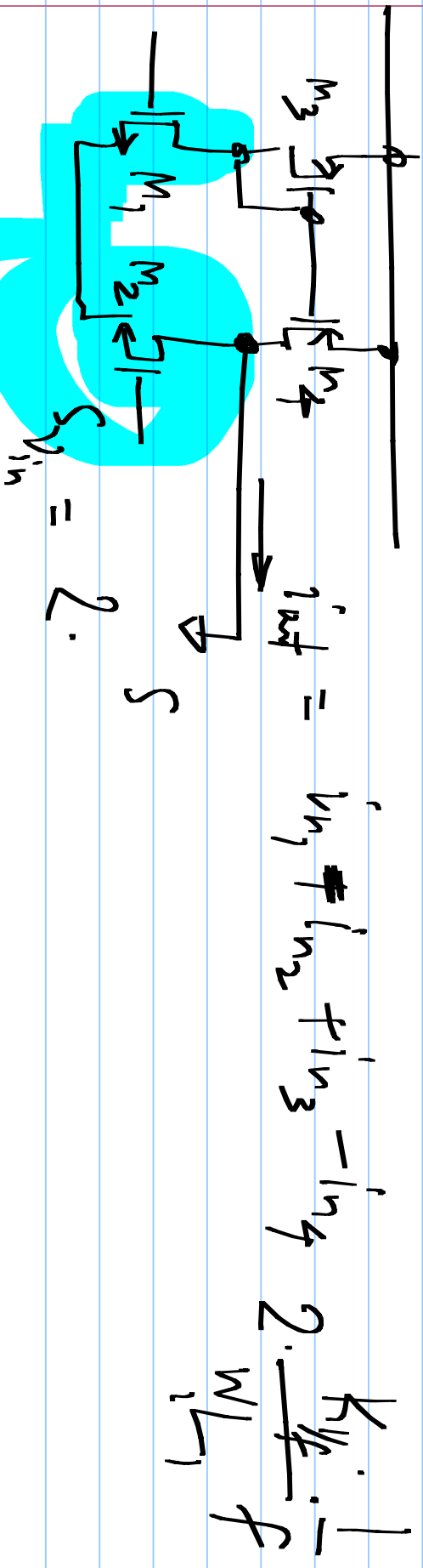


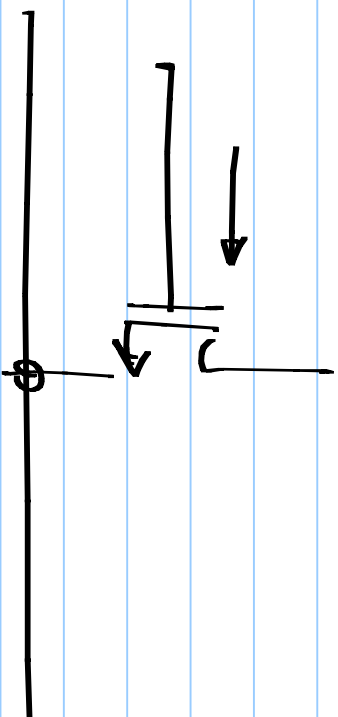
