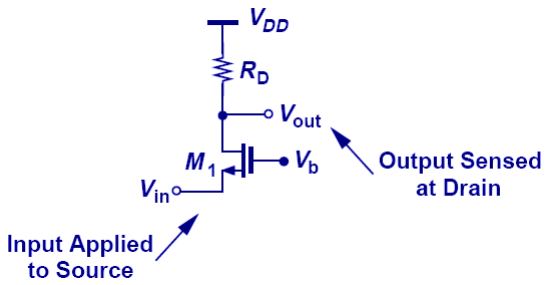
EE 530 Eletrônica Básica I

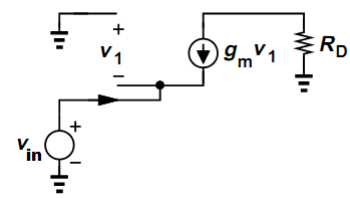
AMPLIFICADORES CMOS

Prof. Pedro Xavier

Porta comum



$$\lambda = 0$$
$$A_v = g_m R_D$$
$$|A_i| = 1$$



$$R_{in} = \frac{1}{g_m}$$
$$R_{out} = R_D$$

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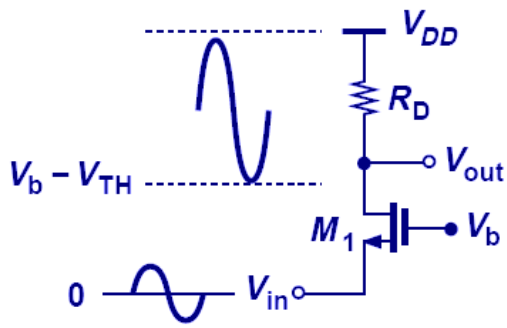
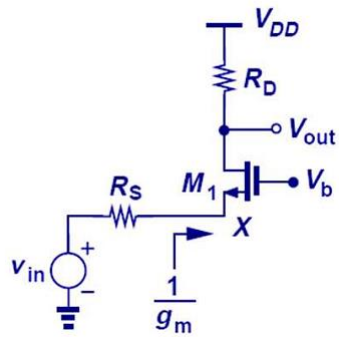
Porta comum

- Excursão do Sinal dentro da região de saturação



Porta comum com resistência de fonte



$$\lambda = 0$$

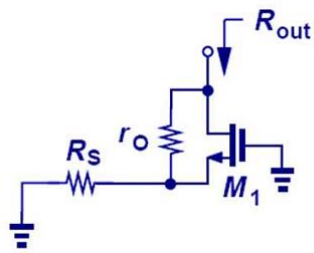
$$A_v = \frac{R_D}{\frac{1}{g_m} + R_S}$$

$$R_{in} = \frac{1}{g_m} + R_S$$

$$R_{out} = R_D$$

Porta comum com resistência de fonte (λ>0)

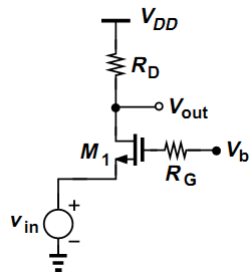
- Impedância de Saída



$$R_{out} = (1 + g_m r_O) R_S + r_O$$

Porta comum com resistência de gate

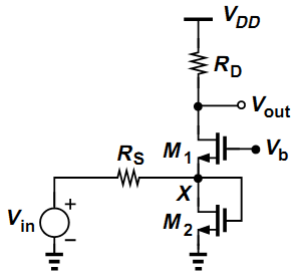
- Não passa corrente em RG, portanto o ganho e as impedâncias são os mesmos.



