# Homework #4

Due Wed., Feb. 10, 2010

In this homework, we use SPICE or Cadence to study a single-VCO heterodyne receiver. The architecture and circuit implementation are shown below. The IF mixers are realized as passive switches. For simplicity, the divide-by-two stage that would generate LO_2 from LO_1 is omitted from this homework. All transistors have a channel length of 0.18 μm. For LO_1, assume a frequency of 3.5 GHz, a common-mode level of 1.6 V, and a peak-to-peak differential amplitude of 0.75 V. For LO_2, these numbers will be 1.75 GHz, 0.9 V, and 3.6 V, respectively. The inductors must be modeled as shown, where $C_P = 8$ fF for every nanohenry of inductance.
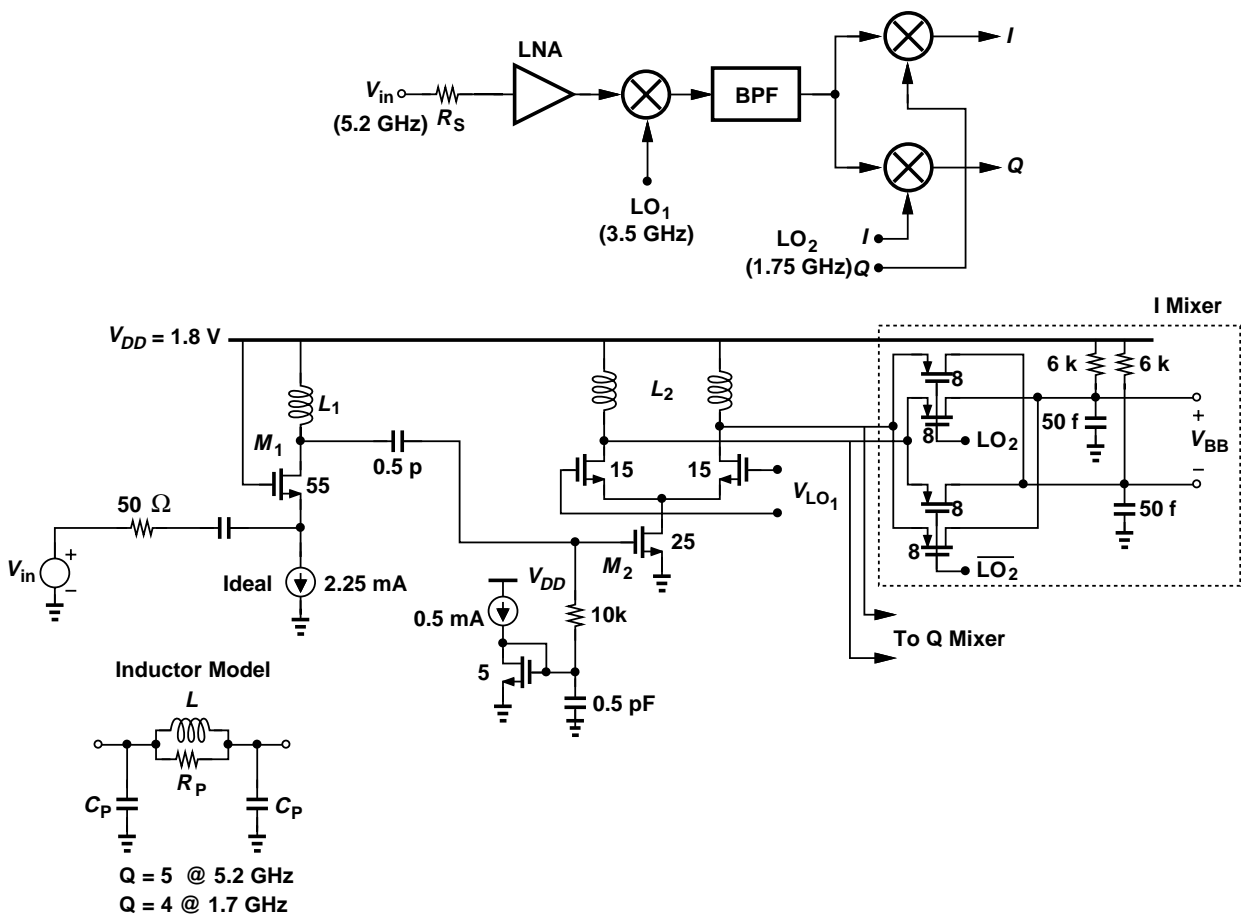
(a) Determine the values of L_1 and L_2 to obtain resonance at 5.2 GHz and 1.7 GHz at the LNA output and RF mixer output, respectively.

(b) Compute the total voltage gain of the receiver, with the input level defined as $V_{in}/2$.

(c) Determine the image-reject ratio of the receiver.

(d) Identify two mechanisms through which the receiver translates an interferer at 8.7 GHz to baseband. Assume no mismatches or even-order harmonics. Determine the gain experienced by such a component and normalize the result to the gain found in (a).