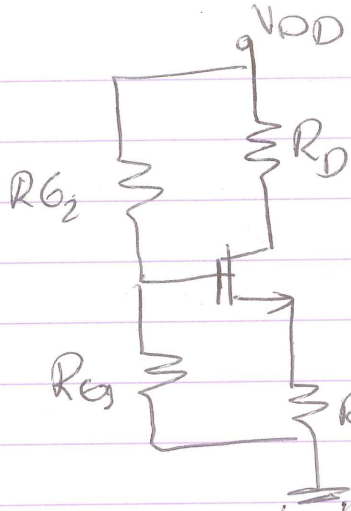
~~$R_{G2} = 22M\Omega$~~



$V_{RD} = 0,25 . V_{DD}$; $V_{RS} = 0,05 V_{DD}$

$I_D = 2,0mA$; $k_n\left(\frac{W}{L}\right) = 1mA/V^2$

$R_{G2} = 2.R_{G1}$ $V_t = 2,0V$

$V_{DD} = 18V$

$V_{RS} = 0,06 . V_{DD}$

$V_{RD} = 0,3 . V_{DD}$

- $V_{DD} = 18V / I_D = 2mA$

$V_{RD} = 4,5V \rightarrow R_D = 2,25k$

$V_{RS} = 0,9V \rightarrow R_S = 450\Omega$

- $V_{DD} = 15V / I_D = $ ~~$2,5mA$~~ $2mA$

$V_{RD} = $ ~~$4,75V$~~ $\rightarrow R_D = 2,25K$

$V_{RS} = $ ~~$0,95V$~~ $\rightarrow R_S = $ ~~$450K$~~

$V_{DD} = V_{DS} + 2,7K . 2m$

15

$V_{DS} = 9,6V = 0,64 V_{DD}$

$0,06$

$0,3$

0

$I_D = \frac{k_n}{2}\left(\frac{W}{L}\right)(V_{GS} - V_t)^2$

$V_{GS} = \sqrt{\frac{2 I_D}{k_n'(W/L)}} + V_t$

$= 2 + 2 = 4V$

$V_{GS} = 4V = V_G - 0,9$

$V_G = 4 + 0,9V = 4,9V$

$V_G = \frac{R_{G1}}{R_{G1} + R_{G2}} . V_{DD}$

- P/ $R_{G2} = $ ~~$10M\Omega$~~

$4,9 . R_{G1} + 49 = R_{G1} . V_{DD}$

$R_{G1} = \frac{49}{V_{DD} - 4,9}$ → $R_{G1} = 3,7m\Omega$ ($V_{DD} = 18V$) → $R_{G1} = 4,8M\Omega$ ($V_{DD} = 15V$)

$4,9 (R_{G1} + R_{G2}) = R_{G1} . V_{DD}$

$R_{G2} = 50M\Omega$

$4,9 . 50 = R_{G1} . (V_{DD} - 4,9)$

$R_{G1} = \frac{4,9 . 50}{V_{DD} - 4,9} = \frac{245}{V_{DD} - 4,9}$ → $V_{DD} = 18V$ ⊙ $\frac{15}{2.10^{-7}} = 75M\Omega$

$\frac{2,0m}{10^4} = 2,0 . 10^{-7}$

$\frac{18}{2.10^{-7}} = 90M\Omega$

$R_{G1} + R_{G2} = 90M\Omega$

$$I = I_{RG1} = I_{RG2} = \frac{I_D}{10000}$$

P/ $V_{DD} = 18V$
$R_{G1} + R_{G2} = 90M$

$$4,9 = \frac{R_{G1}}{90M} \cdot 18$$

$$\begin{cases} R_{G1} = 24,5M\Omega \\ R_{G2} = 65,5M\Omega \end{cases}$$

P/ $V_{DD} = 15V$
$R_{G1} + R_{G2} = 75M$

$$4,9 = \frac{R_{G1}}{75M} \cdot 15$$

$$\begin{cases} R_{G1} = 24,5M\Omega \\ R_{G2} = 50,5M\Omega \end{cases}$$

$$g_m = \frac{\partial I_D}{\partial V_{GS} - V_t} \qquad I_D = \frac{k_n'}{2}\left(\frac{W}{L}\right)(V_{GS} - V_t)^2$$

$$\frac{\partial I_D}{\partial V_{GS}} = k_n'\left(\frac{W}{L}\right)(V_{GS} - V_t)\frac{2(V_{GS} - V_t)}{2(V_{GS} - V_t)}$$

