
Subject: Under-Biasing Output Tubes

Posted by [AudioFred](#) on Fri, 09 Mar 2012 14:04:01 GMT

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The manual for my Ella amp recommends 0.40V for EL34 tubes and 0.45V for KT88's. I read somewhere that lowering the bias somewhat will extend tube life. The amp is rated at 50w/ch with KT88's, and I'm using efficient speakers that never require more than about five watts peak. What's the upside and downside of biasing the tubes to 0.43V instead of 0.45?

Subject: Re: Under-Biasing Output Tubes

Posted by [Wayne Parham](#) on Fri, 09 Mar 2012 15:39:15 GMT

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Remember that bias is used to bring an active component into its linear operating range. In a class A amp, it should be biased precisely at the center of its range, so the signal swing can move as far in the positive direction as it can in the negative direction without exiting the linear range. If it were to be biased too low, then it would cutoff on negative cycles, partially rectifying the input signal. If biased too high, it will hit B+, and again, partially rectify the signal. So by biasing in the middle, you get the largest usable swing before clipping.

In a Class B amp, there is no bias because each side operates on a half cycle, so each really does rectify the signal and operate on its half. But the "handoff" between half cycles is not clean. In class AB, each amp is biased slightly, to prevent this crossover distortion. So assuming the amp is Class AB, the bias level isn't quite as important as Class A, but you still don't want to go so low that crossover distortion becomes apparent.

I'd probably get out my scope and watch the output with a sine on the input. Zoom way in on the zero crossing and look for artifacts. See how low you can bias the tube before the slope of the zero crossing changes. Maybe Bruce will chime in on a better way to do it, but I think that's what I'd look for when playing around with bias levels.

Subject: Re: Under-Biasing Output Tubes

Posted by [SteveBrown](#) on Fri, 09 Mar 2012 23:39:59 GMT

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Given the numbers here, I don't know the value of the resistor you're measuring the voltage across, but I'd guess we're talking about the difference of a few mils. Personally, I wouldn't sweat it, try it and listen. I've heard that many prefer their EL34's biased nearer to 35 to 40ma on Dyna ST-70's. You could also post this on the DIY Hi-Fi Supply forum, if you have not already, to see what others who own the amp might suggest.

Hi AudioFred,

"I read somewhere that lowering the bias somewhat will extend tube life. The amp is rated at 50w/ch with KT88's, and I'm using efficient speakers that never require more than about five watts peak. What's the upside and downside of biasing the tubes to 0.43V instead of 0.45?"

Without actually seeing your amplifier's schematic, I'd venture to guess that what you're probably measuring here is not the actual bias voltage, but a reference voltage created by the tube's cathode current being drawn through a precision 10 ohm resistor. That tells you how much current the tube is actually conducting, which is really the only number to be concerned with. The actual negative bias voltage required to achieve the desired idle current doesn't matter, only that you achieve it.

A reading of .45V means you're drawing 45mA of current through the 10 ohm reference resistor. Going from .43V to .45V on your reading means you actually increased the bias voltage, which gave you a net decrease in cathode current of 2mA. To increase the current you decrease the bias, and to decrease the current you increase the bias. "Underbiased" means the tube is running too hot, likewise, "overbiased" means it's running too cold. A good way to remember this is that bias literally "biases against" the unwanted condition of the tube conducting wide open all the time.

FWIW, the bias voltage on a KT88 drawing 45mA in an amplifier that'll also run EL34s will probably be around -45 to -47 volts, depending on what your amplifier's exact power supply voltage is.

