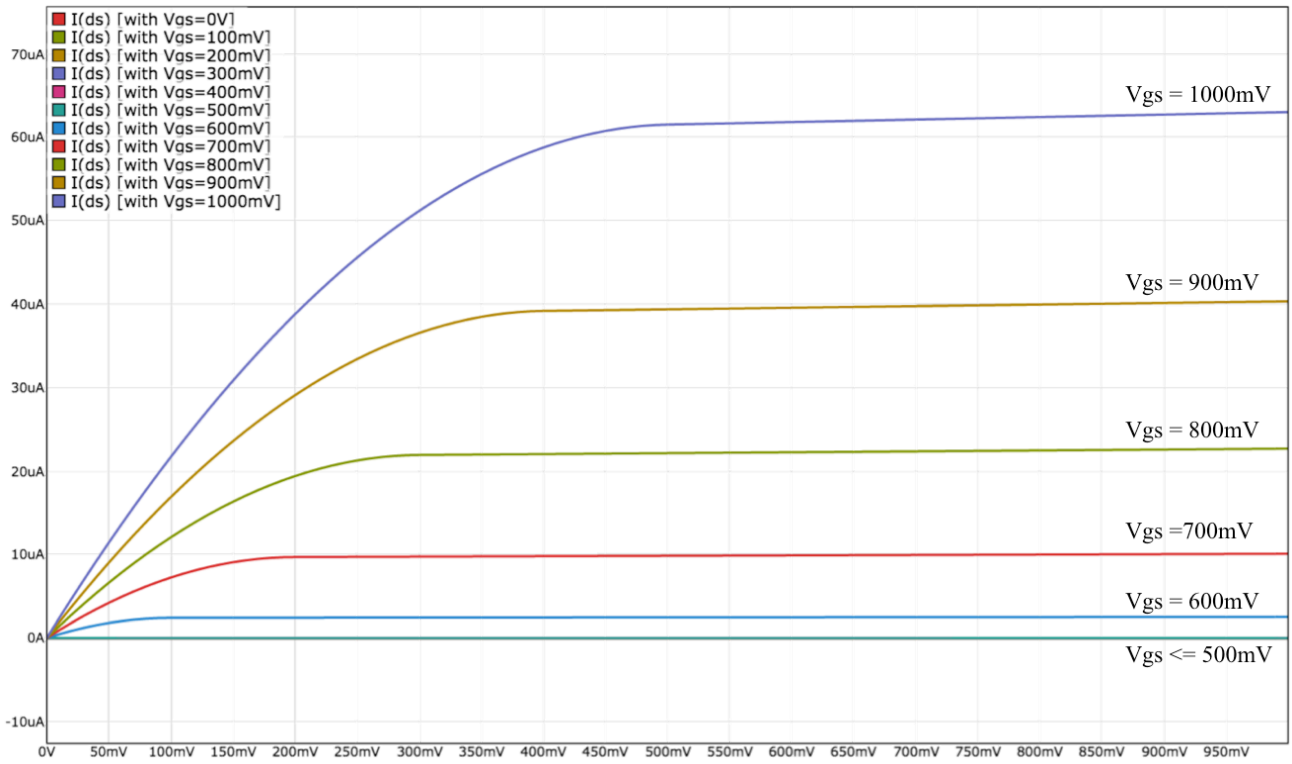
LE3.1.1: MOSFET Measurements

3/3 points (ungraded)

Here's the figure from the last video showing I_{DS} as a function of V_{GS} and V_{DS}. The threshold voltage, V_{TH}, of the MOSFET is 0.5V. The measurements were taken using an n-channel MOSFET with a width of 4 and a length of 1, expressed as multiples of the minimum feature size for a particular manufacturing process.

In the graph below, the vertical axis is I_{DS} and the horizontal axis is V_{DS}.



Please use the plots to answer the following questions.

(A) If $V_S = .1V, V_D = 0.5V$ and $V_G = 0.8V$, how much current will flow through the MOSFET switch, i.e., what is I_{DS}? Note that the units are in μA.

I_{DS} (in μA, $\pm 10\%$): 10 ✔ Answer: 10

Explanation

$V_{GS} = 0.7V$ and $V_{DS} = 0.4V$, so finding the value on the red curve, at 400mV on the x-axis, gives $I_{DS} = 10\mu A$.

(B) Using the topmost curve in the figure, we see that when $V_{GS} = 1V$ and

$V_{DS} = .15V$, $I_{DS} = 30\mu A$. Please compute the effective resistance R_{eff} using Ohm's Law, which tells us $V_{DS} = I_{DS} R_{\text{eff}}$.

R_{eff} (in Ohms, $\pm 10\%$): 5000 ✔ Answer: 5000

Explanation

$R_{\text{eff}} = \frac{V_{DS}}{I_{DS}} = \frac{.15}{30e{-}6} = 5000\Omega$

(C) If we changed the width of the MOSFET from 4 to 6 and remeasured I_{DS} when $V_{GS} = 1V$ and $V_{DS} = .15V$, give an approximate value for the new I_{DS} measurement. Hint: $I_{DS} \propto W/L$.

I_{DS} (in μA, $\pm 10\%$): 45 ✔ Answer: 45

Explanation

We know that $I_{DS} \propto W/L$. So increasing W by 50% from 4 to 6, will increase I_{DS} by the same percentage: $1.5 \cdot 30\mu A = 45\mu A$.

Submit

Answers are displayed within the problem

Discussion

Topic: 3. CMOS / LE3.1

Hide Discussion

Add a Post

Show all posts by recent activity

- (b), (c) — 4
  For (B), why is I_DS=30e-6? For (C), how do we know if I_DS is 30uA? and what does the sign bet...
- ? [STAFF] The course is archived. Where can I find the assignments? — 6
  Hi, 6.004 staff. I began learning the course two weeks ago. And I found the course hard yet incredi...
- Saturated Region ? — 4
  Hello , In the first Question where we are calculating the value of Ids from the plot we can clearly s...