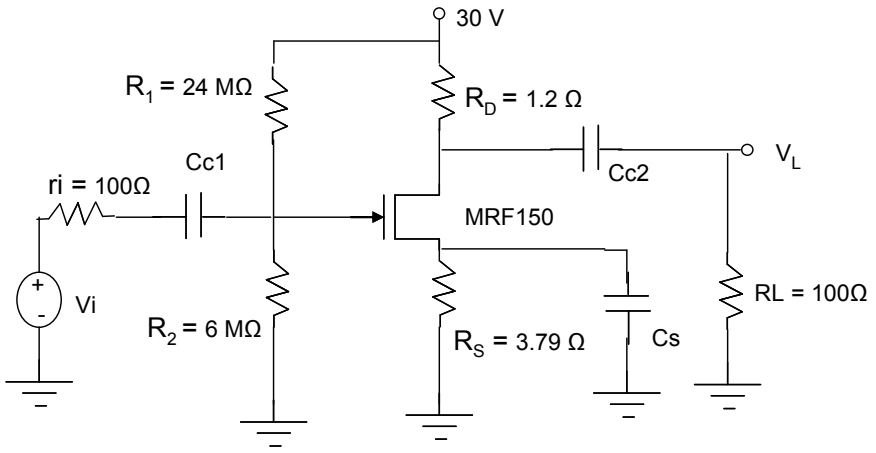
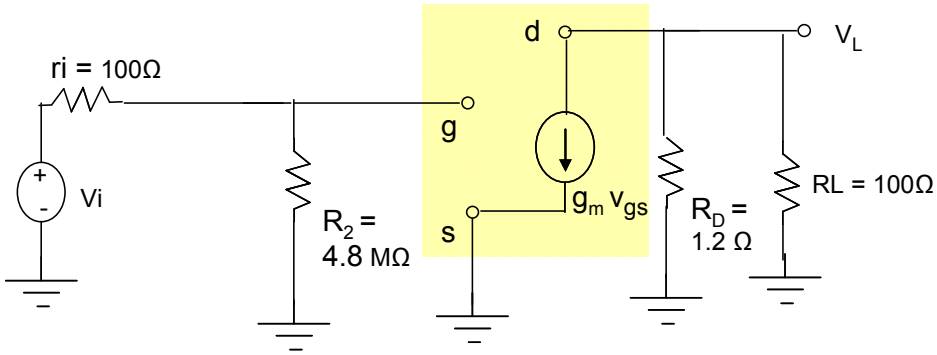
Pequeña Señal con MosFET



