Subject: "Crossover Electronics 101"
Posted by Wayne Parham on Mon, 10 Mar 2003 06:33:36 GMT
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I've just uploaded the handout that will be passed out at the "Crossover Electronics 101" seminar at the Midwest Audiofest. It contains some of the things mentioned on the forum over the past few years, such as was discussed recently in the threads called "Low-order and high-order crossovers" and "LC Peaking."The handout is very much like a condensed form of the crossover document, and it also includes some basics like Ohms Law and reactive circuit formulas. Don't let any of that scare you 'cause it's pretty easy stuff. But do bring your calculators.I plan on having some speakers and connecting different crossover configurations so we can listen to each of them. This will allow us all to actually hear the effects of things shown in response graphs. We'll start off by going through some basic electronics and move quickly into things like low-order crossovers, high-order crossovers, resonance, peaking and damping. We'll look at various circuits and why they act as they do, and we'll see what happens at resonance and why that's important. We'll also look at various compensation circuits and dampers including Zobels.It's just a month away. I hope to see you all there!

Subject: Re: "Crossover Electronics 101"
Posted by DRC on Mon, 10 Mar 2003 11:51:06 GMT
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Wayne,Very Cool! If I can only take the time out from running my room to do one seminar, this will be the one!Do ya want a guinea pig grouping of drivers to demonstrate on? ;-)
Keep your ears and your mind open.

Subject: Re: "Crossover Electronics 101"
Posted by spkrman57 on Mon, 10 Mar 2003 16:30:55 GMT
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Wayne, Looking forward to it. I hope when I ask questions, I don't hold your star pupils up, I not sure how many others suffer from same affliction I have. I can do basic math all day long, anything past light Algebra is not going to happen, I just go "Braindead"! I got the basic 4 math (+)(-)(*)(/) functions, after that my mind bogs down. I not saying that I am ignorant, but never did catch up with higher levels of Math. I am 45 years old, a Military/Govt employee for 24 years, currently as a Computer Specialist, have been in a number of technical/electronics posistions, all without actually being able to go beyond basic math. So, whenever I get a shortcut to the answer, I take it. For instance, take "Steve Reids" crossover page, just plug in the values, click on the (compute), and Shazammmm !!!! Instant answers! People often say I am smart because I sit

and tweak out a stereo system at their house, but I only take other peoples information and apply it. Nothing more than basic principles. I want to make that clear, because I want readers to know they don't have to be "Math geniuses", in order to enjoy this hobby, I am proof of that! just listen to others, and you too will learn!!! But in Lima, I hope to be like a sponge, and take in all those factors that might result in me actually learning how to do the Pi-align/Spice/Boxplot and other math problems/programs, so I can find a way to shortcut to the info. I tried to download those 3 and failed, almost crashed my pc at home(no tech to call and fix, like at work!) so I will wait until Lima and learn how to do it right! Still looking for audio-nuts to join the "Central Ohio Audio Club" There is nothing official about us yet, Currently only have 2 unofficial members, TillE and Me, and maybe a handfull of possibles!!!Just e-mail me: rsemega@insight.rr.com Need someone to help me setup a website for the COAC, nothing fancy, my computer is limited(just like my brain). That way projects could be put on the website for all to see! Just want to be able to get good people together, and bulld and tweak great audio systems, and then enjoy them! I have some older audio gear from a audio store here in Columbus, Ohio that shutdown and they sold me the remains, mostly just gutted chassis's that were in for repair and left to die, so I have some starter material for those with little bit of electronics knowledge. Thanks for the bandwidth, Ron (Your "Bumbling student")

Subject: Re: "Crossover Electronics 101"
Posted by Wayne Parham on Mon, 10 Mar 2003 21:24:23 GMT
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Don't sweat this deal - The math is pretty easy and you'll be able to handle it, no problem. Once you start, it's easy. Looking over the documents sometimes makes it seem harder than it really is - The algebraic functions we'll be discussing have only three or four terms. So it's pretty simple stuff, especially with a calculator.I wanted to discuss certain elements of crossover filters, because I feel that lots of people align their boxes and tune their horns for linearity and then use a crossover that introduces peaks. It was always apparent to me that the main thing people identify as a "horn sound" was actually a crossover problem - The MF horn is much louder than the LF subsystem and it is peaking from the crossover too. So this is something I think will be good to look at in the seminar.

