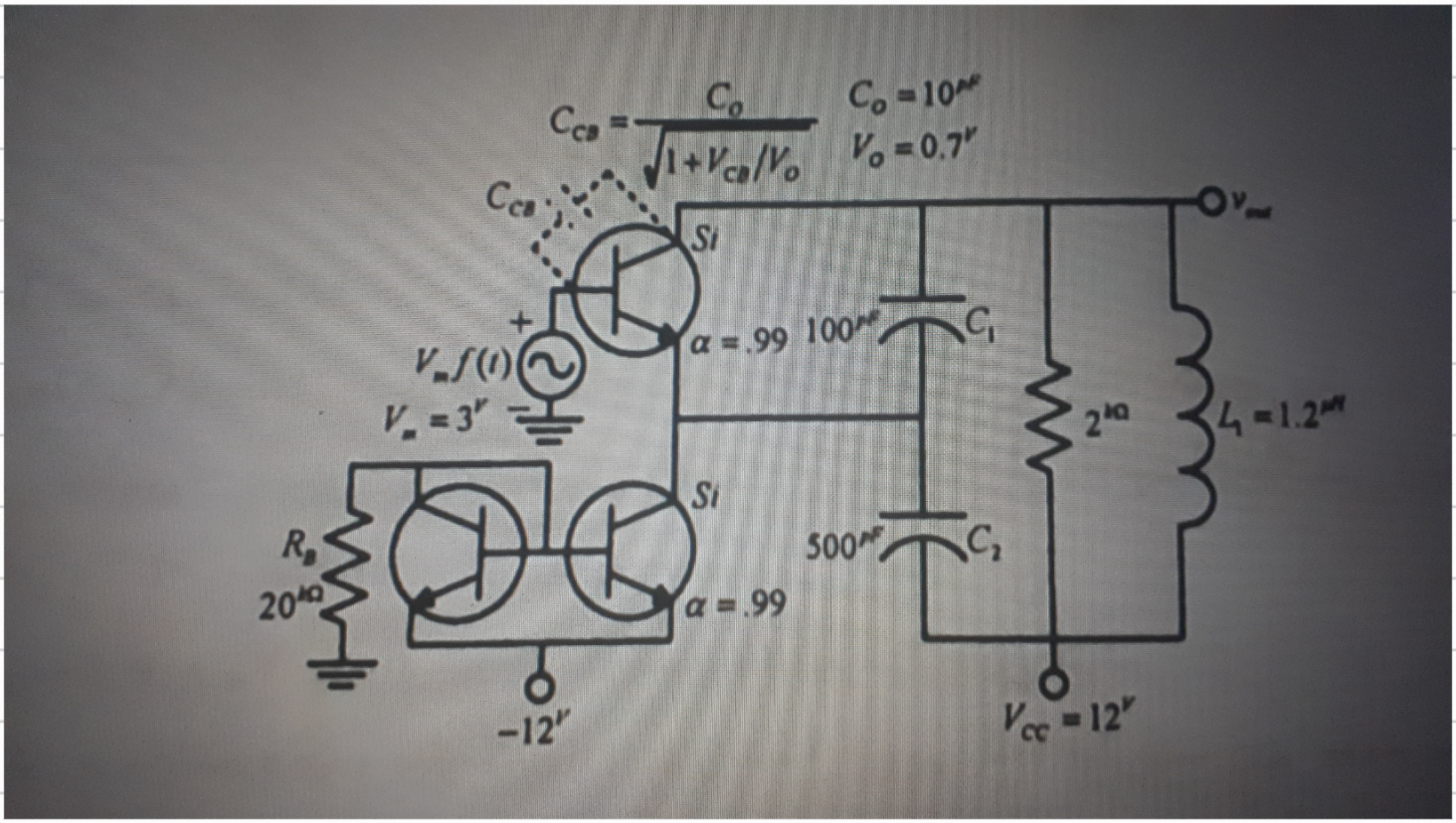


$$I_E = \frac{12-0.7}{(2-\alpha)\,20k\Omega} \approx \frac{11.3}{20k\Omega} = 0.565\,mA$$

