Subject: Been learnin' about crossovers
Posted by Bill Epstein on Mon, 05 Sep 2011 22:34:58 GMT
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Still in search of a way to improve the imaging of the Utahs, I came across this fairly easy paper by Rane that deifies the Linkwitz-Riley:
 http://www.rane.com/note160.html

Further reading led me that way as well:
http://faculty.spokanefalls.edu/InetShare/AutoWebs/pamelam/crossover%20filters%20amundson.pdf

The cascaded Butterworths appear to my Freshman eyes to make sense and there's no doubt the conventional 24dB slope will help protect the tweeter crossed at just twice it's Fs. My Googling also turned up the Marchand site and his well-known SS and tube crossovers that emply only the L-R crossover in a choice of 24 or 48dB cut.

I even have a better understanding of why Wayne uses a 3rd Order Butterworth on the Pi horns so even if the Utahs still suck (!), at least I learned a little something about lobes and phase angles, etc.

That Marchand X-9 looks kinda tempting at $599 when you see all the caps it's gonna take to build my 24dB passive. Here's a mock-up on a piece of notebook paper that pretty nearly emptied my parts box!

I had to order a .33mH coil, the one value I was missing so I drew a circle that reads .33 inside if you can see it LOL

File Attachments
1) IMG_2225_1.jpg, downloaded 5405 times

Subject: Re: Been learnin' about crossovers
Posted by Wayne Parham on Tue, 06 Sep 2011 03:13:59 GMT
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One thing I've learned about crossovers - Textbook garden-variety filters are never optimal. The best crossover will always have some fudged values, not textbook ones. Getting the phase angles right for the complex load and specific path lengths always means juggling the values to dial-in the lobe. So there's little meaning for me of the basic slopes described as Butterworth, Linkwitz-Riley, Bessel, Chebyshev, Elliptic, etc. All describe a specific transfer function, but I never implement any of them in practice. Mine are always modified slopes, hybrids, dialed in to set the transfer function and forward lobe precisely where I want it to be.

Subject: Crossover design is science and art!
Posted by spkrman57 on Tue, 06 Sep 2011 13:40:44 GMT
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I agree with Wayne that you can't just throw a textbook crossover together without taking the drivers/amps/environment into consideration.

Right now I'm trying to decide if I want to build Wayne's new 4 Pi crossover or reduce the LF section to be a 2nd order w/heavy zoebel. Either design is modified for 16 ohm use!

JBL 2226J and 2446J/Be/500hz round tractix Edgarhorn are the drivers and it has been mentioned before that the round horn has a different dispersion pattern and that affects the lobing.

In the past I have had success with the old 4 Pi crossover w/single coil on the 2226. I also built the new design years ago and I felt the whole did not equal the sum of the parts. Bear in mind the different compression drivers/horns I used.

I will probably build 3 versions of the LF crossover section and listen to each one for a week or so and see which I prefer in the long run.

I'm currently using a modified version of the 3 Pi crossover as it worked very well in my previous system using a EV SP-12. However the 2226 and SP-12 are 2 completely different drivers.

I just had to break-in some 2226's I just swapped for recently. The part that was really hard to handle is using a pair of JBL 2426's on a 1" to 2" JBL adaptor for my 2nd pair of 500hz Edgarhorns.

"Titanium vs Berilium" (sp?) is a no brainer, I just did not want my good horns/drivers out while swapping things around and testing.

The Be diaphrams are everything a diaphram can be. I'm spoiled big-time with them and listening to the Ti phrams now is depressing!

Sorry to go so far OT Bill/Wayne, I just have not posted much lately and trying to catch up!

Regards, Ron

Subject: Re: Been learnin' about crossovers
Posted by Bill Epstein on Tue, 06 Sep 2011 19:03:53 GMT
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Wayne Parham wrote on Mon, 05 September 2011 23:13
One thing I've learned about crossovers - Textbook garden-variety filters are never optimal. The best crossover will always have some fudged values, not textbook ones. Getting the phase angles right for the complex load and specific path lengths always means juggling the values to dial-in the lobe.

