

# Homework Problems

## BJT Amplifier Design

rev 1

Design the following circuits to meet the following requirements. For each common-emitter and common-base design, perform the complete process for  $R_C = R_L/2$ ,  $R_C = R_L$ , and  $R_C = 2*R_L$ . For each common-collector design perform the complete process for  $R_E = R_L/2$ ,  $R_E = R_L$ , and  $R_E = 2*R_L$ . The three designs will illustrate the issues over the range of choices. For all designs, use  $B_{min} = 100$ ,  $B_{max} = 250$ ,  $T_{min} = 10$ ,  $T_{max} = 50$  degrees C, and  $V_{BE}$  @ 25 degrees C = 0.62 Volts with a temperature coefficient of -0.0022 Volts/degree C. Use  $K_B = K_T = 1.2$ . Confirm the designs by analysis.

1. Design a common-emitter amplifier with a net voltage gain of 20 that operates off of 9 VDC. The source impedance is 2000 Ohms and the load impedance is 5000 Ohms. What is the maximum possible net voltage gain that each of the three circuits can achieve if  $R_{E1}$  is 0?
2. Design a common-base amplifier with a net voltage gain of 10 that operates off of 15 VDC. The source impedance is 25 Ohms and the load impedance is 1000 Ohms.
3. Design a common-collector amplifier that operates off of 12 VDC and drives a load of 470 Ohms. What is the input impedance of each of the three circuits? What is the power gain of each of the three circuits?

Problems 4, 5, and 6 are derivation problems using your design methods for problems 1 through 3 but with  $V_{CC}$  and  $R_L$  used symbolically instead of as numbers. The conclusions of these problems are both useful and interesting.

4. Using the parameters at the top of this page, and given  $V_{CC}$  and  $R_L$ , determine the maximum possible power gain in dB for a common-emitter amplifier for each of the three choices of  $R_C$ . What effect does  $V_{CC}$  have on ultimate power gain? What effect does  $R_L$  and the choice for  $R_C$  have on ultimate power gain?
5. Repeat problem 4 for a common-base amplifier. What effect does  $V_{CC}$  have on ultimate power gain? What effect does  $R_L$  and the choice for  $R_C$  have on ultimate power gain?
6. Repeat problem 4 for a common-collector amplifier using the three choices for  $R_E$ . What effect does  $V_{CC}$  have on ultimate power gain? What effect does  $R_L$  and the choice for  $R_E$  have on ultimate power gain?