Subject: Pi Crossover Boards and Biamping
Posted by rkeman on Tue, 02 Apr 2013 02:40:49 GMT
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Is there any convenient way to allow biamping of the speaker (i.e. separating the woofer and tweeter or midrange/tweeter) using the Pi crossover PCB? Also, the bare PCB pictured doesn't seem to have the wire terminals soldered to the board as in the preassembled crossover. Are these available from Pi Speakers or some other source?

Subject: Re: Pi Crossover Boards and Biamping
Posted by Wayne Parham on Tue, 02 Apr 2013 15:48:47 GMT
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can get them at any electronics supplier, Digikey, Newark or Mouser, for example. Do a search for "PCB Quick-Fit Male Terminal 0.205" and you'll find plenty of them. They're all designed to be mounted on pads with plate-through holes but I bend over the hole tabs because I want one side of the board to be completely flat for mounting purposes.

nice to have the passive crossover, because it is fully optimized and provides a baseline. It allows the speaker to be used with a single amplifier too. But a biamp configuration is possible, of course, and would negate the need for a passive crossover.

I tend to warn people that they'll need to do some work to setup an active crossover, and not to think that they will enjoy improvements just by simply having one. It requires a crossover/processor that can be programmed to provide any transfer function, not just one that allows the user to select a set crossover frequency and slope. And it takes a little bit of time with an acoustic measurement system, to optimize the system at all off-axis angles. The process is shown in my "Crossover Optimization" thread. The basic process is described, and there is a link to a video that shows you how to find the vertical nulls, which mark the edges of the forward lobe.

The low-pass filter for the woofer is pretty straightforward, but the tweeter circuit is a little more complex. And of course, proper on-axis and off-axis summing through the crossover region requires careful selection of both high-pass and low-pass sections, both in terms of frequency and phase. This is usually set by slope and filter type, and sometimes standard types aren't even used.

The damping of the waveguide's high-pass filter circuit must be adjustable as well as the slope and frequency, because we set the lower "shelf" by setting filter Q. In most cases, it is slightly underdamped because (properly sized) conical horns and waveguides tend to rolloff a little down low. On the other hand, truncated conical horns and waveguides tend to have a peak down low, and in this case, the tweeter circuit can be overdamped to partially compensate. This is a very

above crossover and to tailor it for any waveguide. You will need to provide this in an active crossover as well.

Most people tend to think an active crossover can be easily configured using "CD compensation" but I find this is rarely the case because of the lack of filter Q adjustability. The 6dB/octave compensation for mass-rolloff is the easy part, it's just a single pole RC or RL filter. That's what "CD equalization" in most active crossovers provides. But the result is a transfer function that's a diagonal line, and that doesn't work well in most cases.

Mass rolloff doesn't start to occur until around 4kHz, so we usually want flat response up to that point, followed by 6dB/octave rising response. And as I said above, each individual waveguide has its own unique charasteristics in the ~1kHz octave too, some needing a little more damping, some a little less. So for the active crossover to be useful, it needs to capable of adjusting the transfer function of the tweeter circuit accordingly, usually something like this:

Subject: Re: Pi Crossover Boards and Biamping
Posted by rkeman on Tue, 02 Apr 2013 16:52:01 GMT
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Thank you for such a complete explanation of electronic crossover and biamplification implementation. The question that was meant to be asked is if the input legs on the passive crossover board (i.e. woofer and tweeter or midrange/tweeter) can be electrically separated on the pcb board. Passive or "vertical" biamplification as provided in many current audio/video receivers uses full range front left and front right signals to drive two separarte sets of amplifiers, usually the main left and right and the side surround or second zone channels. The latter outputs would otherwise remain idle. The passive speaker crossover is not bypassed in this configuration, but the low and high (or mid/high) portions of the crossover must be electrically separated. Can this be easily accomodated for on the Pi speakers crossover board?

Subject: Re: Pi Crossover Boards and Biamping
Posted by Wayne Parham on Tue, 02 Apr 2013 17:53:15 GMT
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To separate the low-pass and high-pass inputs, you would need to cut two traces on the printed circuit board. It would be pretty easy to do, and you could even add a switch or jumpers for input selection. But thinking outloud, I wonder what benefit that would bring? The main benefit of biamplification is reducing amplifier bandwidth, which then reduces power supply requirements. If the amps are run full range, you lose that advantage. Why, then, run separate amps at all?