$$g_m = \frac{2I_D}{V_{GS} - V_t} = \frac{2 \cdot 2m}{2} = 2mA/V$$

$$A_V = -2m\left(\frac{2,25k \,||\, 100k}{102,25k}\right) = -4,4$$

EQ.2

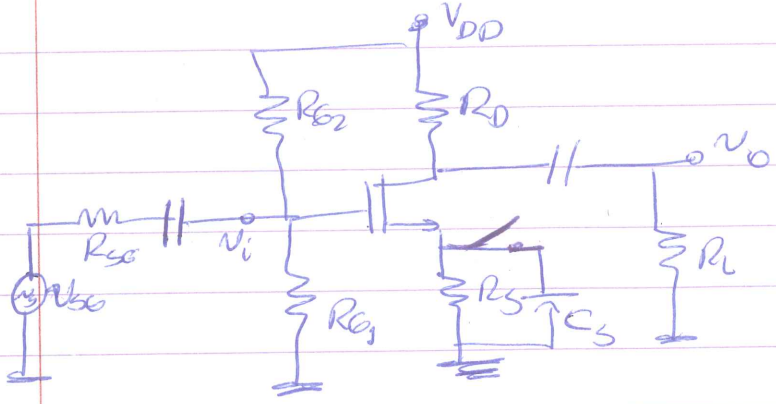
- $I_D = \frac{k_n'}{2}\left(\frac{W}{L}\right)(V_{GS} - V_t)^2 \Rightarrow \boxed{V_{GS}}$
- $V_{RD} \in I_D \Rightarrow R_D$
- $V_{RS} \in I_D \Rightarrow R_S$
- $V_S = V_{RS} \in V_{GS} = V_G - V_S \Rightarrow V_G \in V_G = \frac{R_{G1}}{R_{G1}+R_{G2}} \cdot V_{DD}$
- $I = I(RG1) = I(RG2) = I_D/10^4$
  $I(R_{G1} + R_{G2}) = V_{DD}$

$$\boxed{g_m = \frac{2I_D}{V_{GS} - V_t}}$$

Ex. 1

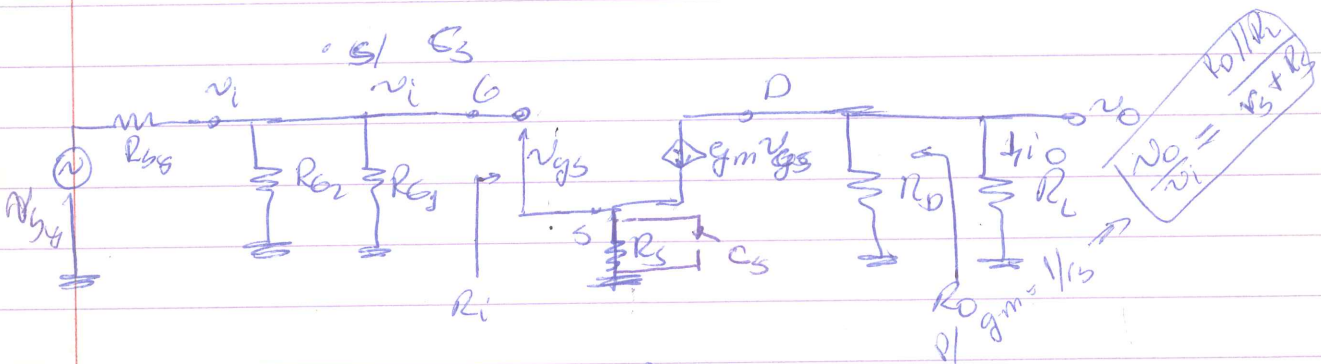
- $|V_{DS}| \leq |V_{GS}| - |V_t| \rightarrow$ TRIODO
- $|V_{DS}| \geq |V_{GS}| - |V_t| \rightarrow$ SATURAÇÃO
- $|V_{GS}| \leq |V_t| \rightarrow$ CORTE

• FONTE COMUM



$A_i = \frac{i_O}{i_i}$ (curto na saída)

• s/ C_S



$v_o = -g_m v_{gs} \cdot (R_D // R_L)$

$v_i - v_{gs} = g_m v_{gs} \cdot R_S$

$\left.\begin{array}{l} \\ \text{s/ } C_S \end{array}\right] \frac{v_o}{v_i} = \frac{-g_m (R_D // R_L)}{1 + g_m R_S}$

$v_i = v_{gs} + g_m v_{gs} \cdot R_S = (1 + g_m R_S) v_{gs}$

s/ C_S $\Rightarrow$ $v_i = v_{gs} + 0$ $\quad \frac{v_o}{v_i} = \frac{-g_m (R_D // R_L)}{1}$

