Subject: crossover point
Posted by zonkers on Mon, 09 Jun 2008 17:47:46 GMT
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hi gang,how does one decide on crossover point(s)? say for example you have a woofer that can do 40-6000 and a tweeter that does 2000-20000. looks like you could do it anyplace between 2000-6000. if both woofer and tweeter are nice 2000-6000 does it matter? how do you decide where to crossover? also besides frequency how do you pick order?thanks, zonkers

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Subject: Re: crossover point
Posted by spkrman57 on Mon, 09 Jun 2008 18:37:23 GMT
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Very few woofers have response to 6khz, and if they do they are beaming at that point.I always try and use tweeters beginning as high a crossover frequency as possible for protection.I'd say that without more info on the drivers themselves that 2.5khz would be my best "guesstimation".Please provide info on the drivers if you can.Regards, Ron

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Subject: Congratulations! You've made the 65,000th post!
Posted by admin on Mon, 09 Jun 2008 19:40:45 GMT
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You've won the 65,000th post game! Please write your address (by private E-Mail if you wish) and we'll send your prize right away!

Subject: Re: Congratulations! All right, Spkrman!
Posted by Bill Epstein on Wed, 11 Jun 2008 06:14:26 GMT
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Subject: Re: crossover point
Posted by zonkers on Wed, 11 Jun 2008 19:04:30 GMT
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hi ron, thanks for the advice.i'm really looking for a general set of rules if possible. from what you say it sounds like a balance. tweeters like higher crossover better for protection but woofers like lower crossover best for good response and not beaming. is that the general idea?thanks, zonkers

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Subject: Re: crossover point
Posted by Duke on Thu, 12 Jun 2008 07:14:24 GMT
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I look at the radiation patterns, and try to match them up in the crossover region - in the horizontal plane at least.For example, suppose your tweeter is a 90 by 40 degree horn, and your woofer is 8" in diameter. So the woofer's radiation pattern is roughly 90 degrees wide at somewhere around 2000 to 2500 Hz (depending on the characteristics of that particular woofer). In this case, I'd put the crossover somewhere in that ballpark. If you're using a direct-radiator or bullet tweeter, you won't be able to match up the radiation patterns. In that case, the crossover frequency is less critical than when you're trying to match up radiation patterns but keep in mind that the ear's sensitivity peaks around 3.5 kHz to 4 kHz, so you don't want any peaks in that region or else you'll have a fatiguing loudspeaker. I'd probably want a good 3 or 4 dB or more dip on the tweeter's side of the crossover, this because I place a higher priority on the power response than on the on-axis response. Duke

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Subject: Re: crossover point
Posted by zonkers on Thu, 12 Jun 2008 17:58:43 GMT
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hi duke, thanks for your advice.there is one thing i don't follow. can you explain this?"I'd probably want a good 3 or 4 dB or more dip on the tweeter's side of the crossover, this because I place a higher priority on the power response than on the on-axis response."what's the difference between power response and on-axis response?thanks, zonkers

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Subject: Re: crossover point
Posted by Duke on Fri, 13 Jun 2008 10:33:22 GMT
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Hi zonkers,Thanks for asking for clarification.The "on-axis response "measures the frequency response along one axis only, typically assuming anechoic conditions (in other words, reflections are excluded from this measurement).The "power response" is the summed omnidirectional response of the loudspeaker; it's total output taking into account all angles. It is impractical to measure, but because the ear hears the reflected sound in a room it matters. The power response is strongly influenced by the speaker's radiation pattern.Assuming a two-way with a dome tweeter, the woofer will be beaming somewhat at the crossover frequency but the tweeter's radiation pattern will be quite wide, possibly more than 180 degrees if the speaker's front baffle is less than 1/2 wavelength wide at the crossover frequency. So if the speaker measures "flat" on-axis, the tweeter will be putting out quite a bit of extra energy off-axis just above the crossover frequency. Typically, this is the lower treble region, maybe 3-4 kHz or so, right smack where the ear is most sensitive. Because the reverberant energy contributes to perceived tonal balance, such a speaker may measure "flat" but sound bright and in extreme cases even harsh due to all the extra lower treble energy in the reverberant sound.Such a speaker cannot have a smooth on-axis response and a smooth power response at the same time, and in my opinion the power response corresponds more closely with perceived tonal balance in a normal listening room. So, my suggestion (and it's hardly original) is to design in an on-axis dip on the tweeter's side of the crossover, in that lower treble region, as this will smooth out the power response. Because of the way frequency response is typically measured this approach will look less smooth on paper, but it will sound smoother under most listening conditions. Let me know if you have further questions.Duke

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Subject: Re: crossover point
Posted by zonkers on Fri, 13 Jun 2008 20:03:31 GMT
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hi duke, thanks again for your explaination!if i understand you, you are saying the speaker sprays sound differently at high frequency than low so the total sound in the room is what matters. that makes sense.why are speakers made this way? what causes it?tia, zonkers

