



Passive vs DSP Based Crossovers and “Hearing the Convertors”

When we started to design the MAD-MAX the decision to use DSP based crossover filtering was because we believe this is the best solution for modern active monitor systems. Although the final product uses DSP the initial design work was all done using passive filters. Once the passive design was finished the complex task of re-creating this into the digital domain was commenced.

DSP filtering is a loudspeaker designers dream, it opens up potential design solutions that are just not possible with passive filters. However, new capabilities throw up new problems. Just because you can doesn't mean you should and this brings up an interesting observation.

The general consensus amongst engineers is that DSP based monitors don't sound as good as passives because they can hear the convertors. While I don't doubt there is some truth to this with cheap monitors using low quality ADC's and DAC's, I believe the bigger issue with expensive monitors is that the designers are over processing the DSP based filtering.

I must admit even I was initially taken in by the ability to over process the filtering, the ability to add a parametric EQ to flatten that little peak here and add another to raise that little dip there was all too tempting and before I knew it I was down that rabbit hole chasing the theoretically perfect frequency response.

It wasn't until I sat back to listen to my 'masterpiece' that I realised the mistake, because whilst the measured frequency response was almost technically perfect the listening experience was definitely not. The sound was flat and lifeless with no sparkle or air, it was almost like the speaker was covered by a sheet of heavy cloth masking the sound.

In A-B tests comparing DSP to the original passive design the passive won out every time! What was the problem? Was it the op-amps? Was it the convertors? or something as simple as a component mismatch?

Days of re working the DSP board ensued. I tried swapping out chipsets and components with no marked improvement. It wasn't until one morning when using a signal generator to sweep through the frequency range whilst A-B testing that I finally found the problem. I had fallen into the trap of over processing the filter design.

As I started to remove the parametric EQ's and other EQ filtering from the design, as if by magic the flat lifeless sound was gone. I spent the next week redesigning the DSP filtering following the tried and tested passive design rules that I had successfully used for the last 18 years as a passive loudspeaker designer.

Now when A-B testing against the passive design the new 'less is more' DSP based filtering was audibly superior to the traditional passive design and this is the filter design that is in the production MAD-MAX.

So when someone claims to be able to hear the convertors, are they in fact hearing the ADC's and DAC's of the DSP design, or are they really hearing over-processed DSP filtering as a result of poor filter design from the manufacturer of that particular monitor?