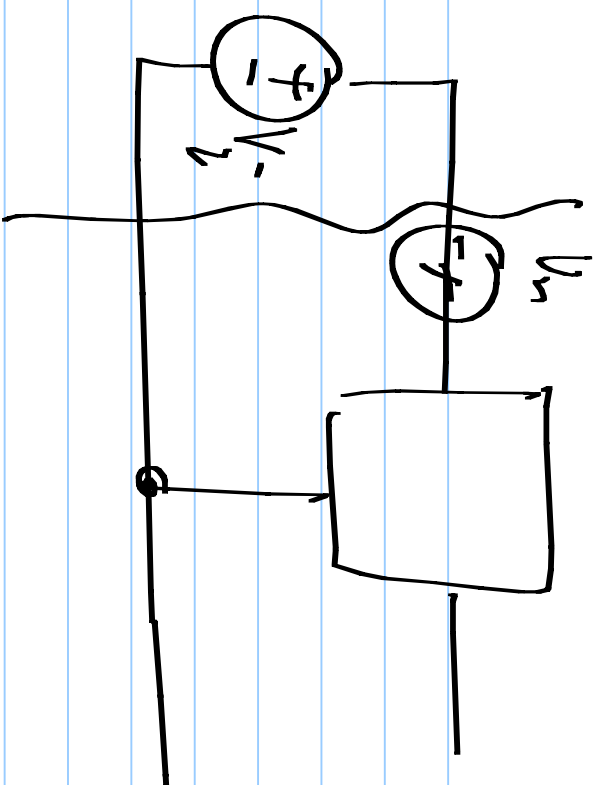
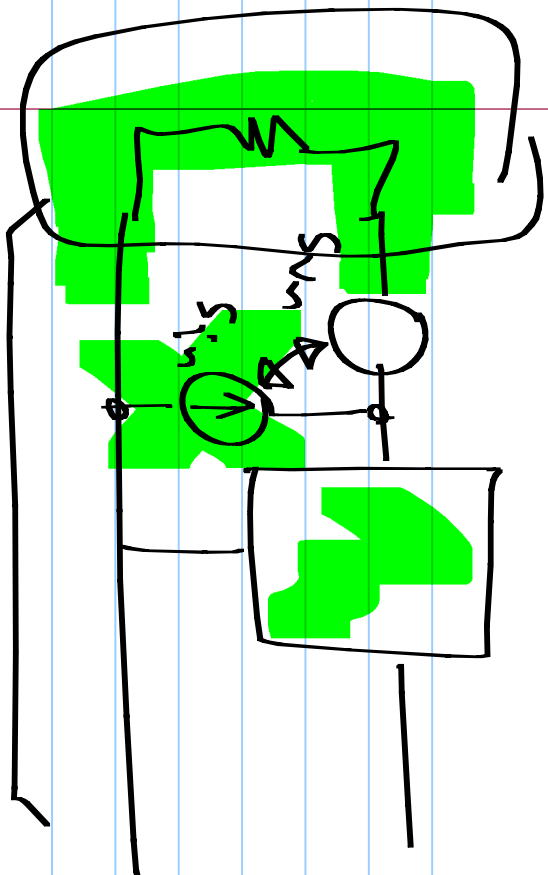
Lecture 30

