I hope the following Q&A session with TC of Hong Kong may be of interest:

TC: I intend to build an over 40W SE amplifier based on the KR-T1610 (an audio tube made by KR audio).
My preliminary concept, which is basically based on your design, will be:
"Super Mu Follower (76 or 6P5G or 6C8G) - Direct Couple (if possible) - 45 driving tube (or 6W6 triode-wired or 2A3) - LL1677 Interstage Transformer (80ma primary, ratio 1:2) - KR-T1610 output tube - KR 1.25K single-ended transformer"

Richard: I am aware of this tube. It is attractive. It requires 140Vp-p to drive it, a bit less than the 845 at the operating point I am using. The 45 will do this, just. I think a 2A3 will be hard-pressed to develop this much swing. A 300B would have more headroom but sonically, a 50 or even a 10 could be better. When I rebuilt from the EL34 drive, I chose the 45 because I like the sound of this type and I could easily adapt a filament supply from the existing resources. [I made an error in my response: Yes, the T1610 requires 140Vp-p drive. However, the 845 requires almost 300Vp-p. When I commented on the 2A3 as a driver I was recalling my thought process on the 845, the 2A3 will drive the T1610 just fine.]

TC: In this connection, much grateful if you could clarify my queries as follows:
(1) Can you elaborate why you change your Super Mu Follower from "76 - LL1168 - 76 - 680 ohm" to "27 - LL1168 - 1k ohm - 76 - 1.2k ohm"? What are the benefits of such a change? Any more updates now?

Richard: OK. A compromise, what I did was to change my mind about what compromise I wanted. Originally, I chose the 27 to be the input tube and the 76 to be the follower. I could see from the 76 curves that the 76 would bias nicely using the 680 Ohm DCR of the choke and so the 27 became the input tube by default. However, I had some hum from this tube. The heater current for the 27 is 1.75A and I do not have enough room to include a DC heater supply for these tubes. Additionally, I also wanted a little more gain; mu for the 27 is 9 while that of the 76 is 13.8. I already had DC heater supply for the 76 and so I decided to change the tubes around. The 680 Ohm DCR of the choke does not fit well with the characteristics of the 27 and so I re-jigged the operating points, increasing the bias resistance for both tubes and increasing the B+ level to what I felt resulted in a good operating compromise between voltage, current and dissipation.

TC: (2) Why don't you consider a Direct Couple design of Super Mu Follower to the grid of 45 so as to omit the RC coupled capacitor 0.68 uf (2.2 uf in previous version)? What do you think about the DC design here?

Richard: Good question and I did in fact consider this. The reason I chose capacitor coupling was to avoid having to provide a ‘stand-off’ voltage for the 45 cathode. My design philosophy includes as few components in the cathode path to ground as possible. So I had a choice: DC coupling and a voltage stand-off for the 45 (that may be gas tubes, a mosfet or even a resistor bypassed by a capacitor. If I were rebuilding the amp I would consider gas tubes but as-is I do not have the room. The mosfet was not attractive to me; I wanted to keep this amp (but not all my amps) as tube-pure as I reasonably could. The bypassed resistance approach breaks all my rules because it requires that most elusive of all audio components, a transparent large-value capacitor. And so, the compromise for this aspect of the design was to use ac coupling and a small, high quality capacitor.

TC: (3) Have you considered using ultra-sonic AC (around 100k Hz, square wave) heating of

filaments of DHT tubes (modified from an electronic transformer for powering halogen lamps at the Audio Asylum forum, e.g. )? How do you compare it to the DC current regulated one?

Richard: I general, I think it is a good idea to avoid RF circuits in audio equipment, especially square waves with the broad harmonics. Most of us have heard an improvement in sound when a good line-conditioner is installed. So why go to a lot of trouble to provide extremely clean B+ (and ac) supplies then introduce a noise generator? I have compared constant V and constant I supplies and I strongly prefer constant I. AC may be better still but then there is the hum issue. A couple of years back, I think some listening test were done at the European Triode Festival; if I recall correctly, the conclusion was that constant current was best.

I also would ask why do you need so much power? Even with 90dB speakers, my 845 is a monster, relegated to winter use to keep the room warm! I have learnt (along with many, many others) that the audio signal is complex and fragile so the best way is to use efficient speakers and do as little to the signal as possible (least number of stages, low power). My next move is into the sub-4W area with Tannoys, most likely bi-amped. I see 50s for the low end and perhaps 71As for the tweeters. I already have built several sub-4W amps and they all sound incredibly open and lucid. The 845 does match them but lower efficiency speakers mean that more compression takes place in the voice coil (most of the power is dissipated as DC resistance heating) and so the openness is not fully realized.

TC: For power tubes, I prefer the sound of 2A3 to 300B. I have heard a 250 amplifier, it is much better than a 300B one But 2A3 has lower plate resistance than the 45, so that's why I want to try 2A3. 6W6 is a sleeper tube of low plate resistance when triode-wired. Very cheap. I don't know the reason why it is so under-used.

Richard: I've not heard a T1610 but in order of what I have heard, my preference for driver or output is (good to better) 300B, 2A3, 45, 50/71A/845 (The last three are all different but offer to me comparable satisfaction.) To drive an 845, a plate resistance of several kOhms will not cause slew-limiting. The Rp of the 45 is around 1700 Ohms which is plenty low to drive the transformer shunt C and the Miller capacitance of the 845. I cannot speak for the T1610. On the 6W6 there is a 'snob' factor around multi-grid tubes, one that I am not immune to (see comments on pentode follower below).

