

A 300B parallel single-ended tube amp

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1. OVERVIEW

The 300B PSE is an unusual single-ended tube amplifier that I designed in 2002. The amplifier uses two 300B tubes in parallel, which yields 30 W of clean and wonderful single-ended 300B power! The input stage also relies on two paralleled triodes (ECC88), which drive the 300Bs through a step-up transformer. All this makes for a very simple and direct signal path with no capacitors. The 300B tubes can be replaced with stronger tubes, such as the 32B. In this case, this single-ended amplifier can deliver more than 40 W!

2. DESCRIPTION OF THE AMPLIFIER

The aim of building this amplifier was to design a single-ended amplifier which has enough power to drive “normal” loudspeakers with sensitivities of 90 dB/W/m or less. I decided this design should work with down-to-earth voltages lower than 400 V and it should use easily available tubes. The concept of this amplifier (Fig. 1) is based on proven designs by Electra Print and Andrea Ciuffoli. The power stage uses two 300B tubes in parallel to produce enough power to drive “normal” speakers, while the venerable sonics and qualities of the 300B are retained. The input and driver stage (Based on a ECC88 / 6922 / 6DJ8 tube) is coupled to the power stage through a high-quality transformer. For simplicity and for best sonic results, no feedback loops exist in the amplifier. Only triode tubes are used throughout the entire amplifier. The power tubes are operated in fixed bias mode. Their operating point can therefore easily be adjusted to accommodate for non-matched tube pairs. This also allows the use of other power tubes, such as the AVVT 302B / 32B or the Emission Labs XLS tubes, which provide even more power than the standard 300B (e.g. more than 40 W with the 32B). This amplifier sounds very nice and clean. Yet, it has enough power to drive speakers like the ScanSpeakers without difficulties. With standard 300B tubes, the output power is 30 W.

3. THE POWER SUPPLY

The B+ power supply design is, in principle, nothing fancy (Fig. 2). In contrast to “traditional” designs, however, it uses two cascaded LC filters with massive inductors (L) and capacitors (C) to produce an extremely clean the B+ voltage. The energy stored in the last capacitor stage alone

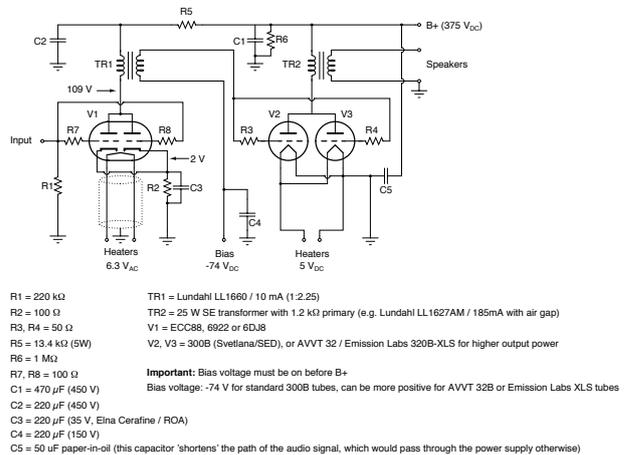
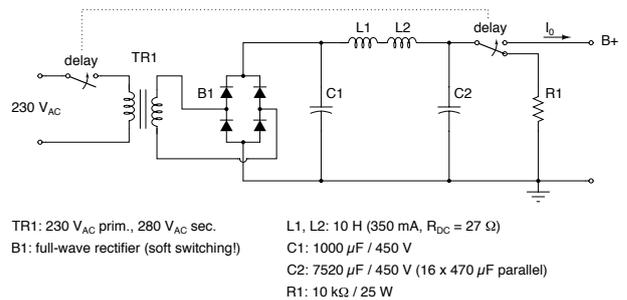


Figure 1: Schematic of the 300B PSE amplifier.



Important: switch on B+ only after bias voltage is applied to the grids of the power tubes

Figure 2: Schematic of the B+ power supply.

is enough to play music for almost half a minute without getting power from the mains (or to lift an average person by 1 metre into the air)! The rectifier is solid state (i.e. not a vacuum tube, which are not capable to deliver enough current for this amp). The rectifier consists of four high-speed and soft-switching diodes to avoid the negative sonic effects of “normal” solid-state rectifiers.

For the filaments, regulated DC supplies are used (Fig. 3). The DC voltage ramps up slowly after turning on the power switch. This increases tube life by avoiding excessive currents through the filaments when they are still cold.

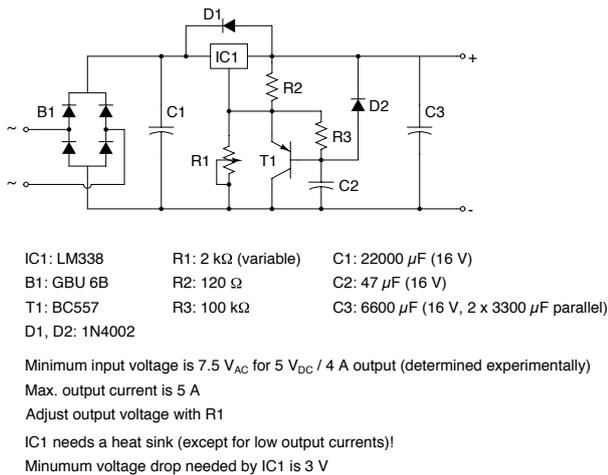


Figure 3: Schematic of the filament power supply (with slow turn-on).

