Subject: Wayne, crossover and L-pad confusion
Posted by Bill Epstein on Sun, 24 Feb 2008 20:48:07 GMT
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Happened upon this site today which coincides with my day to try L-pads. There's an explanation of L-pads and an attenuation chart.I installed an 8 ohm L-pad on the B&C DE-250/2226J left channel and couldn't find a setting that mated with the right. The L-pad channel sounded crisper and maybe 'brighter'. Figured the difference was the .33 cap so I clipped it. Now I could balance the sound of the left, L-pad and right 24ohm fixed speakers.First confoosion: what accounts for the large discrepancy between the attenuation values of this guys chart: 5.47 R1 and 3.7 R2 and yours: 24ohm R1 and 16ohm R2 for 10dB attenuation with an 8 ohm driver?Second confoosian: With the L-pad in place on the left channel and 24 ohms fixed on the right w/o a cap, the 2 channels seemed to match with the L-pad reading about 6 ohms for both R1 (terminals 2&3)and R2 (1&2).Remind of you nude parallel resistors on the beach?

Subject: Top octave augmentation for compression horn tweeters
Posted by Wayne Parham on Sun, 24 Feb 2008 22:54:01 GMT
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source is desirable. In most cases this is true, but in this case, it's not.

The values I've chosen for the compression driver horn circuit are purpose-designed to provide a

curve with flat response from the crossover point up to the frequency where HF augmentation begins. A typical L-Pad with bypass capacitance would make response be a diagonal line from the crossover point up. That's why a compression horn using a typical L-Pad sounds thin to you. The power response of a compression driver is flat for a couple octaves, then starts falling off after that. The conjugate of this is to be flat for a couple octaves, and then start augmentation. That's

Subject: Re: OK, I'll quit re-inventing the wheel
Posted by Bill Epstein on Sun, 24 Feb 2008 23:18:02 GMT
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Got this bug about the L-pads because of them on the GP Altec 704 co-ax crossover. Of course, they have capacitors.Where can I find the 4 Pi Pro crossover attenuation chart? My copy from, omigosh, 6 years ago(?) is among the missing.

Subject: Never!
Posted by Wayne Parham on Mon, 25 Feb 2008 00:05:47 GMT
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Never quit experimenting! That's at least half the fun!Here's the chart for 1" compression drivers.

frequencies around 1.6kHz. Attenuation (< 5kHz) R1 R2

0.22µF==========R2 is connected across the crossover tweeter output. R1 is connected after that, placed in series with the driver. C1 is connected in parallel across R1.I've tried these values on 1.2kHz crossovers and they work well, but once you get much below that, the values change. That's because of the reactive values of the crossover. The chart is different for 1kHz and below. I've worked out values for 1kHz, 800Hz and 600Hz, so let me know if you need them and I'll post them. But frankly, I wouldn't use a PSD2002 below 1kHz, not even with flea-power. I don't know about the DE250.Understand that the selection of these values isn't really so much about crossover frequency as it is about the inductances and capacitances in the tweeter circuit. I'm talking about it in terms of crossover frequency as a sort of shorthand, since the values required to make a 1.6kHz crossover for an

typical crossover values, the chart might have to be altered too.

Subject: Re: Pi Align strikes again!
Posted by Bill Epstein on Tue, 26 Feb 2008 10:58:51 GMT
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I went from 12dB to 10. I used 12 originally because I didn't have a .47 cap and 10 with a .33 sounded 'wrong'.16 and 16 ohms, R1 & R2 with a .47 cap gives much better integration of the drivers. I'm even more amazed now with the quality of the B&C DE-250.

Subject: Re: Upon further review
Posted by Bill Epstein on Tue, 26 Feb 2008 18:10:10 GMT
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Doing some serious listening today, being unemployed is the best!Got in the last 3 Cheskys I needed to complete the set from Jason. His Moondog operation, BTW, is the class act in the biz as far as I'm concerned. I've gotten 5 LPs now, and each one is cleaned and placed in a new sleve before it ships. Condition is just as he represents and the prices, considering the quality, are reasonable.The Sibelius 2nd Symph showed me the 10dB atten. wasn't enough so I went to 12. Oboes sounded like English Horn and Trumpets, strident. Much better now.Maybe...just a tad more atten. is called for, have to listen some more. Kinda on the cusp. If so, don't know whether to go back to the .33uF cap with the 24ohms or keep the .47 and add a few more ohms.

Subject: What about 16ohm drivers
Posted by Kim Schultz on Tue, 26 Feb 2008 20:18:26 GMT
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Hi Wayne.I use Altec 902-16HF drivers in my front and center PI7 speakers, this is the normal 902 driver with a 16ohm voicecoil.After playing around with Spice and measuring the driver with the crossover, I arrived with these values:R1 = 33ohmR2 = 12ohmC1 = 0.22uFThis gives a load of about 9.5ohm on the crossover, where the normal lpad with the Eminence driver, gives a load of about 9.4ohm.All good so far, but I really can´t seem to remember how to calculate how many db´s this lpad is damping.Do you have another chart for 16ohm drivers on hand ?I have another question regarding lpad with topend compensation.After much consideration I have bought four Eminence Beta 8A drivers, and eight BMS4524 drivers with 18Sound XT120 horns for my bipole surround speaker project.I will be running the BMS4524 drivers in series for a resistance of 14-16ohms.Can I just use the same lpad as above (if the sound levels match), or are there a better way to do this ?I was thinking of using a single coil on the woofer, and a third order crossover at about 2200hz on the hf drivers.Btw, these drivers are excellent, they sound really nice and the horns are good too.

