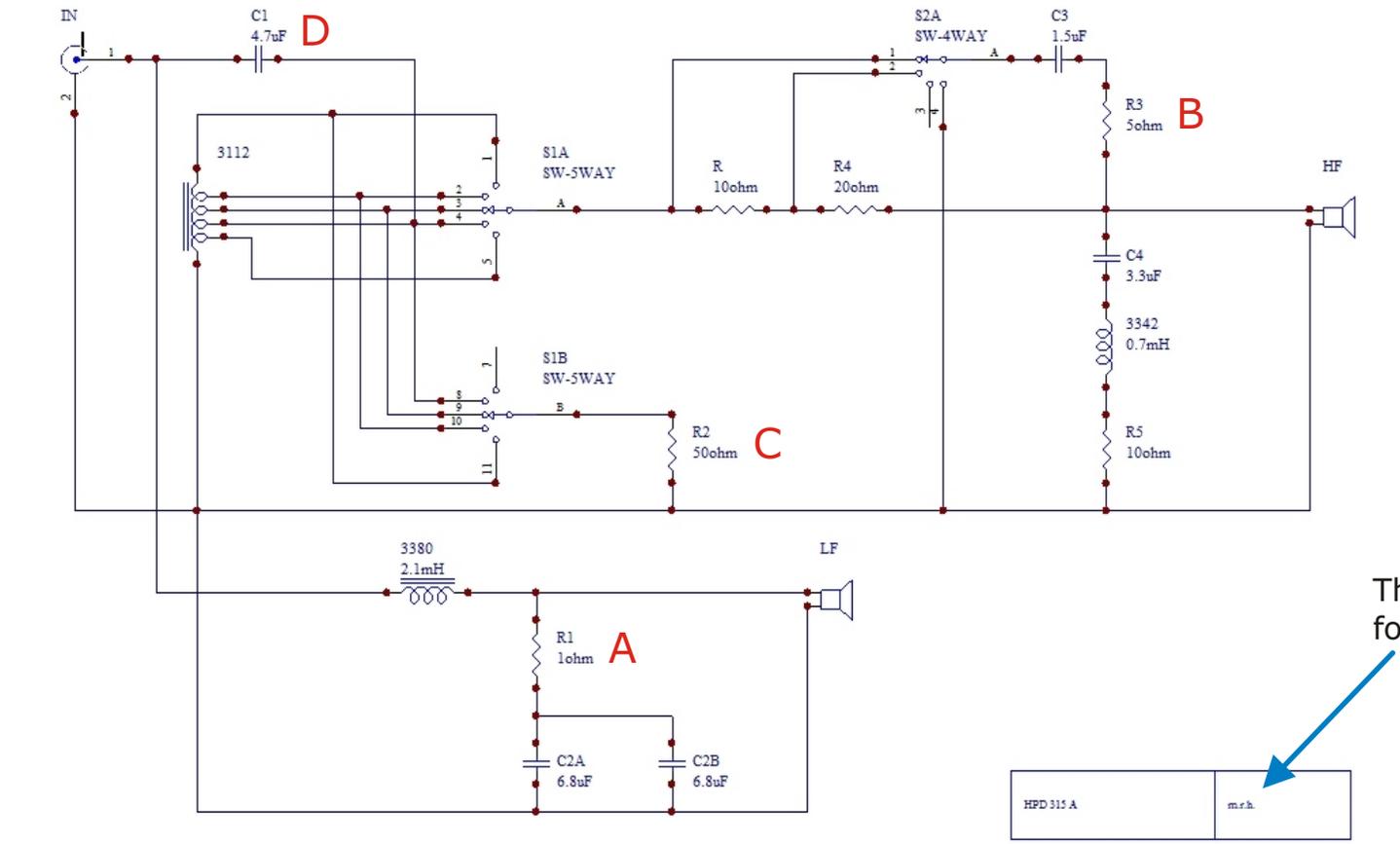


MkIV Replacement X-Over for Tannoy HPD315A Loudspeakers (Cheviots).

Updated: 12/05/2013

I noticed on my unmodified x-overs that there were a couple of resistors not on the Tannoy schematic. Other owners have noticed the same and one drew this circuit, which exactly matched my unmodified unit. "A" & "B" locations are additions by Tannoy. See below:



No disrespect to Hans Hilberink, but his suggested mods, which I tried in the MkIII X-Over, just didn't work out for me, using my equipment and choice of X-Over parts. His aim was to create a mid range for the HPD315A more like the Monitor Golds. In trying to achieve this I found it was at the expense of mid range timing, especially on Piano - Previn's version of Rhapsody in blue on Phillips etc. The notes in the percussive fast passages had no start or end, they just merged into a tempo less noise. This can be attributed to the addition of the 2 ohm resistor in the LF stage. Same location as point "A" above. Reducing the value helps but it sounds best when removed altogether. So lets try something else. Tannoy obviously had a reason for adding a resistor at point "B" above, so lets remove "A" from the circuit and experiment with the value at "B".

Determining the value for resistor at location "B" as per diagram on 1st page

To avoid too much expense I am initially going to use low cost wire wound ceramic resistors. These can be replaced with better parts once the correct value is established. (Value in brackets is the actual measured resistance of component)

OK, my original Tannoy circuit had a 5 ohm here. Lets pop a 4.7 ohm (4.85) there and see how it sounds - The timing is not great and its way too soft and lush for my taste. I like a fast response and instruments to sound like the real thing.

I know a value of nil is fast and times well so lets try 2.2 ohm (2.3) - This has great timing but has harsh/in your face/shouty treble.

