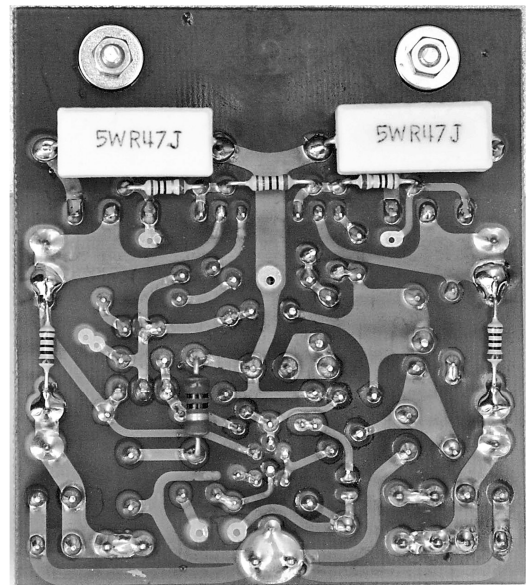




## AKSA POWER AMPLIFIER

found some values on the schematic hugely affected the sound quality.



**a. Current source for Voltage Amp (VAS) [bootstrap – ratios]**

**b. C5 lag compensation** [effect on too much, or too less]

**c. Adoption of JLH ‘phase lead’ cap, C6 on schemat.**

**d. EFII ‘Self’ output stage (best version with driver emitters connected via a stay-on resistor of critical value)**

**e. Correct choice of VAS – use of video driver 2SC1819.**

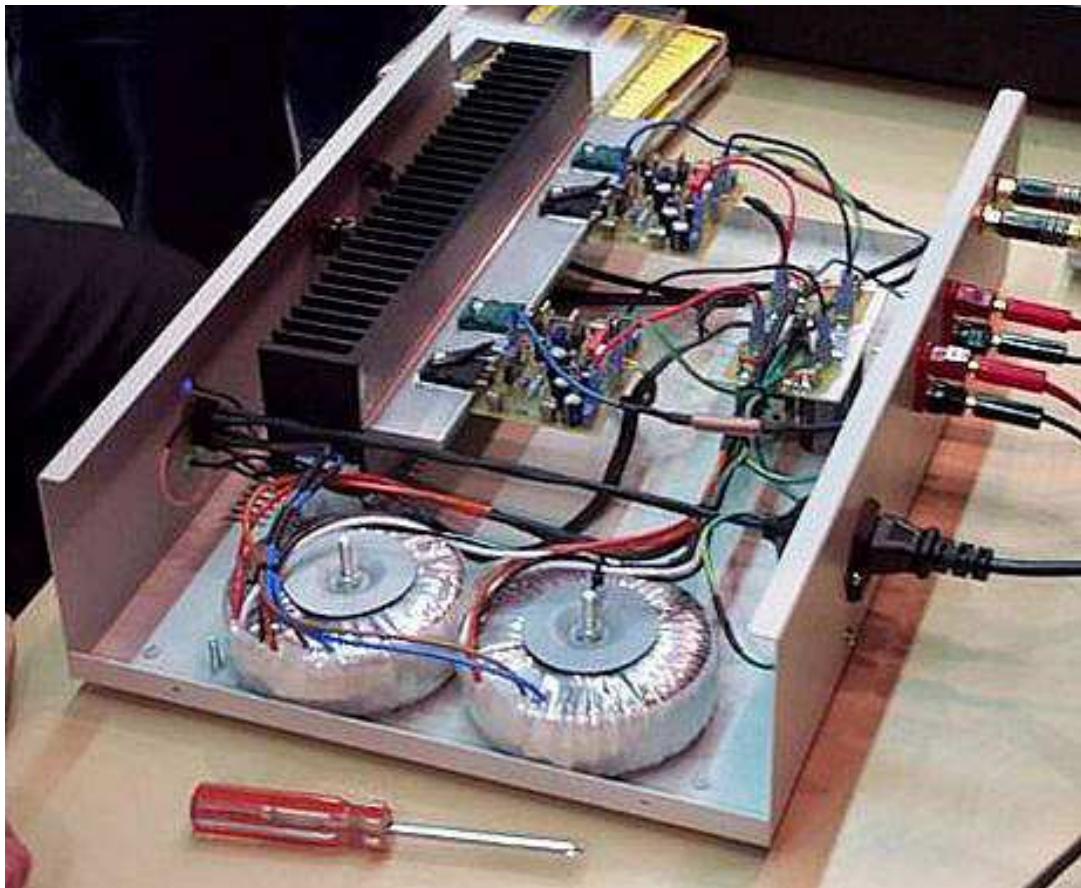
**f. Careful use of LTP transistors (150V rated)**

g. Use of single resistor from rail to supply the LTP.