(F-4

$$C_T = \frac{C_1 C_2}{C_1+C_2} + C_{CB} = 83.3\,pF + \frac{10pF}{\sqrt{1+V_{CB}/0.7}}$$

$$V_{CB} = V_C - V_B = V_{CC} - 3f(t)$$

$$C_T = 83.3pF + \frac{10pF}{\sqrt{1+\frac{12-3f(t)}{0.7}}} = 83.3pF + \frac{2.34\,pF}{\sqrt{1-0.23f(t)}}$$

$$\simeq 83.3pF + 2.34pF + \frac{0.23}{2} f(t) + \cdots$$

$$\omega(t) = \frac{1}{\sqrt{L C_T}} = \frac{1}{\sqrt{1.2\mu H\,(85.64 + 0.115f(t))}}$$

$$\omega(t) = \frac{1}{\sqrt{1.2\mu H \times 85.64\,pF}\ \sqrt{1 + 0.0013 f(t)}}$$

ω_0

$$\omega(t) = 9.864 \times 10^6 \left(1 - \frac{0.0013}{2} f(t) + \cdots\right)$$

$$= \underbrace{9.864 \times 10^6}_{\omega_0} - \underbrace{6.411 \times 10^3 f(t)}_{\Delta\omega}$$

ω_0 ← فرکانس مرکزی

$\Delta\omega$ ← انحراف فرکانس

$$G_m = \frac{G_L}{n(1 - n/\alpha)} = \frac{1/2k\Omega}{1/6(1 - 1/6)} = 3.6\ mS$$

$$g_m = \frac{I_C}{V_T} = \frac{0.565}{0.025} = 22.6\ mS$$

$$n = \frac{C_1}{C_1 + C_2} = \frac{100}{600} = 1/6$$

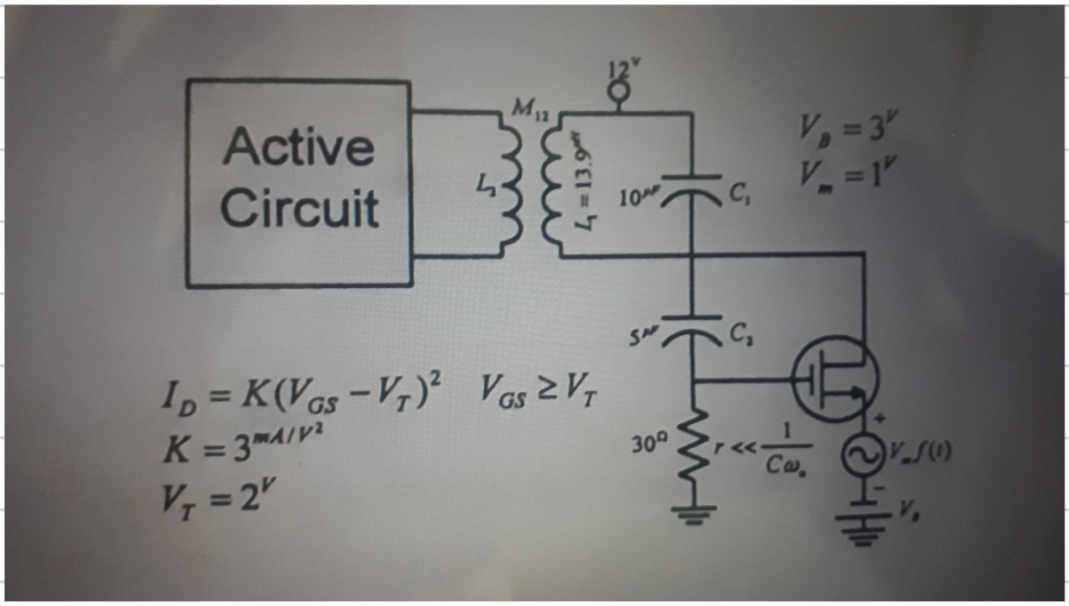
$\frac{G_m}{g_m} = 0.16$ ⟶ نمودار ⟶ $x \triangleq 13$