$$\lambda = 0$$
$$A_v = g_m R_D$$
$$|A_i| = 1$$

$$R_{in} = \frac{1}{g_m}$$
$$R_{out} = R_D$$

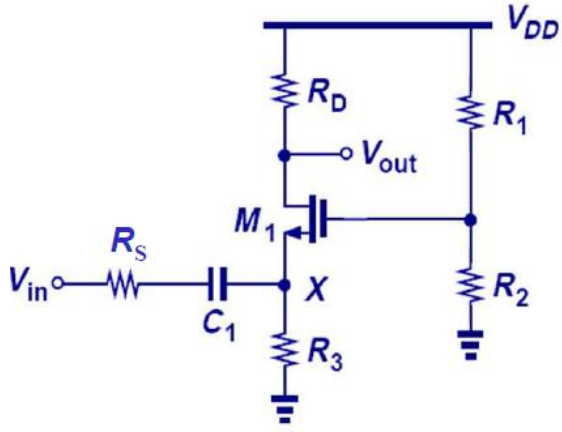
Exemplo 7.13 RAZAVI



A_v ?, λ=0

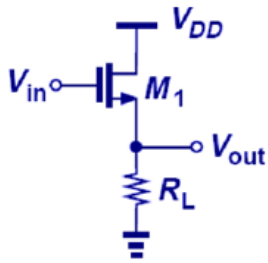
Z_{out}?, λ>0

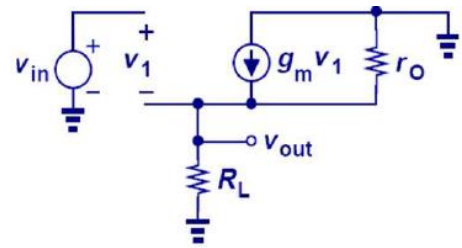
Porta Comum com polarização



$$\frac{v_{out}}{v_{in}} = \frac{R_3 \| (1/g_m)}{R_3 \| (1/g_m) + R_S} g_m R_D$$

Seguidor de Fonte (Dreno comum)





$$\lambda > 0$$

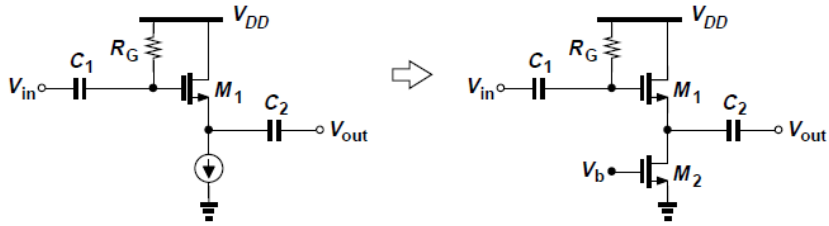
$$A_v = \frac{r_o \,//\, R_L}{\frac{1}{g_m} + r_o \,//\, R_L}$$

$$R_{in} = \infty$$

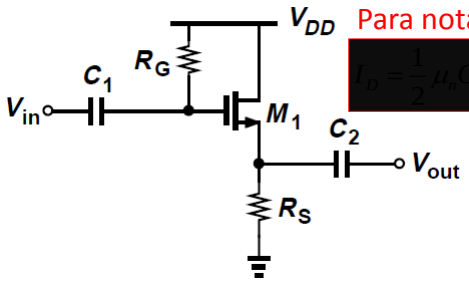
$$R_{out} = R_L \,//\, r_o \,//\, 1/g_m$$

Seguidor de Fonte com Carga Ativa

- Como I_D varia com V_{DD}, em Cis o transistor é polarizado com fonte de corrente.

