Multi-way Transient Perfect (TP) Crossovers

Woofer:	Low-Pass,	Fc=500Hz,	Node 6
Midrange:	Band-Pass,	500-5000Hz,	Node 17
Tweeter:	High-Pass,	Fc=5000Hz,	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

🖬 CAD Edit	tor											
	$\begin{array}{c} \begin{array}{c} & & \\ & & \\ & & \\ & \\ & \\ & \\ & \\ & \\ $	1 0 4 R6 4 0 4 0 5 1 C11 8 0 1 8 0 1 1 0 1 0 1 0 1 0 1 0 1 0 1 0	4 1 6 C9 7 5 5 5 8 8 8 14 - 11 3 11	6 6 7 7 7 7 7		11 12 A16 12 13 12 11 11 11 11	12_15 R22 12_ 12_ 19 19 19 19 19 20 20 1 20 7	15 17 5 C25 723 16 6 16 16 19 0 P30 - 22 22 22 29 22	17 17 17 17 17 17 17 17 17 16 17 17 17 17 17 17 17 17 17 17	+ • ∳ [₹] 2 ∰ ∰	···· ∳ ···· ∳ ····	Elem: 54 Cmp: 32 A0 = 1000.0000 Ku A1 = 1000.0000 Ku A1 = 1000.0000 ku C3 = 0.79581 uF L4 = 127.28454 mH R5 = 1199.90405 ohm R6 = 90000.00000 ohm R7 = 10000.00000 ohm R7 = 10000.00000 ohm C1 = 0.00398 uF C11 = 0.02000 uF C12 = 0.18000 uF C12 = 0.18000 uF A13 = 1.0000 Ku R14 = 7956.71582 ohm R14 = 7956.71582 ohm
250. 250. 200. 200. 150. 150. 100. 100. 50.0 50.0 0.00 0.00 -50. -50. -100 -100 -150 -150 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200 -200												Frequency 100.00 [Hz] Exclude Driver SPL Include Diffraction
1.41 [14]	0.000	2.000	4.000	6.000	8.000	10.00	12.00	14.00	16.00	18.00	20.00r	ns

Modified Nodal Method used to display time response of all three nodes 6+17+22

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, 2-nd order, TP crossover

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

SoundEasy 2-nd order TP Calculator is shown below. The 2-way, 2-nd 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.

1. "Transient Perfect Second Order Crossover" - May 2001, AudioXpress.

2. "Design Rules for Active Implementation of Transient Perfect 2nd Order Crossovers". - In preparation.

3. www.geocities.com/kreskovsky/John1/html

CAD Editor	
中	Elem: 0 Cmp: 0
(D)	**** ****
	+*** ****
Crossover Parameters Done NN	
Overlap 1.5-2.0 2.00 Print	
Filter Of 0.4000	→~ ***
Highpass Fc 500.0 Hz	+ ***
Equipier Section	
Equaizer Gam 11410 Equaizer Qe 0.3333	+#~D ****
	<u>t</u> <u>+</u> + ★★★ ± + ★★★★
	D **** ***

	Erase Draw Add Draw MODE
Pick & Place a Component or Draw a Connection Using LEFT MB	

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)*Rout*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 = 70mH

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

Q = 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 + R2/(Rout+R4) Rout = 200 ohm R4 = 1100 ohm R2 = 500 ohm Hence: G = 0.385