**EE5390 Homework 2: Due Wednesday 07/03/2012**

1. Derive the expression for output impedance of the BJT cascode current mirror in Figure 1.
2. Derive the expressions for $R_{out}$, $V_{out,min}$ and $I_{out}$ for the MOS current mirror in Figure 2.
3. Derive the expression for $I_{out}$ and $V_{in}$ for the MOS peaking current source in Figure 3.
4. Determine the value of $I_{out}$ and $R_{out}$ for **(a)** the BJT Widlar current source in Figure 4(a) **(b)** the circuit in Figure 4(b) **(c)** the BJT Wilson current mirror in Figure 4(c) (in all cases, assume $V_A$=20V, β=100).
5. Determine the value of $I_{out}$ for the BJT peaking current source (you are given $I_0$=10μA and R=12kΩ) shown in Figure 5.
6. Derive the accurate expression for the low-frequency gain of the circuit shown in Figure 6. Simplify your expression by writing $r_\pi$ in terms of β and $g_m$ of the BJT.
7. Derive accurate expressions for the effective $r_\pi$, β, $g_m$ and $r_o$ for the two circuits shown in Figure 7(a) and 7(b).
8. For the circuit shown in Figure 8, determine the voltage gain and input referred noise (assume amplifier is noiseless). What happens if the amplifier is noisy?
9. Determine $\Delta I_{D2}/I_{D2}$ for the circuit shown in Figure 9. Assume mismatches in $\mu_n C_{ox}$, W/L, $R_S$ and $V_T$ between the two transistors.