With a Class AB amplifier such as the Ella, you'll not see any difference in tube life with small changes in bias unless you normally play the amp at very high output levels, and since you don't do that it won't really increase the tube life for you. Here are the hows and whys of this:

As Wayne had noted, an amplifier running in Class A operation is typically biased to a point about halfway between cutoff and saturation. Whatever the zero-signal idle current is at that particular bias point will also be the average current at the amplifier's full, undistorted output power. For example, let's say you have a triode-configured EL34 running in Class A operation at 320 volts plate-to-cathode, with the bias set to an idle current of 82mA. When the tube is then driven to full power, the plate current will swing down to around 50mA on the negative half-cycle of the AC music signal, and probably a tad above 125mA on the positive half-cycle, but the *average* current will still be about 82mA.

However, with Class AB operation, both the average and peak currents increase much more sharply with output. In your particular amp, the peak current at the full, unclipped output will be maybe 4 times that of the idle current. The average current will be nearly double the idle current value. Needless to say, playing an AB amplifier at high output places a lot more stress on the tube's cathode than at low output, and uses up its emissive capabilities much faster.

But, you're only taking the Ella to just above its idle condition, so your power tubes will last far

longer than if you kept 'er cranked, or if those same tubes were in a Class A amplifier. So in your particular case, biasing it slightly colder won't make any difference in tube life. But, it could very well affect the sound negatively.

Biasing colder will increase the high order harmonic distortion products, as well as increasing the overall THD. It also generally decreases the dynamic attack and punchiness in the bass regions, and takes the overall sound in a colder, more sterile direction. Biasing slightly hotter will generally make it sound warmer, juicier, and punchier, and will lower the high order distortion products and overall THD. Of course, you don't wanna get too wild with it, even though your particular situation means you'll never push it hard enough to overheat the tubes.

Also note that different brands of tubes will sound their best at different idle currents; 45mA is not a perfect generic setting for all KT88s, 40mA is not a perfect generic setting for all EL34s, etc. Let your ears be your guide, instead of a nominal idle current figure. With certain power tubes, sometimes just a small increase in current from a setting that sounded perfectly fine with a different brand can really unlock the magic.

Hope this helps.

Thermionic

Subject: Re: Under-Biasing Output Tubes
Posted by [AudioFred](#) on Mon, 12 Mar 2012 09:59:05 GMT
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Thanks, all, for informed and focused responses.

Subject: Re: Under-Biasing Output Tubes
Posted by [gofar99](#) on Wed, 14 Mar 2012 18:40:43 GMT
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Hi, I agree that you are indirectly measuring the cathode current. In my class A push-pull designs I run the EL34s and KT77s at 62ma per tube, KT88s at 90ma each and KT120s at 155ma each - all at 450-475 volts B+. Cathode voltages (which effectively subtract from the applied B+ run from low 20's to high 40's). For AB use it would be about 2/3 that much and B use about 1/2. I try to keep tube dissipation under about 85%. Then tube life is nearly forever. Many power tubes are rated at the 100% level and then the hours of use until they are considered no good varies from 2000 to 5000 hours. I would set your amp at the manufacturer's recommended values for best performance.

Subject: Re: Under-Biasing Output Tubes
Posted by [SASAudioLabs](#) on Thu, 22 Mar 2012 19:30:58 GMT

I have found that as the idle current lowers from class A towards class B, at some point the sound will start to be perceived as leaner.

With that said, class AB is not a problem if one biases towards descent values, not close to class B.

From .45 to .43 is most likely a couple of ma, and is not going to make any difference in longevity. However, I would check the sonics and see if .5 or higher would be perceived differently with the KT-88s. Set for the best sound. (Always be sure the power tranny does not overheat.)

Cheers.

Subject: Ella with EL34's

Posted by [spkrman57](#) on Sun, 22 Jul 2012 17:48:26 GMT

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I would go with 40 - 45 mA with EL34's in the Ella.

I'm trying to locate a schematic for the early Ella design as I'm in the process of buying a used one that I will need to verify what mods have been done to it.

I checked on DIY HiFi for a source for the schematic, but not successful so far.

If anyone has a schematic for the older Ella (approx 2004 timeframe) please send me a msg through this forum!

Regards, Ron
