LINEAR PHASE TECHNOLOGY

1. Introducing FIR Filters

The implementation of Linear phase technology, using FIR (Finite Impulse Response) filters in Lynx Pro Audio's acoustic cabinets has been a development conceived and carried out by our engineers. By integrating digital FIR filters in our DSP-B22 and DSP-B24 it enables us to achieve better transition area between all the cabinet's components, better temporary system alignment and greater impulse response. All this resulting in a much improved sound and phase response enabling the user to optimize their systems when using different sources of sound.

2. Application:

Thanks to the previous development of Lynx Pro Audios in-house DSPs, using this type of filter can now be easily applied. Linear phase technology with FIR filters is now applied in all self-powered Lynx Pro Audio cabinets and thus in all installations, whether it be a live concert using an LX Series line array or a theatre, auditorium, house of worship using an ADP system.

Here is a list of all cabinets now with integrated FIR filters:

LX Series	ADP Series
LX-V12	ADP-215
LX-V8	ADP-15
LX-F6	ADP-12
	ADP-26
	ADP-15M
	ADP-12M

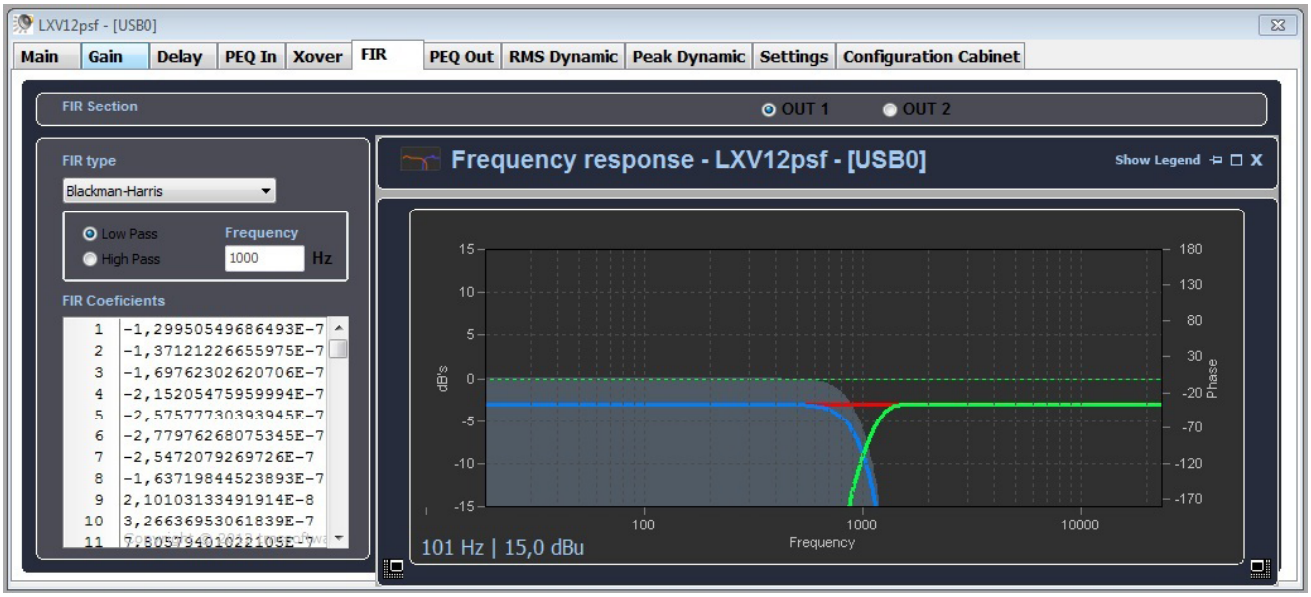


Figure1. Example of a crossover carried out using FIR filters. The image shows a totally linear phase in dis-continuous black over the 0dB line.

3. FIR Filters Vs IIR Filters

Traditionally, cabinet developers have used IIR (Infinite Impulse Response) filters in their developments for crossover and equalization design. This type of filter simulates anologue filters, modifying the phase and applying delay in certain frequencies.

The advantage of FIR filters far outweigh their disadvantages, the main one being an increase in system latency. Lynx Pro Audio engineers have enabled their software to be both FIR & IIR compatible with the option of even combining the two and tailoring them to the users preferences.