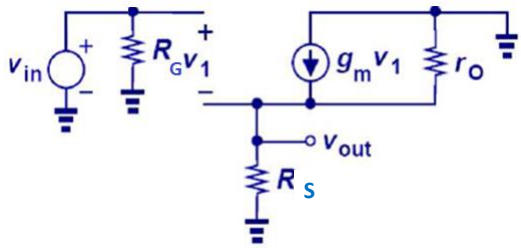


Seguidor de Fonte com Polarização



Para nota: encontre I_D e A_v

$$I_D = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}(V_{DD} - R_S I_D - V_{TH})^2[1+\lambda(V_{DD} - R_S I_D)]$$

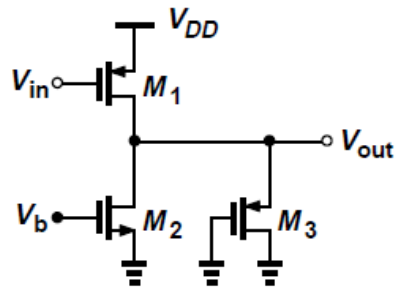


$$R_{in} = R_G$$

$$R_{out} = R_s \,//\, r_o \,//\, 1/g_m$$

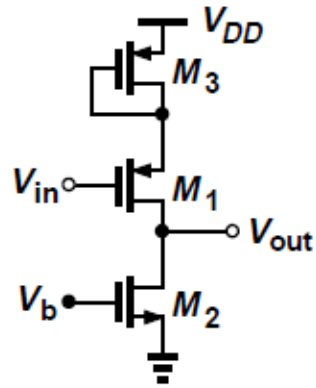
Exemplo 7.19 RAZAVI

- R_{out} e A_v? (λ>0)



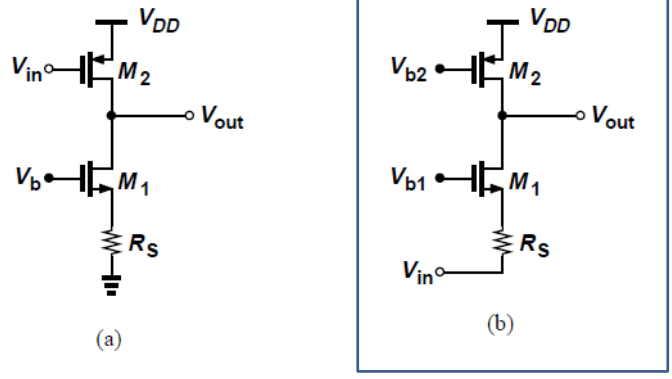
Exemplo 7.20 RAZAVI

- A_v? (λ_1=0)



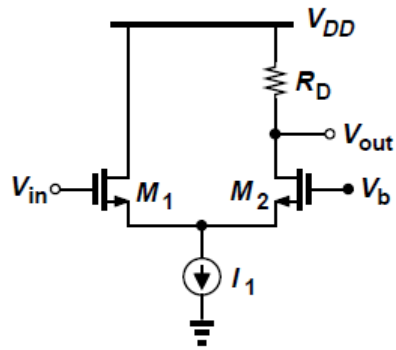
Exemplo 7.21 RAZAVI

- A_v?



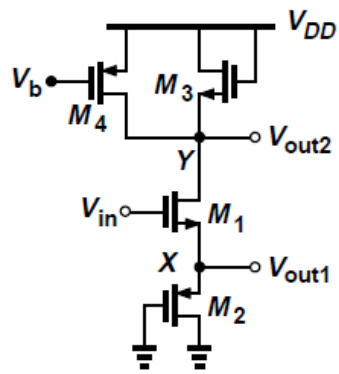
Exemplo 7.22 RAZAVI

- A_v? (λ=0)



Exemplo 7.23 RAZAVI

- A_v? (λ1=0)



Fontes de figuras da aula

- Aula do prof. Fabiano Fruett
- Fundamentos de Microeletrônica (Razavi)
- Microeletrônica (Sedra)

Sugestão de estudo

- Razavi, cap. 7
- Sedra/Smith cap. 5 seções 5.4 até 5.6
  - Exemplos, exercícios e problemas correspondentes

Para saber mais:

Paul R. Gray e Robert G. Meyer, Analysis and Design of Analog integrated Circuits, John Wiley & Sons

T. Tsividis, Design considerations in single-chanel MOS analog integrated circuits – A tutorial", IEEE JSSC SC 13, pp 383-391, junho de 1978