ECE 304 Hands-on Lab 2: Output Stage

Introduction

Figure 1 shows the circuit to be designed and built. It differs from the examples that a current mirror represents the current bias source. It is chosen to have no leg resistors to keep its compliance voltage low, so it will have less effect on headroom. All transistors are represented by their own parameters (no matching is assumed except in the current mirror). Because the mirror has a low output resistance, the current delivered is different in the case of zero output voltage than in the case of high output voltage.

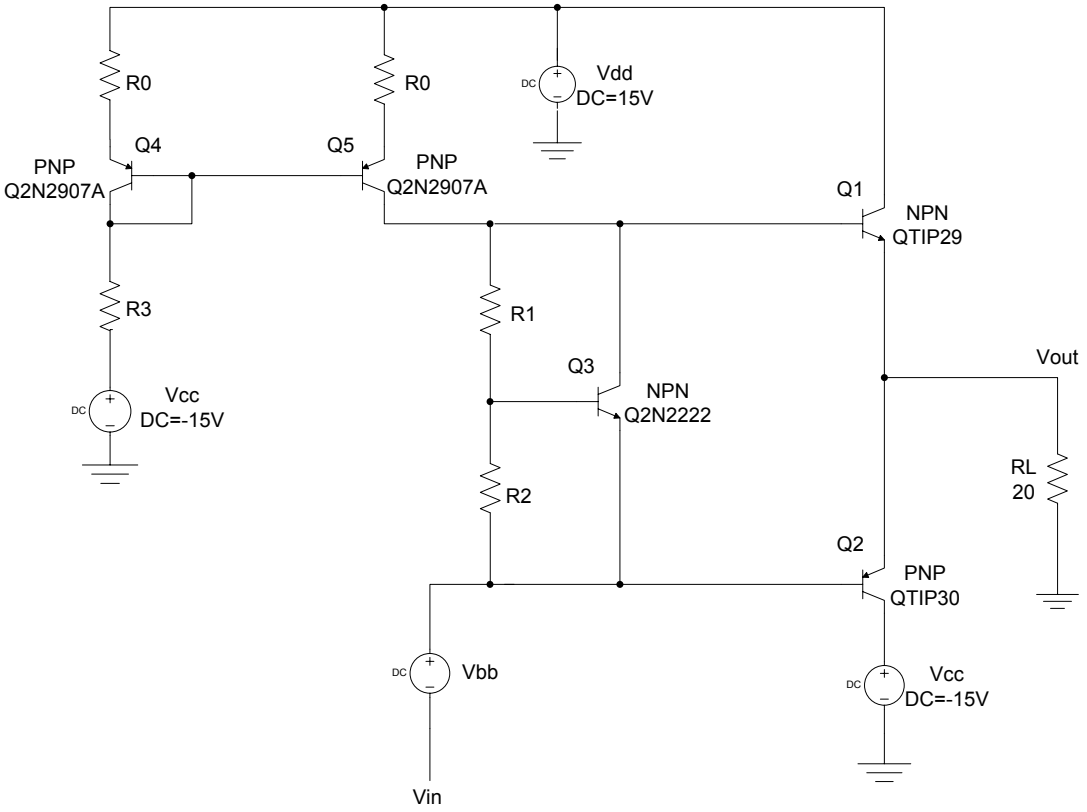

Figure 1. V_{BE} multiplier-biased class AB power output stage

V_{dd} = 15V, V_{cc} = -15V, R_L = 20Ω. Maximum mirror current ≤ 45mA to keep power consumption by the current bias mirror within the power limitations of the transistors in the mirror.

Pre-Lab

Using hand calculations, design the circuit of Figure 1 so that Vout=0 when Vin=0. Assume BJT V_{BE} and β values to manually determine the resistor values of R_0, R_1, R_2 and R_3 that meet the requirements. Restrict your resistor choices to those available at the Stockroom. Build the current mirror circuit first (maximum mirror current ≤ 45mA), and then complete the whole circuit in Figure 1. Use voltage rails of±15 V.

In-Lab

In the lab, build the circuit of Figure 1, and do the following measurements:

1) measure all the resistors with the multimeter.
2) measure the current through each resistor.
3) record Vbb and Vout.
4) measure the DC operating points for all transistors.

Measure the small-signal gain using the following signal for input: Vin = amplitude of 5V and frequency of 1kHz.

Discussion

Compare experimental results with manual calculations. Give reasons for differences. How do real transistors differ from simulated or theoretical ones?

Extra Credits:

1) How to replace the current version of current source design with a self-biased current source? (don’t forget to add start up circuit)
2) How to get rid of dead zone totally. Check Vin Vs Vout. Find out whether you still have crossover situations.