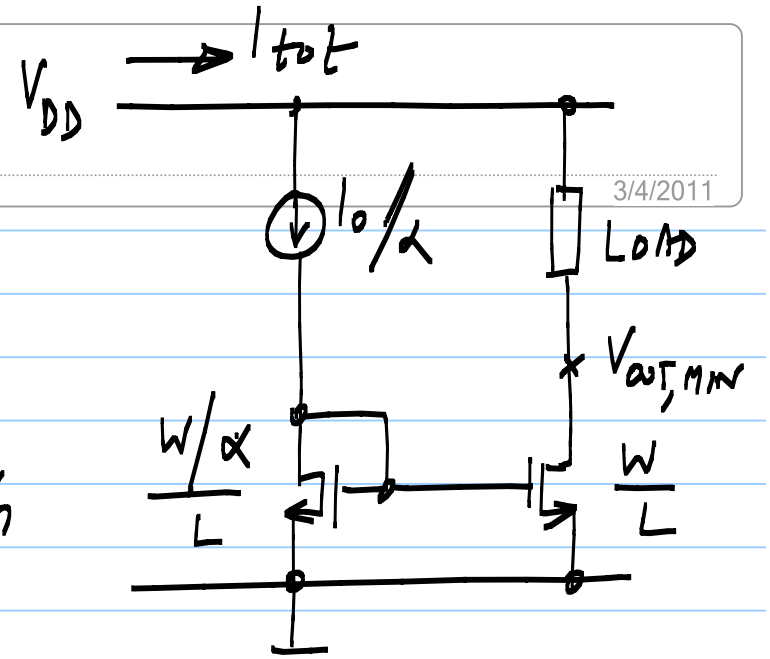
Assignment 5

Note Title 3/4/2011



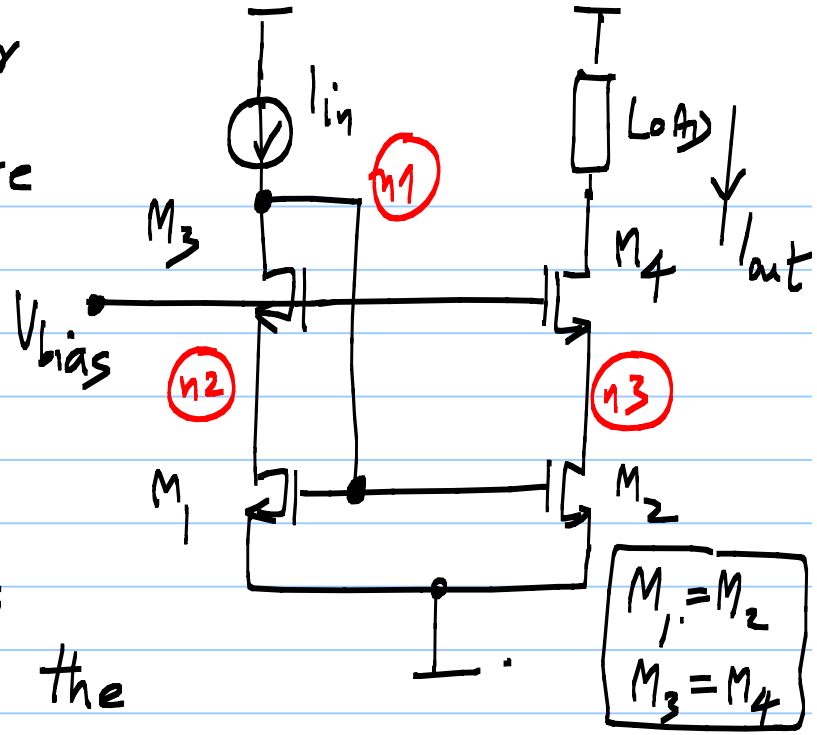
(1) The current mirror shown on the right delivers a current I_0 to the load. The reference branch current can be tailored using the parameter α.

* The transistors must be sized to allow a minimum voltage of $V_{OUT,MIN}$ in saturation region.
* The total current must be I_{tot}

* The signal (current in the load) to the noise (rms current in a bandwidth f_3) has to be maximized.

Determine W/L, α, output signal & noise rms in terms of the given parameters.

(2) In the cascode current mirror shown here, all transistors are in saturation region.



