1. Why We Don't Over-drive Mixers

Contrary to what was mentioned in class, the switches in the upper diff. pairs of the mixer should be in the Saturation region.
- this is because they only need to switch the current back and forth between the two sides. This can be done without exiting the Saturation region to the Triode region.
- With a voltage-based switch, such as a pass transistor, the switch would be in the Triode region, but it is a different situation for the current switching used here.

Let's consider in more detail the negative effects of over-driving the mixer:
- Consider the single-balanced mixer shown below, where
  - $V_{io+}$ is high and all of the current has been switched to one side, but $M_1$ is still in saturation.
  - $C_p$ is the parasitic capacitance at the source of the diff. pair.

- Now consider what happens when $V_{io+}$ increases further (represented by $+$ in next figure).
  - Because $M_1$ is already driving the maximum current of $I_{in}$, $V_s$ must increase to accommodate the increase in $V_{io+}$ and hold $V_{os}$ constant.
  - Because of the parasitic capacitance ($C_p$) at the source, this increase in $V_s$ requires a spike in the drain current of $M_1$ (shown as $I_{spike}$) to charge $C_p$.
  - This spike in current is seen by the output load, resulting in a disturbance in the output voltage at the LO freq. (LO feedthrough)

- Additionally, the rise in $V_s$ coupled with the drop in $V_o$ caused by the spike in current may push $M_1$ out of Saturation into Triode. Moving from Sat. to Triode involves charging the channel charge, this change in channel charge must come from the power supply where it is seen by the load, leading to additional output disturbance.

- I will go over the above points in class on 3/24/2009.
2. Baluns 101

- Balun stands for Balanced-Unbalanced, as they are used to convert between single-ended (unbalanced) and differential (balanced) signals.

- Here is an example of where the balun would appear in a receive chain:

- Everything after the balun will be differential, allowing the rejection of common-mode disturbances such as substrate noise and power supply noise.

- There are a number of ways to realize a balun, the simplest is by using 2 transformers, as follows:

- Each transformer has 2:1 turns ratio, so that the input amplitude will be equal to the differential output amplitude.

- The common terminal sets the common-mode output voltage.

- For matching, if the input impedance is 50 Ω, both of the positive and negative terminals should see 25 Ω to ground for a total of 50 Ω.

- In Cadence, the easiest way to implement a balun is by using the "ideal-balun" component from the Analog Lib library.

- An example of how to hook this up is shown on the following page.

- I will go over this material in class on 3/26/2009.