### **h. Avoidance of protection circuits to simplify assembly and enhance the sonics – controversial**

i. Careful choice of speed up cap – 100nF – across speed up R15 (polyurethane from Rifa)

**j. Careful choice of input cap, and physical location of Zobel cap**



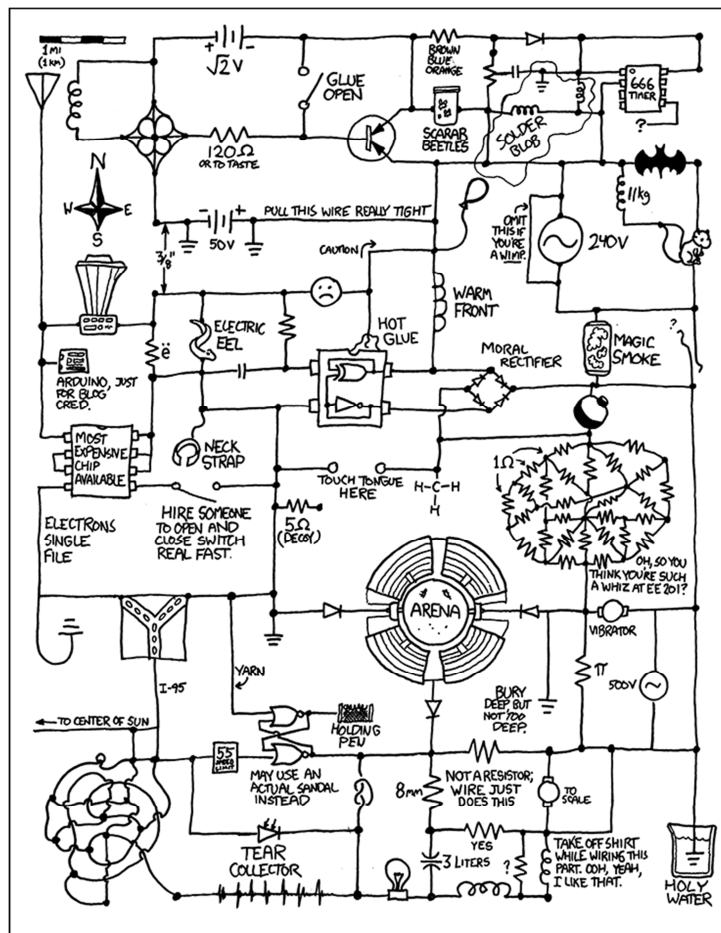
7. *Global Feedback.* Speed of semiconductors, precise lag compensation, careful cap selection, assiduous overview of stability issues and any affect on sound quality.

8. *Subjective perception.* **A unique faculty of the ear is to establish timbre personality and fundamental notes by successive analysis of harmonics starting with the highest orders.**

[Excerpt from Jean Hiraga - AudioXpress October 2005]

HOW does this correlate with the schematic? During early auditions at heavy compensation we detected 'slow' presentation; too little the sound was sharp, fatigueing and lacking bass. We had known that some amps with low THD sounded bad (cf. 80s Japanese integrations!), and some high THD examples like tube amps sounded marvellous. Conclusion: there was something else involved. In 2000 I had not been aware of these nuances.