Lets move up to 3.3 ohm (3.4) - Not far off here! Voices are realistic, cymbals have a shimmer to them and certain Sax notes have that reedy rasp. Great bottom end. Good Piano timing with nice timber on lower notes. Zeppelin and Sabbath in good voice with nice edgy guitar. Tracy Chapmans acoustic guitar is gorgeous. Overall pretty good if maybe the slightest bit bright still.

Bypass Caps

Now I'm pretty close lets try a test with or without Bypass caps (Vishay MKP 1837 0.01uf bypass fitted to all Sonicaps).

With - Initially very impressed, bass deep, tight and fast, highs excellent on cymbals etc. It's a very analytical sound though, bit like a studio monitor, and the sound is polarized with a big hole in the midrange.

Without - Middle is back and has a warmth to the overall presentation. Drum beats seem further back in the mix and it needs a little more volume to generate the same sound level. But very easy on the ear, without being overly thick or lush. Timing is better and will allow slightly larger value at "B" before it deteriorates.

I much prefer the sound without the bypass caps, it seems more natural and musical.

Try a bypass on the HF series cap only - Result 80% of when all bypassed. So in this circuit I will not be using them.

Trying 3.0 ohm (Mills) at "B" - This is best, Mills smoother less grainy than ceramics, value works better now bypass caps removed.

HF Series Cap Value

After my poor results with the resistor addition at "A" I have a nagging doubt about the HF series Cap change. The 6.8 uf value means there is a bit of an overlap at the X-over point. With both drivers trying to produce the same sound. I will revert back to the Tannoy stock value of 4.7 uf for comparison (Sonicap). This should have a flatter response curve. Parts, including additional resistors ordered.

Autoformer

I prefer to use the Green/Orange tap combination on the Autoformer. Since upgrading the Caps and Resistors the Yellow/Yellow (Level) setting seems too bright. Also the Green tap gives a direct signal path, from the 1st HF series cap to the down stream components, without going through the autoformer windings. The autoformer then just sits across the circuit as a 2.6 mH 0.7 ohm inductor. These values taken off similar part numbers tested by Monitor Gold owners. So I should be able to substitute an ordinary coil. The output voltage for all the other taps are altered, for the Orange tap by a factor of x1.42 (difference between the Green input and Orange output through windings) which the 50ohm resistor (location "C") is attached to. The Orange tap reportedly measures 5.5 mH and 1.0 ohm. (Thanks to Martin Ackroyd for taking the measurements off his MG's).

STOP EVERYTHING! - I am really nervous about the values of the inductors I am replacing, they may be different to the MG's, even though the part numbers are the same.

I have invested in a LC200A metre, supposed to be within 1% accuracy for inductance at the range being covered.

I will measure all my original X-Over parts - Results on next page.

Now I know the true value of the Green tap I can replace the autoformer with a simple 2.9 mH inductor. I will probably need to tweak (reduce) the value of the 50 ohm resistor at "C" due to it's voltage lift no longer being present.

Low Pass Coil

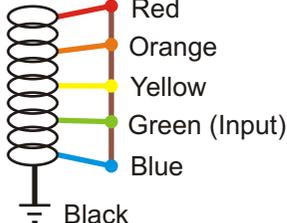
My Low Pass coils average 2.2 mH which is slightly higher than the 2.1 mH figure on some of the drawings doing the rounds, but may be within tolerance. If you want a true 2.2 mH for instance, buy a 2.3 mH and wind off a few turns till you reach the right value, there is always going to be a fairly broad tolerance on the manufactured parts, so buy bigger and wind it back. You will of course need an inductance metre. There's a picture of my Inductance/capacitance metre a few pages on. It's remarkably accurate for the £26 I paid on fleabay.

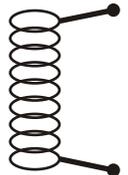
Note - You can't replace the autoformer if you want to keep treble controls, due to each setting having a change in inductance and voltage.

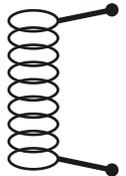
Also, I wouldn't advise swapping it out to any single fixed value, of anything other than the value of the Green tap. As far as I can see, the Green tap has no voltage change and works solely as a 2.9 mH inductor, grounding through the black lead. Swapping out the Autoformer for a 2.9 mH inductor should not alter the circuit characteristics and keep the "Tannoy Sound" that I love.

When I rebuild the board with the new cap/coil/resistors, I'll initially attach the resistors at locations "A" "B" "C" and caps at "D" (diagram on page 1) using terminal blocks. This will allow me to experiment on my external x-overs, with quick changes, back and forth, using different values. - Parts arrived - nice xmas present.

Measured coils on Tannoy HPD315A (Cheviots) - My results for both 8 ohm x-over parts

		<u>A</u>		<u>B</u>		<u>AVG</u>		
WB 3112 (145T x 5/8") 1/32" GRP Spacer As used on HPD315A (12") HF Stage		Black - Red	9.195 mH	1.1 ohm	9.051 mH	1.4 ohm	9.123 mH	1.25 ohm
		Black - Orange	6.039 mH	0.9 ohm	5.845 mH	1.2 ohm	5.942 mH	1.05 ohm
		Black - Yellow	4.263 mH	0.7 ohm	4.062 mH	1.0 ohm	4.163 mH	0.85 ohm
		Black - Green	2.918 mH	0.6 ohm	2.833 mH	0.8 ohm	2.876 mH	0.70 ohm
		Black - Blue	2.012 mH	0.5 ohm	1.997 mH	0.7 ohm	2.005 mH	0.60 ohm

		<u>A</u>		<u>B</u>		<u>AVG</u>	
WC 3380 As used on HPD315A (12") LF Stage		2.351 mH	0.3 ohm	2.130 mH	0.3 ohm	2.241 mH	0.3 ohm

		<u>A</u>		<u>B</u>		<u>AVG</u>	
WC 3342 As used on HPD315A (12") HF tuning circuit		0.682 mH	2.2 ohm	0.686 mH	2.3 ohm	0.684 mH	2.25 ohm

This is a low resistance coil, unlike that used on the MG's which ways in around 12 ohms.

