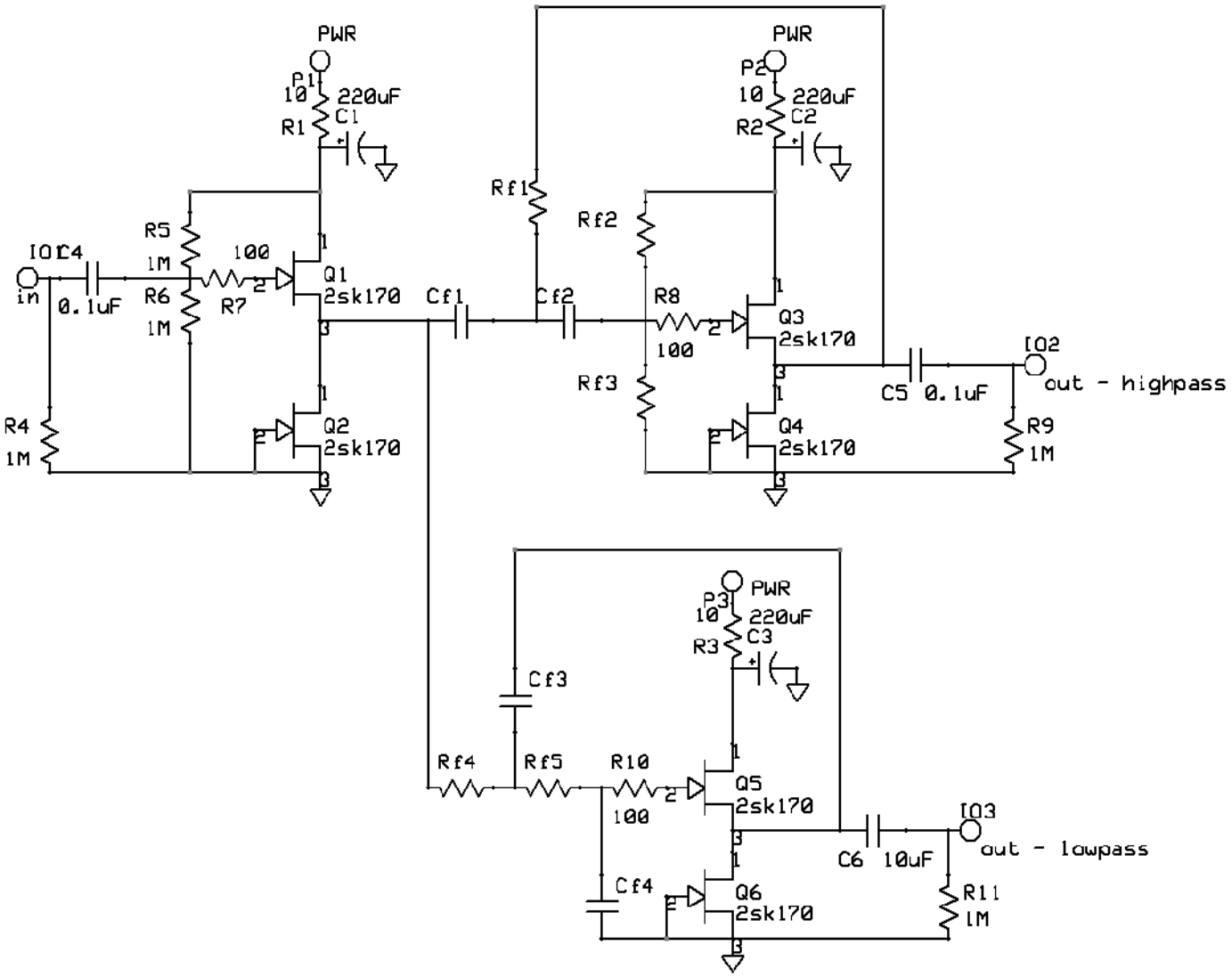
Boozhound Laboratories
Crossover Assembly Manual (v.1)

The Boozhoundlabs Philosophy

The plan here is to offer kits that let the curious audiophile experience designs that they would otherwise have to build from scratch. The parts used in this kit are for the most part considered obsolete and are probably no longer being manufactured. I source this stuff from overseas via eBay.