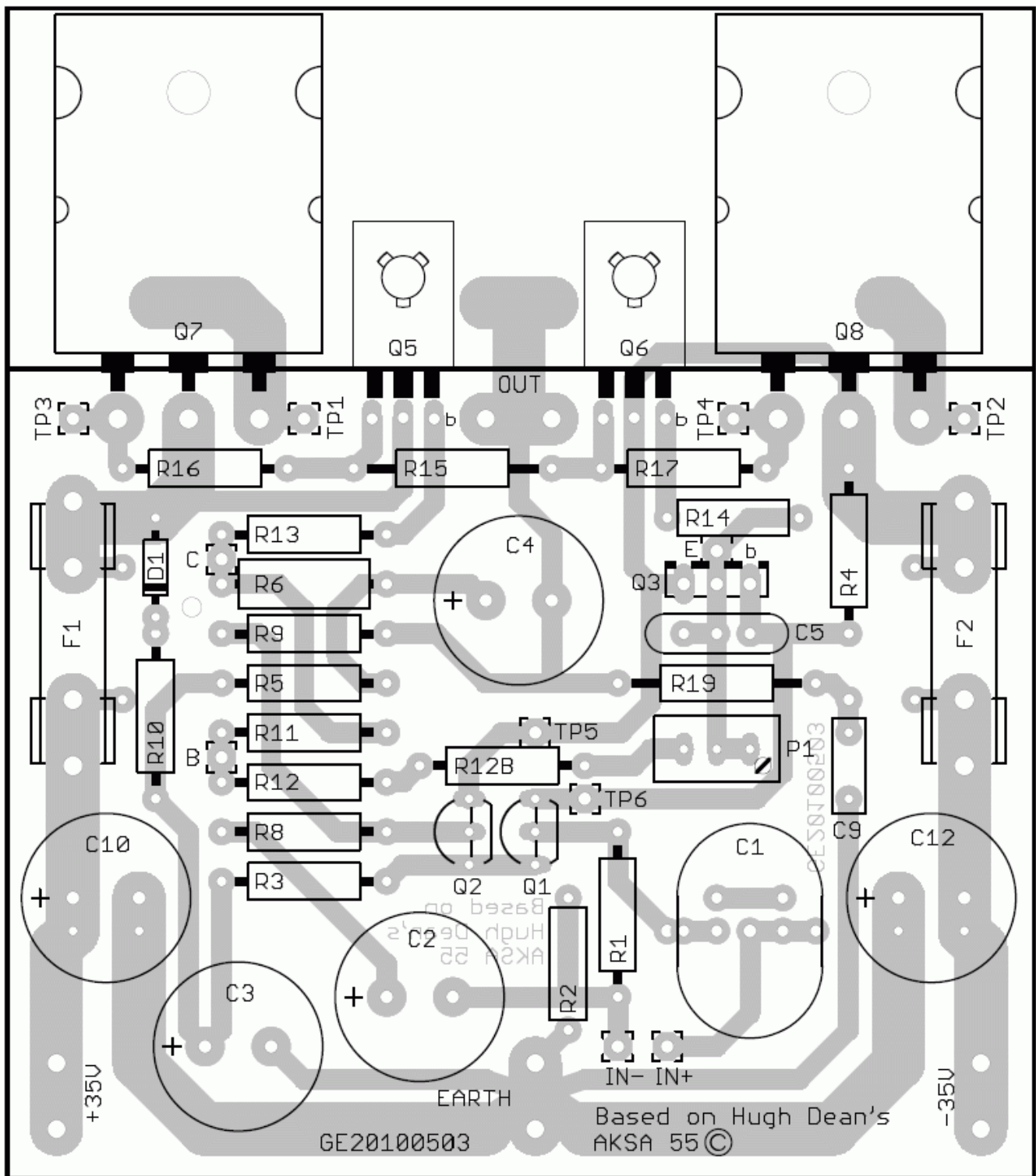
9. *Auditions.* I decided that many people had to listen during the R&D, and many were loaned and give away over the years. I quickly found people with ‘audio memory’, often people who love music and/or other languages. I love music, but my hearing is poor; my thrill is the design, so I had to listen to other critics! There are preferences, too; some like it sweet, some like it savoury. I even found people who hated ‘my’ sound; some of these guaranteed others would love ‘my’ sound! Different genres required different amps too. I was trying to sell a product, so the preferred amp enjoyed by a maximum number of listeners got the nod. This is a lot of fun!!



10. Over the next 3 yrs I produced Nirvana and Nirvana Plus updates. Many more were sold and the testimonials grew. Sales hit 200 in 2003! Even today a clone of the AKSA, the BAKSA, is being built all over the world. Here's the pcb artwork, created by Greg Erskine in Sydney, an old AKSA customer whose design I



sanctioned in 2014. It is very similar to the AKSA layout.



