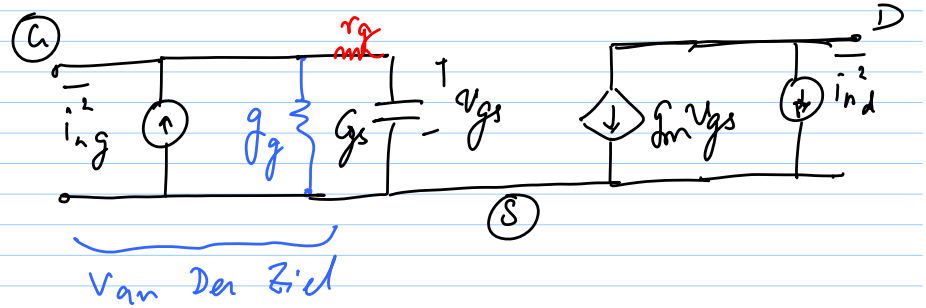
2-9-13

Lec 13

MOSFET 2-port noise parameters

* Refer to sections 12.2 of T. Lee's textbook



$$\overline{i_{ng}^2} = 4kT\delta g_g \Delta f$$

$$g_g = \frac{\omega^2 C_{gs}^2}{5 g_{do}} = \frac{\omega^2 C_{gs}}{5} \cdot \frac{C_{gs}}{g_m/\alpha}$$

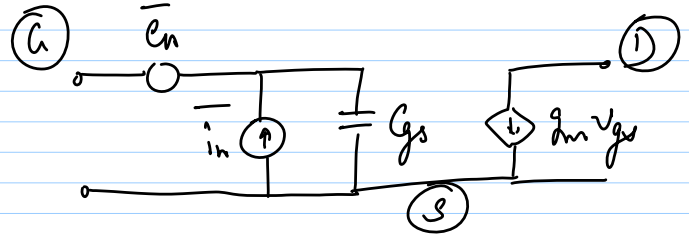
$$= \frac{\omega^2 C_{gs} \cdot \alpha}{5 v_T}$$

$\delta \equiv$ empirical value

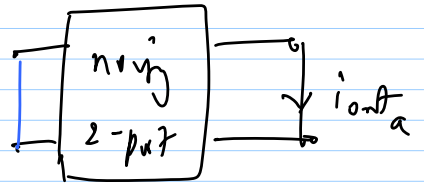
$\delta = 2\gamma$

* $$C \equiv \frac{\overline{i_{ng} \cdot i_{nd}^*}}{\sqrt{\overline{i_{ng}^2}}\sqrt{\overline{i_{nd}^2}}}$$

$= j\,0.395$ for a long-channel MOSFET

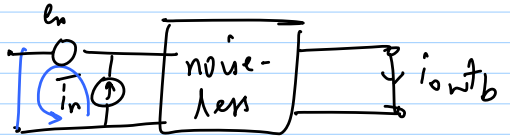


(a)



(||)

(b)

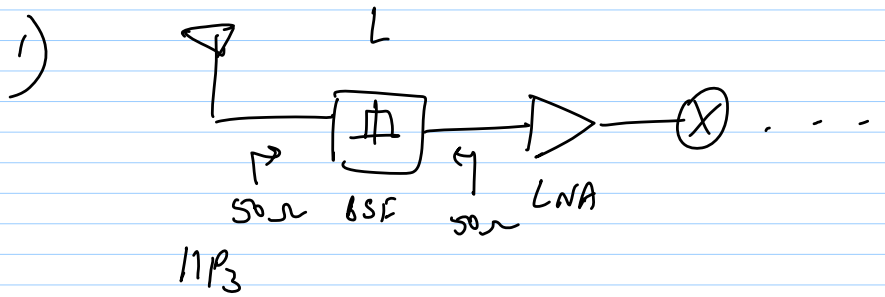


1) Input O.C.

2) " S.C.

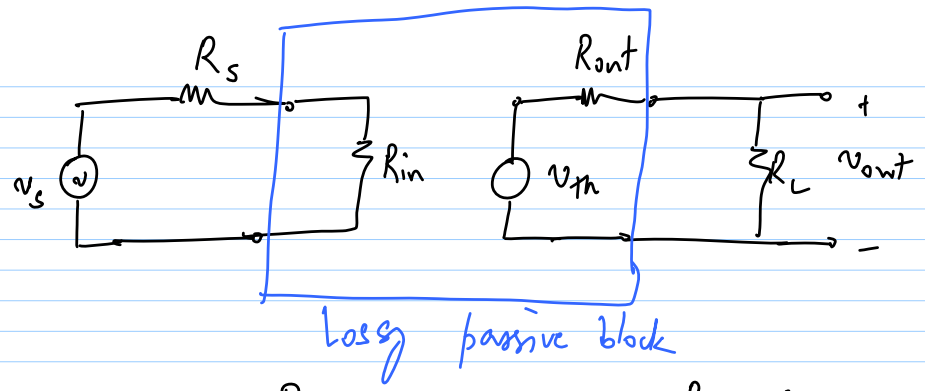
Noise Figure

1)



(1) SNR limited by frontend blocks

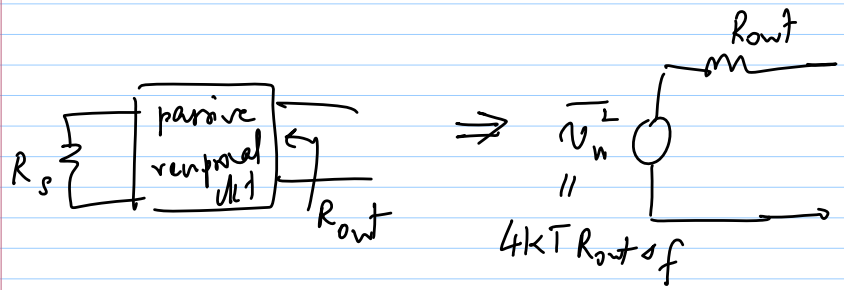
(2) NF of lossy passive block



$$L = \frac{P_{in}}{P_{out}} \qquad R_s = R_{in} \quad R_{out} = R_L$$

$$L|_{dB} = P_{in}|_{dB} - P_{out}|_{dB}$$

$$L = \frac{v_s^2/4R_s}{(v_{th}^2/4R_{out})} = \frac{v_s^2}{v_{th}^2} \cdot \frac{R_{out}}{R_s}$$



$$\frac{\overline{v_{n,out}^2}}{\Delta f} = 4kTR_{out}\left(\frac{R_L}{R_L+R_{out}}\right)^2$$

$$A_V = \frac{v_{th}}{v_s} \cdot \left(\frac{R_L}{R_L+R_{out}}\right)$$

$$F = \frac{\overline{v_{n,out}^2}}{\overline{v_{n_{R_s}}^2} \cdot A_V^2} = \frac{4kTR_{out}\left(\frac{R_L}{R_L+R_{out}}\right)^2}{4kTR_s \cdot \frac{v_{th}^2}{v_s^2} \cdot \left(\frac{R_L}{R_L+R_{out}}\right)^2}$$

$$= \frac{v_s^2}{v_{th}^2} \cdot \frac{R_{out}}{R_s} = L$$

$$\boxed{NF = L_{dB}}$$