Subject: Re: Can I remove harmonic distortion with crossover?
Posted by Wayne Parham on Fri, 11 Apr 2008 17:15:41 GMT
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This a common misconception, and the answer is no. When a loudspeaker system generates harmonics, the HF components are generated artificially, without them being ever presented to the driver at all. For example, if a 60Hz signal is presented to a loudspeaker that generates 30% 2HD and 10% 3HD distortion, then 120Hz will be heard 10dB lower than the fundamental 40Hz tone and 180Hz will be heard 20dB lower than the fundamental. Those are noticeable levels, definitely audible. This would be true even if the crossover is set to filter everything out above 100Hz, a hypothetical brick wall filter.I think the confusion is caused by the fact that acoustic low-pass filtering of high frequencies from a horn or bandpass system tends to reduce harmonics. But this is because the harmonics generated by the driver are removed acoustically after they are generated. It is also important to realize that acoustic low-pass filtering reduces harmonics but not the non-linearity that caused them. This is an important distinction, since driver non-linearities are responsible for other anomalies besides harmonic distortion.Consider for a moment what harmonic distortion does to the sound, and where it is most distracting. Since harmonics from tweeters are shifted up to very high frequency, low quality tweeters tend to make a scratchy sound. This is only true if harmonic distortion is high, since the very fact that they are shifted up so high tends to mask them. Low distortion levels are harder to hear in tweeters. Distortion from midranges are much more audible, since harmonics tend to fall into our most sensitive range of hearing. Midrange should be very free from distortion otherwise the speaker will cause listening fatigue. Distortion in the midrange tends to sound congested and painful. Woofers also should be distortion free, since bass harmonics fall into the midrange band. As an example, the frequencies shown above - 60Hz fundamental, 120Hz second harmonic and 180Hz third - the fundamental is bass, very close to B1, but the harmonics are midrange, in the octave below middle C. The second harmonic 120Hz is near B2 and the third harmonic 180Hz is near F#3. This is smack dab in the middle of the midrange, so woofer distortion muddies piano, vocals, pretty much everything.