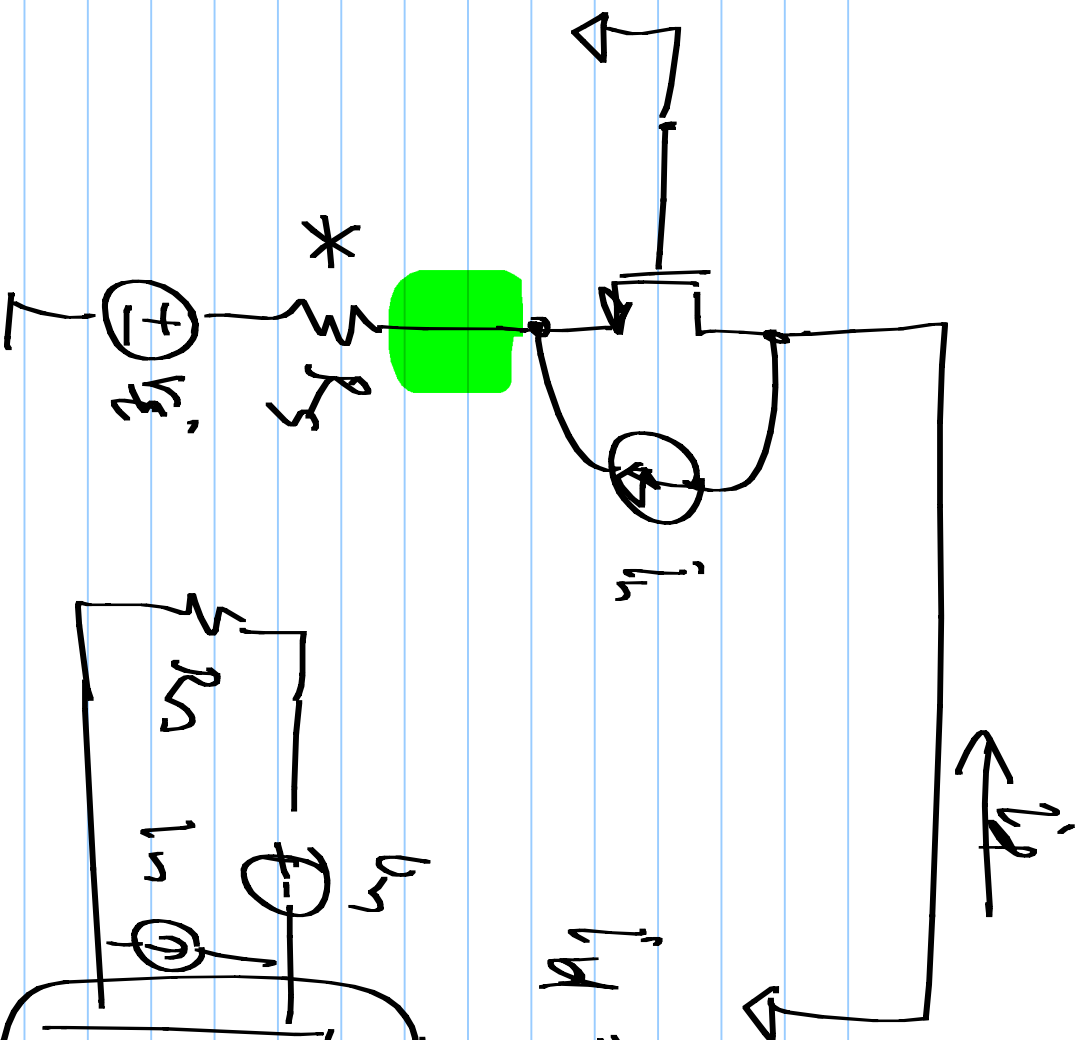
17/3/2016

Two-stage opamp: $S_{v_{in}} \approx \frac{1/g_{m1}}{g_{m1}} \left(1 + \frac{g_{m3}}{g_{m1}}\right)$

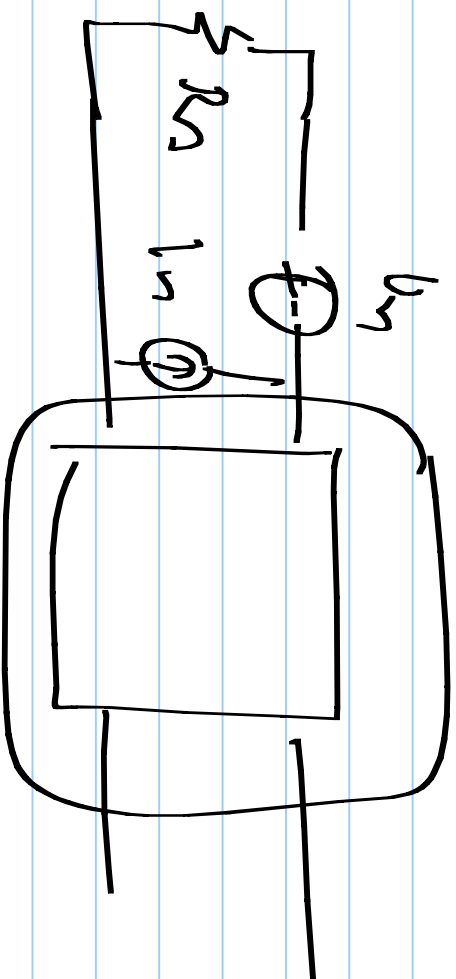
(low freq. noise PSD)