The following demonstrates some of the differences between IIR and FIR

Phase:

IIR: Difficult to control with no particular solution

FIR: Always delivers a linear phase response

Order:

IIR: Normally offer up to 48dB per octave, equivalent to an 8th order.

FIR: The slope is calculated according to the number of taps and the algorithms employed and varies according to the frequency cut and the frequency sample rate. It can also be calculated using adaptative FIR.

The response and phase graphs show how the crossover carried out with IIR filters has a phase modification equivalent to 360º and the graph with the FIR filter crossover is totally flat.

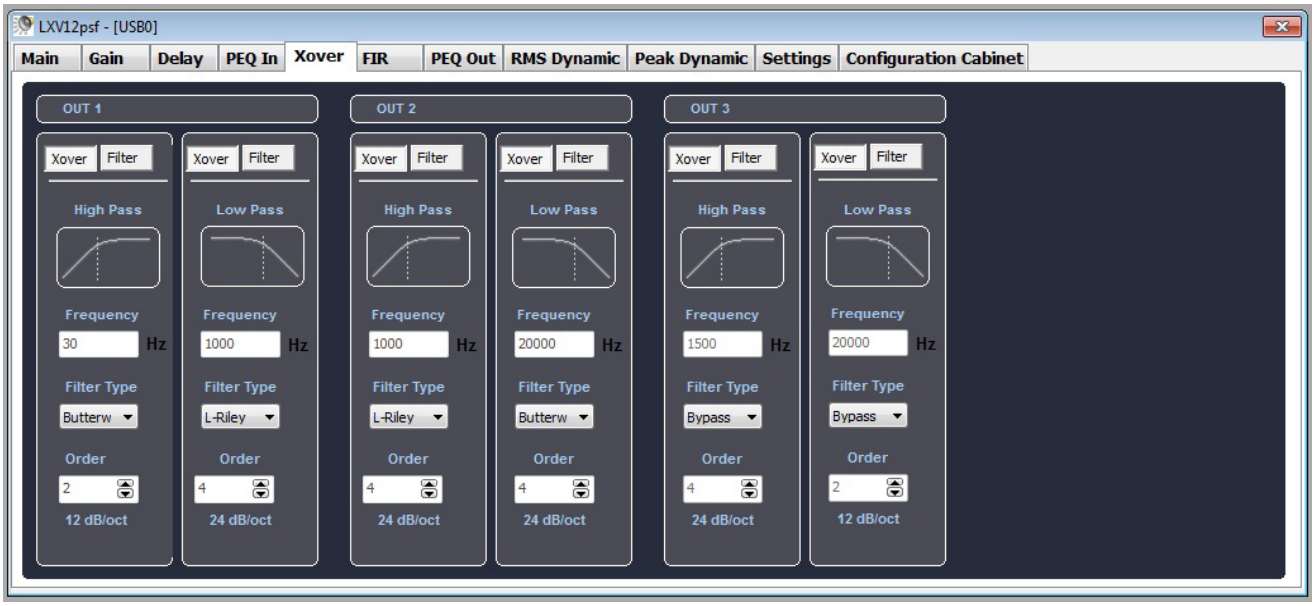


Fig2. A crossover design using IIR filters

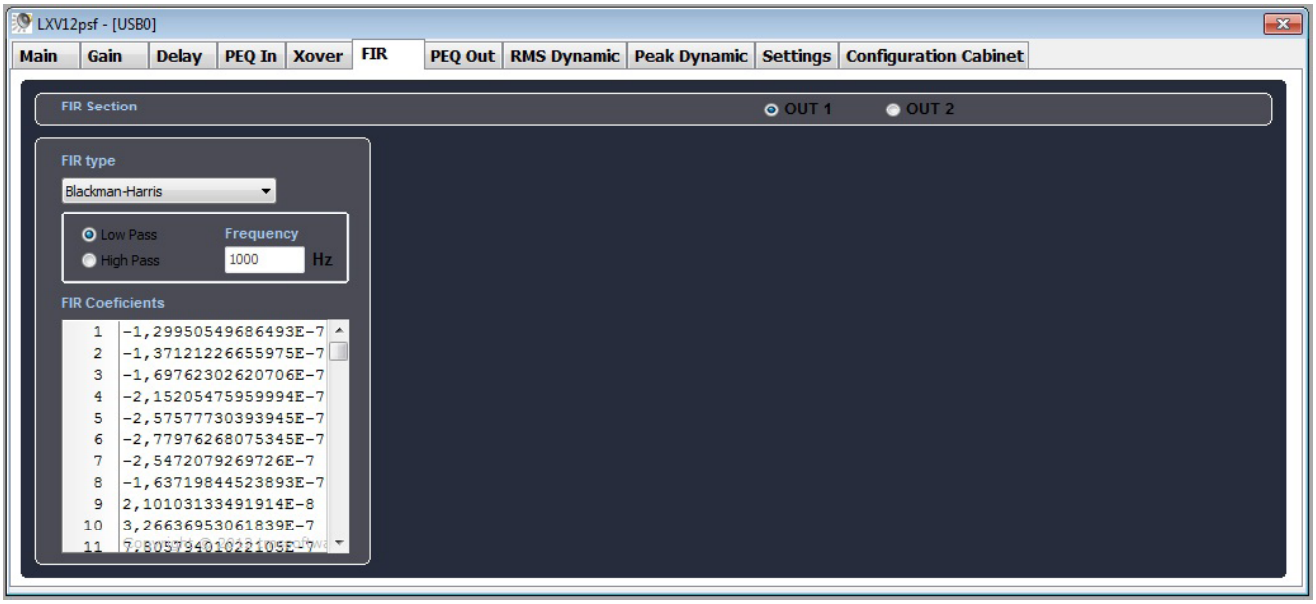


Fig3. A crossover design using FIR filters

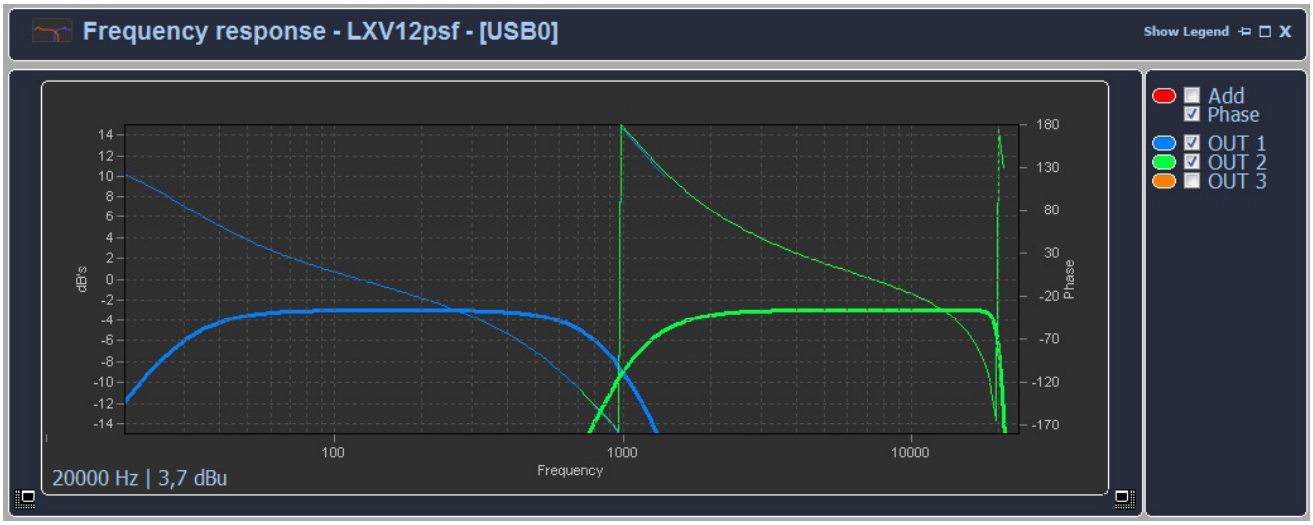


Fig4. Response and phase graph with IIR filters

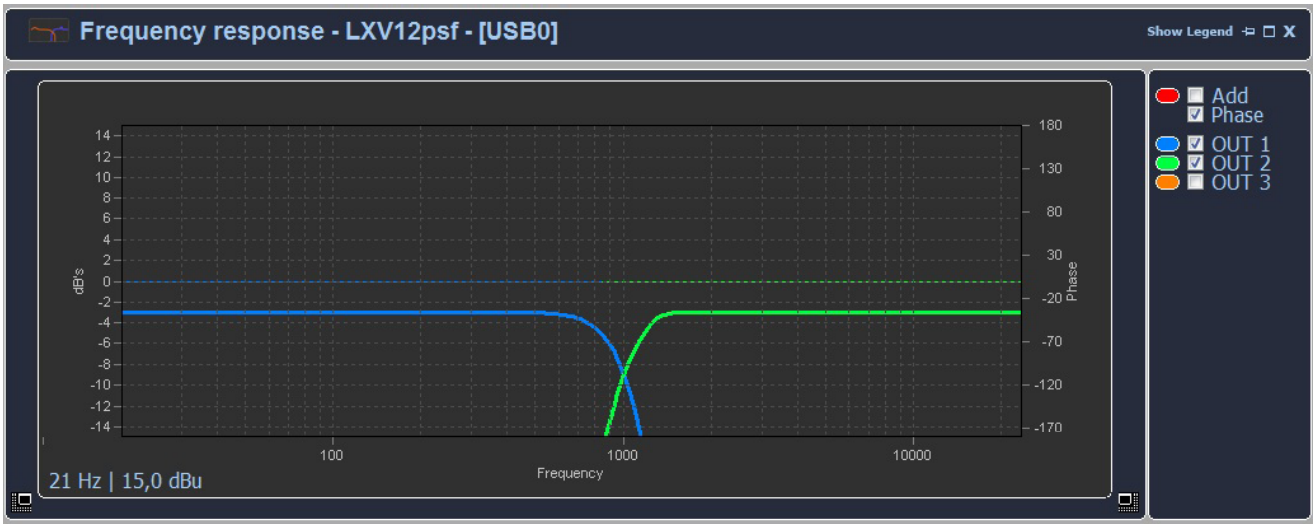
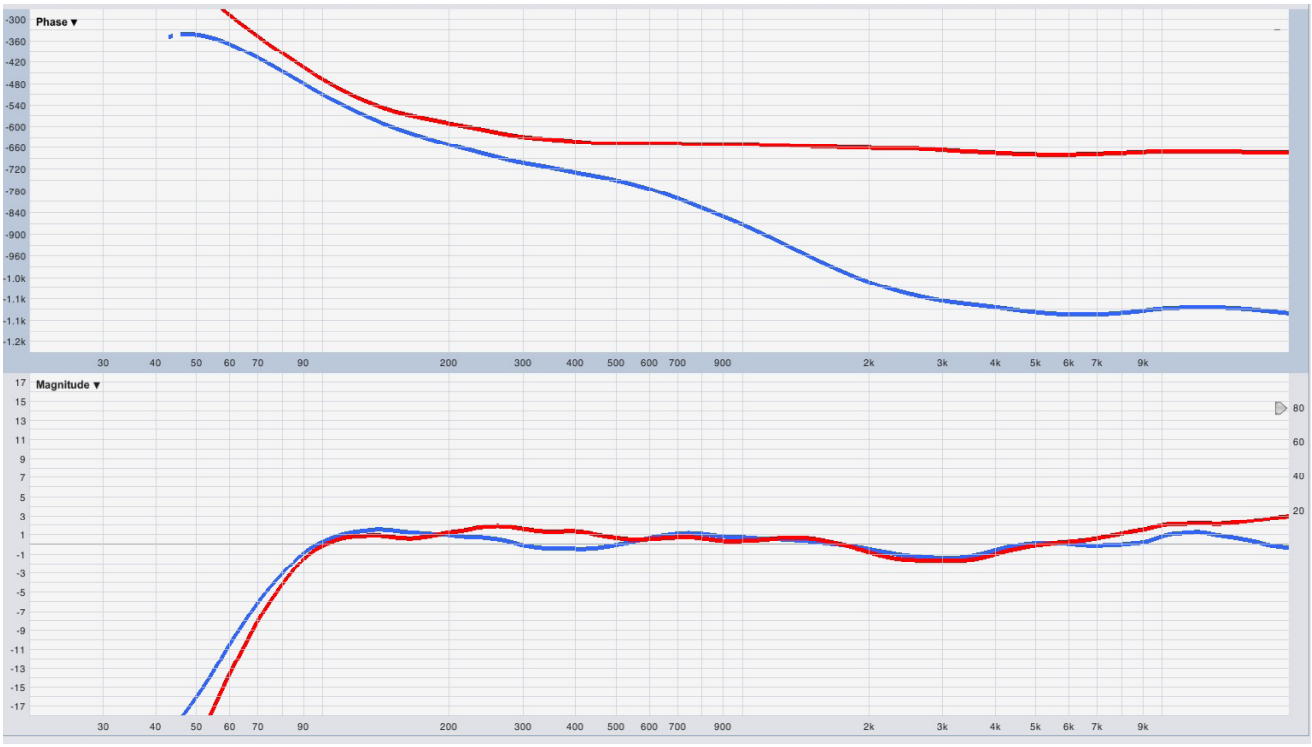


