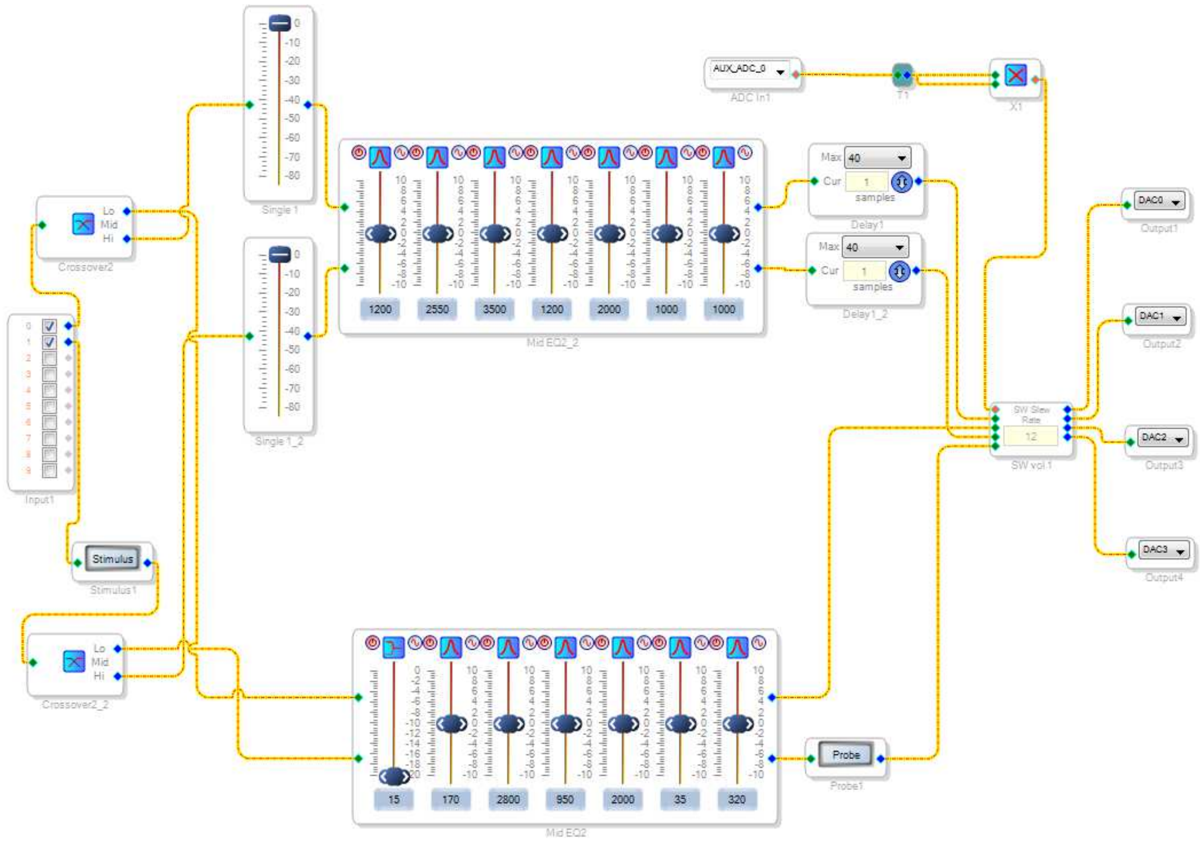
Generic 2-Way Crossover (V0.2)

1. Introduction

This example for a generic 2-way crossover is intended to help all newcomers to implement their first crossover in Sigma Studio for the FreeDSP. It includes the modules needed in most crossover design. It is easy to adapt these for additional features once the principle is understood.

The modules are defined as double-precision wherever it makes sense. The difference between single precision and double precision design is clearly hearable with good loudspeaker designs. So double precision is recommended.

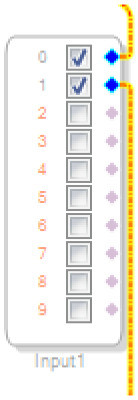
Block diagram:



Each module of the design will be explained in chapter 2.

2. Description of the different modules

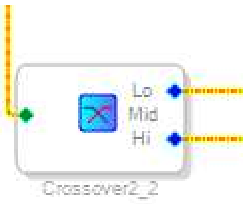
2.1 Input section



Picture 1: Input section

This is simply the input section suitable for the FreeDSP.

2.2 Crossover module



Picture 2: Crossover module

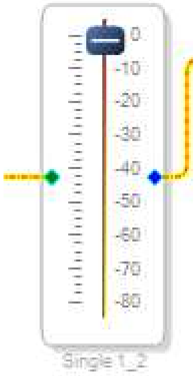
The crossover module is used to separate the high from the low frequencies needed to supply tweeter and woofer respectively with the appropriate signals.

With a right mouse click on the symbol several options can be selected like corner frequencies for both the tweeter and woofer section (currently both 2.0 kHz). Also the type of filter (currently Linkwitz-Riley 24db/oct.) for both sections can be adjusted as required.

The default values were chosen because they should give a good starting point for further adjustments.

Remark: Please be aware that there are 2 crossover modules (for left and right channel, “crossover2” and “crossover2_2”) which need to be identical to ensure same behavior on left and right channel. Practically the easiest way to ensure this is to do a right mouse click on the symbol of the module that should be reused and select “Cell settings” and “copy”. Do then a right mouse click on the symbol where you want the parameters to be copied and select “Cell settings” and “paste”.