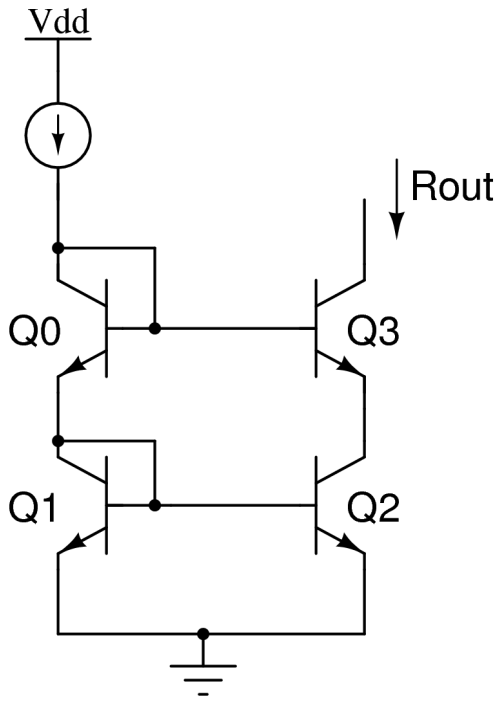


Figure 1

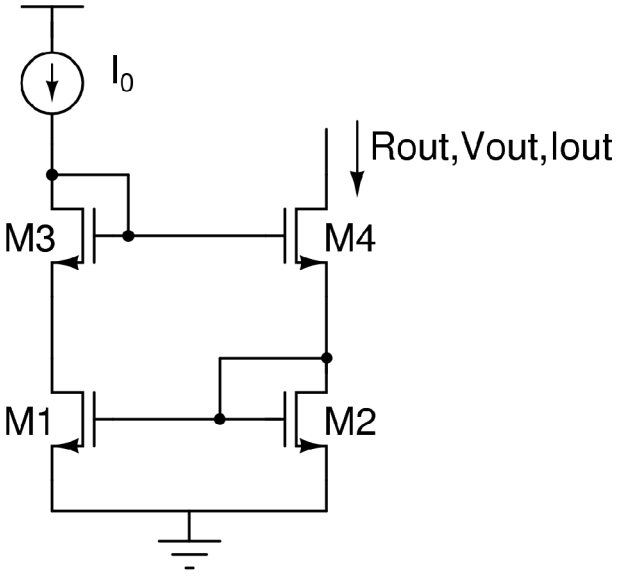


Figure 2

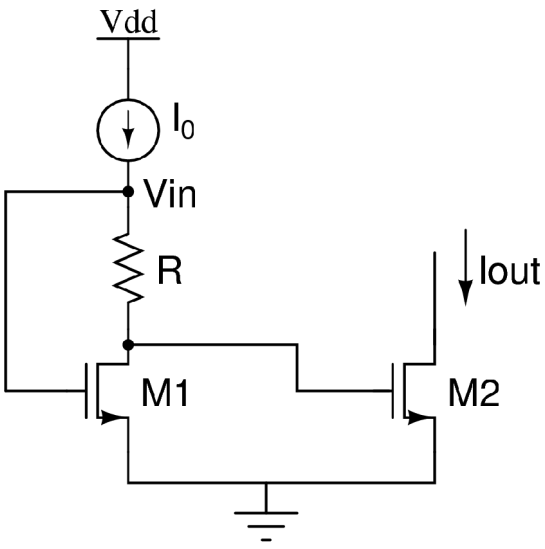


Figure 3

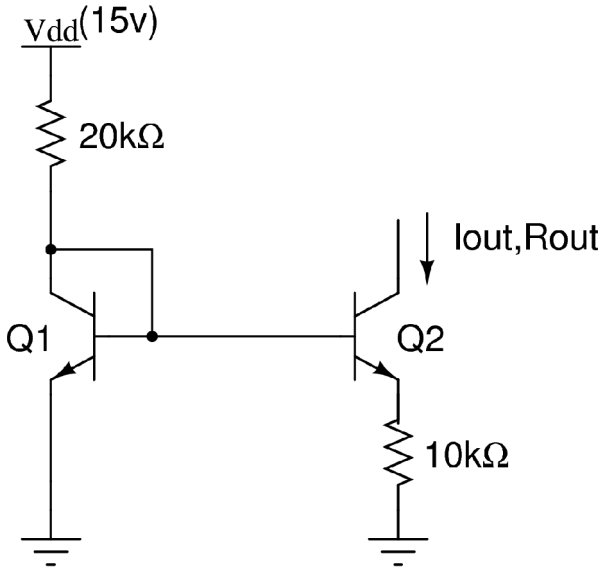


Figure 4(a)

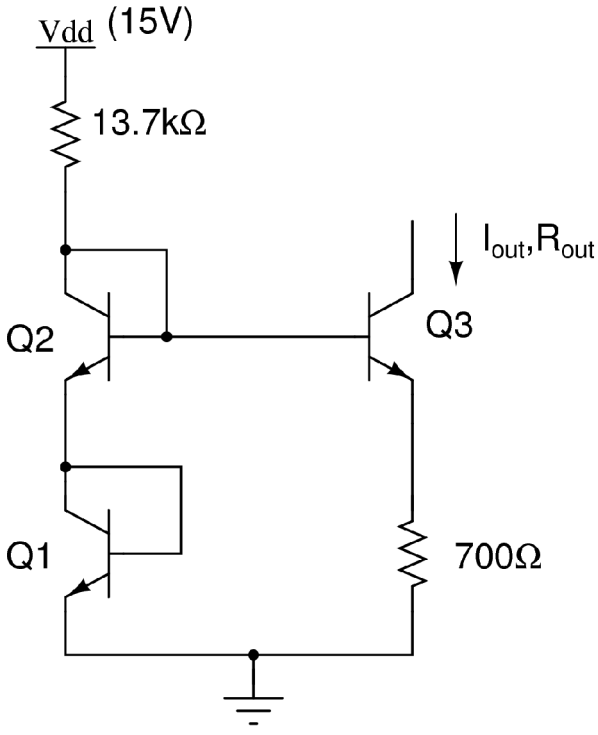


Figure 4(b)

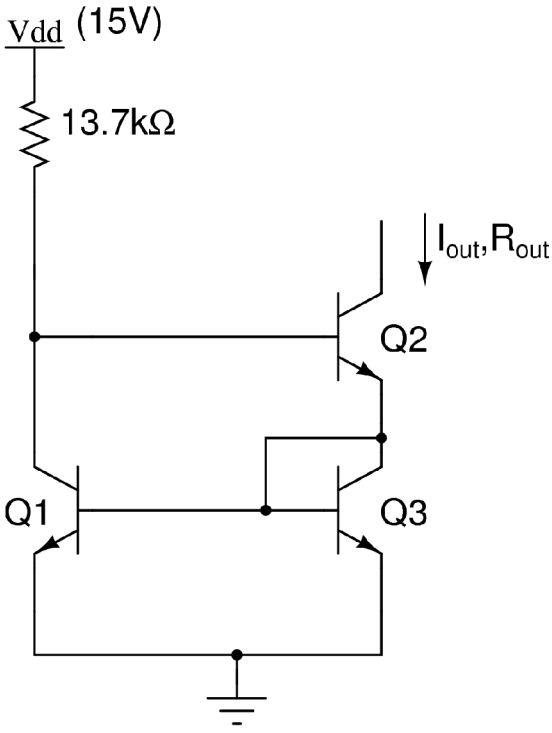


Figure 4(c)