Fig5. Response and phase graph with FIR filters

Fig 6. The following diagram shows the complete phase response without cycle changes. We can see the delay produced by IIR filters applied in the crossover



RED: ADP-26 with FIR filters BLUE: ADP-26 with IIR filters

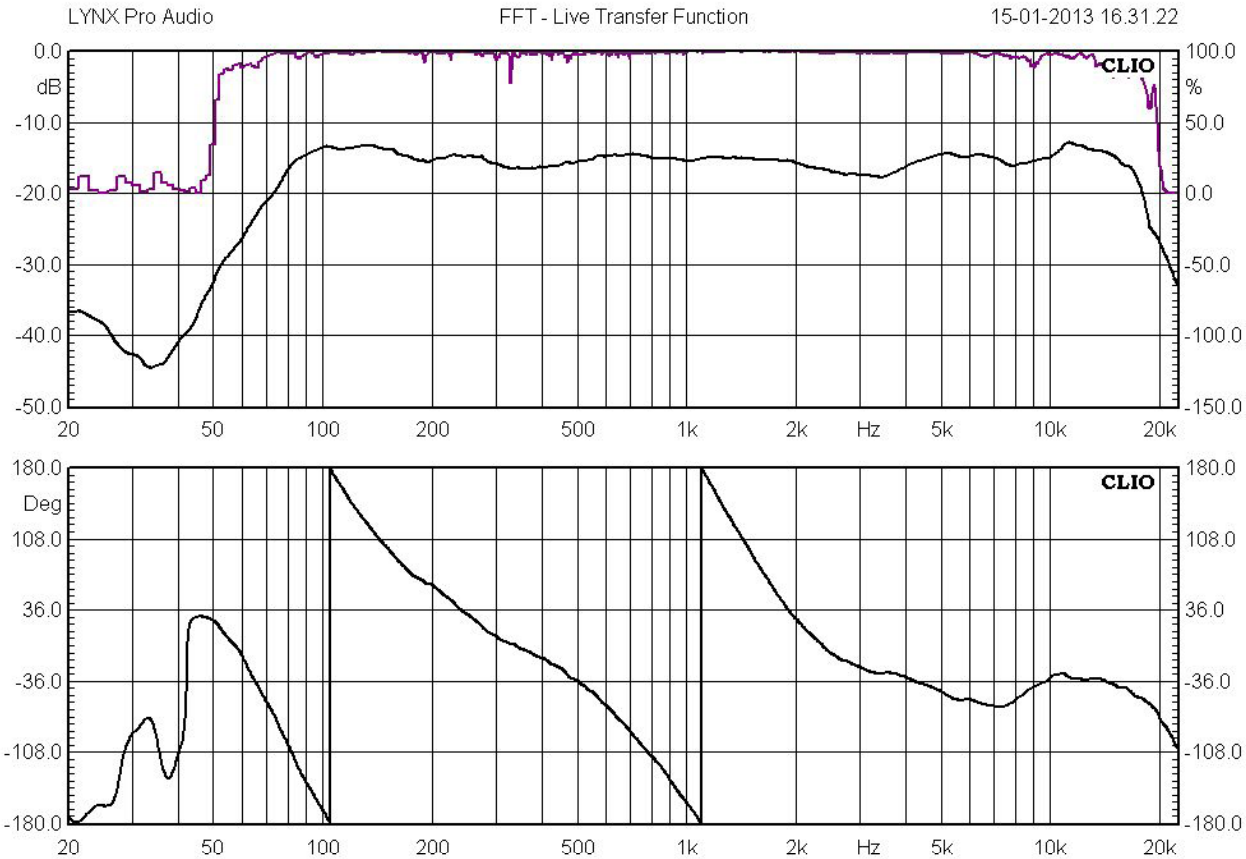
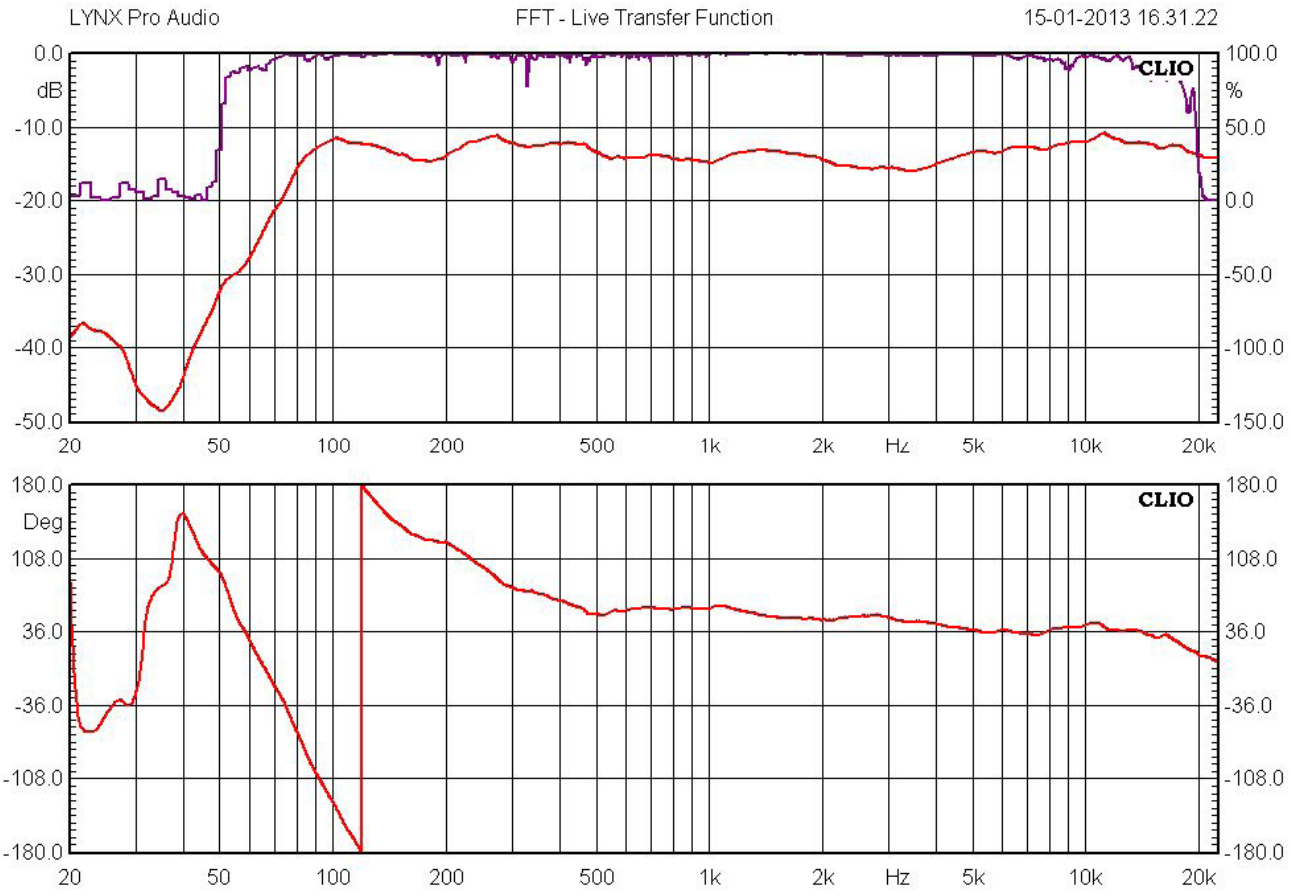


Fig7. Now we can see an example of an ADP-26 cabinet demonstrating the phase differences caused when we apply an IIR filter or an FIR filter in the crossover.