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Subject: Re: crossover point
Posted by Duke on Fri, 13 Jun 2008 23:45:07 GMT
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Again, thanks for asking for clarification.The radiation pattern of a direct-radiator driver depends on how physically wide the driver's diaphragm is compared to the wavelengths being reproduced. If the diaphragm is more than 1/2 wavelength wide, it will start to "beam" - that is, the radiation pattern will start to narrow. Let me try to explain why beaming occurs. Let's assume we have a 5" diameter cone that is reproducing a sine wave at 1350 Hz, so at this frequency the cone diameter equals 1/2 wavelength (sound travels 13500 inches per second, so one wavelength at 1350 Hz is 10 inches long). The sound from the right-hand edge of the cone actually radiates in all directions, including straight across the cone towards the left-hand side. But by the time it gets to the left-hand side, which is 1/2 wavelength away, the left-hand side of the cone is now moving exactly out-of-phase with the sound that originated on the right-hand side. So, it gets cancelled.

This is happening all across the surface of the cone. As a result, less energy is radiated to the sides of the cone than out in front of the cone. The higher up in frequency we go the narrower that main frontal lobe becomes (though we do get some side-lobes at higher frequencies). So let's take a hypothetical speaker with a 6.5 inch woofer and a 1" dome tweeter, crossed over at 2700 Hz. The actual cone diameter of the woofer is about 5 inches. At this crossover frequency, a sound wave is 5 inches long . Our woofer's diameter is thus one wavelength at the crossover frequency, so the woofer will be beaming - in this case it's radiation pattern will be roughly 90 degrees wide (that's not a "brick wall" at 90 degrees; the anechoic sound pressure level will be down by 6 dB by the time we get to 45 degrees to either side of the centerline.) Now our 1" dome tweeter's diameter is much less than 1/2 wavelength, so its pattern will be very wide. In fact, it will probably want to be close to 360 degrees (omnidirectional), but the front baffle of the enclosure acts as a 180 degree "horn" and confines its radiation to a 180 degree angle (this assumes the tweeter is not mounted in virtually free-air atop the enclosure, like on some B&W speakers).Very few driver manufacturers publish polar response plots of their drivers, but prosound manufacturer Selenium of Brazil does. At the link below you'll find the spec sheet for one of their 12" woofers. Note that the radiation pattern narrows as we go up in frequency until we get to 3.125 kHz - where suddenly, the pattern widens! The reason is cone break-up; now the cone is flexing severely, and acting as if its diameter is much smaller than it really is. Note also that in the 2 kHz plot we see side-lobes starting to form. Finally, the Selenium woofer's pattern is generally wider than rigid piston theory would predict even below well 3.125 kHz, and this is because the cone is not perfectly rigid so some flexture is occuring. Let's look as some implications of this beaming phenomenon. At low frequencies the woofer diameter is much smaller than a wavelength so the bass will be omnidirectional. At 13,500 Hz the tweeter's diameter if equal to one wavelength, so its radiation pattern will be about 90 degrees at that frequency, and will continue to narrow as we go up higher. What about an MTM? Well, the vertical woofer arrangement will result in beaming setting in in the vertical plane at a much lower frequency than in the horizontal plane. And look at the traditional sideways MTM used for a center channel - now the dual-woofer beaming is in the horizontal plane! This is exactly what you don't want - you want the center channel to have correct tonal balance for everyone in the room, but instead it's now the speaker whose tonal balance changes the most with different listening positions. Let's look at a ribbon tweeter, with its relatively tall, narrow diaphragm. A ribbon will have a very wide radiation pattern in the horizontal plane, but will beam badly at high frequencies in the vertical plane. Well I've probably rambled enough. Hope this helps. And if I've made any mistakes here, I welcome correction or clarification.Duke

Selenium 12 inch woofer - polars on page two

Subject: Re: crossover point
Posted by zonkers on Sat, 14 Jun 2008 17:43:16 GMT
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thank you so much for the helpful explainations! i see what you mean about the cone beaming. how does an mtm work though?this is very enlightening. thank you so much! zonkers

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Subject: Re: crossover point
Posted by Duke on Sat, 14 Jun 2008 21:08:29 GMT
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The two M's of an MTM act almost as one unit, sort of like one big odd-shaped cone (with a gap where the tweeter is) in the vertical plane. Just as a ribbon's pattern is wide in the horizontal plane and narrow in the vertical, so too with the woofers in an MTM. Now the lobing pattern of an MTM is different from what it would be if that were just one big oval woofer, so it's not an exact correspondence, but it's pretty close.Some manufacturers prefer to go with a TMM layout, as this way there's less beaming in the vertical plane. In my opinion Tyler Acoustics is doing the MTM right in their Pro Dynamics series - using a horn tweeter whose pattern is wider than it is tall, roughly corresponding to the pattern of the woofers.