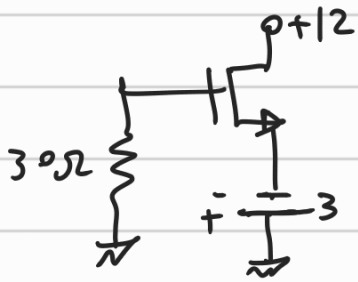
$\hookrightarrow V_i = V_T \cdot x = 0.325$ ولت

$V_o = 1/n \cdot V_i = 1.95$ volt دامنه موج خروجی

$$v_o(t) = 1.95 \cos\left(\omega_o + \Delta\omega \int f(\lambda) d\lambda\right)$$

۵-۷





$V_{GS} = 3 \rightarrow I_D = K(V_{GS} - V_T)^2$

$I_D = 3(3-2)^2 = 3mA$

$g_m(t) = 2K(V_{GS} - V_T) = 2 \times 3 \times (-V_m f(t) + V_B - 2)$

$= 6(1 - f(t))$

$v_{C_1} \simeq v_{C_2} \longrightarrow$ زیرا مقاومت r صرفنظری شود

$i_{C_2} = C_2 \frac{dv_{C_2}}{dt} \simeq C_2 \frac{dv_{C_1}}{dt}$

$v_r = i_{C_2} r = r C_2 \frac{dv_{C_1}}{dt}$

$i_D = g_m v_r = \underset{mS}{6}(1 - f(t)) r C_2 \frac{dv_{C_1}}{dt}$

$i_D = 6 \times 10^{-3} \times 30 \times 5 \times 10^{-12} (1 - f(t)) \, dv_{C_1}/dt$

خاصیت خازن متغیر

$$C_{tot} = C_1 + C(t)$$

$$C_{tot}(t) = 10pF + 0.9\,pF\,(1 - f(t))$$

$$f(t) = \frac{1}{2\pi\sqrt{L_1 C_{tot}(t)}} = \frac{1}{2\pi\sqrt{L_1 \times 10.9pF\left(1 - \frac{0.9 f(t)}{10.9}\right)}}$$

$$= \frac{1}{\underbrace{2\pi\sqrt{L_1 \times 10.9pF}}}\left(1 + \frac{0.9}{2\times 10.9} f(t) + \cdots\right)$$

$$f_0 = 15.92\,MHz = \frac{1}{2\pi\sqrt{L_1 \times 10.9pF}}$$

$$\Rightarrow L_1 = 9.17\,\mu H$$

$$\Delta f = f_0 \times \frac{0.9}{2\times 10.9}$$

انحراف فرکانس

صورت مسئله برای FET بوده است با پارامتر داده ولی درست

که با پارامترهای داده شده در شکل مسئله حل شد.

$$V_r = i C_2(t) \cdot r = C_2 r \frac{dV_2(t)}{dt} \simeq C_2 r \frac{dV_1(t)}{dt}$$

