Multi-way Transient Perfect (TP) Crossovers

Woofer: Low-Pass, \( F_c=500\text{Hz} \), Node 6
Midrange: Band-Pass, 500-5000Hz, Node 17
Tweeter: High-Pass, \( F_c=5000\text{Hz} \), Node 22

Note: \( A0+A1 \) = differential amplifier. \( A16+A17 \) = differential amplifier.

3-Way TP Crossover showing all component values

Principle of creating multi-way TP networks: cascade another 2-way TP network (Hump+LP+HP) from tweeter port. Therefore, 4-way 5-way... crossovers can be assembled the same way.
Red – SPL(flat), Green – Phase(flat), Black – individual channels

Blue colour is the summed time response of three channels – perfect square wave
Additional requirements:

1. The active implementation of the 3-way TP network requires three (3) power amplifiers to be connected to each of the crossover outputs. Obviously, 4-way TP network requires 4 amplifiers and so on....
2. Gain of the each channel (power amplifier + speaker’s SPL) MUST be set exactly the same.
3. 2-way TP HP/LP filters can be implemented as passive networks, therefore you can get away with single power amplifier.
5-way, 2nd order, TP crossover

Woofer – Node 6
Upper Bass – Node 17
Midrange – Node 28
Tweeter – Node 39
Super Tweeter – Node 44

SoundEasy 2nd order TP Calculator is shown below. The 2-way, 2nd order active crossover with EQ correction is your building block. All you need to enter is crossover frequency and overlap parameters. Filter Section parameters and Equalizer Section parameters are calculated automatically from the two mentioned above. However, you can still edit Filter and Equalizer parameters to force the program into “what-if” analysis.

Targets for HP and LP sections of the TP crossover are also built-in for optimizations of the full acoustic response of the crossover – see figure below.

Acknowledgement:
The 2-way TP Crossover and Calculator concepts are due to the excellent papers from John Kreskovsky.

2-nd order TP Calculator – your “building block”

HP and LP Optimizer templates for TP, 2-nd order crossover
TP 2-nd order crossover version with GYRATOR replacing inductor in the EQ circuit.

Note: A16 output impedance is the used as one of the GYRATOR’s components. Outputs are Node 5 (LP) and Node 9 (HP).

Approximated value of the inductor, L, created with the gyrator:

\[ L = (R17 - Rout) \times Rout \times C15 \]

Rout = 200 ohm, output impedance of the A16. Rout should be selected from 200-470 ohm.

R17 = 400 kohm

C15 = 0.009 uF

Hence: \( L = 70 \text{mH} \)

Approximated value of the inductor’s, Q, created with the gyrator:

\[ Q = \frac{XL}{(Rout + R4)} \]

Rout = 200 ohm

R4 = 1100 ohm

L = 0.070 H

Hence: \( Q = 0.33 \)

Approximated value of the gain, G, created with the gyrator:

\[ G = 1 + \frac{R2}{(Rout + R4)} \]

Rout = 200 ohm

R4 = 1100 ohm

R2 = 500 ohm

Hence: \( G = 0.385 \)