Subject: Re: "Crossover Electronics 101"
Posted by Wayne Parham on Mon, 10 Mar 2003 21:32:06 GMT
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The horns and drivers will not actually be what we're discussing as much as the electronics in front of them. But one of the main points that I'd like for us all to see is just how much effect there is from the reactive characteristics of the drivers, themselves. We must know the electrical

characteristics of a driver in order to properly design a filter for it. The driver is a part of the filter, so its properties have a large influence on circuit behavior.

Subject: Re: "Crossover Electronics 101"
Posted by DRC on Mon, 10 Mar 2003 22:12:30 GMT
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Hey, Wayne!I think you may be familiar with the drivers in question ;-)TAD 2001's in Martinelli HornsJBL 2123's (16 ohm version)TAD 1602's (these should look very familiar!)The mid and woofer will be in a bass reflex cab, with the mid in its own small isolated chamber (

Subject: Active crossover question with protection cap
Posted by Robert Hamel on Mon, 10 Mar 2003 23:34:56 GMT
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Hello WayneI guess from looking at your document that if you have a series protection cap you need a dampening resistor across the driver or you will get LC peaking like in your example. Would this have an audible effect even with an active 4th order L/R crossover???Thanks

Subject: Re: "Crossover Electronics 101"
Posted by mikebake on Mon, 10 Mar 2003 23:44:52 GMT
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How much time did you see you wanted to spend? MBB

Subject: Protection caps
Posted by Wayne Parham on Tue, 11 Mar 2003 03:57:31 GMT
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If the crossover (including driver reactance) is underdamped in or near the passband of the device, you will hear it. An underdamped crossover filter causes a peak that can range anywhere from a mild lift to a huge 10dB peak. Rarely will you find a voice coil driver peaking so bad that it oscillates, but some piezo tweeters can interact with inductances in the speaker circuit at this

level. For voice coil drivers, it is common to find 2dB to 4dB peaks in the passband, and sometimes even worse.If you have an active crossover and also a protection cap, then you still have a passive filter in the speaker circuit. Protection capacitors are first-order filters. There are reactive components in the loudspeaker circuit, so care must be taken to ensure you don't reduce the benefits afforded by bi-amplification.There are a couple of things that can be done, and both amount to the same thing - Check for peaking and remove it.One thing you can do is to put a very large protection capacitor in series, so that the peaking would be at a very low frequency, far below the useful range of the transducer. But this has a couple of downsides. First is that this will move the peaking down to a low frequency, where a power-on "burp" might be the most harmful. And second is that the larger value capacitors get expensive, especially in the good film/foil technologies. Still, these are things that can be resolved and the use of a large protection capacitor is a good solution to the peaking issue.The second thing that can be done is to use a damper resistor across the capacitor. This has the advantage of potentially allowing the use of a smaller capacitor. This, in turn, gives more confidence that a power-on surge will be removed or at least presented at a frequency that the transducer can handle. You can even use a protection capacitor configured as a crossover filter at the same frequency as the active crossover, effectively making another node.Probably the best thing to do is to make a quick Spice analysis of your speaker circuit to find out how much effect there will be from peaking. You may find that your best solution is one that has a damper and a fairly large capacitor, or you may find peaking is so minimal that it almost doesn't matter. But to know for sure, you'll want to run the numbers and see.

Subject: Re: "Crossover Electronics 101"
Posted by Wayne Parham on Tue, 11 Mar 2003 04:08:40 GMT
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I think we'll probably only run an hour or so, but it's hard for me to say. On one hand, I don't want it to get boring so that means we should rush right through to the good stuff. On the other hand, I'm not going to race through something that people have an interest in. So I think that an hour is probably a safe bet, but if it goes a little longer or shorter, that's fine too.

Subject: Re: "Crossover Electronics 101"
Posted by Wayne Parham on Tue, 11 Mar 2003 04:26:57 GMT
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Subject: Re: "Crossover Electronics 101"
Posted by DRCope on Tue, 11 Mar 2003 06:53:33 GMT
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Hey, Wayne!Not this pair, although he is in the on-deck circle to build a second pair. (Check out the burl Pi7 on his design page. Garland is building the proof-of-concept pair that's coming to Lima. The anticipation is killin' me! ;-)Aw heck, I thought this was a wild-and-crazy one-off project. ;-0 Keep your ears and your mind open.

Subject: Schematics and response graphs on-line
Posted by Wayne Parham on Wed, 12 Mar 2003 06:16:59 GMT
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I've added the schematics section of the handout, which shows the exact circuits that will be used in the seminar, along with their response graphs.