2.3 Tweeter attenuators



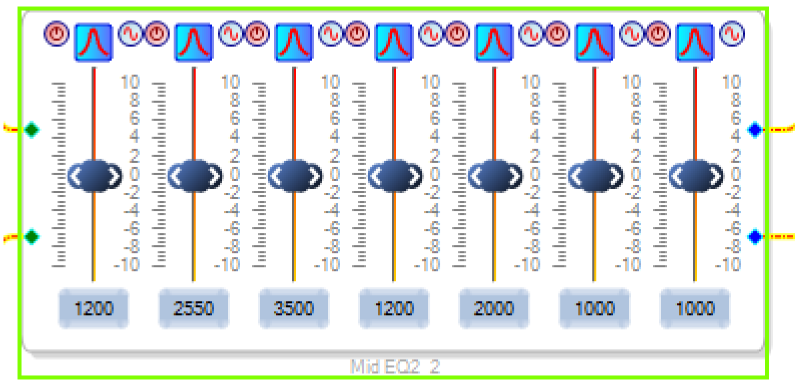
Picture 3: Tweeter attenuators

Generally the tweeters have higher efficiency than the woofers.

So the design has 2 attenuators (for the left and right channel) to adapt the different SPLs coming from the tweeter and the woofer. Please make sure that both attenuators use the same value.

Default setting: 0dB (no attenuation of the tweeter)

2.4 Filters for the tweeter section



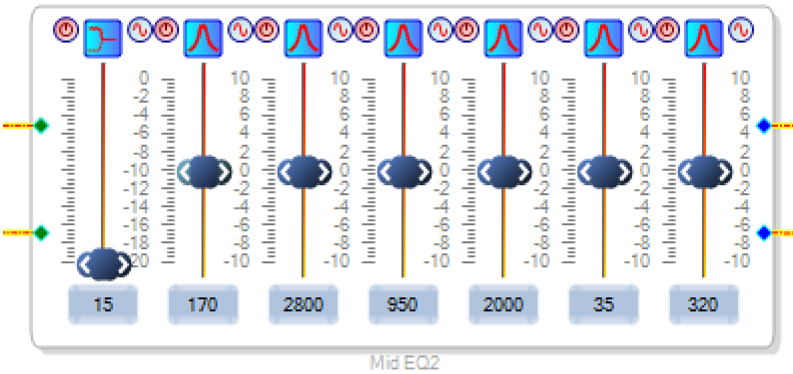
Picture 4: Filters of the tweeter section (mid_EQ2_2)

There are 7 different filters where to choose from.

The filter functions for the tweeter section can be chosen here. With a double mouse click on the corresponding filter graph you can chose different filter types (peaking EQ vs. shelving EQ), gain and Q factor of the filter. The round button switches on and off the corresponding filter.

Default: All filters are switched off; the range is selected between -10 and +10dB (of course the default values can be changed if needed)

2.5 Filters for the woofer section



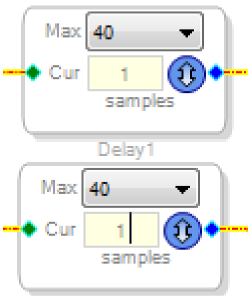
Picture 5: Filters of the woofer section (mid_EQ2)

There are 7 different filters where to choose from.

The filter functions for the woofer section can be chosen here. With a double mouse click on the corresponding filter graph you can chose different filter types (peaking EQ vs. shelving EQ), gain and Q factor of the filter. The round button switches on and off the corresponding filter.

Default: All filters are switches off; the first filter can easily be used as a subsonic filter. Anyhow the cutoff frequency and the slope has to be chosen correctly for the loudspeaker design.

2.6 Delay for the tweeter section

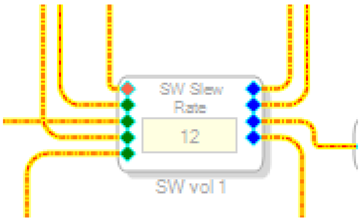


Picture 6: Delay of the tweeter section (Delay1 and Delay1_2)

Generally the woofer has some timing delay in comparison to the tweeter as its acoustical center is located with more distance to the hifi-enthusiastic than the one of the tweeter. So it is often helpful to delay the tweeter section in order to time align both chassis. Every step of delay means: 340/48000m=~7mm. A maximum of 40 samples (~28cm of delay) is chosen currently.

Please make sure that both delays (for left and right channel) use the same values. Per default 1 sample delay (~7mm) is selected.

2.7 Loudness control

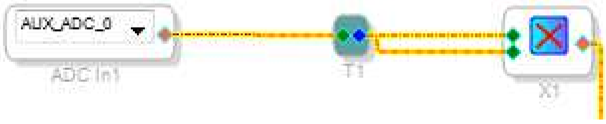


Picture 7: Basic loudness control

There is one basic loudness control module that affects all 4 channels in an identical way: Tweeter right, Woofer right, Tweeter left, Woofer left.

The loudness is defined by the value on the red input of this module.

In order to change the loudness of the outputs from the outside the schematics in picture 8 are used.



Picture 8: ADC input for potentiometer

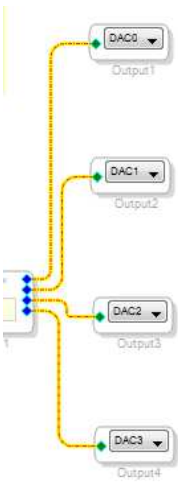
ADC reads the voltage values on ADC_0. In order to have a more logarithmic type of loudness the value of ADC_0 is multiplied with itself (module X1).

Applications:

1. Usage of a linear potentiometer connected between GND, 3.3V and the ADC_0 pin.

2. “Digital volume control” through a µC and its PWM output or with a so called “digital potentiometer”. An IR control can be realized easily with this feature.

2.8 Output section



Picture 8: Output section

This module simply routes the signals to the different DAC outputs of the FreeDSP module.

Important remark: This is a spare time project. No warranty and liability can be given to any information/design or modules. The user must be able to understand the information and use the information in an appropriate way.