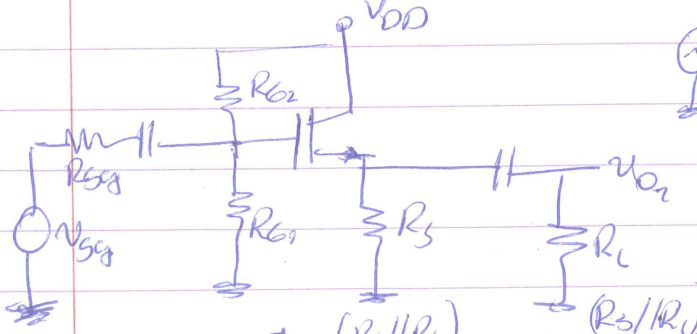
$A_V = \frac{v_o}{v_i} \cdot \frac{v_i}{v_{sg}}$

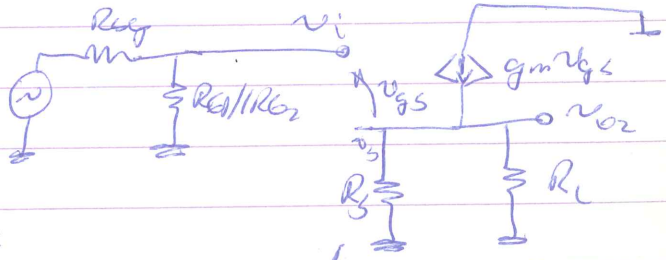
$A_V = \frac{R_{G1} // R_{G2}}{R_{sg} + R_{G1} // R_{G2}} \cdot \left[\frac{-g_m (R_D // R_L)}{1 + g_m R_S}\right]$

$R_i \equiv \frac{v_i}{i_i} \cong R_{G1} // R_{G2}$

$R_O = R_D$ ou $R_O = R_D // r_o$

• DRENO COMUM:

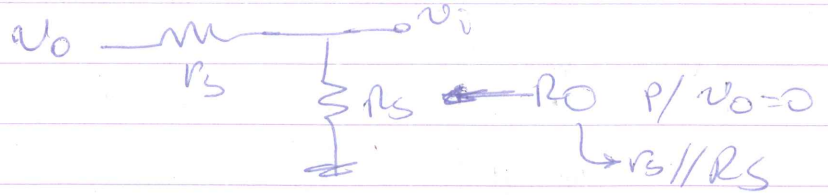




$v_{O2} = g_m v_{gs} (R_S // R_L)$

$\frac{v_{O2}}{v_i} = \frac{g_m (R_S // R_L)}{1 + g_m (R_S // R_L)} = \frac{(R_S // R_L)}{\frac{1}{g_m} + (R_S // R_L)}$

$v_i = v_{gs} + g_m v_{gs} (R_S // R_L)$



$$R_i = \frac{v_i}{i_i \to 0} \simeq \infty \cong R_{G3} // R_{G2}$$

$V_D = V_{GS} - V_t \rightarrow V_D = -R_S \cdot I_D - V_t \rightarrow \boxed{V_S = V_D + V_t}$

$\boxed{V_S = -(V_D + V_t) < 0}$

$V_{DD} - V_D = R_D \cdot I_D$

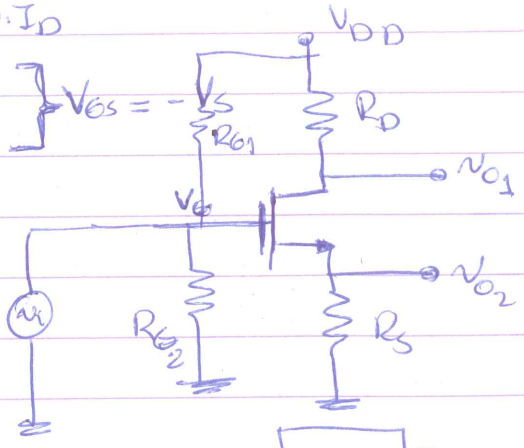
$V_S = R_S \cdot I_D$

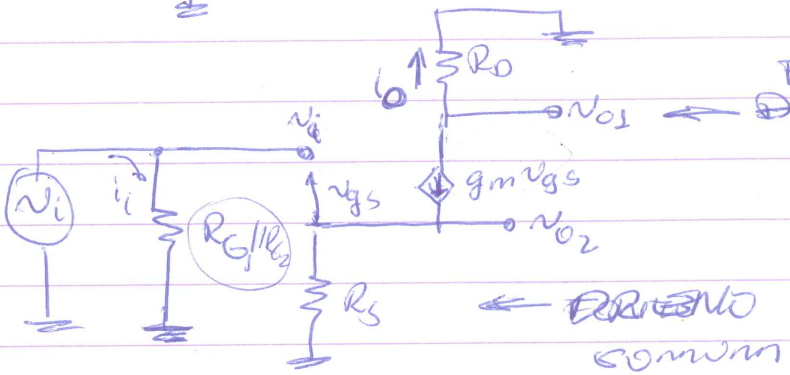
$V_G = 0$

$V_{GS} = -V_S$

$I_D = \frac{-V_{GS}}{R_S}$

$V_G - V_S = R_G \cdot I_G$





FONTE COMUM:

$v_{O1} = -g_m v_{gs} \cdot R_D$

$v_i = v_{gs} + R_S \cdot i_D = v_{gs} + g_m v_{gs} \cdot R_S$

$$\boxed{\frac{v_{O1}}{v_i} = \frac{(-g_m R_D) \cdot v_{gs}}{(1 + g_m R_S) \cdot v_{gs}} \simeq -\frac{R_D}{R_S}} \quad (p/\ g_m R_S \gg 1)$$

DRENO COMUM:

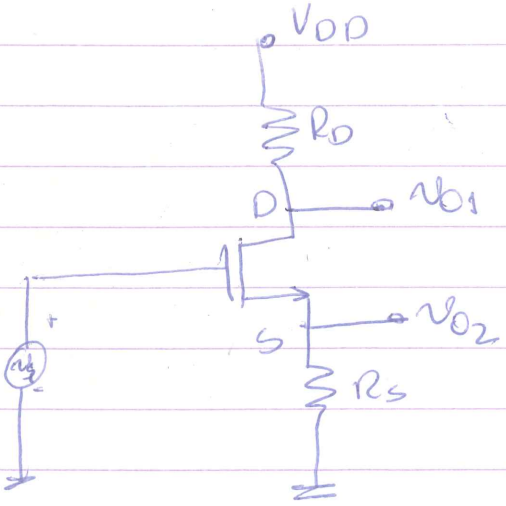
$v_{O2} = g_m v_{gs} \cdot R_S$

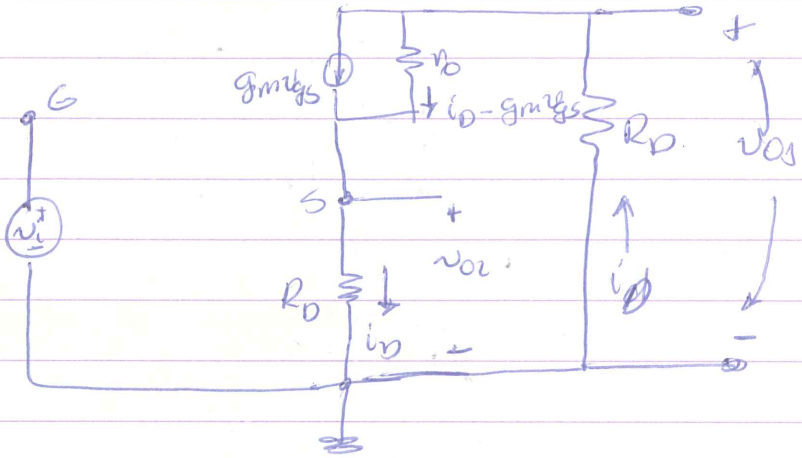
$v_{gs} = v_i - R_S \cdot i_D \Rightarrow v_i = (1 + g_m R_S) \cdot v_{gs}$

$$\boxed{\frac{v_{O2}}{v_i} = \frac{g_m R_S}{1 + g_m R_S} \simeq 1} \quad (p/\ g_m R_S \gg 1)$$

$R_O = R_S \ (p/\ \lambda \simeq 0)$ ou $R_O = R_S // r_O$

$R_{in} = R_G // R_{G2} = \frac{v_i}{i_i}$

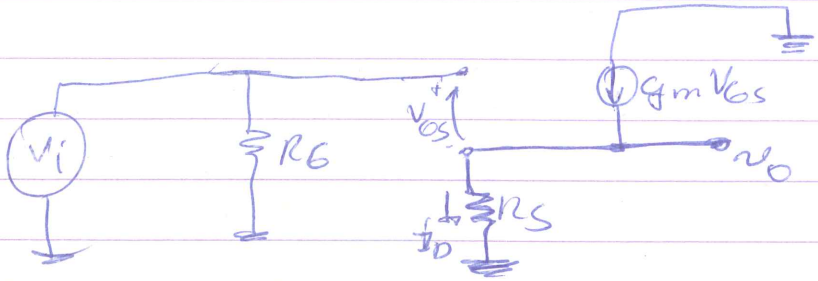




$$\cdot\ i_D \cdot R_D + r_o\left(i_D - g_m v_{gs}\right) R_D + i_D \cdot R_S = 0$$

$$\cdot\ v_{gs} = v_i - i_D \cdot R_S$$

$$i_D = \frac{v_i - g_m \cdot r_o}{}$$



$$v_o = g_m v_{gs} \cdot R_S \qquad v_{GS} = v_i - v_o = v_i - g_m v_{gs} \cdot R_S$$

$$v_i = (1 + g_m \cdot R_S) \cdot v_{GS}$$

$$\boxed{\frac{v_o}{v_i} = \frac{g_m R_S}{1 + g_m R_S}}$$