Do not presume the value of these parts is the same on other Models even if the same part numbers are used. It appears that Tannoy would buy in a basic part/number and modify it for specific models, adding spacers etc to tailor the value. The earlier HPD315 (None "A") used a completely different inductor in the LF stage (WC3120 with 1/16" spacer). There could be other differences so measure any part value before replacing it.

Measured Capacitors on Tannoy HPD315A (Cheviots) - Results for both 8 ohm x-over parts

Note: All Caps are the Brown ITT PMT Type.

6.8 uf x 2 (13.6 uf) (The Sonicap 15 uf I fitted measure 14.0 & 14.4 uf)

Measured as a pair

A = 12.1 uf

B = 12.8 uf

4.7 uf

A = 4.56 uf

B = 5.11 uf

3.3 uf

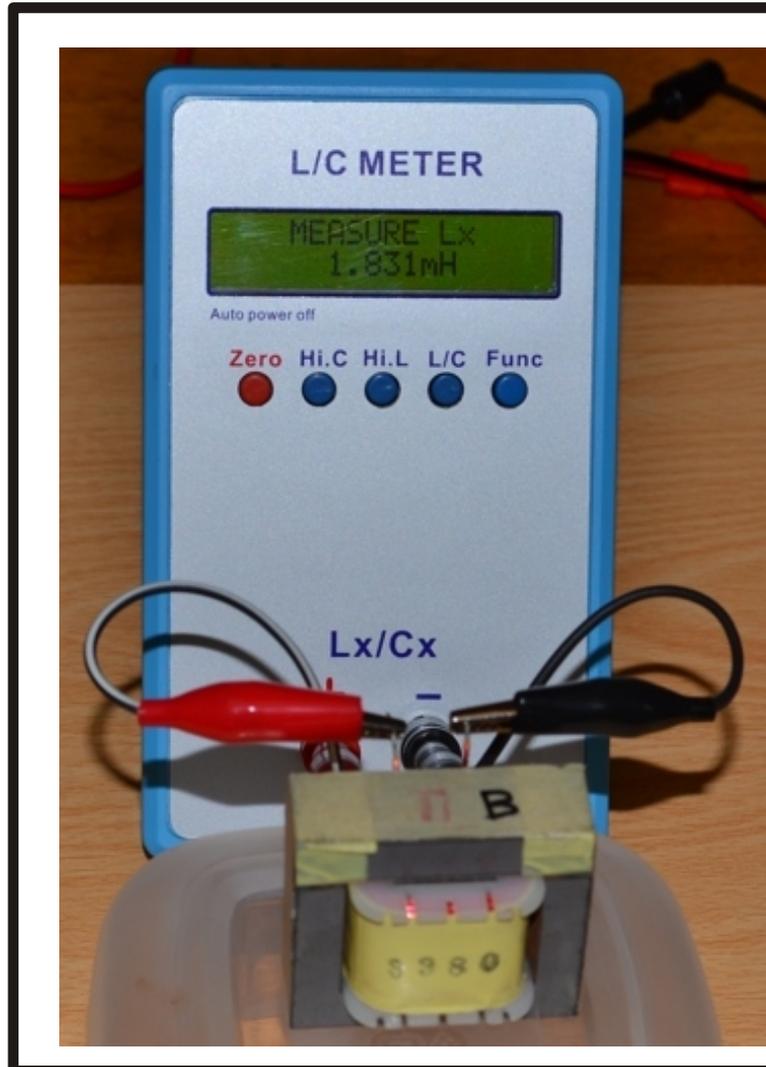
A = 3.09 uf

B = 3.36 uf

1.5 uf

A = 1.30 uf

B = 1.44 uf



Notes on measuring Inductors

The "I" piece just sits on top of the "E" laminations with a bit of sticky tape holding it in place. When the unit is PCB mounted, the plastic cradle is screwed down and clamps the two together. The loose reading for this Low Pass coil can be seen as 1.831 mH. Press down on the top face with your thumb and the reading goes up to 2.130 mH. It is important to apply this pressure to get an accurate reading.

Autoformers replaced by 2.9 mH (measured/matched) inductors - No other change at this point.

Initially much more detail in mid/high frequencies, upper half of piano keyboard comes across sharper, less smeared, overall presentation rather cold. I will let the circuits burn in a bit as I've made lots of wiring/solder joint changes.

After 2 Hours - They have deeper more pronounced sound stage, lower bass seems tighter/dryer - don't ask why?

After 4 Hours - Warmer presentation now, on REM's Out of Time, stringed instruments, mandolin etc have subtleties I've not heard before. With Previn's Rhapsody in Blue, the horn section is more forward and beautifully detailed. The orchestra just seems sharper with more attack in the smaller crescendos.

After 6 Hours - Its just soooo much better without the Autoformers.

After 30 Hours - To sum up, treble is cleaner and smoother, not as harsh, which is a common criticism of Tannoy DC's. The sound is immediate and more detailed.

6.8 uf HF series Cap changed to 4.7 uf (Measured value).

After 45 Hours - Already prefer the 4.7's to the 6.8's.

