Subject: 2Pi Tower Update: APT80 Tweeters
Posted by GarMan on Mon, 01 Dec 2003 18:31:23 GMT
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Hello everyone.Just thought I'd give everyone an update on how I'm doing with my 2Pi Towers. From my post a couple of weeks ago, the Towers are complete as originally designed. The piezo was not to my taste. However, putting a 22ohm resistor in parallel with it did cool it down.The Towers are good speakers with many strengths. However, at the end of the day, they are still "budget speakers" and do have their shortcomings. For me, I wanted to explore alternatives to the KSN1038. For the last two weeks, I've been working on and off, trying to integrate a pair of Eminence APT80 with the Tower cabinet and Alpha10's. Going through the project of integrating the APT80, I did learn to appreciate the benefits of Wayne's simple approach to his 2Pi:1) Less variables to control (and to get wrong)2) Greatly reduce costs. I can't believe how quickly crossover components add up!3) Maximum efficiency. Crossover components do not only suck up money, but also SPL.4) Speed/effortlessness. My crossover seemed to have robbed some of the micro-dynamics that the original Pi had.I want to make a note about my qualifications on this topic, as a warning to anyone who wants to copy my "design". Qualifications: ZERO! I also don't have any measurement equipment of any kind. All I'm going by is what I've read on loudspeakers101.com, what I was able to understand from Wayne's paper on crossovers, and by my own ears. I tried using programs like SPICE, but could not get it to work on my computer. I'm not taking responsibility for anyone who spends money to follow these steps and don't like what they hear.Cabinet PrepFirst thing I did was install a double binding post cup on the back baffle and rewire the woofer and tweeter directly to their own set of terminals. I knew I was going to do a lot of tweaking with the crossover and I did not want to open and close the thing every time I made a change. The double terminal allowed me to have the crossover external of the cabinet for tweaking.WoofersI put a Zobel across the woofer with values of 11uF and 6.6ohms to stabilize its impedance at 6 ohms. Aided by the dBSPL chart on the Alpha10's spec sheet and many sheets of logarithmic graph paper, I decided that a first-order cross at 1K would have the effect of flattening the hump that starts at 850Hz. I was hoping that the 1K cross would give me a flat response at 94dB with f3 occurring between 3K and 3.5K. Value for the coil worked out to be 1mH (using 6 ohms as load).TweeterThird order Butterworth at 3500Hz. Couldn't find the exact values in parts, so I ended up using 3.3uF for C1, 0.27mH for L1, and 11uF for C2. The dBSPL chart on the APT80's spec sheet shows flat response at 104dB. I didn't know if this referred to the APT50 without horn attachment or with horn. I started with values for a 12dB attenuation L-Pad with Rs=6 and Rp=2.7 to see what it would sound like.Putting it all togetherThe crossover components were assembled in the old-school fashion of breadboarding it on a plank of 1/4 inch poplar I had lying around. Instead of nails, I drilled holes and inserted pieces of solid 8 gauge copper wires that I had use as a ground-bus in a previous amp project. Components were wrapped around the copper spikes and made for easy changes.How did it sound?I like the sound of the APT80's. To me, it was an improvement to the KSN1038's. However, it also costs five times more. The APT also does not integrate as well with the Alpha10's as the KSN1038. The Alpha10's and 1038's have very similar timbres. If you stick your face in front of the speaker and move your head back and forth between the APT and Alpha, you will notice they have different timbres. However, stepping back, the combined sound that they make is very pleasant.Without running my values through software, or measuring the speakers, I can't tell if I've integrated the drivers well. I have however reduced the L-pad to only 9dB attenuation as I found the -12db too dark. I also listened for a while with the 0.5mH coil that came with the kit in place of the 1mH in series with the woofer, but preferred the 1mH.Another concern I have with the current set up is

phase response. I'm not sure if I have to reverse polarity for the tweeter or not. But from time to time, something's definitely happening phase-wise. Kind of like that fake surround sound effect you can get on Sony TVs. I was not able to find any information on what compensations are necessary to match 1st order with 3rd order. In fact, I'm not even sure if the woofer is 1st order anymore as the addition of the Zobel would make it resemble a 2nd order.Overall, I like the improvements the APT has made, even with my questionable crossover design. I did cost me approx $100 USD in components for the pair and I am losing out on some efficiency and effortlessness of the original design. I don't think with project is for everybody. It really depends on what's important for you in a speaker.I'm very interested in hearing from others if they've had any success integrating a tweeter like the APT80, or if there are any suggestions on how I can improve my crossover. I see a lot of potential with this current set up and if done properly, would fit perfectly in price and performance between the 2Pi and 3Pi. Perhaps we're halfway there in designing a 2 1/2 Pi?Gar.

