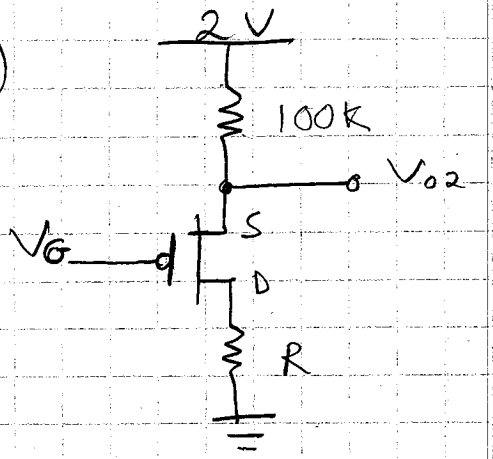
Anthony Mancuso
ECE321
HW-7
6 SEP 2012

(3.33)



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

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

$I_{SD} = \frac{2V - 1.2V}{100K} = 8\mu A$

(Assume Saturation)
$I_{SD} = \frac{K'_n}{2}\left(\frac{W}{L}\right)(V_{GS} - V_{tp})^2 \Rightarrow V_{GS} = (-0.927, -0.273)$

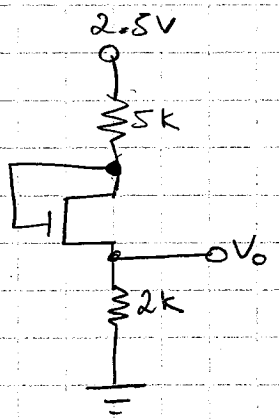
$V_{GS} \neq -0.273 > V_{tp}$ (would be in cutoff, but V_D indicates channel is present)

$V_{GS} = \boxed{-0.927}$ $\quad V_{DS} = -0.4 < V_{GS} - V_{tp} = -0.326$

$\therefore$ transistor is in saturation (verified)

$R = \frac{V_D}{I_{SD}} = \frac{0.8V}{8\mu A} = \boxed{100k\Omega}$

(3.35)



$K'_n = 90\mu A/V^2$
$V_{tn} = 0.5V$
$\frac{W}{L} = 10$

$V_{GS} = 0V < V_{tn}$ ✓ (channel)

$I_{DS} = \frac{K'_n}{2}\left(\frac{W}{L}\right)(V_{GS} - V_{tn})^2$ (for saturation)

$= \boxed{112.5\mu A}$

$V_D = 2.5V - (112.5\mu A)(5k)$

$V_D = 1.9375V$

$V_O = V_S = (112.5\mu A)(2k) = \boxed{225mV}$

$V_{DS} = V_D - V_S = 1.7125V > V_{GS} - V_{tp} = -0.5$

$\therefore$ transistor saturation verified

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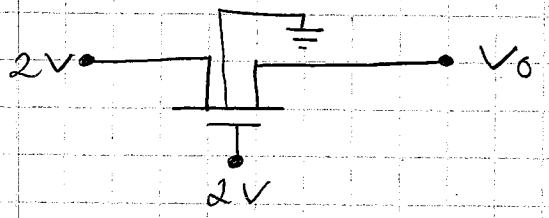
(3.37) $V_{tn} = 0.62V$
$V_{tn}(S/B) = 0.60V$
parasitic source to substrate suspected of raising V_{tn}
$\gamma = 0.4$, $\phi_F = 0.35V$, Find V_{BS}

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

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

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

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



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