Piano and violin sound more like real instruments, the slightly warmer presentation of the 6.8's with the fuller midrange, sounds very pleasant, but lacks a bit of realism for me, ever so slightly sugar coated. The 4.7's are sounding great.

After 96 Hours - The 6.8's were obviously the main cause of the timing issues, the 2 ohm resistor I'd fitted at position "A" had amplified this trait. The 4.7 caps will allow a 1 ohm resistor at point "A" which gives a richer, fuller feel to the upper bass and mids. As the caps are burning in there is too much treble coming through, increasing the resistor at "B" from 3 to 4 ohm, then 5 ohm, that's better. Slightly ragged edge to upper frequencies, change resistor at "C" from 50 to 30 ohm, too much, starting to sound tamed and shut in, try 40 ohm - better. I predicted the 50 ohm would have to come down in value. The speakers are really sounding superb. I will keep assessing up to about 180 hours for any changes. I tried the bypass caps on the 4.7's but had the same issues as before so removed them.

Apart from the resistor at "C" the values are all back to those of the original Tannoy circuit, as per the diagram on the first page. The lower value at "C", is needed because my fixed value coil is replicating the Autoformer value when set at one step below "Level". This makes sense as the Autoformer lifts the voltage to the 50 ohm part at this setting. So without the Autoformer a lower value resistor will be needed. This all adds to my confidence when replacing the Autoformer and the fact that the other part values are the same as the originals, leads me to two conclusions:

- 1) The folks at Tannoy had the component values right - so they did know what they were doing!
- 2) The coils I have used, based on measuring my Tannoy parts, are ok to replace the originals, without altering the circuit characteristics and the corresponding voicing.

It always troubled me that some folks had used different value components in their replacement X-Overs, inferring that Tannoy had it all wrong. I have done much experimenting, in the belief that I also knew best, before my ears brought me, reluctantly, back to where I started. The coil values were critical, but once these were established the other values just fell into place. Purchasing a metre was invaluable, there is too much bad information around, as to what the coil values should be.

After 180 Hours

40 ohm at R2 - I have been listening to mainly 34 to 45 ohm in this position and got kind of acclimatized to the sound, which is very nice in this range but quite sibilant. I tried lower values very briefly in the past but maybe didn't give them a decent shot as it just sounded so different to what I was now used to. I have done a lot of listening to this part this time and had some resistor values in and out up to seven times. (I can change both x-overs in half a minute).

After 300 Hours

I discussed this component with Paul Coupe of Reference Fidelity Components and a fellow enthusiast, he calculated a value of 25 ohm for this resistor when using a fixed value replacement coil. He worked back from the original value of 50 ohm connected to the Orange tap on the Autoformer which has a raised voltage over the Green input and he calculated this value. After a lot of trials I established the following:

At 20 ohms there is no sibilance at all but the sound is too laid back.

At 30 ohms it is more open but with sibilance.

The ideal is somewhere in the middle, so the calculated 25 ohm was looking good.

I experimented a lot using 24/25/26 ohm and settled on the 25 ohm as the best match for my other parts/drivers.

The 25 ohm won me over as being better integrated and capable of higher volumes without distress. It's quite subtle when you get this close and not easy to differentiate at lower volumes. The sound I am getting now is more sophisticated and detailed than before and without the sibilance. Paul is using 25 ohm in his x-overs and is very happy with the results, I think he has it spot on and I will be keeping this value. It works for the Maths and sounds great too.

HF Notch Filter

I decided to replace the original Tannoy coil in this Filter, it was the only original part left in my circuit.

I purchased a Jantzen coil of the same (0.68mH) inductance but its resistance was 1 ohm lower, 1.2 ohm as apposed to the 2.2 ohm of the original. So I increased the value of the resistor in series with the coil from 10 to 11 ohm keeping the overall resistance as the original Tannoy circuit.