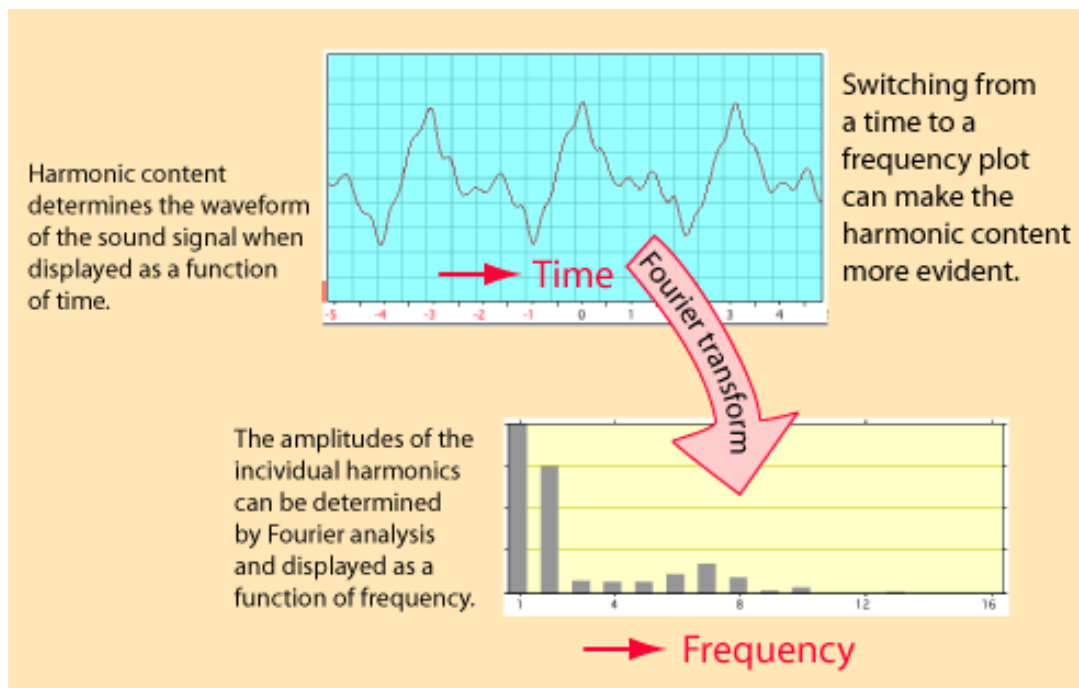
12. *Future after the AKSA success.* I moved on with the LifeForce, Soraya, and later, the NAKSA. All delivered improvements to the original. I visited RMAF in Denver in 2007.

In 2010 I began to use LTSpice to analyse harmonic distortion. Here's the AKSA 55 at +20dBu, 12.5 watts into 8R at 1KHz:



11. *Profile:* This correlated with a THD instrument in 2013:  
H2 -73dB, H3 -90dB, H4 -92dB, H5 -105dB, H6 -96dB, H7 -106dB  
THD at +20dBu 12.5W into 8R: 0.0215%
12. *Question:* Is the profile of an amp's harmonic distortion important? Is a single note sufficient to prescribe an amplifier's distortion profile when music is polytonal? Take a look at a violin at 1KHz in Fourier analysis:





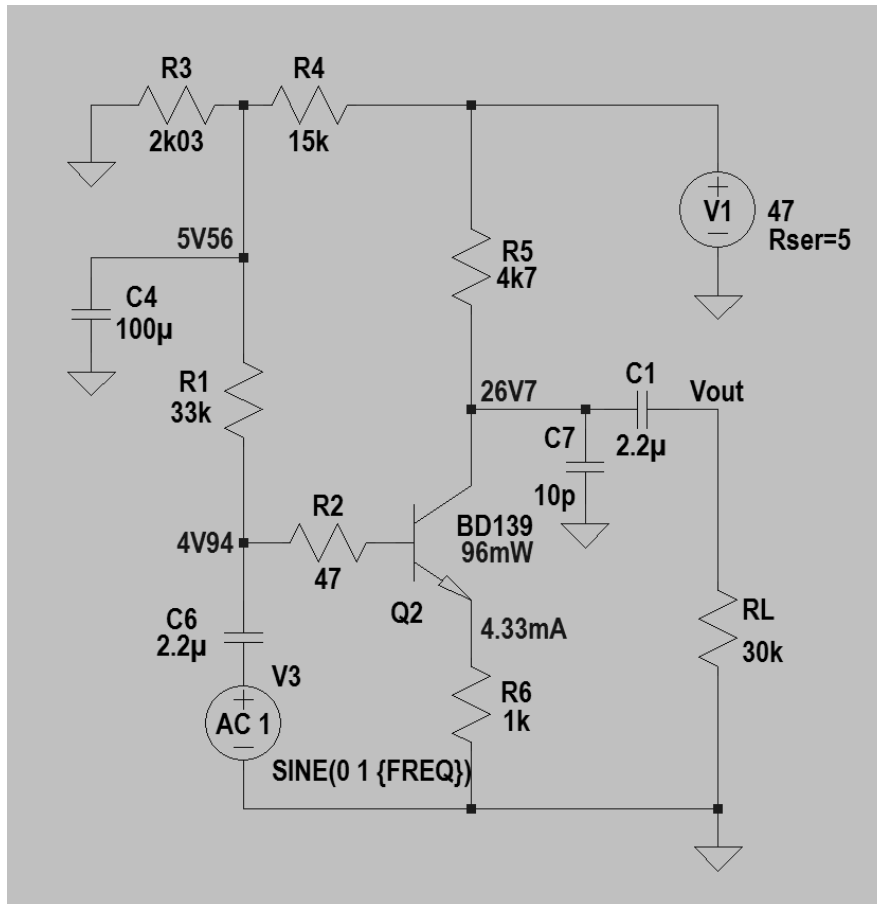
Notice the high amplitudes of H2 and H7. Highest order is H10 – 10KHz, from a 1KHz fundamental. Think about Hiraga’s comment on high orders and the sensitivity of the ear. Hmmm.....

