Michaelson & Austin TVA-1 revamping – By Giovanni Orlando

Foreword

I first saw the TVA-1 in the Seventies, I was a young, poor student and could not afford to buy it, but I could listen to it (audio exhibitions, shop listening sessions, etc.): its sound was superb, delicate but defined high frequencies, powerful but controlled low end, sweet but detailed mid part of the spectrum, ability to drive also difficult speakers.

Almost 40 years later, without particularly looking for it, I noticed a TVA-1 auction on EBay. It had KT-90 power tubes and, looking at the pictures of the inside, the internal wiring was a mess, huge Solen capacitors were installed in a very precarious way, and an additional frame had been added to make space for them!! But the original chassis was unstained, the vendor was saying that the sound was good (no hum) and the irreplaceable components (transformers) appeared to be ok.
My old soft spot for this amplifier resurfaced. Meanwhile I have gained some experience as a hobbyist, in electronic DIY (although only solid state). So I bought it thinking to restore it by myself. It was not cheap, the shipping cost was high (40 kg via courier!) and I had also to pay Customs charges!

It took a month. Box opened, it was heavy! It looked good, no rust, chrome ok, tubes removed and properly packed, etc. I installed the tubes, connected it to my HiFi system, switched it on, no smoke, all tubes were properly lighting.
All ok? Well, no! There was hum from both speakers and also high frequency noise coming as a beat, every second or so. With my speakers (Tannoy System 15 DMT-II, with 98 dB/W of sensitivity) the noise was very audible. At the oscilloscope the hum was clearly from the power supply (50 Hz and its harmonics), while the beat was a periodic burst of very high frequency (various MHz).
I checked for obvious ground loops (power cord, input connectors, etc.) and even temporarily disconnected the earthing of the power cord (I know, I should not do it!) but nothing changed. I was not happy any more!
The seller, a known EBay UK dealer of vintage HiFi, said that when he checked the amp all was OK. He honestly offered to take it back and refund my money. But I would have lost the shipping and Customs costs; then I had to find another TVA-1 (not easy to find nowadays) and lose months in the process. I decided, all considered, to keep it and try to fix the problems. I agreed with the seller for some money back and kept the amp.

My target became not only to restore it but to get rid of the noise and maybe to improve the amp in the process.

The preparation

Having little experience of tube amps, I started searching the net for schematic diagrams, forums advices, experiences from others who did similar works, etc.
The net proved once more a very powerful tool, I learnt a lot. I also learnt that with tube amps you risk your life; the high DC voltage inside can easily kill a person!!

I found many useful websites and forums. I don't remember all of them; however I thank them all very much. Some are listed here for reference:

- **http://leakstereo20.skysite.dk/**
- **http://amp8.com/**
- http://www.tubeamp.hobbysider.dk/
- http://www.freewebs.com/valvewizard/
- http://diyparadiso.com/advicegeneral1.htm
- http://www.jacmusic.com/KT88/kt88.htm
- http://www.turneraudio.com.au/
- http://www.klaus-boening.de/html/tube_schatic.html
- http://www.drtube.com/links.htm
- http://www.dahhorng.com.tw/tubes/tva1.htm

I needed a reference schematic diagram. The published original one was significantly different from that I prepared from the amp I purchased (after removing the Solen capacitors and some of the internal wiring to access the component side of the main PCB and of the bias / power supply one).
Investigating on the net, it was clear that the original published schematic diagram had several wrong component values. I guess this was partly done on purpose; others changes were probably due to the several revisions during the production life of this amp. I read that Tim de Parravicini modified the schematic diagram in the early Eighties; other changes were made when M&A was purchased by Mentmore Industries. There was little information about these changes, but on a web site (http://leakstereo20.skysite.dk/) I found a revised schematic (called at the time Rev 3 schematic), prepared from a late Mentmore TVA-1 amp. I was also able to read some components values from photos available on the net (particular thanks to the site http://amp8.com/ for this).

I put the components values from the original and Rev 3 schematic diagrams, those I measured in my amp and values from other sources in a spreadsheet and tried to evaluate the differences and define the "right" values. I am not an electronic engineer but, with some mathematics, common sense and practical experience, I restricted the component value discrepancies to the following categories:

- Values published in the schematics but different from those I measured in my amp. In this case (in particular for the components which appeared "original" - precision resistors and some capacitors) I chose the values of my amp.

- Values in my amp changed to support the KT-90's in place of the original KT-88's, essentially the cathode and grid resistors and some bias resistors.

- Values in my amp changed to "improve" the original components, essentially capacitors with higher capacity / spec / voltage rating.

Besides addressing the hum and noise issue, my target was also to restore the amp to its original configuration and possibly to introduce some improvements., So I decided the following modifications:

- To re-install the original KT-88's, replacing also the cathode and grid resistors. I purchased a matched quad of Electro Harmonix KT-88 on EBay. I found these tubes well built, with good and consistent performances as well as good value for money. I avoided fancy "Gold Lion" replicas or fakes, as well as any "magic" NOS component sold at crazy prices. The replacement of the power tubes called also for modifications to the bias circuit resistors to suit the KT-88's bias voltage range. I replaced the bias trimmers with high quality multi-turn cermet ones to improve the tuning accuracy.

- To replace all capacitors with new and better ones. First the Solen caps, to remove the additional steel frame. They were used just to filter the DC power supply to the triodes. I replaced these caps and all electrolytic capacitors (they are prone to aging faults) with higher capacity / voltage ones with high quality film bypass capacitors. All capacitors on the signal path were replaced by high quality Polypropylene / PETF ones. Silver-Mica capacitors were used in place of the ceramic capacitors on the ECC83 sockets. The only capacitors which I kept were the two big filter capacitors, already high quality / capacity ones.