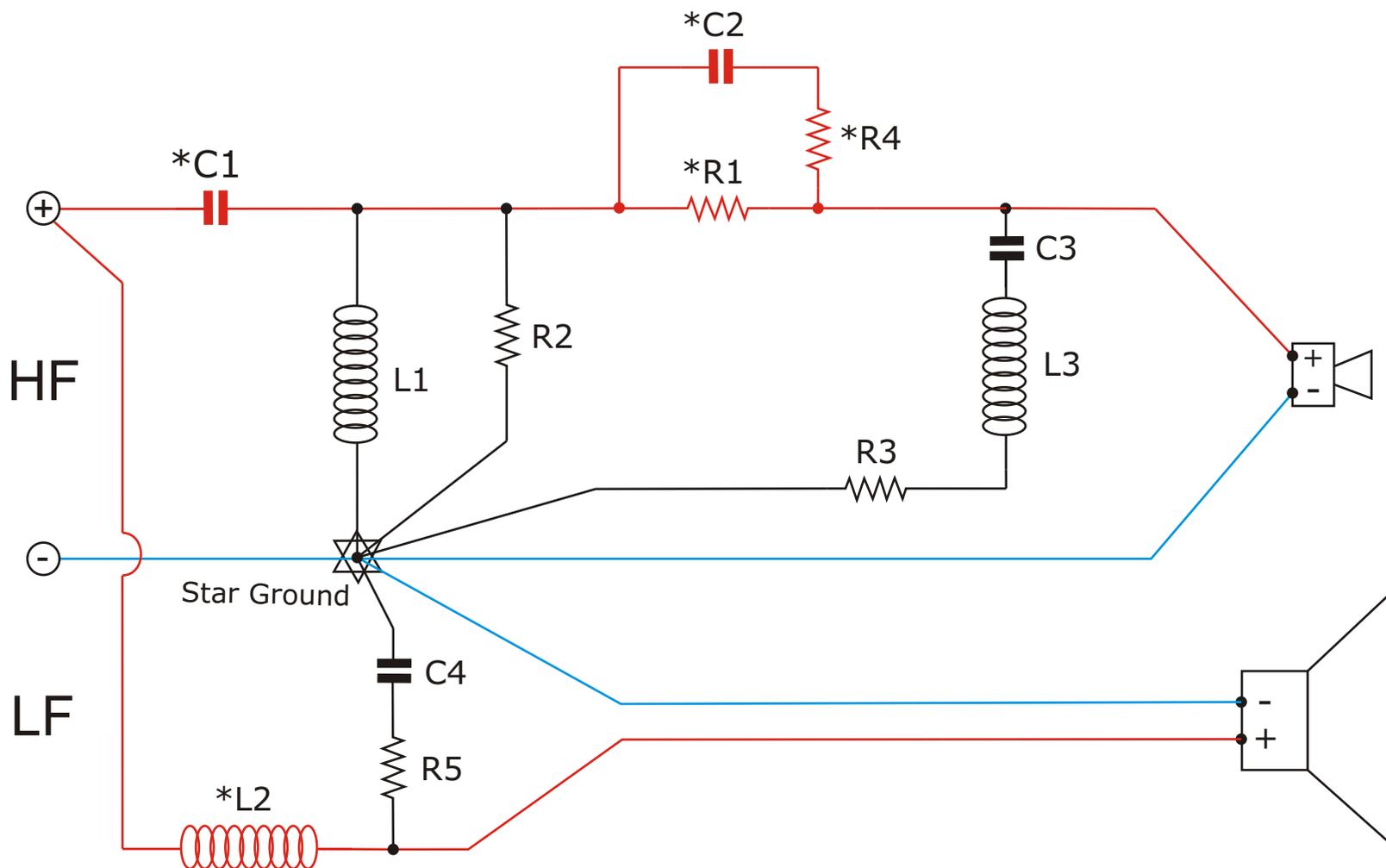
I am convinced that the circuit is now working at its best. Changing values sounds different, not better and there is always a trade off with a loss somewhere in the presentation. I would have saved myself a lot of work if I had just trusted the Tannoy Engineers, they are the experts after all. So all values are as the originals, with the Autoformer replaced by a 2.9mH inductor and the 50 ohm resistor that was connected to it, reduced to 25 ohm to match the unaltered voltage when using the replacement coil.

It wasn't a complete waste of time, the upgraded parts and elimination of the Autoformers has lifted the level of performance by a considerable margin. I have learnt a lot going through the process and have peace of mind that the circuit is getting the best possible results from my drivers.

I have updated the drawings to show this final layout/values.

If you build similar x-overs you will not be disappointed with the results.

Replacement X-Over for Tannoy HPD315A



C1 = 4.7 uf (4.7/4.7)
 C2 = 1.5 uf (1.5/1.5)
 C3 = 3.3 uf (3.1/3.1)
 C4 = 14.0 uf (14.0/14.4)

(Measured values)
 To one decimal place

L1 = 2.9 mH 0.9 ohm
 L2 = 2.2 mH 0.6 ohm
 L3 = 0.68 mH 1.2 ohm

R1 = 30 ohm
 R2 = 25 ohm
 R3 = 11 ohm
 R4 = 5 ohm
 R5 = 1 ohm

Tweeter Role-off values fixed at Min. (Level).

Tweeter Energy Setting:

The Autoformer Green tap is one step below the stock Yellow (level) setting, required to reign in the treble with the new more revealing capacitors. On the Autoformer, if the green tap is used as input/output, it has 0db effect. The Yellow output tap gives approx 1.5db lift over the Green input, even though Tannoy calls it "level". I am not using the Autoformer in this scheme so will substitute an equivalent value inductor to the Green (2.9 mH) tap.

X-Over Components Used - Pricing is just a guide

					<u>QTY</u>
C1 =	5.0 uf	Sonicap Gen I	Dia24x32	\$13.20+P&P	2
C2 =	1.5 uf	Sonicap Gen I	Dia17x25	\$7.92+P&P	2
C3 =	3.3 uf	Sonicap Gen I	Dia20x32	\$10.78+P&P	2
C4 =	15.0 uf	Sonicap Gen I	Dia33x44	\$25.64+P&P	2
L1 =	3.0 mH	Jantzen-1068 Air Coil	1mm (0.99 ohm) Dia 51x30	£7.60+P&P	2
L2 =	2.4 mH	Jantzen-1473 Air Coil	1.2mm (0.66 ohm) Dia 56x30	£9.65+P&P	2
L3 =	0.7 mH	Jantzen-1046 Air Coil	0.5mm (1.2 ohm) Dia 30x8	£1.16+P&P	2
R1 =	30 ohm	Mills MRA12	10w 1%	Dia8x30	\$4.15+P&P 2
R2 =	25 ohm	Ditto	Ditto	Ditto	\$4.15+P&P 2
R3 =	11 ohm	Ditto	Ditto	Ditto	\$4.15+P&P 2
R4 =	5 ohm	Ditto	Ditto	Ditto	\$4.15+P&P 2
R5 =	1 ohm	Ditto	Ditto	Ditto	\$4.15+P&P 2