I have to start somewhere and although I do know how to sing into a microphone I don't have one, or measuring equipment.

The main thing I want to accomplish is to see if a lower crossover point will rid the speaker of beaming from the woofer. That's assuming the woofer is beaming! Seems like the Linkwitz-Riley has become the default for dynamic speakers and pro crossovers so...why not? All it will cost is some time, I have all the parts.

Stay tuned.

Subject: Re: Been learnin' about crossovers
Posted by Wayne Parham on Tue, 06 Sep 2011 21:14:03 GMT
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I always start with textbook values. It's definitely the place to start. Then I manipulate them slightly, sort of fine-tuning the forward lobe.

If you scan through my Spice models, you'll see both the chosen values and a list of textbook figures, not even rounded to the nearest available component value. As an example, look at the

Crossover optimization for DI-matched two-way speakersThe lines that begin with an asterisk are comments. The ones that begin with a component value are actual circuit elements. You can see, for example, that the tweeter circuit uses 6.8uF, 1.0mH and 20uF components in the core high-pass splitter filter.

Now scroll down a little bit and you'll see a whole lot of commented out values. Those are textbook values for crossover between 1.0kHz and 2.0kHz, first-order through fourth-order. They're not even rounded to the nearest available component value. I always start off with one of those, and work through a process to find the best readily available component values, i.e. 1.0uF, 4.7uF, 6.8uF, etc.

The first thing I do is to measure a speaker with a filter having exact textbook values in the crossover, as a start, and see where the lobes and nulls fall. Then I manipulate the values to get the lobe and nulls precisely where I want them to be. After that, I round each textbook value to a readily available component value and measure again. If the lobe/nulls shift too much, I'll manipulate other values in the circuit until I find the best fit.

Subject: Re: Been learnin' about crossovers
Posted by Wayne-o on Fri, 09 Sep 2011 01:52:14 GMT
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Hey Bill,

Like Wayne Parham you are a wealth of information. Read the paper by Rane, nice.

Subject: Re: Been learnin' about crossovers
Posted by Bill Epstein on Sat, 10 Sep 2011 01:47:08 GMT
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Got the parts today and laid'm out on pegboard, my preferred medium for point-to-point.

That's Part One which won't be complete until I at least read thru or die trying to, Part Two, use AIM Spice that I just downloaded. I found out that the Link on the Pi Site has all the libraries for Pi Speakers. The AIM site has a clean "student" version that's free. For now I just have a Desktop Shortcut to the Manual.

If you hear someones eyes rolling back in their head, that's just me looking for Lobes in all the wrong places!

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1) IMG_2227_1.JPG, downloaded 4951 times

Subject: Re: Been learnin' about crossovers
Posted by Wayne Parham on Sat, 10 Sep 2011 03:55:17 GMT
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Spice is a great modeling tool for circuits. There's actually a copy of AIM Spice in the file I distribute with the crossover models, but it's getting a little long in the tooth - it's Version 3.8. Still, it works great and is at least new enough to run on Windows.
Passive Crossover Spice models, complete with the AIM Spice modeling programWhat's really cool is the ICD in Keith Larson's WTPro system. It imports your Spice model, and essentially creates a digital filter from it. You can use it to try out a crossover, and actually make measurements of a physical loudspeaker, drivers in box. Then change the values in your Spice model and see changes in the acoustic measurements. It's just the same as having an infinitely large box of components, filled with every possible value coil, capacitor and resistor. You can try anything, and actually measure it with a microphone.

Subject: Re: Crossover design is science and art!
Posted by SteveBrown on Sat, 10 Sep 2011 04:38:11 GMT
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Hey Ron, I have some Edgar Horns I'd be willing to sell you...