Subject: Thanks Duke for the information (nt)
Posted by Norris Wilson on Sun, 15 Jun 2008 12:48:27 GMT
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nt

Subject: Re: crossover point
Posted by zonkers on Mon, 16 Jun 2008 03:24:20 GMT
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thanks duke, but what does all that mean and how does it work? zonkers

Subject: Re: crossover point
Posted by zonkers on Mon, 16 Jun 2008 03:42:21 GMT
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what i mean is -how- does an mtm or tmm do what it does? is the m&m like an array of 2? how do you figure out where to put the 1st "m", 2nd "m" and "t"? also what happens at the crossover from "m" to "t"? sorry for so many questions. i am trying to understand how this works and wanted to be more specific with my questions than just "how does that work". tia, zonkers

Subject: Re: crossover point
Posted by zonkers on Tue, 17 Jun 2008 01:25:34 GMT
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hi duke, i hope i am not wearing you out with many silly questions. i read around and i think i have the idea. since the mtm midrange control lobes only cover the midrange and can't work at bass i wonder if the idea extends to bass with something like wwmtmww or wwwwmmt? what do you think? thanks again! zonkers

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Subject: Re: crossover point
Posted by Duke on Tue, 17 Jun 2008 04:30:27 GMT
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Okay, the same phenomenon of cancellation by the time the soundwave gets to the other edge, like we had with a single cone, takes place with the two cones in a dual-woofer format (assuming both woofers are active up to the crossover region). Because the distance between the outer edges of the two cones is much greater than the distance across a single cone, beaming in that dimension sets in at a much lower frequency. MTM places the two cones farther apart than TMM does, so MTM beams more in the vertical plane (below the crossover frequency) than a TMM does. On the other hand, a TMM puts the effective center for the midrange frequencies physically fairly far below the center of the high frequencies. So, in choosing between the two, I'd look at where the crossover frequency is. If the crossover frequency is around or below 1 kHz, I'd go with a TMM as the ear is not very good at detecting the height of a sound source down that low. But if the crossover is much above 1 kHz, I'd probably go with an MTM. Now with either one of these formats, assuming a dome T, you will have an even greater radiation pattern discrepancy in the crossover region than if you were only using a single woofer. So, many designers go with a "2.5 way" TMM format - that is, the lower woofer is only active in the bass region, and then it is rolled off well below the main crossover point, while the upper woofer remains active all the way up to the crossover.Hope this helps.Duke

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Subject: Re: crossover point
Posted by Duke on Tue, 17 Jun 2008 04:46:31 GMT
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Directivity control in the bass region is hard to get because the physical sizes required are so great. At the link below is a speaker whose widely-spaced woofers are theoretically directional in the vertical plane down to about 130 Hz, but in the horizontal plane they're omnidirectional down there.An alternative way to get directivity down at low frequencies is to use a dipole or cardioid type enclosure (the former is pretty simple, and the latter is pretty complicated). Dipoles inherently have a figure-8 radiation pattern at low frequencies. The drawback is that they need a lot of equalization to do bass well, unless they are very large.According to researcher Earl

Geddes, radiation pattern control below 500 Hz isn't really necessary in a normal home listening room. Often even getting down to 500 Hz requires tradeoffs. A loudspeaker designed with a great deal of attention to radiation pattern control is the Gradient Revolution. It's a dipole below 200 Hz, then it's a cardioid (lilly-pad shaped pattern) from 200 Hz to about 2.5 kHz, then it's 120 degrees wide above that point (uses a coaxial tweeter, and the angle of the midrange cone is about 120 degrees). But, it's only about 85 dB efficient - that's one of the tradeoffs.Duke
 WwmtmwW format speaker

Subject: Re: crossover point
Posted by zonkers on Tue, 17 Jun 2008 18:29:49 GMT
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thanks for all your help duke! i really appreciate it! i read around some after you got me thinking. i think i understand what you are saying now. when there are two speakers playing they "squish" each other into a wide but not tall spray. thank you for explaining this to me. zonkers

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Subject: Re: crossover point
Posted by Duke on Wed, 18 Jun 2008 05:37:20 GMT
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You're quite welcome.Your "squishing" analogy is quite close, and provides a good mental picture. Actually the pattern doesn't get any wider in the horizontal plane for an MTM, but if we could see it, it would indeed be fat-looking, as if a squishing had occurred.Duke

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Subject: Excellent :)
Posted by Kim Schultz on Thu, 02 Oct 2008 23:36:01 GMT
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Thank you very much, I finally understand the beaming in MTM´s.Guess I better do a bit of calculation on my center speaker, and maybe lower the crossover a bit.Best regardsKim

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