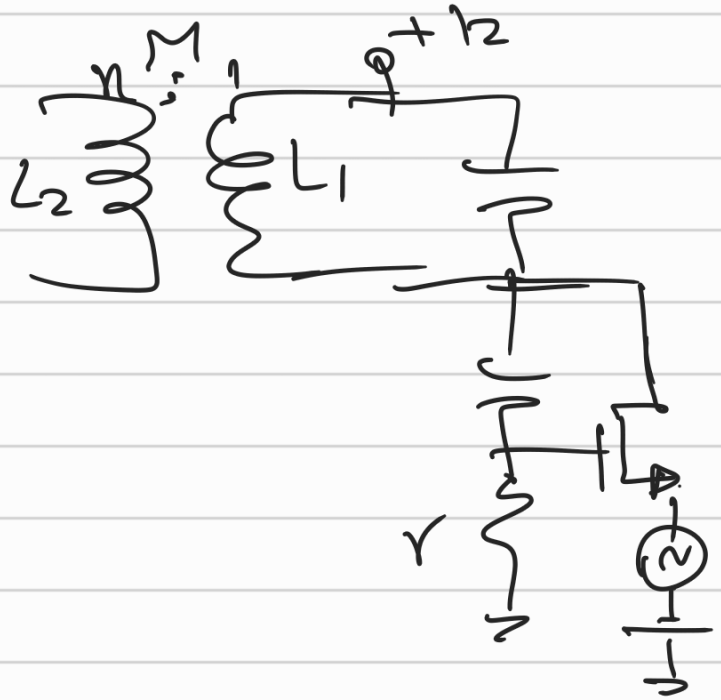
$$V_r = C_2 r j\omega(t) V_1$$

$$|V_r| \simeq |C_2 r \omega_0 V_1|$$

حداکثر مقدار

$$V_r = 5\times10^{-12} \times 30 \times 2\pi \times 15.92\times10^{6} \times 4$$

$$V_r = 6\ mVolt$$



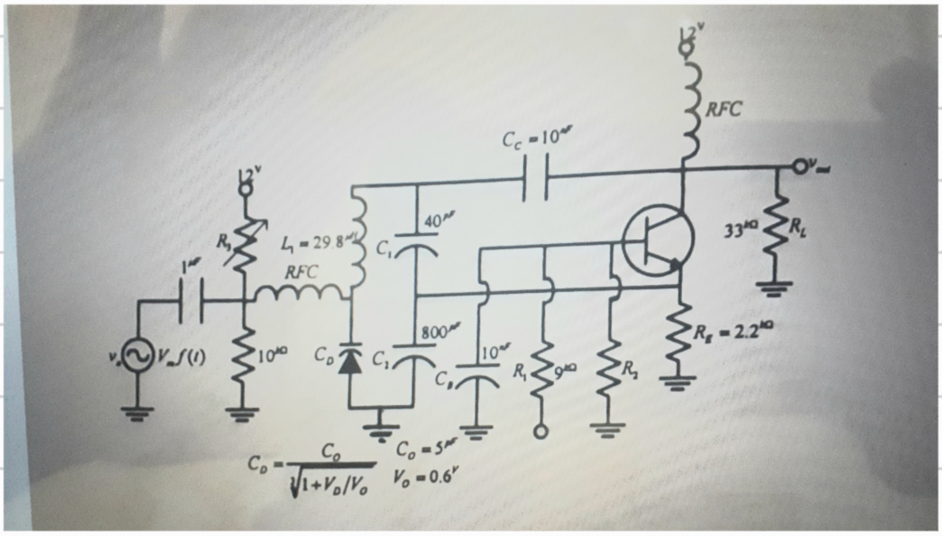
$$n = \frac{M}{L_1}$$

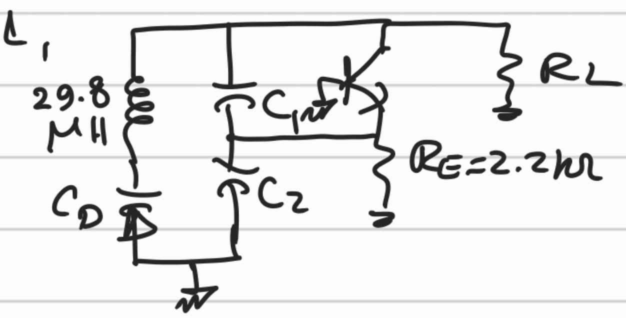
اگر بخواهیم ولتاژ دو طرف L_2 برابر 5Volt شود

$$n = \frac{V_2}{V_1} = \frac{5}{4} = 1.25$$

$$M = n L_1 = 1.25 \times 9.17\ \mu H$$

V-6





هدایت شبکه تشدید در فرکانس تشدید باید

می بایست شود.