I think simplicity is a huge part of why classic equipment sounds so good, and modern stuff can sound so bad. In the days when capacitors and transformers were expensive, designers minimized the parts count in any design, and this approach is audible even when designing with modern devices. And for those of us who not only want to build stuff, but to understand how it works, simple designs are much more comprehensible, with no "black boxes" that we only understand through the abstraction of a spec sheet.

Why not have fun building stuff instead of just pouring dollars into your system on the quest for ultimate-ness? Part of the fun for me is the ability to try something new without having to shell out the big bucks.



The JFET Crossover

This crossover is comprised of an input buffer followed by a pair of Sallen-key filters resulting in a 12dB/Octave crossover slope. The buffer and filters all use discrete JFETs, and there are several tricks used to reduce the parts count to the absolute minimum.

Each board is for one channel. Two are needed for stereo. For a 3 (or more) way crossover, multiple crossovers can be cascaded.

Inventory

Start by verifying that you have all of the parts you need. I endeavor to make sure I send only complete kits, but it is always possible I missed something. If I screwed up and left something out, please email me immediately at jsn@boozhoundlabs.com and I will make it right.

Here is what is included with each kit, with checkboxes to make it easy to verify that you have all of this stuff.

( ) 1 - Printed Circuit Boards
( ) 6 - 2sk170 transistors Q1-Q6
( ) 3 - 220uF electrolytic capacitor C1-C3
( ) 2 - 0.1uF PIO capacitor C4, C5
( ) 1 - 10uF Film Capacitor C6

( ) 3 - 10 ohm resistor Brown, black, black, gold, brown R1-R3
( ) 5 - 1M resistor Brown, black, black, yellow, brown R4-R6, R9, R11
( ) 3 - 100 ohm resistor Brown, black, black, black, brown R7, R8, R10

( ) 4 - capacitors, value determined by the frequency needed Rf1-Rf5
( ) 5 - resistors, value determined by the frequency needed Cf1-Cf4

( ) 4 - standoffs with 4-40 screws
( ) 4 - screw terminals

Crossover Frequency

The frequency of the crossover point is set by Rf1-Rf5 and Cf1-Cf4. To determine the values for these parts, you can either use the following equation, or the chart on the last page of this manual.

$$f = 1/(2\pi RC)$$

Since Capacitors come in a limited number of values, first choose the capacitor value you want to use (in Farads), and use the following equation to find the resistor value needed. Cf1, Cf2, Cf3 and Cf4 are all the same value, equal to C in the equation below.

Note that Rf2 and Rf3 are present parallel AC paths to ground, so they must be twice the value of the other resistors. (This is confusing, but allows for 1 fewer coupling capacitors in the circuit).

$$Rf1, Rf4, Rf5 = 1/(2\pi Cf)$$

$$Rf2, Rf3 = 2(1/(2\pi Cf))$$

To use the attached chart to calculate the R and C values, find the frequency you want to use in the “freq.” column, then move to the right to find the options for R given the values for C shown at the top of the chart. Note that all R values are in Kohms.

Assembly

This is almost self-explanatory, but I will offer a few tips, and a few photos.

It is generally a good idea to install the little stuff first and the big stuff afterwards, so that you aren’t melting the big stuff trying to get to the little stuff. Start with the resistors and the JFETs.

The JFETs will be taped together in matched quads. Q1 and Q2 should match each other as well as Q1 and Q2 on the other channel. Same for Q3/Q4 and Q5/Q6.

I like to solder from the bottom of the board because it is easier to get to things, and the odds of overheating a part are lower because you are that much further from the part itself. Be sure to heat the pad and the leads sufficiently to let the solder flow all the way to the top of the board though. These boards have through-plated holes, so it will be easy. These boards have traces only on one side, leaving the bottom side to be nothing but a huge ground plane. This will reduce grounding problems and make this a very quiet design.

The points where the components do attach to the ground plane will take a bit more heat to solder properly since the ground plane will act as a heat sink.