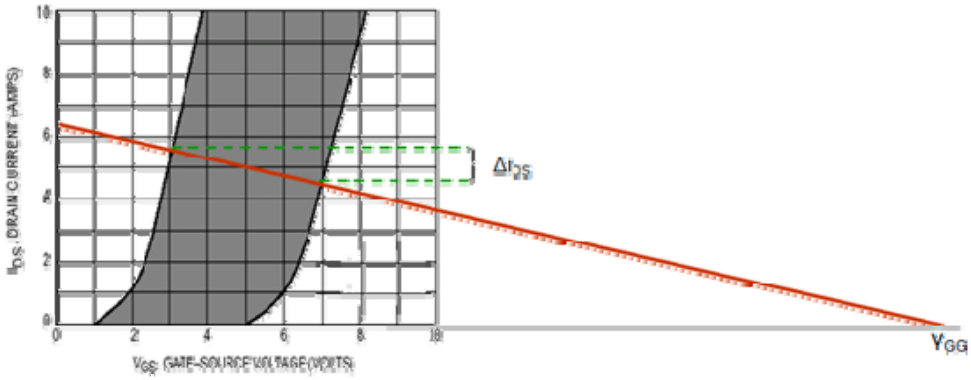
$i_{DS} = k_n (v_{GS} - V_{TN})^2$

$k_n = 1.25\ A/V^2$, $v_{TN} = 1\ V$ → $i_{DS} = 5.5\ A$, $v_{GS} = 3.1\ V$

$k_n = 1.25\ A/V^2$, $v_{TN} = 5\ V$ → $i_{DS} = 4.5\ A$, $v_{GS} = 6.89\ V$



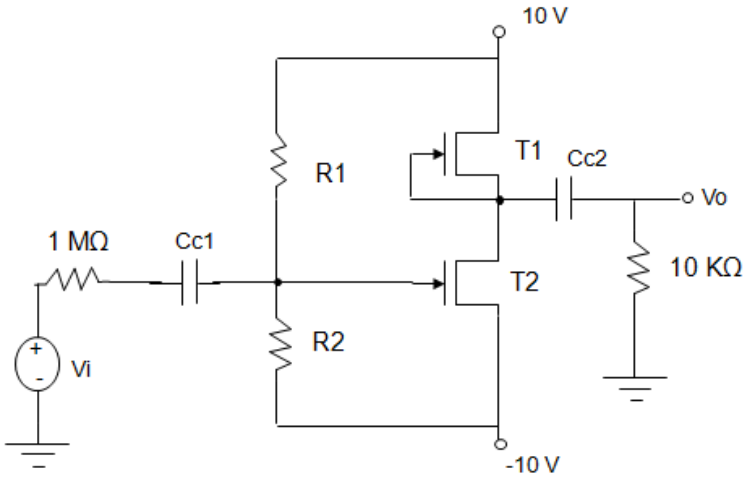
$i_{ds} = g_m v_{gs}$

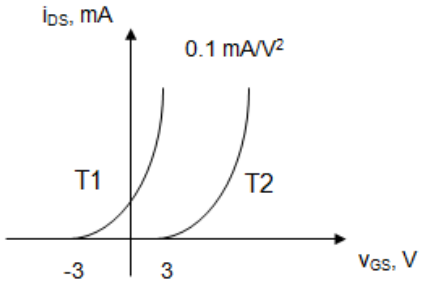


$$g_m = \left.\frac{di_{DS}}{dv_{DS}}\right|_Q \qquad g_m = \left.\frac{d[k_n(V_{GS}-V_{TN})^2]}{dv_{DS}}\right|_Q \qquad g_m = 2k_n(V_{GS}-V_{TN})|_Q$$

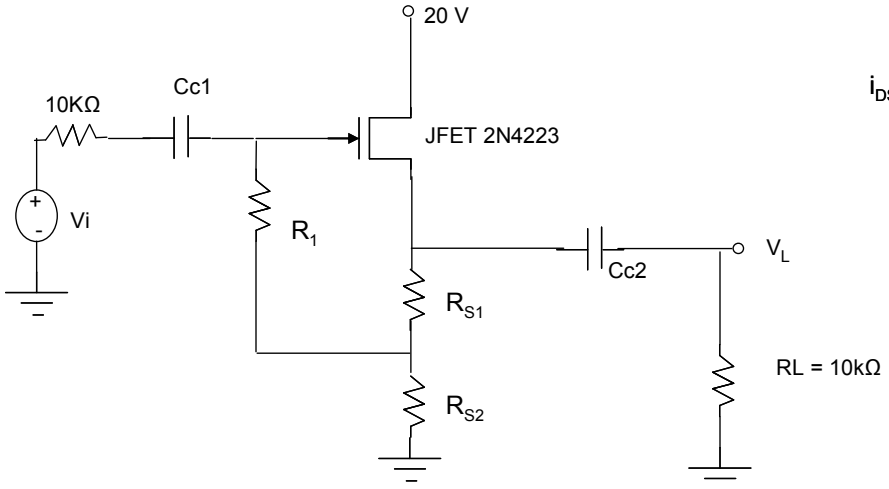
$$V_{GS} - V_{TN} = \sqrt{\frac{i_{DS}}{k_n}} \qquad g_m = 2k_n\sqrt{\frac{i_{DS_Q}}{k_n}} \qquad g_m = 2\sqrt{k_n i_{DS_Q}}$$