$$i_d' = \frac{I_{DS}}{I_{DS} + I_{SS}} \cdot I_{SS}$$

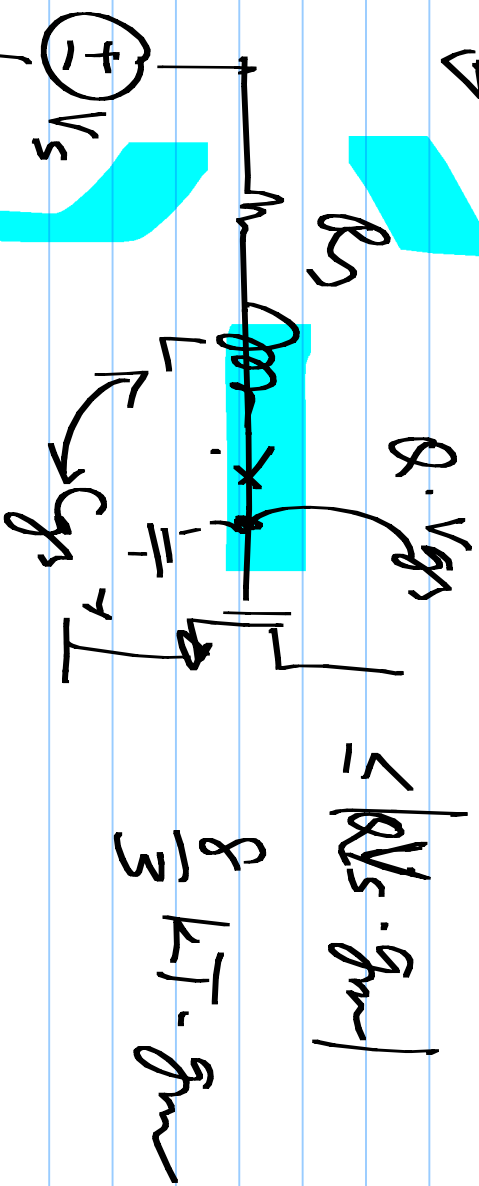
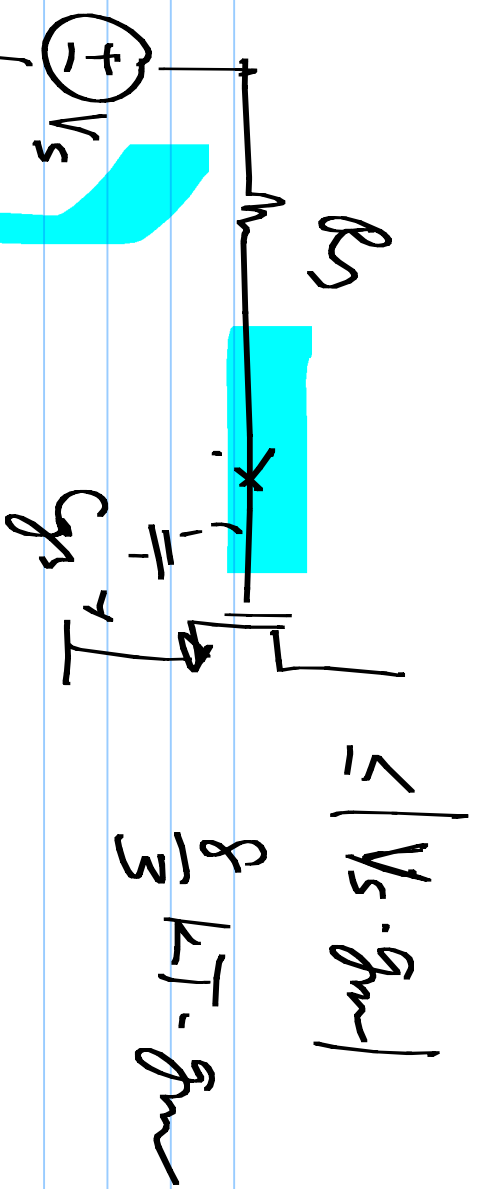


Flicker noise:

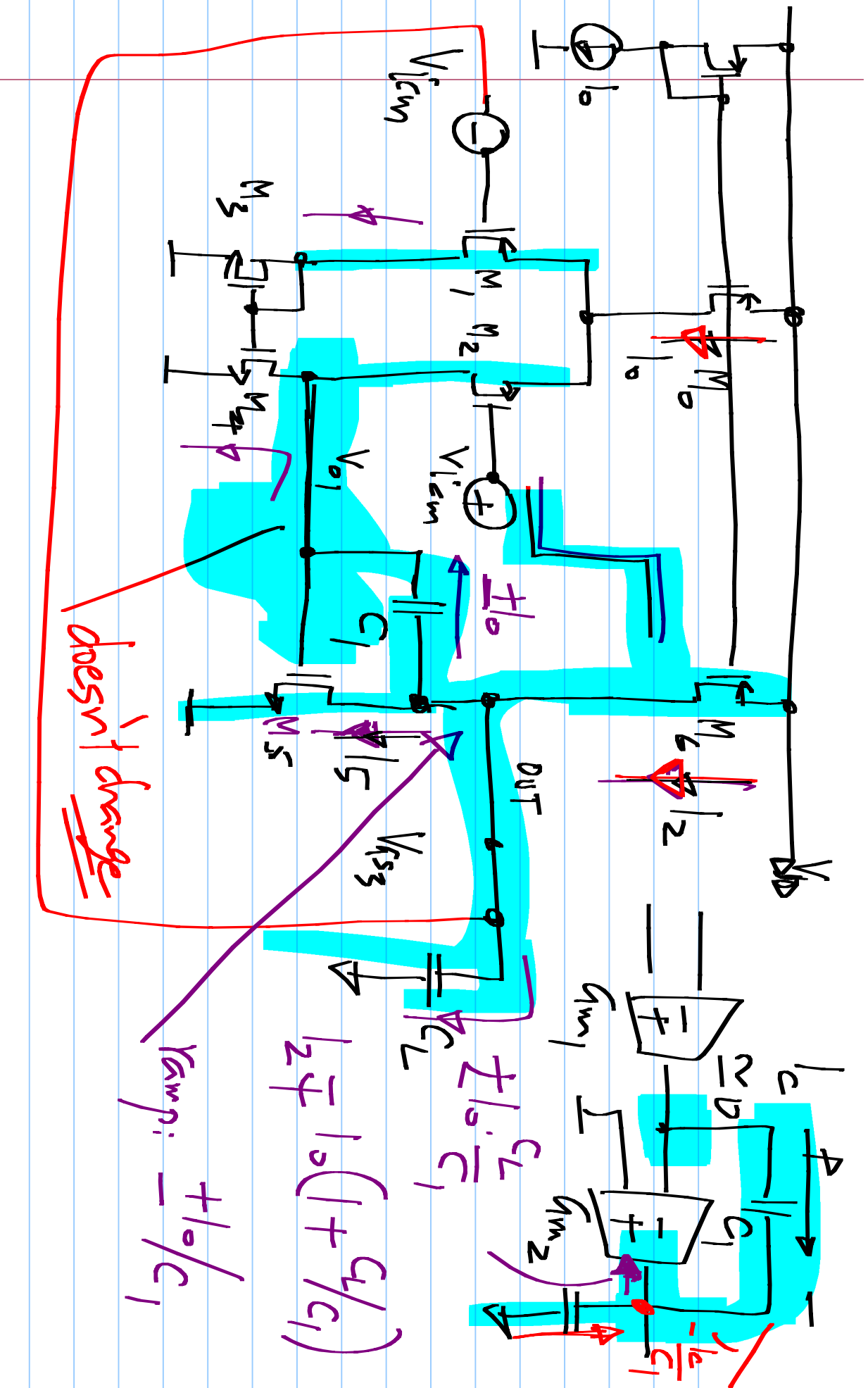
$$i_{n,out} = \frac{i_{n1} - i_{n2} + i_{n3} - i_{n4}}{2}$$

$$S_{i,out} = 2 \cdot \left(\frac{K_{1/f,n}}{W_{L1}} \cdot \frac{1}{f} \right) g_{m1}^2 + 2 \cdot \left(\frac{K_{1/f,p}}{W_{3L3}} \cdot \frac{1}{f} \right) g_{m3}^2$$

$$S_{v,in} = 2 \cdot \frac{K_{1/f,n}}{W_{1L1}} \cdot \frac{1}{f} + 2 \cdot \frac{K_{1/f,p}}{W_{3L3}} \cdot \frac{1}{f} \left(\frac{g_{m3}}{g_{m1}} \right)^2$$



$$\sigma_{V_{DS}}^2 = \sigma_{V_{T12}}^2 + \sigma_{V_{T24}}^2 \left(\frac{g_{m3}}{g_{m1}} \right)^2$$



the step: $I_5 =$

$$I_2 - I_0 \left(1 + \frac{C_L}{C_1}\right) \quad \left| \quad \frac{dV_0}{dt} : \frac{+I_0}{C_1} \right.$$

-ve step $I_5 = I_2 + I_0 \left(1 + \frac{C_L}{C_1}\right) \quad \left| \quad -\frac{I_0}{C_1} \right.$

only if $I_2 > I_0 \left(1 + \frac{C_L}{C_1}\right) \quad I_C = \frac{I_2}{1 + \frac{C_L}{C_1}}$

$$I_f \quad I_2 < I_0 \left(1 + \frac{C_L}{C_1}\right) \quad I_2 - I_C \left(1 + \frac{C_L}{C_1}\right) = 0$$

$$\underline{\underline{+ \frac{I_C}{C_1}} \quad \underline{\underline{\frac{C_L + C}{C_1}}}}$$