13. In 2010 I was approached by Frank Hinton, of Classic Audio Design. We determined to design a 170W SS AB pro-audio studio reference amplifier to be sold under Grover Notting. In July 2012, after testing and nearing initial production, I was almost taken out by an aortic aneurysm. Graham Huon and Paul Bysouth stepped in with major help. In November, as I recovered at Talbot Rehab, Frank brought in the first production amp to show me! This amp is now used at the ABC Southbank Studio for Classic FM broadcasting monitoring and recording purposes. This amp is highly regarded and is now being exported. The ABC love the sound quality, it is their flagship, and it adopts more advanced principles used in the early AKSAs.

14. *Preamble:* A Fourier analysis of a musical instrument reveals a complex of harmonics. If we pass this complex waveform through a zero distortion amp, then the output waveform should be identical to the input. [Of course, we assume the recording process is perfect, which it never is!] However, amp distortion is inevitable during recording *and* playback, so this fact will corrupt the original waveform, changing the ratios of the harmonics. If this distortion has more H2, H3 and H4 than higher orders, and the majority influence is the second harmonic, and if the harmonic ratios are in linear decreasing amplitude, then we might assume that the proportions of the original instrument will be reasonably close. In particular, H5, H6 and beyond should be VERY low for best ‘natural’ rendition. In practical terms, output should be approximately follow the ‘real’ instrument waveform. A good reduction of H5 and beyond should be lower than -100dB below fundamental, regarded as virtually inaudible, it might just sound pretty ‘natural’ since the profile of the harmonic amplitudes of the amp output is roughly closer to the original sound created by the musical instrument, though increased somewhat by H2, H3 and

H4. Other aspects such as intermodulation and phase shift are possibly important too.

15. *Conclusion:* For a better amp, the distortion levels should accord with a 'natural' progression of a 'real' musical note. Here is a giant mental leap: IF H2 in the AKSA is high (97.4% of THD is comprised only of H2!!), H3 is pretty low at -90dB, and ALL ODD ORDER HIGHER HARMONICS ARE LOWER THAN -105dB, inaudible.... we might have an amp that sounds good, or, to put it another way, it might sound 'natural'. We could posit: IF H2+H3+H4 comprise more than 97% of the THD, it MIGHT sound pretty good. H2, H3 and H4 are ALL musical tones.
16. Could there be a connection between the harmonic 'distortion' and the psychoacoustic, 'musical', preferences of the listener? Hugely controversial - *objective v. subjective*, which is correct?
17. AKSA sold well. Two updates, Nirvana and Nirvana plus, made a lot of profit, but even the original was very good. 55W built out to a 100W, also with Nirvana upgrades. But email help was a major problem; one guy needed 83 emails to build his 55!
18. *LTSpice thought experiment.* Let's try a single NPN BD139 voltage amp, and examine the distortion profile with a view to predicting the 'sound quality'.



