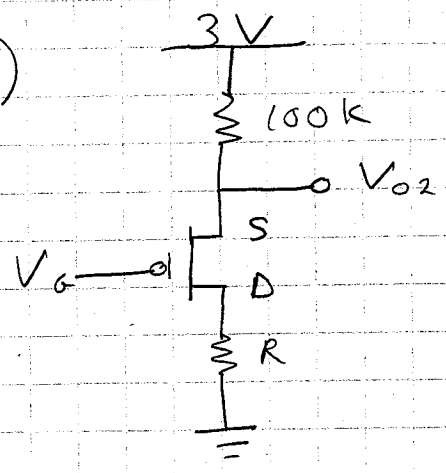
Anthony Mancuso
ECE321
HW-7
6 Sep 2012

(3.33)



$V_{tp} = -0.6V$
$K'_p = 50\mu A/V^2$
$\frac{W}{L} = 3$
$V_D = 0.8$
$V_O = 1.2$

$V_{DS} = V_D - V_S = 0.8 - 1.2 = -0.4V$

$I_{SD} = \frac{3V - 1.2V}{100k} = 18\mu A$

(Assume Saturation)

$I_{SD} = \frac{K'_p}{2}\left(\frac{W}{L}\right)(V_{GS} - V_{tp})^2 \Rightarrow V_{GS} = (-1.09, -0.11)$

$V_{GS} = -0.11 > V_{tp} = -0.6$, which is cutoff. $\therefore V_{GS} \neq -0.11$

$V_{GS} = -1.09 \Rightarrow V_{GS} - V_{tp} = -0.49 < V_{DS} = -0.4$

$\therefore$ saturation fails

(Linear)

$I_{SD} = K'_p\left(\frac{W}{L}\right)(V_{GS} - V_{tp})V_{DS} - \frac{V_{DS}^2}{2} \Rightarrow V_{GS} = \boxed{-1.1V}$

$V_{GS} - V_{tp} = -0.5 < V_{DS} = -0.4$

$\therefore$ transistor is in linear region

$V_G = V_S + V_{GS} = 1.2V + -1.1V = 0.1V$

$R = \frac{V_D}{I_{SD}} = \frac{0.8}{18\mu A} = \boxed{44.44k\Omega}$

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ECE327

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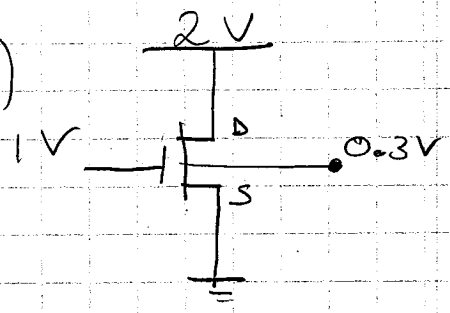
(3.36)



$V_{tn0} = 0.5V$

$K_n' = 200\mu A/V^2$

$\phi_F = \pm 0.35V$

$\frac{W}{L} = 3$

$\gamma = 0.1V$

$V_{BS} = -0.3V \Rightarrow V_{SB} = 0.3V$

$$V_T = V_{tn0} + \gamma\left(\sqrt{|2\phi_F + V_{SB}|} - \sqrt{|2\phi_F|}\right) = 0.516V$$

(Assume Saturation)

$$I_{DS} = \frac{K_n'}{2}\left(\frac{W}{L}\right)(V_{GS} - V_T)^2 = \boxed{70.18\mu A}$$

*used positive value of ϕ_F for NMOS. NMOS was in circuit in homework file, but PMOS was in book. If PMOS was used, ϕ_F would be negative and I_{DS} would equal 81.254A.

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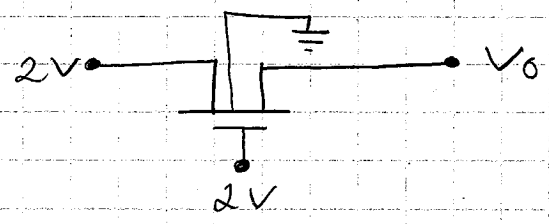
(3.37) $V_{tn} = 0.62V$
$V_{tn}(S/B) = 0.60V$
parasitic source to substrate suspected of raising V_{tn}
$\gamma = 0.4$, $\phi_F = 0.35V$, Find V_{BS}

$$V_T = V_{TO} + \gamma\left(\sqrt{|2\phi_F + V_{SB}|} - \sqrt{|2\phi_F|}\right)$$

$$0.62 = 0.60 + (0.4)\left(\sqrt{|2(0.35V) + V_{SB}|} - \sqrt{|2(0.35V)|}\right)$$

$$\boxed{V_{BS} = -86.17\,mV}$$

(3.38) $V_{to} = 0.6V$
$\gamma = 0.25V$
$\phi_F = 0.35V$



$$V_T = V_{to} + \gamma\left(\sqrt{|2\phi_F + V_{SB}|} - \sqrt{|2\phi_F|}\right)$$

Let $V_o = V_S$, then $V_{GS} = 2 - V_o$, and $V_{SB} = V_o - 0$

For transistor channel to be created:

$$V_{GS} \geq V_T$$

Let $V_{GS} = V_T$

then $(2 - V_o) = 0.62V + (0.1)\left[\sqrt{|2(0.35) + (V_o - 0)|} - \sqrt{2(0.3V)}\right]$

$$V_o = \boxed{1.26\,V}$$

$V_{DS} = 2 - V_o = 0.74V > V_{GS} - V_{tn} = 0.14V$

$\therefore$ transistor is in saturation