\$165.02 +P&P

£41.40 +P&P

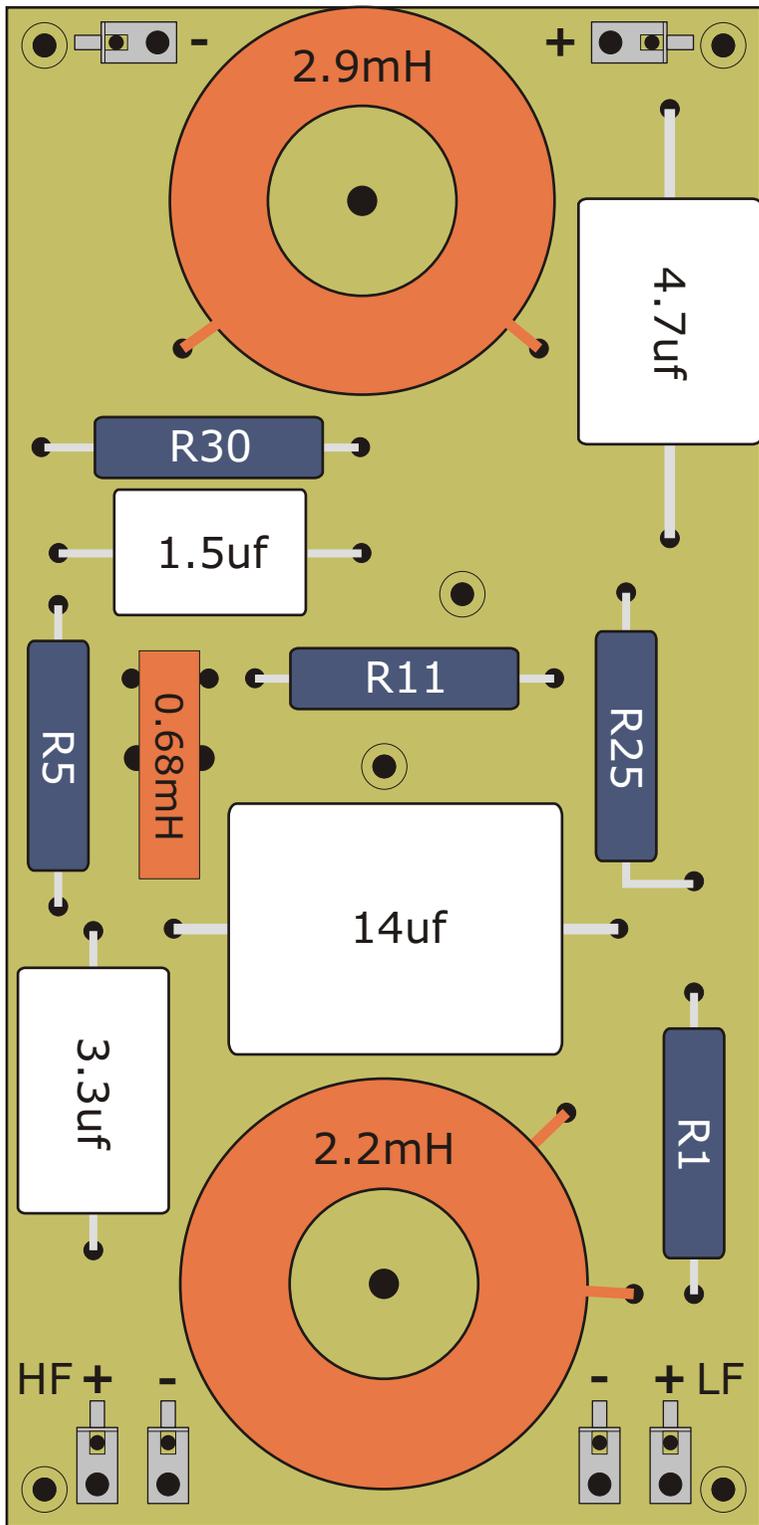
Cost at current exchange rate approx
(Feb 2012)

£140.50 +P&P

I spent about £30 on other parts like the tufnol boards, brass nuts & bolts, heat shrink etc.
Importing the Caps and Resistors cost £30 in Tax.