Next install the capacitors. Or instead of “next” I should say “last” because you are done!

The only thing left to do is visually inspect the solder joints to make sure everything looks good and there are no solder bridges or obvious cold solder joints.

Integration

Connecting this to the various inputs and outputs is also super easy. The pwr pads need to be connected to a source of roughly 12-24 volts filtered DC. There is a bit of filtering (more like decoupling) on the board, but not enough to filter AC. The Boozhound Labs power supply provides an extremely quiet 18VDC at enough current to power many of the BHL kits at once.

-jsn

	C=1uF		C=0.1uF		C=0.033uF	
	Rf1		Rf1		Rf1	
	Rf4	Rf2	Rf4	Rf2	Rf4	Rf2
freq.	Rf5	Rf3	Rf5	Rf3	Rf5	Rf3
Hz	Kohms		Kohms		Kohms	
80	1.99	3.98	19.9	39.8		
90	1.77	3.54	17.7	35.4		
100	1.59	3.18	15.9	31.8		
110	1.45	2.89	14.5	28.9		
120	1.33	2.65	13.3	26.5		
130	1.22	2.45	12.2	24.5		
140	1.14	2.27	11.4	22.7		
150	1.06	2.12	10.6	21.2		
160			9.95	19.9		
170			9.36	18.7		
180			8.84	17.7		
190			8.38	16.8		
200			7.96	15.9		
220			7.23	14.5		
240			6.63	13.3	20.1	40.2
260			6.12	12.2	18.5	37.1
280			5.68	11.4	17.2	34.4
300			5.31	10.6	16.1	32.2
320			4.97	9.95	15.1	30.1
330			4.82	9.65	14.6	29.2
340			4.68	9.36	14.2	28.4
350			4.55	9.09	13.8	27.6
360			4.42	8.84	13.4	26.8
370			4.30	8.60	13.0	26.1
380			4.19	8.38	12.7	25.4
390			4.08	8.16	12.4	24.7
400			3.98	7.96	12.1	24.1
450			3.54	7.07	10.7	21.4
500			3.18	6.37	9.65	19.3
550			2.89	5.79	8.77	17.5

	C=0.1uF		C=0.033uF		C=0.01uF	
	Rf1		Rf1		Rf1	
	Rf4	Rf2	Rf4	Rf2	Rf4	Rf2
freq.	Rf5	Rf3	Rf5	Rf3	Rf5	Rf3
Hz	Kohms		Kohms		Kohms	
600	2.65	5.31	8.04	16.1		
650	2.45	4.90	7.42	14.8		
700	2.27	4.55	6.89	13.8		
750	2.12	4.24	6.43	12.9		
800	1.99	3.98	6.03	12.1	19.9	39.8
850	1.87	3.74	5.67	11.3	18.7	37.4
900	1.77	3.54	5.36	10.7	17.7	35.4
950	1.68	3.35	5.08	10.2	16.8	33.5
1,000	1.59	3.18	4.82	9.65	15.9	31.8
1,100	1.45	2.89	4.38	8.77	14.5	28.9
1,200	1.33	2.65	4.02	8.04	13.3	26.5
1,300	1.22	2.45	3.71	7.42	12.2	24.5
1,400	1.14	2.27	3.44	6.89	11.4	22.7
1,500	1.06	2.12	3.22	6.43	10.6	21.2
1,600			3.01	6.03	9.95	19.9
1,700			2.84	5.67	9.36	18.7
1,800			2.68	5.36	8.84	17.7
1,900			2.54	5.08	8.38	16.8
2,000			2.41	4.82	7.96	15.9
2,100			2.30	4.59	7.58	15.2
2,200			2.19	4.38	7.23	14.5
2,300			2.10	4.19	6.92	13.8
2,400			2.01	4.02	6.63	13.3
2,500			1.93	3.86	6.37	12.7
2,600			1.85	3.71	6.12	12.2
2,700			1.79	3.57	5.89	11.8
2,800			1.72	3.44	5.68	11.4
2,900			1.66	3.33	5.49	11.0
3,000			1.61	3.22	5.31	10.6
3,100			1.56	3.11	5.13	10.3