Subject: Things and stuff
Posted by Wayne Parham on Mon, 01 Dec 2003 20:24:51 GMT
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A first-order crossover adjacent to a third-order crossover has 180o phase shift. So swap the wires on the tweeter. The Zobel on your midwoofer makes your coil act as a first-order filter.Without a Zobel, a series coil acts as (much) less than first-order and it isn't a crossover at all. It is a stepped attenuator, with a nearly flat response curve having 3-6dB attenuation above a the frequency where voice coil inductance becomes significant compared to series coil inductance. There is no electrical rolloff as is expected of a crossover because voice coil reactance rises proportionally to series coil reactance making them form a voltage divider that is nearly linear with respect to frequency. Typically phase shift on such an arrangement is less than 20o rather than the 90o shift at the asymptote of a first order filter.So anyway, the Zobel makes your series coil become a first-order filter. Being adjacent to a third-order filter causes a 180o shift. So swap the wires and see what happens.

Subject: Modeling effects of XOver
Posted by GarMan on Tue, 02 Dec 2003 16:21:12 GMT
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Wayne,Thanks for the tip. I'll swap the leads to the tweeter and see how it sounds.Maybe you can help me with a problem I'm having. As I've mentioned, I can't get SPICE to work, so I'm modelling in MS Excel. I'm using the formluas R(L)=2*pi*f*L R(C)=1/(2*pi*f*C)to table reactance of XOver components across the frequency range and using those figures to determine voltage drop across the drivers for a given Xover configuration. The drivers are modelled as Re and Le in

series and dB drop is calculated as 20*log(voltage drop).Is there anything wrong with this approach? I'm not getting the same curves as I see from textbook examples.thanks,Gar.

Subject: Re: Modeling effects of XOver
Posted by Wayne Parham on Tue, 02 Dec 2003 20:37:35 GMT
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Those are the correct formulas for calculating reactive impedance, but the impedance figures given should not be considred the same as resistance. Resistance is a dissipative load whereas reactance is a reflective load. Pure reactance doesn't actually absorb power and do work; Instead, it reflects the energy back. This property is described by considering reactive impedance to be out of phase with resistance by 90o; It is expressed as an imaginary term with the value i or the square root of -1. As such, reactances must be combined as vectors.You might want to get an electronics textbook and study AC circuits and reactive impedance. That will shed some light on this for you.

Subject: Re: Sounds like school
Posted by GarMan on Wed, 03 Dec 2003 16:10:58 GMT
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Wayne,There was a reason why I chose to study Mechanical, instead of Electrical Engineering 15 years ago. I only studied enough to pass the compulsory electrical courses. Although, if I knew at the time I'd be obsessed with this audio stuff, I might have paid more attention.Gar.

Subject: Re: Sounds like school
Posted by Adrian Mack on Wed, 03 Dec 2003 20:06:32 GMT
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Try this site if you don't feel like buying textbooks
http://users.pandora.be/educypedia/electronics/electricitycircuits.htmIts an "online" textbook, it should get you started.

Subject: Re: Sounds like school
Posted by Wayne Parham on Wed, 03 Dec 2003 22:54:17 GMT
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My best friend in school graduated as an M.E. I was the guy everyone came to for computer and audio stuff and he was the guy everyone came to for hot-rod car stuff. I was always fascinated with mechanical engineering problems but glad I had an M.E. hotshot for a good friend.The mind of an M.E. and the mind of an E.E. are definitely compatible enough to communicate the same language but there's also a difference in our worlds. So all that to say I'm just as impressed with the statics and strengths as you are with reactive phasors.

Subject: SPICE working. Now we'll cooking!
Posted by GarMan on Thu, 04 Dec 2003 11:38:03 GMT
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Finally got SPICE installed properly on my computer! Half an hour to read through the Help Files and another half an hour of playing around. Now I'm armed and dangerous.I found out two things that I did wrong with integrating the Alpha10 and APT80 together. The 1mH inductor I was using with the woofer was too high and was rolling off the driver too early. Trying out different figures, 0.5mH gave me the best results. With 0.5mH, the woofer starts to roll off at 1K, with a 4dB drop at 3K. This flattens the hump of the Alpha10, giving a pretty flat response up to 3K. The 0.5mH was also the figure that Wayne used in his design. Yes, Wayne was right and I had to find out the hard way.SPICE also told me that I did not have enough attenuation with the tweeter, so I dropped it down by another 3dB by changing resistors in the LPad.The program also let me visually understand why I have to reverse the leads on the tweeter, so no more phase problems.Looking back, these two things make sense. I rolled off the woofer too early without realizing it and created a dark sound. To compensate, I reduced attenuation on the tweeter to brighten things up. The changes I found through SPICE now makes for a more balanced, smoother sound. I'm quite happy with how things sound now.I know my crossover is not optimized, but I think I'll let it alone for now (for at least until next week). As always, suggestions are always welcomed.Current config:1st order on woofer: 0.5mHZobel: R=6.6 C=11uF3rd order on tweeter: C1=3.3, C2=11, L=0.27mHLPad = Rs=6, Rp=2.7gar.