Model $M_{1,2}$ by g_{m_1}

Model $M_{3,4}$ by g_{m_3}

] $g_{ds} = 0$ for all transistors

(i) Determine the noise PSD of the output current due to each transistor separately

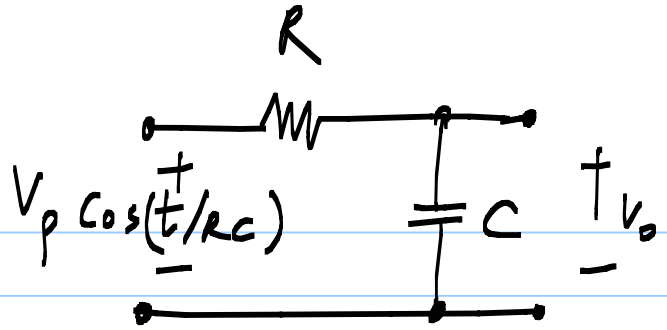
(ii) Determine the current error in the output due to $\Delta V_{T_{12}}$ & $\Delta V_{T_{34}}$ separately

(iii) Determine $\frac{I_{out}(s)}{I_{in}(s)}$ by including a parasitic capacitor C_p to nodes n1, n2, and n3, one at a time

(Not to be submitted:

Reason out why the above results come out the way they do)

(3) For the RC filter, determine



(a) Mean squared o/p signal (S)

(b) Mean squared o/p noise (N)

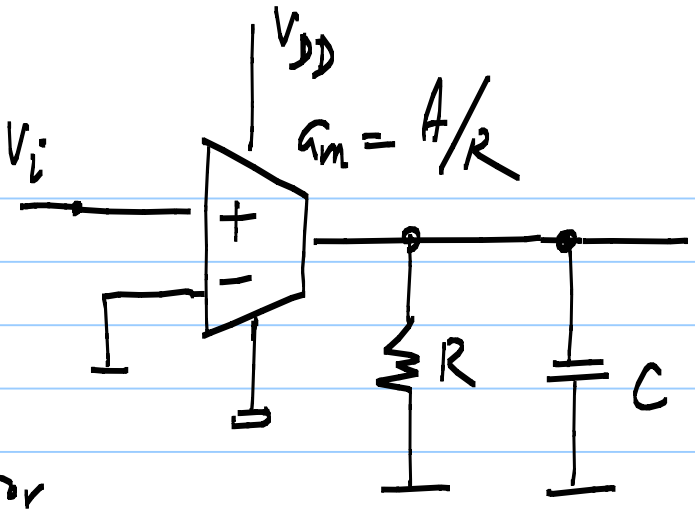
(c) Ratio S/N

(d) Power dissipated in the resistor (P_d)

(e) Bandwidth in Hz (f_B)

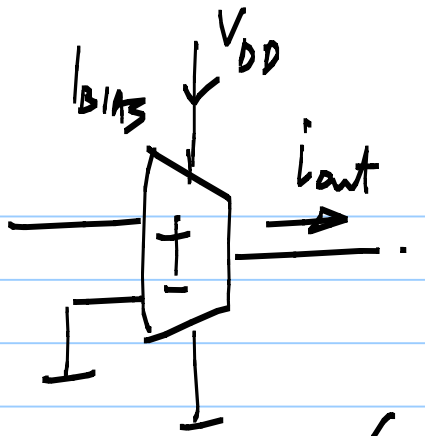
Express the power dissipated (P_d) in terms of the signal to noise ratio and the bandwidth

(4) (a) For the amplifier shown here, calculate the mean squared output noise voltage assuming that the transconductor G_m has an input referred noise voltage PSD of $4kT/g_m$



(b) Assuming that $v_i = \frac{V_p}{A}\cos \omega t$, and a low frequency ω, calculate the output mean squared signal voltage

(c) Assuming a "class A" transconductor, determine the power drawn (average power over one output cycle) from the supply for the above signal

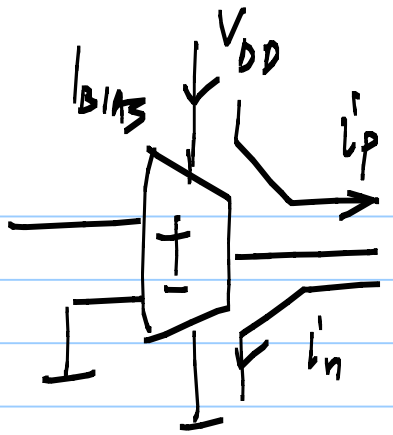


$$I_{BIAS} = \max\left(|i_{out}|\right)$$

["class A"]

(d) Express the power dissipated (P_d) in terms of the signal to noise ratio and the bandwidth

(e) Assuming a "class B" transconductor, determine the power drawn (average power over one output cycle) from the supply for the above signal



- positive i_{out} from V_{DD}
- negative i_{out} into ground

[class "B"]

(f) Express the power dissipated (P_d) in terms of the signal to noise ratio and the bandwidth

(5) What do you infer from the relationships between P_d, $\frac{S}{N}$, and f_B in the previous problems?

(6) Calculate the output noise PSD & the input referred noise PSD due to the opAMP noise (PSD = $S_{v,opA}$), with and without R_2.