4. TUBE ROLLING

4.1. Driver stage

Following Andrea Ciuffoli's design, I started with a 5842 (417A) tube in the input/driver stage. To make a long story short: this tube sounded thin and harsh in this design. I don't think that this is a problem with my specific design, as it is very similar to that by Andrea. Maybe Andrea has a different taste concerning the sound of his designs. So, I was looking for another input triode which provides a high cathode-current rating and high gain to assure a good input sensitivity

A cathode current of $I_k = 20$ mA running through the tube is needed to make sure the grid current for the driver tubes does not affect the performance of the driver stage (see also the VT52.com site for an explanation of this issue; and don't forget we have an additional transformer between the driver and the output tube, which further increases the minimum value of I_k by a factor of 2.25).

The gain factor of the 5842 / 417A is $\mu = 43$, which, in combination with $I_k = 20$ mA, is tough to beat. I had some beautiful ECC33 tubes roaming around my table when I experimented with the input tube. The gain of this tube is $\mu = 33$ and it can easily handle the current, even more so if the two triode systems of this double triode are operated in parallel (note that the ECC33 is often but wrongly used as an equivalent to the 6SN7, but the 6SN7 has lower gain, and probably differs in other aspects, too). So I gave the ECC33 tubes a try, and they worked much better than the 5842 / 417A. After a while, however, I got annoyed by the overly sweet and somewhat mellow sound resulting from the ECC33. In the search for another candidate I flipped open my tube handbook. The choice was obvious: the ECC88 (6DJ8) is the way to go! I had some very good experience with this tube in the output stage of my DAC.

If the two triode systems are operated in parallel (again...),

the ECC88 can easily drive the 300Bs through the transformer. This choice was further supported by the fact that I have a box full of high-quality, new-old-stock E88CC tubes made by Siemens and Philips. I put a pair of the Siemens tubes in, and there they stayed... The sound is more dynamic and open, the bass is much more detailed and has more control than with the ECC33. A further advantage of the ECC88 is that good-quality tubes (both new-old-stock and newly manufactured ones) are easily available at down-to-earth prices, which is not at all the case for the ECC33.

4.2. Power stage

So far, I've tried the following power tubes in this amp, with different results (in alphabetical order):¹

- AVVT 32B (price: a lot): this tube has the same specs like a standard 300B, but can be biased to deliver more power due to its larger electrodes and stronger filament. The 32B is bigger than all other 300B, and it is built like a tank. The glass envelope feels more like a bottle of beer than a fragile electron tube, the base is made of ceramic and has gold-plated pins. Two of these tubes in parallel easily deliver more than 40 W, which is nice (but completely unnecessary, I think). They sound like what you expect from a 300B: neutral and sweet. Despite the fact that the 32Bs feel like a bottle of beer, the sockets are prone to get loose. Also, after about one year of frequent music listening, one of the tubes died. [Note: AVVT has been replaced by Emission Labs]
- Electro Harmonix 300B gold (US\$ 60 each): this tube shows standard 300B specs. The 'gold' version of the EHX 300B has a gold grid, which is supposed to improve the sound of the tube. As far as I understand, Electro Harmonix tubes are produced by the same people and machines as Sovtek tubes. As I've never seen a Sovtek tube working longer than a few minutes (!) before, I did not expect much of the EHX 300Bs. To my surprise, however, they survived several weeks, before they were replaced with Svetlanas (not because they were failed nor because they were bad in any way – but the Svetlanas just sound better). The EHX 300B are nicely built, with a beautiful white ceramic base. They have a powerful sound, but not as sweet, refined and detailed as the other 300B variants in this round (this is not necessarily bad, as, for instance, the Fullmusic 300Bs are way too sweet for my taste).
- Fullmusic / TJ 300B mesh plate (US\$ 155 each): this tube shows standard 300B specs, but looks a bit different with its globe-shaped top. I like the looks, but others don't. While it is not heavy or especially

¹This comparison was done in 2002 when I designed the first incarnation of this amplifier. Pricing, availability and quality of these 300B tubes may have changed since then.

rugged, it is well built. There has been quite some buzz about the Fullmusic tubes, especially the mesh-plate version of the 300B. When I first listened to these tubes, I was blown away by the ease of how tiny little details in the sound were presented, while the sound stayed extremely sweet and some extra “silence” or “coolness” was added. After a while, however, I felt that these tubes lacked the punch to really enjoy the music (bass was deep, but lame) and that they made the music sound too sweet.

- Svetlana / SED 300B (€119 each): a tube with standard 300B specs and no fancy gimmicks (a rare thing these days!). Build quality is ok, although, unlike the other tubes in this list, their sockets are not made of ceramics. The folks at Svetlana don't waste their money in the advertisement business (I'm sure they could have come up with something that sounds as fancy as extra large electrodes, gold grids, or mesh plates). Similarly to previous experience with Svetlanas KT88, their 300B convinced me with great sound: neutral, detailed, and dynamic. The sound has the same strength and “punch” as the AVVT32B, but is more refined and soundstage imaging is slightly better. Also, unlike the Fullmusic, the Svetlana sounds very neutral.

So, who's the winner? It depends. The AVVT / Emission Labs tube is expensive, but it's construction can compete with a bottle of beer, sounds great and has enough power for a trance party. The Electro Harmnoix is the least expensive and sound ok. The Fullmusic is for those who crave for (overly) sweet sound. The Svetlana (my personal favourite) isn't cheap but in the 300B PSE amplifier it sounds really good.

DOCUMENT HISTORY

- January 2014: Publication of 300B PSE on audioroot.net
- October 2015: first version of this document