Subject: Correction
Posted by Kim Schultz on Wed, 27 Feb 2008 09:40:25 GMT
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I just had a look at the crossovers today and I didn´t remember all to values correct, this is the values I´m using:C1 = 0.47uFC2 = 10uFR1 = 11ohmR2 = 33ohmWhen I simulate them in Spice, it seems the f3 might have shifted down a bit.

Subject: Now with measurements.
Posted by Kim Schultz on Wed, 27 Feb 2008 13:04:50 GMT
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I did some measurements today, see below:The most flat is the one using the C2=8.2uF, but it does not look as much like the standard crossover, as the one using C2=10uF.Is the reason for the peaking response around 1800hz, to compensate for the falling response of the midhorn ?
Altec902 vs. Eminence PSD 2002

Subject: Re: Upon further review
Posted by Wayne Parham on Wed, 27 Feb 2008 17:55:31 GMT
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Nice thing about that little chart is it lets you click up the attenuation in notches, keeping the same basic response curve. I'd go up a click and see how it sounds.

Subject: Re: Now with measurements.
Posted by Wayne Parham on Wed, 27 Feb 2008 18:48:37 GMT
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Good stuff, Ken. The peaking you're seeing is what we want, but there is a little bit too much of it.

near the crossover frequency. This is slightly underdamped, and we use it to boost the bottom end.The idea isn't to cover a hole from the midhorn or any other driver, it's to make the first octave flat when a bypassed attenuator is used to increase HF. If you added HF-bypassed padding like that withgout slightly underdamping the crossover, the resulting curve would be a diagonal line starting at the crossover frequency and rising straight away. We don't want output to start rising for an octave, so we peak the bottom of the curve just a smidge, in order to provide a response curve like shown below:Like you, I designed the circuit with Spice. It allowed me to model the compression driver/horn with voice coil resistance/inductance and a series of resonators. I was able to make a very good model that gave accurate results. But by including actual impedance measurements of the driver, I've been able to get even just a little bit closer.Spice models using ZMA filesI found the same thing you did, that my crossovers had a smidge more peaking than I wanted. Your chart is very close to what I've seen. It isn't objectionable, but I changed values as a result. Reducing C2 a little and increasing the size of L1 made an improvement.I'm not concerned about shifting the -6dB frequency by a couple hundred Hertz, in fact, the crossover has always been asymmetrical anyway. They're sloped filters, not brick wall filters, so in-band and out-of-band signals are separated by a relatively large overlap region. That's a grey area, so to speak, in that acoustic summing between drivers is in play, not just electrical slopes. Even if it appears that one crossover point is a few hundred Hertz different than the other, the only thing that matters is that summing results in a nice flat response curve. That's where the rubber hits the

road, so to speak.

Subject: Spice rules ;-)
Posted by Kim Schultz on Wed, 27 Feb 2008 20:03:21 GMT
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Hi Wayne.I have downloaded your .zma files, but where do I put them in the Spice dir. ?When I try to do a simulation I get this error:Circuit: ! Seven Pi mid/tweeter crossover Spice modelError on line 34 : z1 1 0 h290_psd2002.zma 0 0 unable to find definition of model 0 - default assumed error: no unlabeled parameter permitted on mesfetError on line 62 : z2 7 0 sevenpi_midhorn.zma 0 0 unable to find definition of model 0 - default assumed error: no unlabeled parameter permitted on mesfetAnd how do you make the phase simulation you talk about in your crossover white paper ?'RegardsKim

Subject: Re: Spice rules ;-)
Posted by Wayne Parham on Wed, 27 Feb 2008 20:22:31 GMT
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You'll actually have to use Keith Larson's WTpro/ST to incorporate ZMA files into Spice.You can calculate electrical phase with vectors. Here's a write up of the process, with real-world examples and models in Spice:
 Vector calculations for AC analysis

Subject: Re: Spice rules ;-)
Posted by Kim Schultz on Wed, 27 Feb 2008 21:07:41 GMT
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Thx, will look into that phase thing tomorrow.Can you give me the new component values for the crossover, then I´ll try it out and make some new measurements tomorrow.What is the sonic difference between the old and the new crossover ?

Subject: Re: Spice rules ;-)
Posted by Wayne Parham on Thu, 28 Feb 2008 00:49:52 GMT
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The difference is subtle. I did WTPro/ST models of various configurations and tested them. After I narrowed down to a few, I built actual physical models. As I said, the differences were subtle but

I'll revisit other models as I have time and since all models with compression drivers have the same tweeter circuit, I expect that part will carry over.

Frankly, I've walked this road before (or one very much like it) when I made the versions of the crossovers I've been using the past few years. I made first, second and third-order crossovers, with various amounts of attenuation and HF compensation for the tweeter. First was a Spice model, then an actual physical model.

This time around, I did the same thing but I also added fourth-order networks. I had a little better visibility both because of the use of ZMA files and also because my acoustic measuring equipment is better. That's how I found a few small tweaks in the tweeter circuit that made a slightly better response curve. Decrease the value for C2 down to 6.8uF and increase L1 to 1.0mH. I also tried different slopes for each driver. I liked the 2nd/3rd arrangement and the pseudo-first-order circuit, but I liked the 3rd/3rd better. Going to 4th/3rd was too much. I also found that the Zobels didn't need to be as large as I was using. Although the difference is marginal, large capacitors are expensive (especially when using premium brands) so the smaller, the better. In the end, after lots of tests and listening sessions, the crossover I liked best is this: