Subject: Re: Fixed Bias v. Cathode Bias
Posted by Thermionic on Mon, 18 Jul 2005 01:52:11 GMT
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Some personal musings on operating class, in conjunction with Wayne's. Class A means that the tube (or transistor) is biased so that it conducts through the full 360 degrees of the AC signal input cycle, at the full unclipped output of the amplifier. This ordinarily means an operating point that's about halfway between cutoff and saturation. Class A amplifiers exhibit very little increase in conduction between idle and the point of clipping, as they basically idle wide open. Class A is the most linear, lowest distortion operating class, since it keeps the tube well away from the highly non-linear cutoff region on the negative swing of the input signal cycle. But, it's very inefficient and wastes a great deal of it's potential power as heat. Somewhere in the area of 10% efficiency for a Class A power stage is pretty normal. Since the power tube in a SE amp handles the entire signal, all SE amps must be Class A to amplify the entire waveform. Let me see, "hard" Class A now..... A tube is said to be biased into Class A when it conducts for the full 360 degrees at the full, unclipped output of the amplifier. But, the *unofficial* term "biased harder" into "hard" or "hot" Class A is used by some to describe when it's bised even hotter than this point. Class A is Class A, and you can't get "more" Class A, but this is just biasing it to a point of very high conduction, way more than necessary.The earmarks of when you really got that thing cooking that way are reduced tube life, lower power output, and more heat generation, but also lower output Z and also (sometimes!) a pleasing sound (sometimes not!). In general, the higher the plate current in a Class A output stage, the lower the output Z of the tube, and the higher the damping factor over the loudspeaker. But, generally the plate voltage must be lowered as well in order to prevent exceeding the design maximum plate dissipation wattage. The super high current/low voltage/low output Z operating point is extremely inefficient, and is not without it's own set of caveats. Manualblock, the OPT controls the reflected impedance load the tubes see from the speaker. Output Z here refers to the output impedance of the tube itself, independent of the reflected load of the OPT. Class AB means that the device conducts for appreciably more than 180 degrees of the input cycle, but not more. The region near cutoff (excessively low plate current) is very non-linear, and is avoided in Class AB operation.This also prevents crossover notch distortion in PP amps when the signal is "handed off" at the zero degree point. Each tube of the PP pair conducts enough past 180 degrees that both are still fully on and up into a linear region of their operation at the crossover point. They burn up a lot less potential power as heat, and are therefore much more efficient than Class A amplifiers, and are able to put way more more power into their load as a result. But, Class AB operation is also higher distortion than Class A. There's an old wive's tale that "Class AB amps are Class A at low output." They are NOT, otherwise operating class means nothing. They operate in a manner similar to Class A at low outputs, but they are still Class AB. Class B amplifiers are biased so that the devices conduct for exactly 180 degrees of the input cycle, and no more. The distortion is very high, so they are not used for audio, but for radio transmission. In response to how an AC signal rides on a DC voltage, there have been some great answers posted here. One thing I'd like to add that might help is that while DC is *always* a positive or negative voltage, the fact that AC is both in alternation means that the average voltage of AC is zero (i.e. 10DCV- plus 10DCV+ averages 0). That's one of the things that allow it to ride separately on the DC without affecting it, and vice versa.Thermionic