Subject: Constant directivity verses on-axis EQ for non-uniform directivity (aka baffle step filters)
Posted by Wayne Parham on Mon, 27 Dec 2010 04:09:54 GMT
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I'm not a proponent of baffle step compensation, at least not for physically large speakers like mine. This is especially true for speakers that have constant directivity because baffle step is caused by a directivity change. If a speaker has constant directivity, it can't possibly have the so called baffle step.
Baffle StepOf course, most speakers don't have constant directivity through the whole audio range. The only loudspeaker I know of that can truly maintain constant directivity all the way

Still, physically large speakers have a baffle large enough that the baffle step frequency is in or near the modal range, and directivity loses its meaning there. So I'm not big on baffle step compensation for most speakers, at least not the kind I'm interested in.

equalization for non-uniform directivity. It is probably worthwhile for mini-monitors, because those need some voicing anyway. That kind of speaker generally isn't very efficient though, and if it uses a baffle step filter in the crossover, even less so. Those kinds of speakers and that whole design philosophy just isn't my thing.

The idea behind baffle step compensation does have some merit, don't get me wrong. The power response of a speaker and the on-axis response are the same only if it has constant directivity. But if the directivity collapses in a frequency range, the on-axis SPL goes up in that range. Almost every baffled speaker has a directivity change from half-space to some wider angle (depending on the environment) below the frequency where the baffle becomes acoustically small. Where directivity widens, SPL drops and that's why baffle step filters boost the bass. If a speaker is used outdoors or in a very large space, this makes sense because the speaker radiates omnidirectionally at low frequencies but directivity narrows at the baffle step frequency.

The problem is speakers act differently indoors than in freespace. The room sets the directivity at low frequencies, not the speaker. So baffle step is non-sequiter, because it equalizes the on-axis response to conjugate a hypothetical directivity change from half-space to full-space but this isn't what really happens, at least not in a home hifi setup. What actually happens is the room sets the pattern (and therefore, response) up to the Schroeder frequency.

Only above the Schroeder frequency does the speaker set the pattern. If the baffle is large, the pattern is probably half-space or smaller already, and therefore there is no baffle step. If the speaker is small, then there may be a range of frequencies that is radiated into an angle larger than half-space before the baffle begins to set the pattern. But the room will likely still constrain the pattern smaller than freespace, especially if the speaker is near any boundaries.

My conclusion has always been that the problem of low-to-mid frequency radiation and how to equalize for any change of pattern is complex and doesn't lend itself to a cookie-cutter approach like baffle step compensation filters. It is probably worthwhile in speakers designed to be used outdoors or in very large spaces, but those are most likely high-power speakers that use subs to fill in the bottom end. For home hifi speakers, I see it most often used on "wee little" speakers, essentially for voicing.   My approach has always been to get a handle on directivity, which is the root cause.