Subject: Quick and simple formulae for Ra
Posted by Damir on Wed, 26 Jan 2005 20:14:26 GMT
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In transformer - coupled output stage with output triode we must do a graphical load - line analysis to find load resistance Ra (primary resistance, or reflected secondary load). Ra is max. AC voltage "swing" divided with max. current "swing" through the load, orRa = Ua pp/ Ia pp = Ua p / Ia p = Ua rms / Ia rmsPower at the primary: Pa=Ua rms^2 / Ra = Ia rms^2 * Ra = Ua rms*Ia rmsNote that Ia p = Ia dc, Ia pp = 2*Ia dc, Ia rms = Ia dc / 1,4142The "goal" is to avoid graphic analysis, and find the simple formulae, "good enough" for "everyday use". Our triode output tube with its "bias" Ugk, can have max. peak AC input voltage in class A1 equal to Ugk, or Ugk rms = Ugk/1,4142.With very high load Ra, AC voltage at the load Ra is:Ua = mu * UgkBut, our "real" load Ra form voltage divider with tube plate resistance rp, and voltage at the load Ra is actually lower:Ua = (mu * Ugk) / (1 + rp/Ra)And from Ra = Ua / Ia, we have Ua = Ra * IaIf we put together these equations:Ra*Ia = (mu*Ugk)/(1+rp/Ra), and Ra*Ia = (mu*Ugk)/((Ra+rp)/Ra), andRa*Ia = (Ra*mu*Ugk)/(Ra+rp), and Ia = (mu*Ugk)/(Ra+rp), andRa+rp = mu*Ugk/Ia, and finally:Ra = ((mu * Ugk) / Ia) - rp   FORMULAE FOR RaWhat does this mean in practice? If we have some DC operating point for our output triode, say 300B - Uak=400V, Ia=80mA, Ugk=-85V and we know (about) rp and mu from tube manuals (simplification, assumed that rp and mu are constant, but error is minimal and negligible). Say, rp = 700 Ohms and mu = 3,9. Then:Ra = ((3,9 * 85) / 0,08) - 700 = 3443,75 Ohms ~3,5 kOhmsIn agreement with load - line analysis and tube manual data!