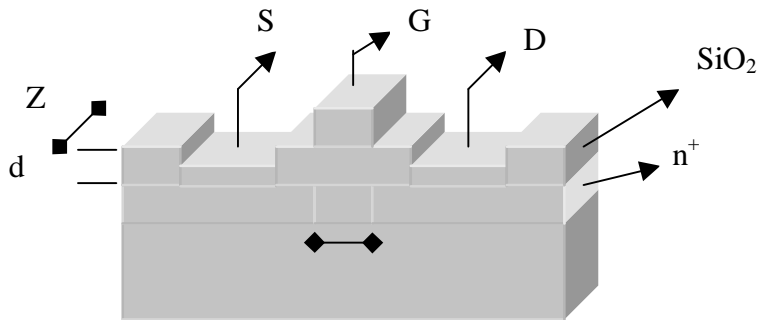


Perancangan Transistor MOSFET

Transistor yang akan dibuat memiliki Spesifikasi :

- transkonduktansi minimum 50 S
- tegangan breakdown 30 V

Gambar :



Asumsi $N_A = \text{doping substrat} = 4 \cdot 10^{16} \text{ cm}^{-3}$, maka untuk $d = 250 = 250 \cdot 10^{-8} \text{ cm}$ diperoleh $V_T = 0,45 \text{ V}$.

Dengan asumsi sambungan $n^+ - p$ abrupt junction maka $N_D = 100 \cdot N_A = 4 \cdot 10^{18} \text{ cm}^{-3}$.

$$V_{BR} = \frac{e_{Si} \cdot e_c^2}{2qN_A} \text{ dan } e_c = \sqrt{\frac{2V_{BR}qN_A}{e_{Si}}} \text{ dengan :}$$

$$q = 1,6 \cdot 10^{-19} \text{ C}$$

$$N_A = 4 \cdot 10^{16} \text{ cm}^{-3}$$

$$V_{BR} = 30 \text{ V}$$

$$\epsilon_{Si} = 11,9 \cdot 8,854 \cdot 10^{-14}$$

maka : $\epsilon_c = 6,04 \cdot 10^5 \text{ Vcm}^{-1}$

$$W_p = \frac{e_{Si} \cdot e_c}{q \cdot N_A} = \frac{11,9 \cdot 8,854 \cdot 10^{-14} \cdot 6,04 \cdot 10^5}{1,6 \cdot 10^{-19} \cdot 4 \cdot 10^{16}} = 1,28 \cdot 10^{-4} \text{ cm}$$

$$W_p = W_0 = \frac{N_A \cdot w_p}{N_D} = \frac{1}{100} \cdot 1,28 \cdot 10^{-4} = 1,28 \cdot 10^{-6} \text{ cm}$$

$$C_0 = \frac{e_{ov}}{d} = \frac{3,9 \cdot 8,854 \cdot 10^{-14}}{250 \cdot 10^{-8}} = 1,38 \cdot 10^{-7} \text{ F / cm}^2$$

$$C_0 = \frac{z}{L} \cdot m_r \cdot C_0 \cdot N_D = \frac{z}{L} \cdot m_r \cdot C_0 \cdot V_{BR} ; \text{ untuk Si maka } \lambda_r = 1450$$

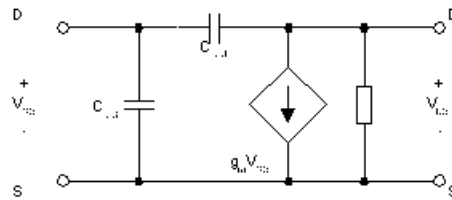
$$\frac{z}{L} = g_m \frac{1}{m_r \cdot C_0 \cdot V_{BR}}$$

Dari spesifikasi : $g_m = 50$

$$\frac{z}{L} = g_m \frac{1}{m_r \cdot C_0 \cdot V_{BR}} = \frac{50}{1450 \cdot 1,387 \cdot 10^{-7} \cdot 30} = 8,329 \text{ mm}^2$$

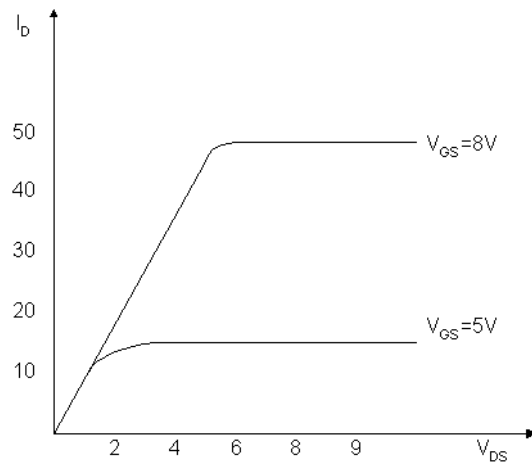
Dengan mengambil $z = 1 \cdot 10^{-4} \text{ cm}$ maka $L = 0,000012 \text{ cm} = 0,00012 \text{ m}$

Dengan menggunakan rangkaian pengganti small signal untuk frekuensi tinggi :



Grafik I_D - V_{DS} :

Kurva karakteristik frekuensi tinggi :



$$I_{IN} = j\omega(C_{GS} + C_{GD})V_{GS} = \omega \cdot C_0 \cdot Z_L \cdot V_{GS}$$

$$I_{OUT} = g_m \cdot V_{GS}$$

$$|Gain| = \left| \frac{I_{OUT}}{I_{IN}} \right| = \frac{g_m \cdot V_{GS}}{\omega \cdot C_0 \cdot Z_L \cdot V_{GS}} = \frac{g_m}{\omega \cdot C_0 \cdot Z_L}$$

$$Gain = \frac{50}{2\pi \cdot f \cdot 1,38 \cdot 10^{-7} \cdot 8,329 \cdot 10^{-8}} = \frac{6,92 \cdot 10^{11}}{f}$$

Karakteristik frekuensi tinggi :