$$j\frac{C_1C_2}{C_1+C_2}\omega_0 + \frac{1}{j\omega_0L_1 + \frac{1}{j\omega_0C_D}} = 0$$

$$j\frac{C_1C_2}{C_1+C_2}\omega_0 + \frac{j\omega_0C_D}{1-\omega_0^2L_1C_D} = 0$$

$$\frac{C_1C_2}{C_1+C_2} = \frac{C_D}{\omega_0^2L_1C_D - 1}$$

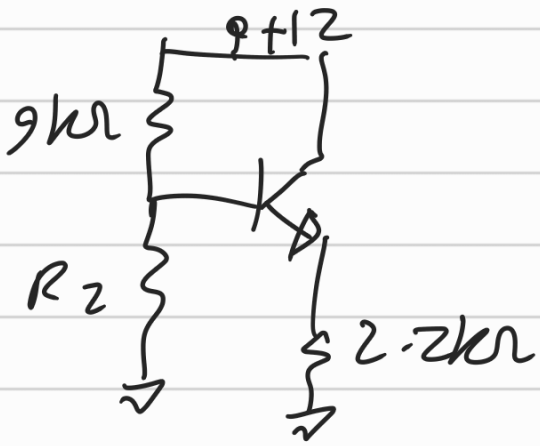
$$C_D = \frac{\frac{C_1C_2}{C_1+C_2}}{\frac{C_1C_2}{C_1+C_2}\omega_0^2L_1 - 1} = \frac{\frac{40\times 800}{840}\times 10^{-12}}{10^{-12}\frac{40\times 800}{840}\times(20\times 10^6\times 2\pi)^2\times 29.8\times 10^{-6} - 1}$$

$$C_D = 2.25\,pF$$

$$C_D = \frac{C_0}{\sqrt{1+V_D/V_0}} = \frac{5pF}{\sqrt{1+V_D/0.6}} = 2.25pF$$

$$V_D = 2.36 \text{ Volt}$$

$$V_D = \frac{12}{R_3+10k\Omega} \times 10k\Omega \rightarrow R_3 = 40.84k\Omega$$



$$\begin{cases} V_o = 11 \text{ Volt} \\ V_o = \frac{V_i}{n} \Rightarrow V_1 = 0.523 \end{cases} \qquad n = \frac{C_1}{C_1+C_2} = 0.0476$$

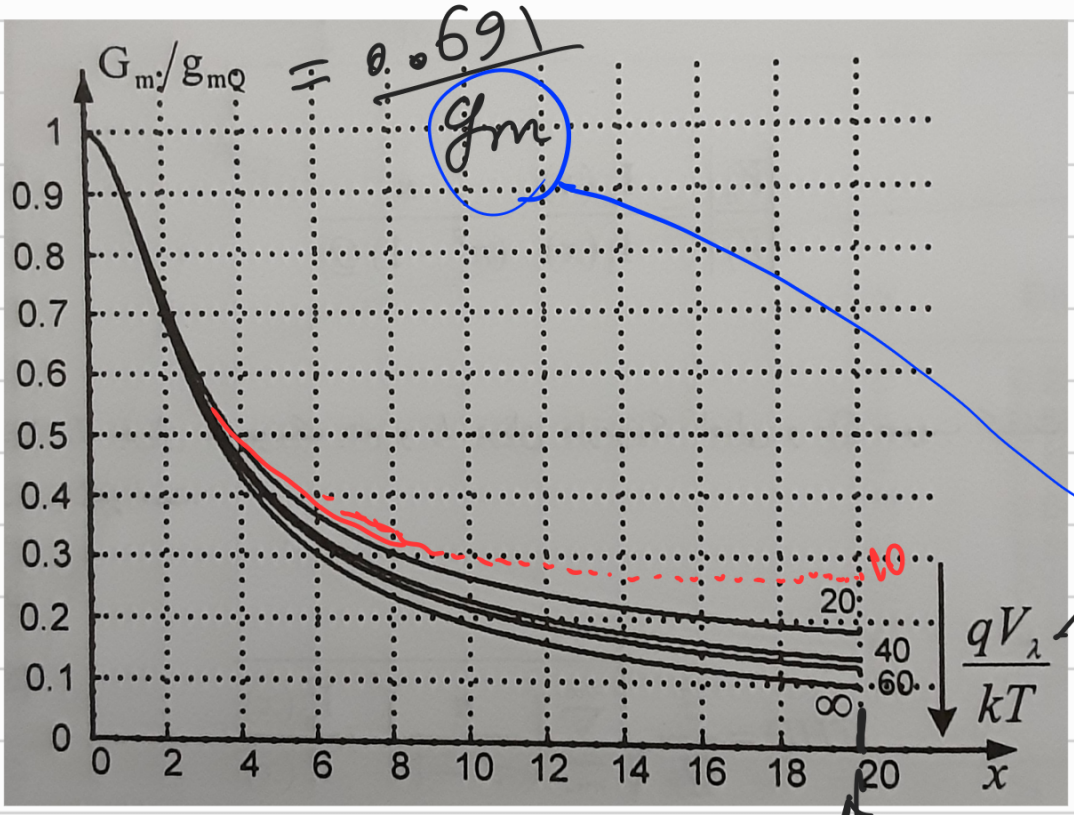
$$G_m = \frac{G_L + n^2 G_E}{n(1-n/\alpha)} = \frac{1/33 + 0.002267 \times 1/2.2}{0.0476\left(1-\frac{0.0476}{1}\right)}$$