ADP-26 frequency and phase response using IIR crossover. As you can see in the phase graphic you can see approximately where is the cross point betweeen the two components (cicle change due to the delay produces by the filters)



ADP-26 frequency and phase response using a crossover configured with FIR filters and EQ FIR adaptative.The phase is lineal between 500 Hz and 20 KHz.

Impulse responses.

Another characteristic which enables us to improve the acoustic cabinet by using FIR filters is the system's Impulse response. The system attack is much quicker and more precise than an IIR filter and is much closer to an ideal Impulse response.The following three diagrams show us different impulse responses.

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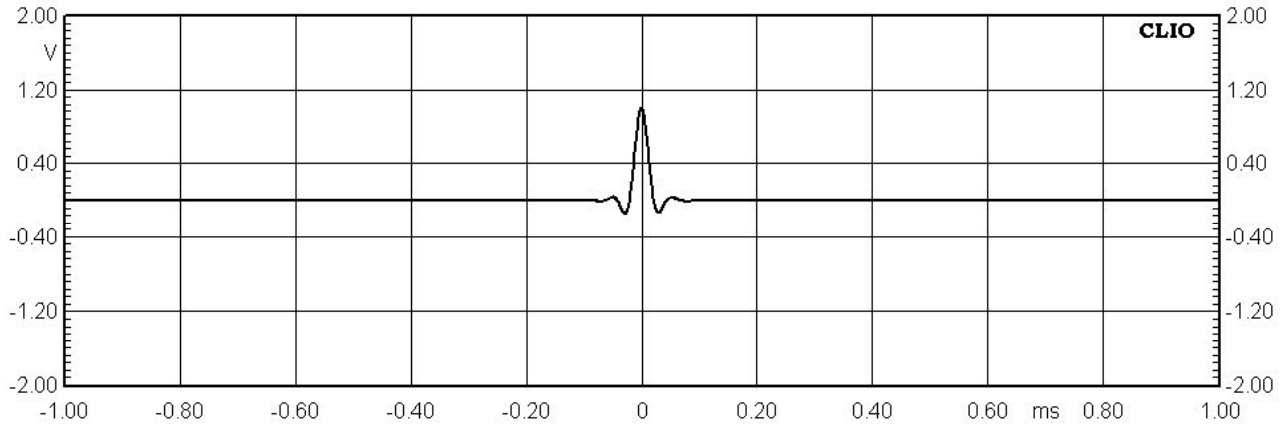
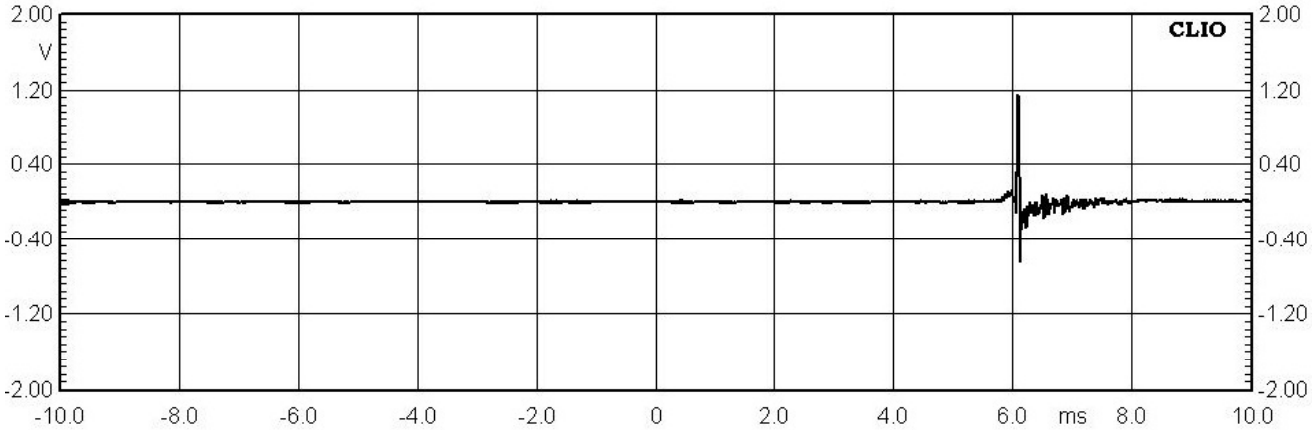


ADP-26 impulse response with FIR filters



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