantzen Cross-Caps, but may be another brand. They'll definitely be high-quality poly caps.

Frihed89 wrote on Thu, 05 May 2011 13:31 My amps are: 12W Class A PP triode made by Jef Larsen, a 10W 300B integrated made by Audio Note (UK) and 3.5 W 2A3 made by Don Garber (Fi).

Excellent. Sounds very much like the amps I have in various rooms. I have an Audio Note Kit 2 (SET KT88), a Stoetkit (UL 6BM8) and an Image Audio (SET EL34).

Subject: Re: Back EMF?

Posted by [Frihed89](#) on Fri, 06 May 2011 11:21:14 GMT

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What is the difference, if any, between a JBL 2226H and 2226J? Which one is the "right" one?

Is the "wave guide" (please don't eat me alive) for the tweeter on the Four- Pi available from

commercial vendors or made to your specs? I am in Denmark.

What happens (both the good and bad) when you add a super tweeter on the top of the box? Will it help my dog appreciate music better? Or me? I suspect it requires a new or another cross-over, correct?

Subject: Re: Back EMF?

Posted by [Wayne Parham](#) on Fri, 06 May 2011 15:06:06 GMT

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Frihed89 wrote on Fri, 06 May 2011 06:21 What is the difference, if any, between a JBL 2226H and 2226J? Which one is the "right" one?

Frihed89 wrote on Fri, 06 May 2011 06:21 Is the "wave guide" (please don't eat me alive) for the tweeter on the Four- Pi available from commercial vendors or made to your specs? I am in Denmark.

It's an Eminence H290. I would be happy if you got that in Denmark, as it would save shipping charges. The most cost-effective thing for you to do is to get the crossovers from us and source everything else locally.

Frihed89 wrote on Fri, 06 May 2011 06:21 What happens (both the good and bad) when you add a super tweeter on the top of the box? Will it help my dog appreciate music better? Or me? I suspect it requires a new or another cross-over, correct?

will result. You won't need the extension anyway, because the DE250 reaches to 18kHz.