$$G_m = 0.691$$

$$V_1 = x \cdot V_T \Rightarrow x = \frac{0.523}{0.025} = 20.92$$

$$V_\lambda = I_{EQ}(R_E + (1-\alpha)R_B) = I_{EQ} \cdot R_E \qquad (\alpha = 1)$$

$$g_m = \frac{\alpha I_{EQ}}{V_T} \rightarrow V_\lambda = g_m V_T R_E$$



$\frac{G_m}{g_{mQ}} = \frac{0.691}{g_m}$

$\frac{V_\lambda}{V_T} = g_m R_E$

$g_m = 5\ mS$

$x = 20.92$

$g_m = \frac{\alpha I_{EQ}}{V_T} \Rightarrow I_{EQ} = 0.025 \times 5 = 0.125\ mA$

$I_{EQ} = \frac{V_{th} - V_{BE}}{\frac{R_{Th}}{\beta+1} + R_E} \simeq \frac{\frac{12}{9+R_2} \times R_2 - 0.7}{2.2} = 0.125\ mA$

$R_2 = 0.796\ k\Omega$

$\frac{C_1 C_2}{C_1 + C_2} = \frac{C_D}{\omega^2 L_1 C_D - 1}$

$$\omega^2(t) = \frac{1 + \frac{C_1 C_2}{C_1 + C_2} \times \frac{1}{C_D}}{\frac{C_1 C_2}{C_1 + C_2} L_1}$$

$$\omega(t) = \frac{\sqrt{1 + \frac{C_1 C_2}{(C_1 + C_2) C_0} \times \sqrt{1 + \frac{V_D + V_m f(t)}{V_0}}}}{\sqrt{\frac{C_1 C_2}{C_1 + C_2} L_1}}$$

ω_0

$$\omega(t) = \frac{\sqrt{1 + \frac{C_1 C_2}{(C_1 + C_2) C_0} \sqrt{1 + \frac{V_D}{V_0}}} \times \sqrt{1 + \frac{V_m f(t)}{V_0 (1 + \frac{V_D}{V_0})}}}{\sqrt{\frac{C_1 C_2}{C_1 + C_2} L_1}}$$

$125.6 \times 10^6 \frac{\text{rad}}{\text{sec}}$

$\downarrow$

20MHz

$$\omega(t) = \omega_0 \cdot \sqrt[4]{1 + \frac{V_m f(t)}{V_0 (1 + \frac{V_D}{V_0})}}$$

$$\omega(t) \simeq \omega_0 \left(1 + \frac{V_m f(t)}{4 V_0 (1 + V_D / V_0)}\right)$$

$$\Delta\omega = \frac{\omega_0 V_m}{4 V_0 (1 + V_D / V_0)} = \frac{125.6 \times 10^6 \times V_m}{4 \times 0.6 \left(1 + \frac{2.36}{0.6}\right)} = 2\pi \times 150 \text{ KHz}$$

$$V_m = 0.088$$