I can see using a stereo amplifier as the pair of amps for biamplification of a single speaker, using one channel for the woofer and the other channel for the tweeter. Low-pass the woofer channel ahead of its amplifier and high-pass the tweeter channel ahead of its amp. That way the

bandwidth is reduced for each. But this requires a crossover be placed ahead of the amplifier. It can be a high-impedance passive crossover or some form of active crossover. Either way, you would need to optimize it as I described in my last post to maintain parity, otherwise the low-impedance (speaker level) passive crossover will still outperform it.

Subject: Re: Pi Crossover Boards and Biamping
Posted by rkeman on Tue, 02 Apr 2013 18:43:36 GMT
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Passive biamplification in an audio/video receiver (AVR) allows the load to be spread over two amplifiers per channel rather than one. The advantage is that a greater porportion of the available power will be dedicated to the (front) speakers needing it most, the power will be spread over twice as many output devices (without a noise penalty!), and any clipping that occurs in the channel dedicated to one driver is not directed into the other. The degree of frequency isolation, while less than with an electronic crossover, is still substantial i.e. the channel driving the woofer "sees" a rising impedance above the low pass frequency and sources less current as a result. Band-limiting amplifiers is inherently good!

Some audio/video receivers can only really handle inefficient multi-way direct radiator or planar magnetic speakers effectively by employing this mode of operation. High sensitivity loudspeakers that present a benign load (such as the 3, 4, 6, and 7Pi) may benefit less, but it costs next to nothing to do and the extra channels of amplification aren't typically used otherwise. Traditional biamplification still occurs in most systems because the bass management system in the AVR (an electronic crossover) feeds the subwoofer(s).

Subject: Re: Pi Crossover Boards and Biamping
Posted by Wayne Parham on Tue, 02 Apr 2013 19:03:17 GMT
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If the input signal isn't band-limited, then the amplifier isn't band-limited. Not that it needs to be - If there's enough voltage and current capacity, then band-limiting is probably not all that important. But the fact remains, if we want to limit the passband, we have to do it at the input. Doing it on the output doesn't really do very much for the amp.

Bi-amping is attractive where the amplifiers are the limiting factors. But that's because biamping does both things: It essentially reduces the voltage requirements and the current requirements by way of reducing bandwidth. The voltage requirements are reduced because the treble isn't modulated by the bass, meaning peaks of one ride on peaks of the other, creating the need for 2x voltage on max-peaks. The current requirement is reduced for the same reason.

But if the full-band input signal is sent to each amplifier, then the voltage requirements remain high. The treble signals will still ride on top of the bass signals. If peaking occurs, it will chop the

high-frequency content first. So while the woofer's low-pass would reduce distortion that resulted, the tweeter circuit would pass it right through. I can't see this being any more than marginally beneficial. Seems like kind of a hack.

When the input is left full-range, I see only two real configurations of value: Bridged and paralleled. For a current benefit, one could simply parallel the outputs. For a voltage benefit, one would bridge the outputs. These would give the benefits I think you're seeking using what I think is a cleaner system design. Or maybe one of these is essentially what you're talking about:

Bridged and Paralleled AmplifiersI do understand you said, "Some audio/video receivers can only really handle inefficient multi-way direct radiator or planar magnetic speakers effectively by employing this mode of operation." And I can appreciate that. But what that really means is the amp just cannot handle its load, and is exceeding voltage or current limits, or perhaps both. There are many ways to solve that, and while biamping is one of them, I would argue that if biamping isn't done by band-limiting the signal ahead of the amp, then all that's really been accomplished is an awkward from of paralleling.

Subject: Re: Pi Crossover Boards and Biamping
Posted by Dave_S on Wed, 03 Apr 2013 06:47:00 GMT
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Wayne,

I just built a FirstWatt F5 and the B1 preamp and started listening to it on Monday. I never thought my old receiver was that bad, but I am hearing a lot more detail on my 4 Pi speakers. It is sort of like hearing my 4 Pi speakers for the first time again. Maybe that is exaggerating a bit.

It is probably not likely to occur in the near future, but I was wondering if you have noticed audible differences with bi-amping when passive crossovers are placed in front of the amp. My understanding is that the amp will not have to fight the crossover components and can just play the music. If there is an advantage, I might consider building a second F5 or another Nelson Pass design. At this point, it is just curiosity. I definitely do not need the power of a second amp.

Thanks in advance.

Subject: Re: Pi Crossover Boards and Biamping
Posted by Wayne Parham on Wed, 03 Apr 2013 14:50:39 GMT
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Please refer back to my first reply in this thread. I would offer the same response. Essentially, I think it is only worthwhile if you can setup the transfer function in the active crossover, which is not trivial. It is not a matter of just picking a crossover point. The closest you might come with

generic crossover slopes is to find (what will almost always be) asymmetrical slopes, usually having different "crossover points" that sum properly through the overlap region. It's all about acoustic rolloff and phase. Then there is also the matter of the tweeter circuit, and again, I refer you back to my earlier reply.

