Which Presets should I choose for my MK3 Speakers

See the KnowledgeBASS article here: TBD

The MK3 series of BASSBOSS Loudspeakers have pushbutton presets that select from various filter types and cutoff frequencies. While we typically recommend finding the right presets using your ear (since the "correct" settings will depend on which boxes you have, your application, and the program material), there are some guidelines for getting better results. This document goes into some details on choosing the right presets for your BASSBOSS MK3 loudspeakers.

TL;DR Summary:

- If using a top in full-range (without a subwoofer) use a preset with a Butterworth highpass filter
- When using tops and subwoofers together, use presets with Linkwitz-Riley for your subwoofers and tops in the crossover region
- David Lee recommends using lower-numbered presets on your subwoofers and higher-numbered presets on your tops
- Use your ear to find the right combination of presets
- All (non-cardiod) presets are time and phase aligned with one another, so there is no "bad" choice or alignment

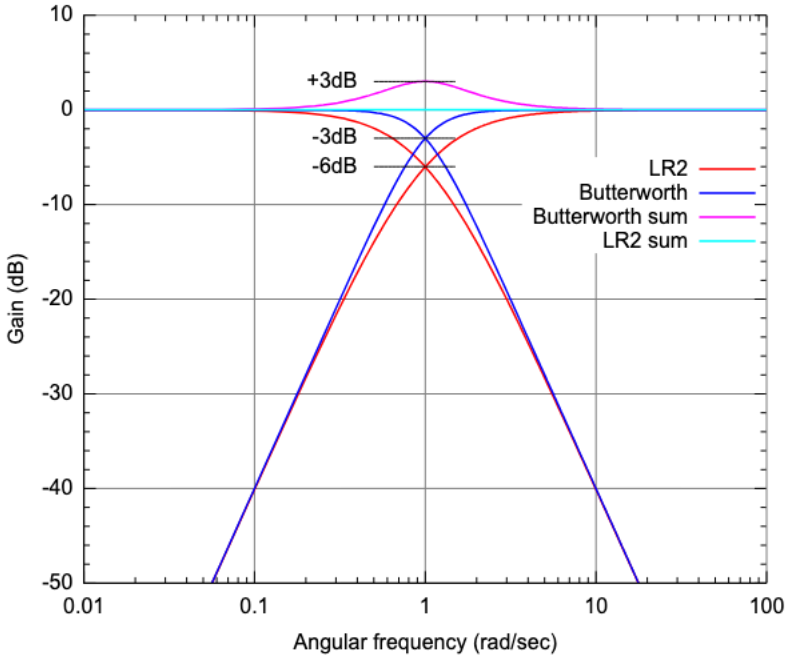
Butterworth vs Linkwitz-Riley Filters

Butterworth (BW) filters are maximally flat in the passband, resulting from them having the maximum number of zero derivatives in the passband thanks to being constructed by a Taylor series expansion. They were first described in 1930 by Stephen Butterworth in his paper "On the Theory of Filter Amplifiers." The magnitude response of a Butterworth lowpass filter is $H(2\pi f) = \frac{1}{\sqrt{1+(2\pi f)^{2n}}}$, where n is the order of the filter. The MK3 presets in BASSBOSS products are usually 4th order ($n = 4$), corresponding to a rolloff of 24dB/Octave, though there are some exceptions for specific alignments.

The "maximally flat" part of the Butterworth filter means that it will have the most low-end (which is usually what you want!): the highpass filters on our subwoofers are all Butterworth to give you the maximally flat low end response that is physically (and electrically) possible. The cutoff frequency of any filter, also known as the half-power point, is where the magnitude response dips down to -3dB of its nominal value. For the most amount of deep bass, choose a preset corresponding to a Butterworth highpass

filter at the lowest frequency. For instance, when using a DV12 in full range, we recommend you use Preset 1, which is a 40Hz Butterworth Highpass filter that provides the flattest and deepest response. In addition to being maximally flat, Butterworth filters have an extremely slow rolloff outside of the passband, which means they will let through more low-frequency content than any other filter type.

However the flat extension and slow rolloff of Butterworth filters causes (an often undesirable) buildup in the crossover region when using subwoofers and tops together. Typically, when you want to have a flat alignment, you will choose a lowpass and highpass filter with the same cutoff frequency. However doing so can lead to an uneven magnitude response when both filters contribute, since half power does not necessarily mean half magnitude! The goal of a crossover is to maintain a flat frequency response as the signal transitions from one driver or speaker to another, so while Butterworth filters are desirable for lowpass and highpass filters alone, they contribute to buildups and "peaks" in the frequency response when used in crossovers, which can be seen in the summed Butterworth response of the image below.



Enter the Linkwitz-Riley (LR) filter. First introduced by Siegfried Linkwitz and Russ Riley in a 1976 AES paper titled *Active Crossover Networks for Noncoincident Drivers*, the Linkwitz-Riley filter fixes this issue of peaks in the crossover regions, allowing a smooth, flat transition. It consists of cascading two Butterworth filters together and has the following magnitude response: $H(2\pi f) = \frac{1}{1+(2\pi f)^{2n}}$. This corresponds to a dip in the frequency response that is -6dB in the crossover region, allowing for perfect amplitude summation in the crossover region.

Now you may be wondering how a filter can have a cutoff point that is -6dB down, since the cutoff frequency is typically defined as the half-power (-3dB) point. This is due to the fact that the Linkwitz-Riley filter is constructed from two cascaded Butterworth filters with the same cutoff frequency. The cutoff frequency of the Linkwitz-Riley Filter is just the frequency of the constituent Butterworth filter. It may be easier to think of the Linkwitz-Riley as an "alignment" constructed of Butterworth filters with a given cutoff frequency, otherwise technically its cutoff frequency would differ.

Thus, to get a perfectly flat alignment between a subwoofer and a top, you would choose a preset that gives you a Linkwitz-Riley Lowpass filter at a given frequency, and your top to have a Linkwitz-Riley Highpass filter at the same frequency. For instance, when using a VS21 and AT212 together, you can use Preset 3 on your VS21's (an 80Hz Linkwitz-Riley Lowpass Filter) and Preset 4 on your AT212's (an 80Hz Linkwitz-Riley Highpass Filter) to allow perfect alignment, as long as the gain on your subwoofer and top match.

Crossover Shift:

When David Lee chooses presets for his shows, he typically uses the subwoofers in Preset 1-2 (Often corresponding to a 65-70Hz Lowpass Filter Cutoff) and tops in Presets 6-8 (Often corresponding top a 100Hz Highpass Filter cutoff). Based on the discussion above, this would appear to create a "hole" or dip in the frequency response in the crossover region around 60-110Hz. What's going on here?

The answer is something called "Crossover shift." Most of us like bass, and enjoy our subwoofers turned up more than our tops. If you ask people to rate the "quality" of a sound system with the subwoofers and tops at differing levels, it is often the case that people prefer the sound of a system where the subwoofers are turned up 10dB more than the tops. While some of this is simply preference, other times it has to do with the sensitivity of our hearing in that region (which is dependent on the overall level) as well as the "tilt" of the music that is played. When you change the level of a subwoofer, it changes the crossover point between your top and sub.

The term "cutoff frequency" is often used in the context of crossover networks, and this can be confusing because technically each filter has its own cutoff frequency. If both filters have the same cutoff frequency, then it makes sense to characterize the crossover with that frequency.

See Also:

- How should I use BASSBOSS Subs or Tops with Speakers from Another Manufacturer

- Linkwitz-Riley Filter
- Butterworth Filter
- MK3 Series Speakers