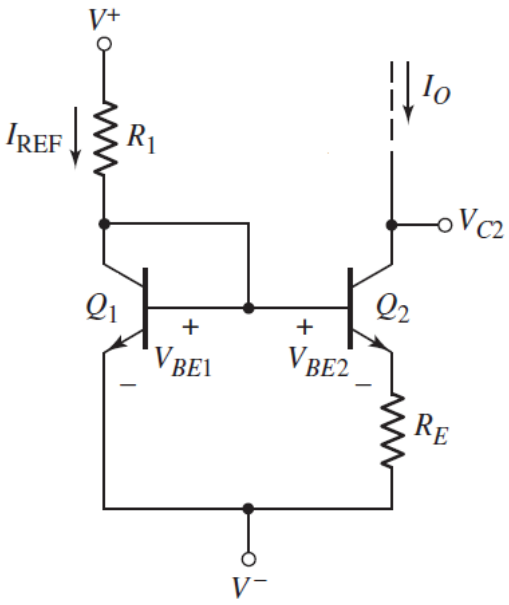
Electronics II, Exam-3, Spring 2023

Department of Communication Engineering, National Central University

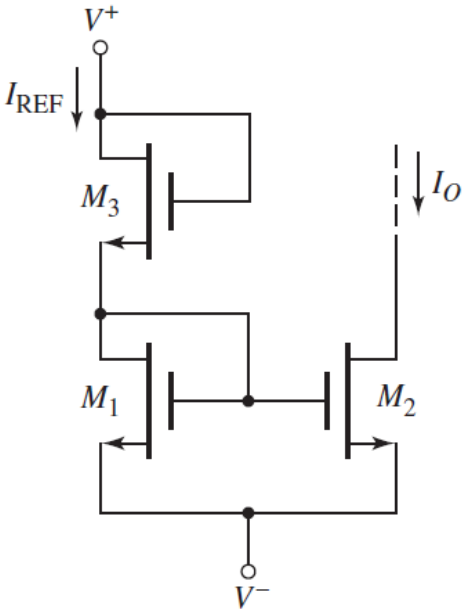
May 12, 2023, Prof. Dah-Chung Chang (E1-311)

---

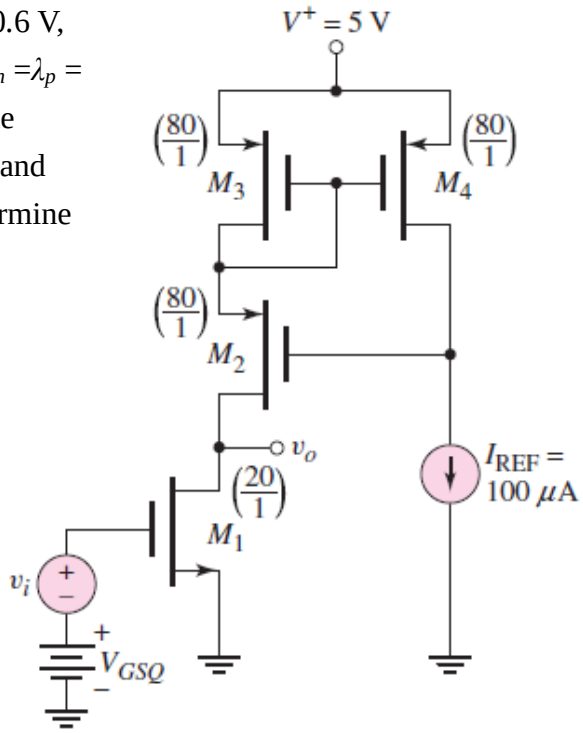
1. (25%) The parameters of the circuit are: V^+=5V, $V^- = 0$, $I_{REF} = 0.7mA$, and $I_O = 25\mu A$ at $V_{C2} = 1V$. The transistor parameters are: β = 150, V_{BE1}(on) = 0.7 V, and V_A = 100 V. Determine the change in I_O when V_{C2} changes from 1 V to 4 V.



2. (25%) The bias voltages of the circuit are V^+=1.8V and $V^- = -1.8$ V, and the transistor parameters are V_{TN} = 0.4 V, $k_n' = 100\mu A/V^2$, and λ = 0. Find those *W*/*L* ratios for three transistors such that $I_{REF} = 0.5mA$ and $I_O = 0.1mA$, and that M_2 remains biased in the saturation region for $V_{DS2} \geq 0.4$ V.



3. (25%) The parameters of the transistors are V_{TN} = 0.6 V, V_{TP}= −0.6 V, k_n' =100μA/V^2, k_p' = 60μA/V^2, and λ_n =λ_p = 0.02V^{-1}. The width-to-length ratios are shown in the figure. The value of V_{GSQ} is such that I_{D1} = 100μA, and M_1 and M_2 are biased in the saturation region. Determine the small-signal voltage gain $A_v = v_o/v_i$.



4. (25%) The bias voltage of the MOSFET amplifier with active load is V$^+$ = 3 V. The transistor parameters are V_{TN} = 0.5 V, V_{TP}= −0.5 V, k_n' =100μA/V^2, k_p' = 60μA/V^2, and λ_n =λ_p = 0.02V^{-1}. The quiescent values are V_O = 1.5V and V_I = 1.2V.
   (a) Find the three transistor W/L ratios, such that $I_{REF} = I_O = 100\mu A$. Assume M_1 and M_2 are matched. (15%)
   (b) Determine the small-signal voltage gain $A_v = v_o/v_i$. (10%)