Tarea 9: Encuentre los valores de R1 y R2 y la ganancia de voltaje



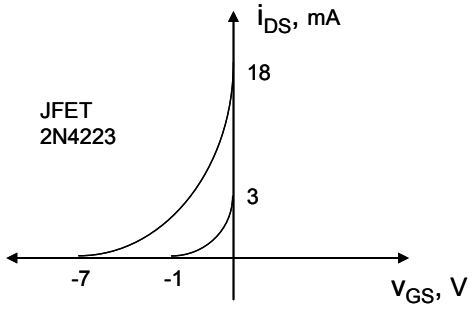


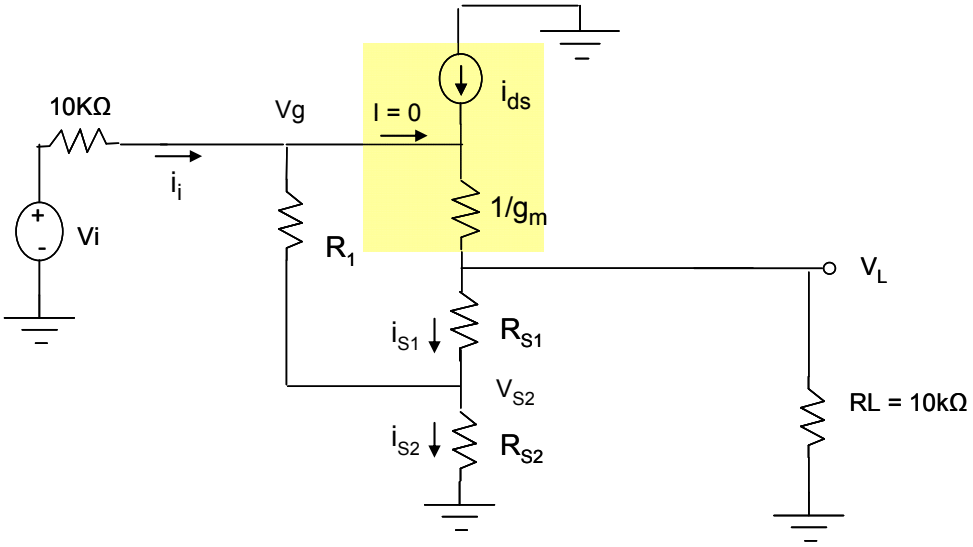
Pequeña Señal con JFET



$$i_{DS} = I_{P0}\left[1 + \frac{v_{GS}}{v_{P0}}\right]^2$$

Encuentre los valores de $\mathbf{R_1}$, $\mathbf{R_{S1}}$ y $\mathbf{R_{S2}}$ para lograr una ganancia de voltaje mayor a 0.8





Tarea 10: Demuestre que $g_m = \frac{2 I_{P0}}{V_{P0}} \sqrt{\frac{I_{DSQ}}{I_{P0}}}$

Av = VL/Vi = (VL/Vg) (Vg/Vi)

Vg/Vi:

$$i_i = \frac{Vi - Vg}{10K\Omega} \qquad i_i = \frac{Vg - V_{S2}}{R_1}$$

$$\longrightarrow \quad \frac{Vi - Vg}{10K\Omega} = \frac{Vg - V_{S2}}{R_1} \quad \longrightarrow \quad Vi - Vg = \frac{10K\Omega}{R_1}\,(Vg - V_{S2}) \quad \longrightarrow$$

Si $R_1 >> 10K\Omega$ → $Vi \approx Vg$

$R_1 = 100M\Omega$

VL/Vg:

$$i_{S1} = \frac{V_L - V_{S2}}{R_{S1}} \qquad i_{S2} = \frac{V_{S2}}{R_{S2}}$$

$$i_{S2} = i_i + i_{S1} \quad \longrightarrow \quad \frac{V_{S2}}{R_{S2}} = \frac{Vg - V_{S2}}{R_1} + \frac{V_L - V_{S2}}{R_{S1}}$$

$$i_i = \frac{Vg - V_{S2}}{R_1}$$

$$R_{S1}\,R_1 V_{S2} = R_{S1}\,R_{S2} Vg - R_{S1}\,R_{S2}\,V_{S2} + R_1\,R_{S2}\,V_L - R_1\,R_{S2}\,V_{S2}$$

$$V_{S2} = \frac{R_1\,R_{S2}\,V_L + R_{S1}\,R_{S2} Vg}{R_1\,R_{S2} + R_{S1}\,R_1 + R_{S1}\,R_{S2}}$$

$$V_{S2} = \frac{R_1\,R_{S2}\,V_L}{R_1\,(R_{S2} + R_{S1}) + R_{S1}\,R_{S2}} + \frac{R_{S1}\,R_{S2} Vg}{R_1\,(R_{S2} + R_{S1}) + R_{S1}\,R_{S2}}$$

$$V_{S2} = \frac{R_{S2}\,V_L}{(R_{S2} + R_{S1}) + \cancel{\frac{R_{S1}\,R_{S2}}{R_1}}\,0} + \frac{\cancel{R_{S1}\,R_{S2}}\,0}{\cancel{R_1}} \cdot \frac{Vg}{(R_{S2} + R_{S1}) - \frac{R_{S1}\,R_{S2}}{R_1}}$$

