BJT Practice Problems

Oct. 8, 2012

All transistors have VBE at 25 C = 0.65 volts and a -0.002 volt/C temperature coefficient. Use the transistor_designer.xlxs spreadsheet on the website to check your work. It provides all of the answers for both design and analysis. It is possible that some of the designs won't work – i.e. negative results – I have not had time to check all permutations – do not worry if that happens – it might happen once or not at all. These problems give plenty of practice doing bias design, AC design, bias analysis, and AC analysis.

1. Design a common-emitter amplifier to drive a load resistance of 2,000 ohms with an Avl of -50 using optimum large signal design (VCQoptimum). Tmin = 0 C, Tmax = 60C, Bmin = 50, Bmax = 200, KT = 1.2, KB = 1.2, VCBmin = 2 volts. Do three designs: (1) VCC = 6 volts, RC = 1,000 ohms; (2) VCC = 12 volts, RC = 2,000 ohms; (3) VCC = 24 volts, RC = 3,900 ohms. Do analysis on each of your designs to verify that the required VCQ is met and that Avl is met.

2. Design a common-collector amplifier to drive a load resistance of 500 ohms using optimum large signal design (VEQoptimum). Bmin = 80, Bmax = 250, KB = 1.2, do not worry about temperature, VCEsat = 0.2 volts. Do three designs: (1) VCC = 6 volts, RE = 270 ohms; (2) VCC = 12 volts, RE = 510 ohms; (3) VCC = 24 volts, RE = 1,000 ohms. Do analysis on each of your designs to verify that the required VEQ is met. Also calculate Avl for each case.

3. Design a common-emitter amplifier to drive a load resistance of 5,000 ohms with an Avl of -100 using small signal design (use specified VCQ). Tmin = 10 C, Tmax = 85 C, Bmin = 100, Bmax = 240, KT = 1.2, KB = 1.2, VCBmin = 2 volts. Do three designs: (1) VCC = 6 volts, RC = 2,700 ohms; (2) VCC = 12 volts; RC = 4,700 ohms; (3) VCC = 24 volts, RC = 10,000 ohms. Do analysis on each of your designs to verify that the required VCQ is met and that Avl is met.

4. Design a common-collector amplifier to drive a load resistance of 1,000 ohms using small signal design (let VEQ = VCC – VCBmin –VBEnom). Use VCBmin = 1 volt and VCEsat = 0.1 volts. Do three designs: (1) VCC = 6 volts, RE = 1,500 ohms; (2) VCC = 12 volts, RE = 3,000 ohms; (3) VCC = 24 volts, RE = 7,500 ohms. Do analysis on each of your designs to verify that the required VEQ is met. Also calculate Avl for each case.