19. At 1Vp input 1KHz sine input, we have 0.0224% THD of 4Vp O/P. Clip is at 17Vp at high distortion. Even at low OP, THD is fairly high, much more than a usual power amp. However, the sound quality and the profile of the harmonics are interesting:



H2 -73dB, H3 -92dB, H4 -108dB, H5 -111dB linear decreasing

H2 is more than 99.29% of the entire THD!!!

H2, H3 and H4 – all musical - are the largest harmonics

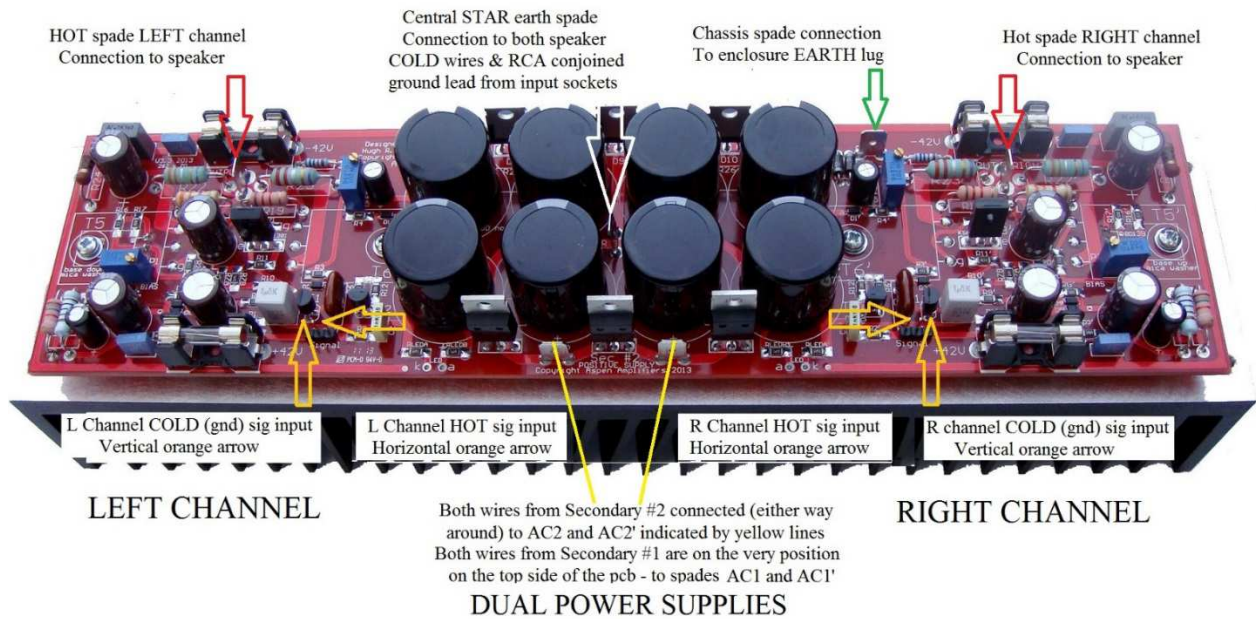
H5 and odd orders harmonics are ‘machine’ tones, not very musical  
Higher harmonics sound ‘bad’, and rapidly become objectionable

20. Sonics? This simple voltage amp uses as a preamp makes a SS amplifier sound ‘warm’, but with great dynamics, clarity and no hum! The ear enjoys this simple circuit. You could say it’s a bit like a tube amp, with no cons!