Total to produce the two x-overs was about £230

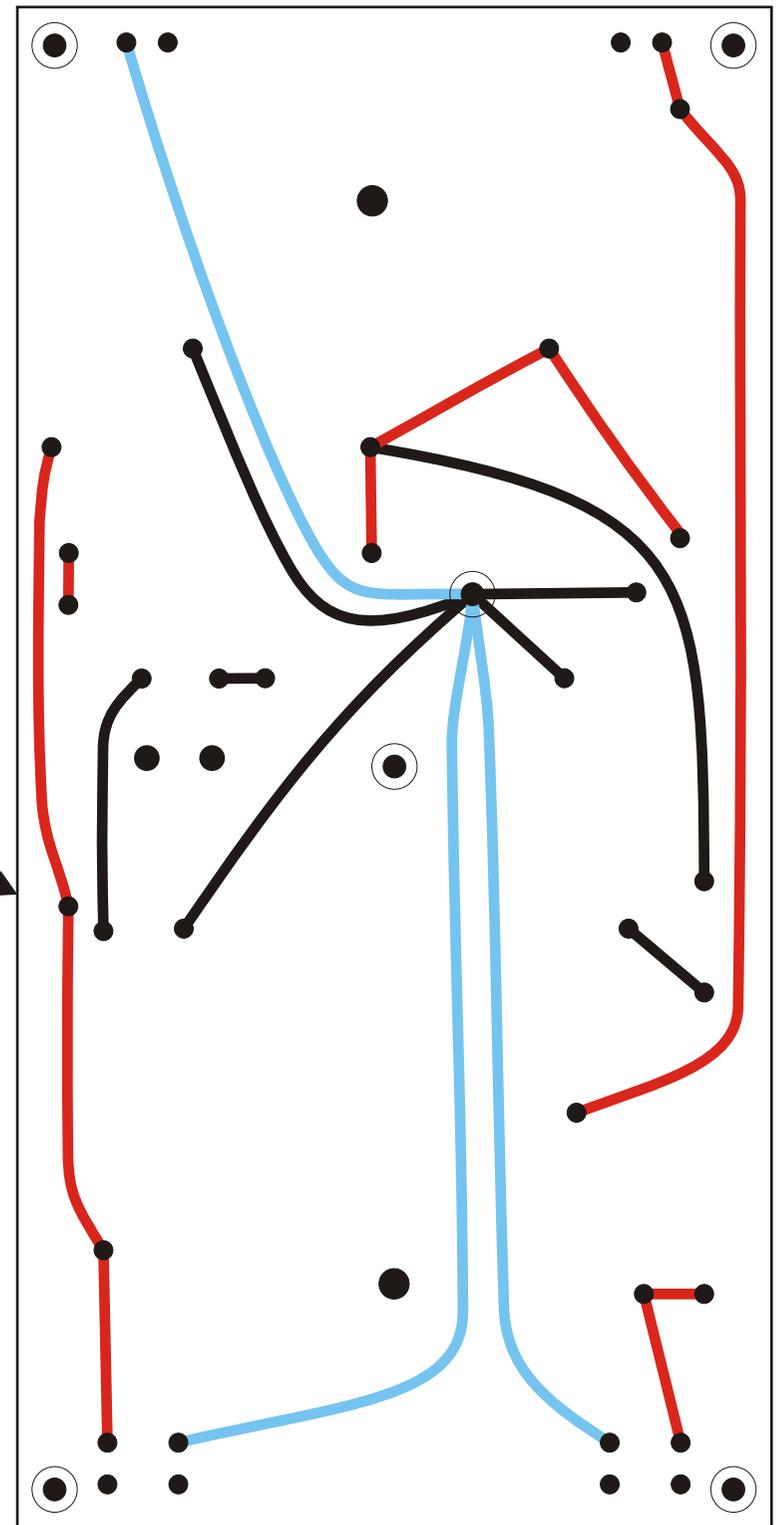
Note: The Jantzen coil values are larger than required and needed a few turns removing to reach the correct values, as per my Drg. I took a gamble when ordering the 5 uf Sonicaps, I had noticed all the other Sonicaps were on the lower side of the tolerance, the parts actually measured 4.72 uf & 4.75 uf (4.7 uf required).
The 15uF Caps measured 14 and 14.4 uF.



