

MOSFET - Tutorial 1

Ques If two identical MOSFET are placed in series, then what will be an expression for the current flowing through the MOSFET?

Ques Calculate the total charge stored in the channel of an NMOS device, if $C_{ox} = 10 \text{ fF}/\mu\text{m}^2$, $W = 5 \mu\text{m}$, $L = 0.1 \mu\text{m}$ & $V_{GS} - V_{th} = 1 \text{ V}$. Assume $V_{DS} = 0$.

W = width of the NMOS
 L = length of the device
 C_{ox} = oxide capacitance

Answer:
5 fC

Ques The drain current of the MOSFET in the triode region is expressed as:-

$$I_D = \mu_n C_{ox} \frac{W}{L} \left[(V_{GS} - V_{th}) V_{DS} - \frac{1}{2} V_{DS}^2 \right]$$

If the value of $\mu_n C_{ox}$ & $\frac{W}{L}$ are unknown then is it possible to determine the quantities by applying different values of $(V_{GS} - V_{th})$ & V_{DS} and measuring I_D ?

Ques An NMOS device carries 1mA with $(V_{GS} - V_{th}) = 0.6\text{V}$ and 1.6mA with $(V_{GS} - V_{th}) = 0.8\text{V}$. If the device operates in triode region. Calculate V_{DS} and W/L .

Answer

$$V_{DS} = 0.533\text{V}$$

$$\frac{W}{L} = 28$$

Ques Derive an expression for drain current of a MOSFET in triode and Saturation region.

Ques Compute the transconductance of a MOSFET operating in the triode region. Define g_m .

$$g_m = \frac{\partial I_D}{\partial V_{GS}}$$

for a constant V_{DS} .

Explain why $g_m = 0$ for $V_{DS} = 0$?

Ques An NMOS device operating with a small drain-source voltage serves as a resistor. If the supply voltage is 1.8V , what is the minimum on-resistance that can be achieved with $W/L = 20$?

Answer:-

$$R_{ON} = 179\Omega$$

Ques We wish to use an NMOS transistor as a variable resistor with $R_{ON} = 500\Omega$ at $V_{GS} = 1\text{V}$ & $R_{ON} = 400\Omega$ at $V_{GS} = 1.5\text{V}$. Explain why this is not possible?