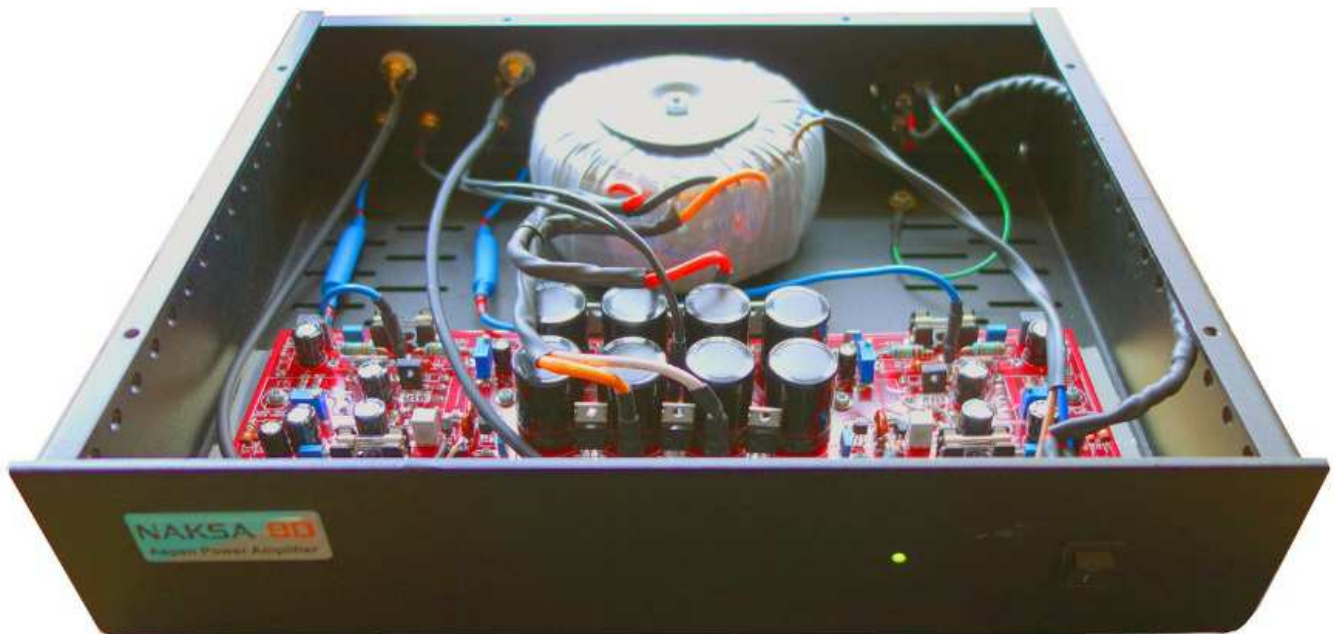
21. *Beyond the AKSA*

- i) Lifeforce: 2004, CFP LTP, nested fb
- ii) Soraya: 2007, Rush Cascode input, nested fb, CFP VAS
- iii) Maya: 2009, RC input, programmed CCS diamond buffer, nested fb
- iv) NAKSA70/100 2010 S’ton, CFP VAS, nested fb, FET OPS
- v) Grover Notting pro-audio 170W 2012, S’ton, CFP VAS with single double Bootstrap, nested fb, FET OPS, full protection.
- vi) NAKSA80/125 2013 S’ton, CFP VAS, nested fb, asym double Bootstrap, Fairchild FET OPS
- vii) MAYA II (under R&D) Zero global fb under development

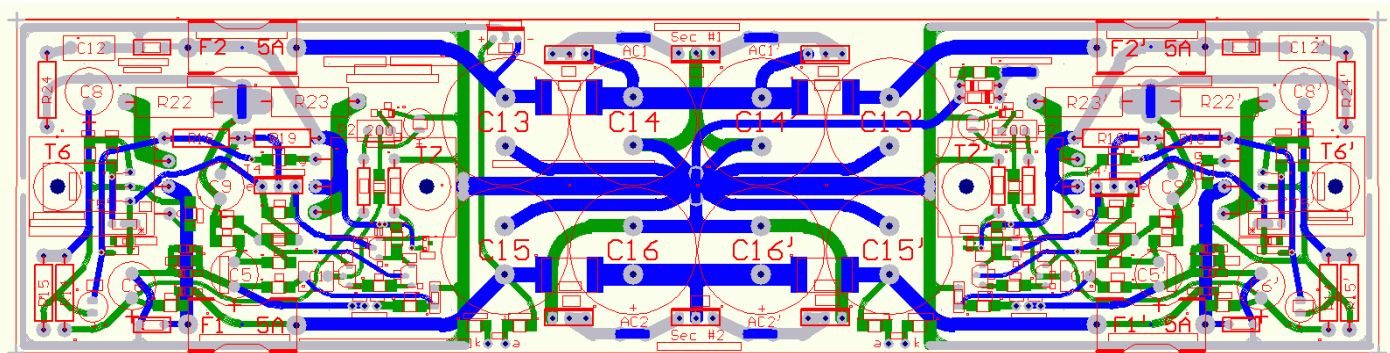
## CONNECTING TO THE NAKSA 80 FOR OPERATION



NAKSA 80 installed in enclosure with 300VA toroid:



NAKSA 80 270mm x 70mm two sided, 70um 2mm pcb:





## NAKSA 125 pcb