Subject: Re: Pi Crossover Boards and Biamping
Posted by dheflin44 on Wed, 03 Apr 2013 16:57:59 GMT
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Dave_S wrote on Wed, 03 April 2013 01:47It is probably not likely to occur in the near future, but I was wondering if you have noticed audible differences with bi-amping when passive crossovers are placed in front of the amp. My understanding is that the amp will not have to fight the crossover components and can just play the music. If there is an advantage, I might consider building a second F5 or another Nelson Pass design. At this point, it is just curiosity. I definitely do not need the power of a second amp.

Dave,

Are you saying you want the signal chain to be preamp -> passive XO -> amp -> speaker? This may be possible, but the passive XO needed for this configuration will be very different from your current XO between the amp and speaker. The speaker drivers have much lower impedance and more reactive load than the amp inputs which drastically affects the crossover's transfer function. In any case if you're wanting to do a high-level XO to isolate the amps' frequency ranges, then use a DSP crossover to have the best chance of getting the correct overall system response. Since a lot of trial and error will be needed, being able to reprogram a DSP will make it easier.

-Darrell

Subject: Re: Pi Crossover Boards and Biamping
Posted by Dave_S on Wed, 03 Apr 2013 17:40:03 GMT
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Darrell and Wayne,

Thanks for the information.

I am thinking about the chain described.

Except for component size, I didn't realize that a crossover would be that different depending upon its position in the audio chain. It is good to know now. I may take the challenge on some day for the learning experience, so maybe a DSP crossover is the way to proceed.

My next priority is to obtain a DAC. I suspect that is the weakest link in my system at the moment.

Dave

Subject: Re: Pi Crossover Boards and Biamping
Posted by Nelson Bass on Wed, 03 Apr 2013 20:13:41 GMT
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Dave_S wrote on Wed, 03 April 2013 01:47
I might consider building a second F5 or another Nelson Pass design. At this point, it is just curiosity. I definitely do not need the power of a second amp
Sorry, but I believe you'll introduce more problems with your ideas than you'll solve. Been there, done that.

I once cloned the Emerald Physics CS2 loudspeaker using software based crossover and even that I had a pretty good idea of what I did, I gave up. No matter what I couldn't get the system to really sing.

Everybody can make a crossover between two drivers but make the speaker really sing takes a lot more. Just read the progress Wayne did over the years. If one thinks its an easy task to make a perfect crossover don't fully understand what it takes to make a fully optimized crossover for a loudspeaker system. Theory is one thing but one really needs to make lots of experiments, measurements, adjustments and listening tests.
I know a very skilled person nearby and it takes him about a year to finetune a crossover for a speaker system...

For a loudspeaker as efficient as the 4pi I see zero advantage using separate amplifiers for the tweeter and mid/bass driver....

You've been warned!

A better DAC sounds like a much better project than the bi-amplifier project!

While the F5 is very very good for a solid state amplifier you can make it even better. Look at the F6 as the Semisouth JFETs brings down the overall distortion. I rebuild my F5 for my own variant of the J2 and like the result.

But we can do even better than the solid state amps... The Atma-sphere OTLs transform music reproduction into high fidelity beyond anything else I've heard in my system no matter the cost (the highly acclaimed AudioNote 300B SET can't compete if you ask me).
You can order the DIY instructions for the kit amplifier at Atma-sphere for a very reasonable cost and build your own from scratch. Or order the kit or the fully built amp(s).

I really look forward to finish my 4pis, 3pi subs and my DIY M60 OTL. The end is near...

Subject: Re: Pi Crossover Boards and Biamping
Posted by Dave_S on Thu, 04 Apr 2013 02:19:41 GMT
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Nelson Bass,

I will have to do some research on Atma-sphere OTLs. Making a tube amplifier does interest me. I felt the need to make the F5 as the reference for comparison. The F6 looks less familiar with the transformers, so I would probably stay away. Some version of the J2 may be interesting if the supply of SemiSouth are not depleted or suitable replacements arrive if and when I decide to build. I also have some interest in the 7 Pi speakers. An intermediate step may be to educate myself on amplifier design basics.

Maybe bi-amping does not make sense. I have not particular goal for sound improvement in mind. I am probably just looking for an excuse to build another amp.

A DAC is definitely on the top of my priorities. After I built my 4 Pi's, I discovered how bad digital music playback can be. The term jitter was new to me and I thought the transfer of digital information was perfect. I am reasonably happy with my Squeezebox Touch, but there should be room for improvement.

Dave