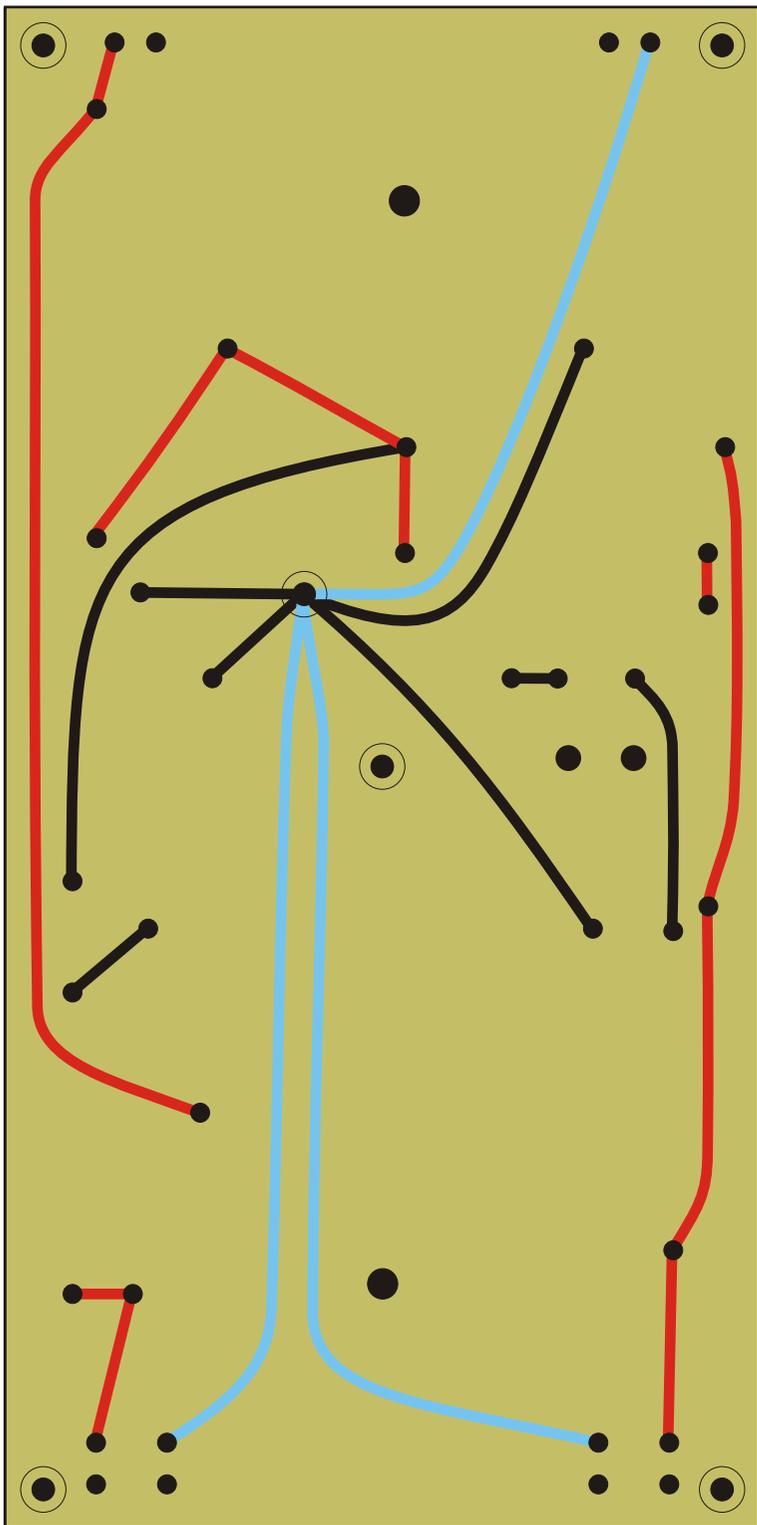
Component Layout

Drawn at full size.
 The board measures 100 x 200mm.
 Board is 2.5mm Tufnol with brass eyelets inserted as solder fixing points for part legs.
 The parts (As described in component list), are drawn to size. If you use alternatives, make sure you have room for them.

Looking through a Transparent Board and seeing the connecting wires beneath.



Layout Optimised for Mk IV components: 12/05/2013

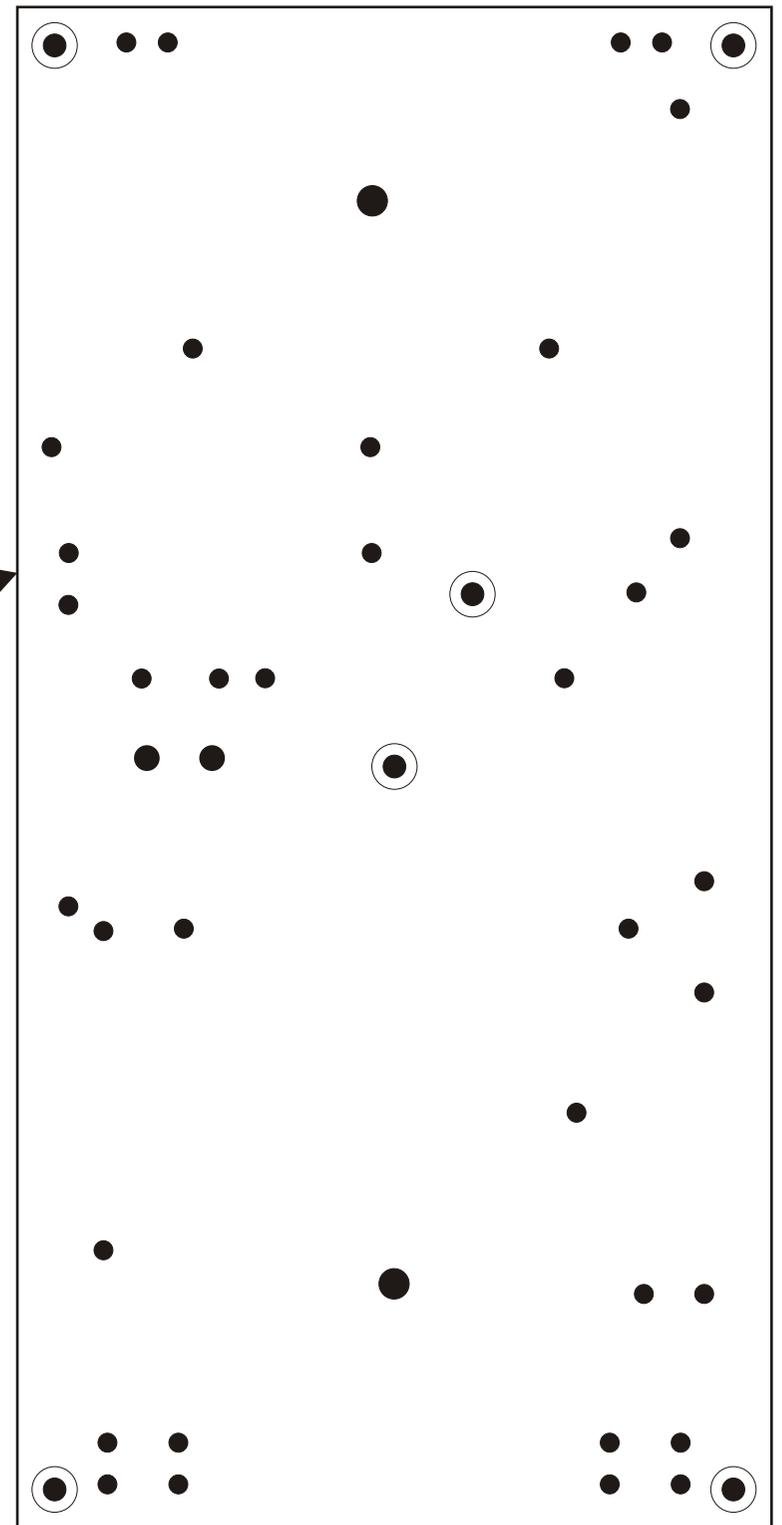


True view of rear showing point to point wiring.

Drilling Template

(Top Face)

When Printing, check it prints 100 x 200mm. Stick the template to board with spray glue. Run a 1.8mm size drill, required to take the brass eyelets, through all the centres. Enlarge holes as required to take other parts and fixing screws, then remove template with white spirt.



Completed MkIV X-Overs

Picture to follow

I'll wait until I try the circuits with the new cabinets before I take pictures, adjustments may be needed.

For more pictures see www.jkwynn.co.uk