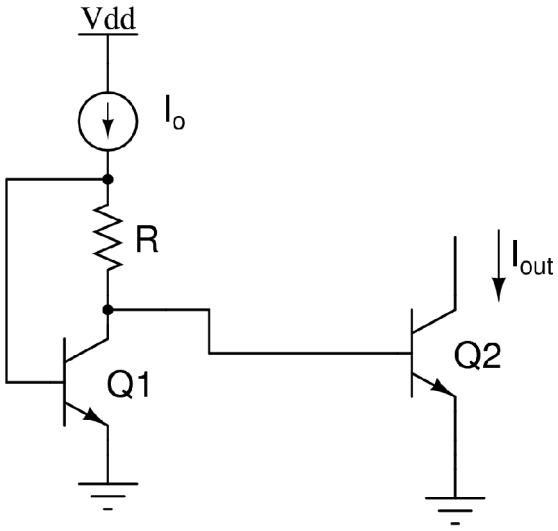


Figure 5

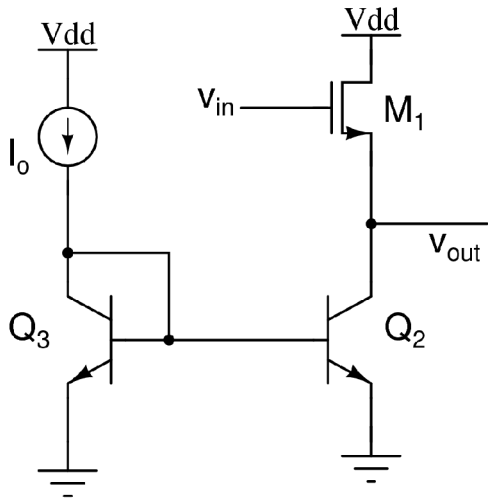


Figure 6

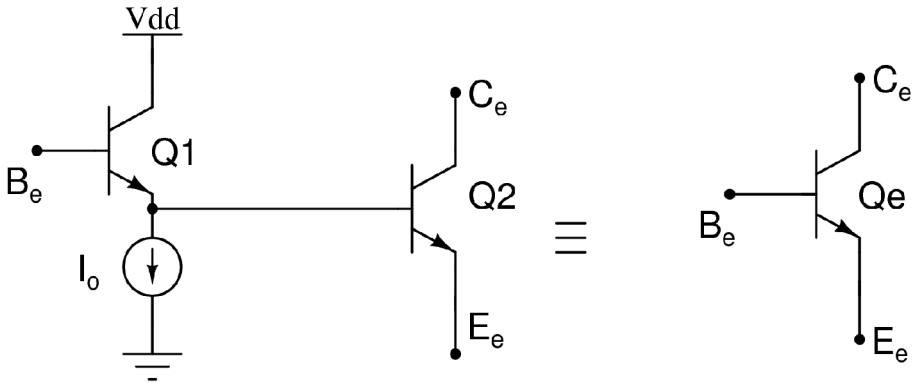


Figure 7(a)

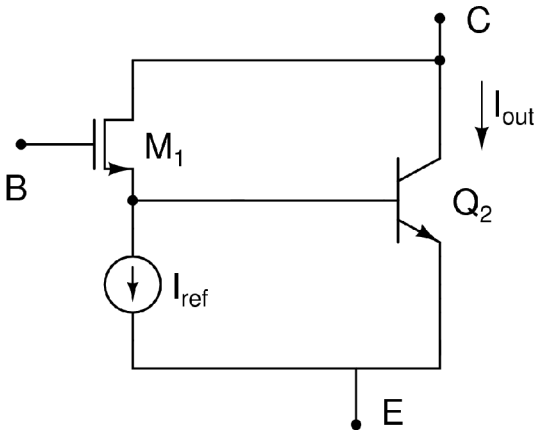


Figure 7(b)

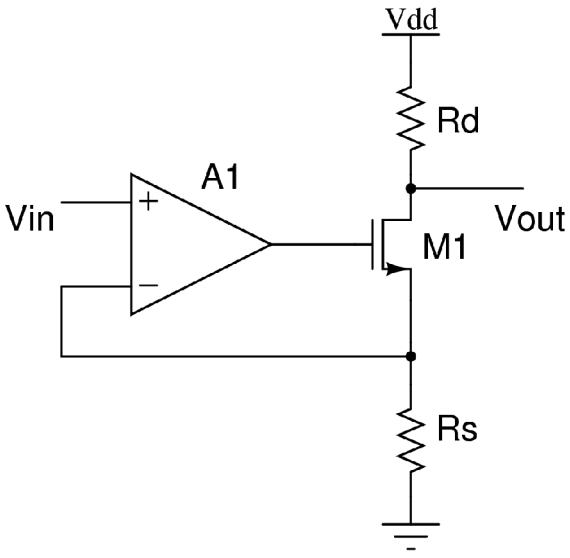


Figure 8

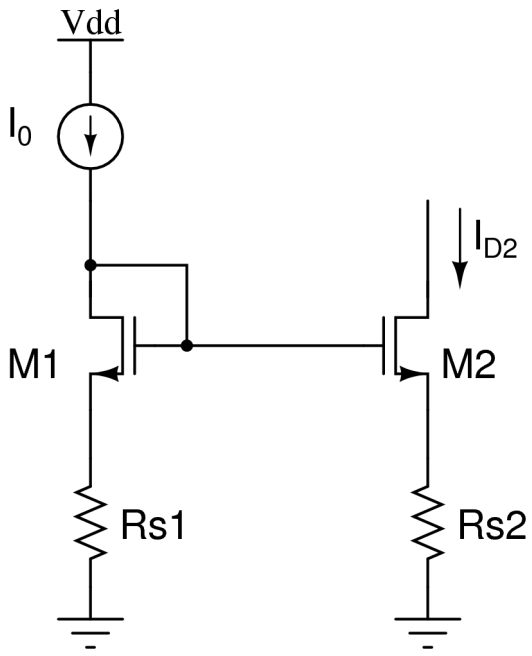


Figure 9