TC: other approach that I will consider is Allen Kimmel's mu-stage (but choke assisted). The implementation will be "D3A - LL1168 - 6P5G - a resistor". Very similar to your Super Mu Follwer, except that the top tube is a pentode of very high transconductance (~30 mA/V) running at pentode mode. One more difference is that at the cathode of the D3A there is a also a resister (Rk) connecting to the ground. I am considering using a tube current sink to replace the Rk. Do you have any comment on this choke-assisted mu-stage design?

Richard: Electrically, the pentode follower is superior – I try to avoid multi-grid tubes in filamentary triode designs because if I am going to lengths to provide clean, DC current filament supplies, I don't want to "corrupt" the design any more than I can. Having said that; multi-grid tubes can sound excellent. So I use them in projects where I am willing to compromise in the interests of experimentation.

TC: It sounds very interesting. I agree with your approach to try sticking to a tube-pure design first, unless it is apparently overwhelmed by the solid state one. What's meant by the gas tubes that you are mentioning? Is it the VR tubes such as 0A3, 0C3 or 0D3? Could you kindly elaborate more or sketch

the schematics? For the Direct Couple approach, the designs that I have seen are quite dangerous as the 2A3 or 45 will blow up when there is something wrong with the front tubes.

Richard: Yes, I mean something like 2 0D3s in series 'under' the cathode, with around 10nF across them to attenuate the HF noise. People get fairly emotional about gas tube noise but I have never been able to detect sonic degradation resulting from their use, even in my ultra high-resolution 416D phono pre-amp. It is important not to impress too much current swing onto gas tubes so the load resistance on the drive tube (if any) should not cause more than a few mA of current swing at full drive. This again is a compromise; we have to run the gas tube hard enough to prevent it (or them) from extinguishing at current troughs, but not so hard as to cause flaring at current peaks. DC coupled designs are tricky, I (usually) do not DC couple more than 2 stages. As I said, the clear best compromise for my design was to RC couple the Super Mu Follower to the drive tube.

TC: They mentioned about the Common Mode Choke (CMC) design. Can you elaborate what's the difference between CMC and the chokes that you are using?

Richard: The common mode choke effectively shorts any common mode noise that is on the (filament) supplies, within the frequency range of the choke. It does this more efficiently than separate chokes. What I am trying to do is to 1/ attenuate line noise and 2/ isolate the end-to-end ac signal on the filament from the DC supply circuit. I used choke values that do this well down into the audio band, I am not sure where the cut-off is though. A common mode choke will try to short the end-to-end signal as well as incoming common mode noise. Usually the inductance of such chokes is too small for this to be significant within the audio band. However, in the same way, the inductance is not sufficient to keep the end-to-end signal out of the DC supply. So, once again, a compromise. I have not tried common mode chokes so this is a philosophical issue for me and not proven, whatever that may mean; in fact, I find that what seems to be proven in audio all too often turns out to be the flavour of the moment. The ONLY line of thought that I find to be solid is to do as little as possible to the signal in increasing its energy to a transducible level.

TC: Also, I find that some TV damper diode tubes are very good sounding rectifying tubes, but cheap too. Some examples are 6CJ3 (half-waved) and 6BY5G (full-waved). I have tried 6BY5G personally, very very good. Have you tried this? I will use two 6BY5G (with choke) to feed the B+ of T1610: both plates of 6BY5G will be connected together (to increase the current) to act as a half-wave rectifier tube and two such 6BY5G will be used together as a full-wave rectification.

Richard: I maintain that if you can hear the rectifier then the PSU is not efficient in keeping the audio signal out of the least linear portion of the circuit, the rectifie;, see the notes on PSU design on my site.

TC: For the B+ of input and driver stages, I will use another 6BY5G (full-wave) with choke and am considering of using the simple VR tube shunt-regulated design to feed them, such as 0A3, 0C3, 0D3, etc. Any comments?

Richard: It should work well. Ensure the DC to the gas tubes is well filtered, try to minimize any resonance due to smoothing chokes or better, use an C-R-C filter and a mosfet current feed to the gas tube. This will provide an extremely high level of isolation of the regulated B+ from the rectifier and line noise. Put a good (Teflon) 10n cap directly across the gas tube to minimize the gas tube hash, keep the gas tubes say 3 inches or more away from the audio components.

TC: For your Super Mu Followers, how do you compare the 76-choke-76 and the 76-choke-resistor-27 in terms of sound quality?

Richard: On the 27-76 and 76-27, I cannot really comment since I lost my aural memory as I made the changes. I do know that both ways sounded good and I did not get any sense that I lost anything when I made the change.

TC: In comparing various types of driver tube, you mentioned that your order of preference is 71A/50/845, 45, 2A3 and 300B. So I will choose 71A, 45 or 2A3. Can you elaborate more the brands and types (e.g. clear or smoked glasses, single-plated or double-plated) of the 71A, 45 and 2A3 that you have used in the comparison for my reference please. One more point is that the plate current of 71A seems to be too small for my case, isn't it?

Richard: On tube types, I have not had the privilege to evaluate a range of brands. In general RCA tubes sound good. On the 2A3 I did get a chance to review a range of types but my memory does not serve me well. I do know that of the several we tried, the RCA bi-plates were clearly superior; I am told that the rare mono-plate is better still. The 71A is capable of generating up to 3/4W and as an output tubes is miraculous. Nothing I have heard quite gets the balance, resolution and transparency of a 71A. If you are operating in Class A1, the plate current will be more than sufficient. I would suggest that you do not allow the issues of plate resistance and current for the drive stage to constrain you overly unless you want to consider the 6C33 (and why not?).

In conclusion, I believe that the art of this field is in finding the magic compromise that works for the individual.