- To replace the input and output connectors with higher quality, gold plated ones and also to replace the rubber feet with better ones.

- To review and rationalize the internal wiring. To me this was the main cause of the hum and noise of the amp. I did try to improve wire routing, checked / opened ground loops (following the star grounding principle) and used shielded cable for all signal bias voltage wiring.

- To add a soft-start circuit to (gradually) apply the HV to the tubes with a delay vs. the heating and bias voltage.

All of the above considered, I finalized my list of components (see the attached component list). I purchased the new components mostly on EBay. This web site is really invaluable. I could select my components among a vast variety and buy what I wanted at reasonable prices too! The shipping costs were also reasonable, considering I bought items from all around the World. The only small problem is that you have to wait an average of 2 weeks to get the materials, not a big deal if you are doing it as a hobby.

The work

Once received the new components, I put the TVA-1 upside down and installed the modifications in stages: the input/output connectors first, then the main board, the bias / power supply board, the soft start and, last, the internal wiring.
After each stage I tested the amplifier with a signal generator and oscilloscope, to check for any problems / improvements.

Due to the high voltage present inside (more than 600 VDC!), each test required careful attention, clean test table, all connections (cables, load resistors, probes, etc.) made before switching on the amp, checking and double-checking everything and, very important, with no hurry. After each test, the power socket had to be unplugged and sufficient time given to allow the discharge of the capacitors.
After the instrumental tests, I checked each stage of the work with the music. I have carried this 40 kg beast back and forth so many times between studio/lab and living room! A good exercise, undoubtedly.

I tried to change in the power supply to the triodes heating filaments from the original 6.3VAC to a stabilized VDC supply. I built a low drop (LM1084 based) DC voltage regulator and got a clean 5 VDC output. However I have not seen any significant hum improvement, while the filament voltages of 5 VDC, although still sufficient, is lower than the recommended value. So I restored the original 6.3VAC power supply.

A finding I consider important is related to the voltage rating of the coupling capacitors between drivers and power tubes. These are two 0.47µF capacitors per channel (C7 and C8 in my schematic diagram). Those installed in my amp were rated 450VDC. I have seen similar rating also in photos of other TVA-1 on the internet, with some exceptions with 630VDC. At first I installed new Polypropylene film capacitors with the same 450VDC rating. During the initial tests the bias voltage of the power tubes was slowly but constantly drifting. After a few hours the anode current was reaching dangerous values. Any bias adjustment was just temporary, with the drifting resuming again.

This could be enhanced by the fact that the high voltage supply of my TVA-1 is particularly high. On the transformer secondary the mark indicates 2x-*225 VAC vs. 2x190 VAC in the original schematic. This becomes, after the rectifier diodes, approx 622 VDC with no load! My TVA-1 is one of the last produced and, maybe, this high HT was to increase its power output.

The HT voltage is applied to the drivers' anodes (ECC81) through a drop resistor, giving an anode voltage of about 420 VDC. This is the voltage upstream the coupling capacitors. A negative bias voltage of about -80 VDC is applied downstream the same capacitors. Therefore the voltage across these capacitors is normally about 500 VDC (+420 to -80). In particular conditions (e.g. removing the driver tubes for test reasons) the voltage across these coupling capacitors can be as high as 700 VDC!
When operating close to their voltage limits, these capacitors leak more and more current. This causes the bias voltage of the power tubes to go higher and higher, with a similar trend of the anode current, until the tube exceeds its static power capacity and burns! I guess this can be the reason for the scarce reliability of some TVA-1's and for its fame of "flaming amp".
I installed Wima MKS4 (with PETF film) with 1000 VDC rating. They barely fit in the available space! After this modification the bias point become rock stable (after the initial heating period) and no drift was noticeable any more.

I was also concerned by the high HT value applied to the power tubes. This value (approx. 610 VDC) is no problem for the KT-90's but is high for the KT-88's (the data sheet reports 800V max, but 560V as typical value). To operate at 610V good quality tubes are needed. The EH KT-88's demonstrated their quality. They can take this anode voltage without any problem. With this anode voltage (see attached chart) I selected a bias current of 30 mA, with about 18W of power dissipation (with no load) per tube, about 50% of the KT-88 max power rating.

The result
The photos show clearly the changes before / after the revamp. Now it is "original" with improved connectors and filter capacitors.

How does it work? To hear some faint hum you need to put your ear next to the tweeters (with no musical signal, of course). No trace of any other noise or oscillation.

The power is high (75W on 9 Ohm, 85W on 4.7 Ohm) and equal for both channels. The oscillograms show no significant distortion till the clipping, the bandwidth is ample (for a tube amp), flat from 10 Hz to about 30 kHz, the 1000 Hz square wave is, well, square!

But the result I am most proud of is the sound. Exactly as I remember from the old times, detailed but sweet in the high side, powerful and controlled in the low side. The mid-range is a real pleasure too! Maybe this result is helped by the characteristics of my speakers (high sensitivity), but the voice is fantastic, as is the performance with symphonic music, piano, violin, trumpet, etc. All the orchestra is well represented, balanced, each instrument clearly localized and sounding real.
My music collection (LP's/CD's/SACD's/DVD-Audio) is producing the best sound I have heard from my system and also my live recordings (taken by DPA-4060 microphones and a portable digital recorder working at 24 bit / 48 kHz) gives me new emotions.

Emotions in listening to the music, this is our passion for HiFi ultimate goal, isn't it?

I decided to post this to help others who may be in a similar situation. If I can, I am glad to help. Just write me an email.

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Attachments: Photos, Schematic Diagrams, Components list, Measurements