Si $R_1 >> R_{S1}\,R_{S2}$

$$V_{S2} \approx \frac{R_{S2}\,V_L}{(R_{S2} + R_{S1})}$$

$$i_{S1} = \frac{V_L}{R_{S1}} - \frac{V_{S2}}{R_{S1}} \longrightarrow i_{S1} = \frac{V_L}{R_{S1}} - \frac{R_{S2}\,V_L}{R_{S1}\,(R_{S2} + R_{S1})}$$

$$i_{S1} = \frac{\cancel{R_{S1}}\,(R_{S2} + R_{S1})\,V_L - \cancel{R_{S1}}\,R_{S2}\,V_L}{\cancel{R_{S1}}\,R_{S1}\,(R_{S2} + R_{S1})} = \frac{\cancel{R_{S1}}\,V_L}{\cancel{R_{S1}}\,(R_{S2} + R_{S1})} = \frac{V_L}{R_{S2} + R_{S1}}$$

$$R_S = R_{S2} + R_{S1}$$

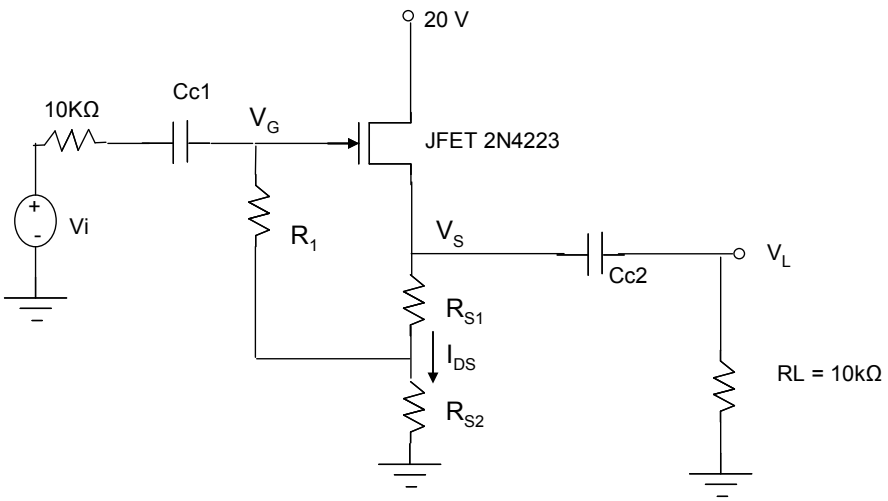
$$i_{S1} = \frac{V_L}{R_S}$$

$$i_{ds} = g_m(V_g - V_L) \qquad i_{ds} = i_L + i_{S1} \longrightarrow g_m(V_g - V_L) = \frac{V_L}{R_L} + \frac{V_L}{R_S}$$

$$i_L = \frac{V_L}{R_L} \qquad g_m V_g = \frac{V_L}{R_L // R_S} + g_m\,V_L \qquad \frac{V_L}{V_g} = \frac{g_m\,R_L // R_S}{1 + g_m\,R_L // R_S}$$

$$\frac{V_L}{V_i} \approx \frac{g_m\,R_L // R_S}{1 + g_m\,R_L // R_S} > 0.8$$

$$\frac{2\,I_{P0}}{v_{P0}}\sqrt{\frac{I_{DSQ}}{I_{P0}}} = g_m > \frac{4}{R_L // R_S} \qquad I_{DSQ} > \frac{4\,v_{P0}^2}{I_{P0}(R_L // R_S)^2}$$



$V_G = I_{DS} R_{S2}$

$V_S = I_{DS} R_{S1} + I_{DS} R_{S2}$

$V_{GS} = I_{DS} R_{S2} - (I_{DS} R_{S1} + I_{DS} R_{S2}) = - I_{DS} R_{S1}$

$V_{GS} = - I_{DS} R_{S1}$

$V_{DS} > V_{GS} + v_{P0}$
(Zona saturación)

$V_{DS} = 20 - I_{DS} R_S > V_{GS} + v_{P0}$

$V_{DS} = 20 - I_{DS} (R_{S2} + R_{S1}) > - I_{DS} R_{S1} + v_{P0}$

$20 - I_{DS} R_{S2} > v_{P0}$

$20 - v_{P0} > I_{DS} R_{S2}$

$20 - v_{P0} > I_{DS} R_{S2}$

RS1	RS2	RS1*RS2 (K)	RS
7750	250	1937.5	8000

Av max	Av min	ΔIDS (mA)
0.833	0.821	0.617