EE 420 / ECG 620

Analog IC Design

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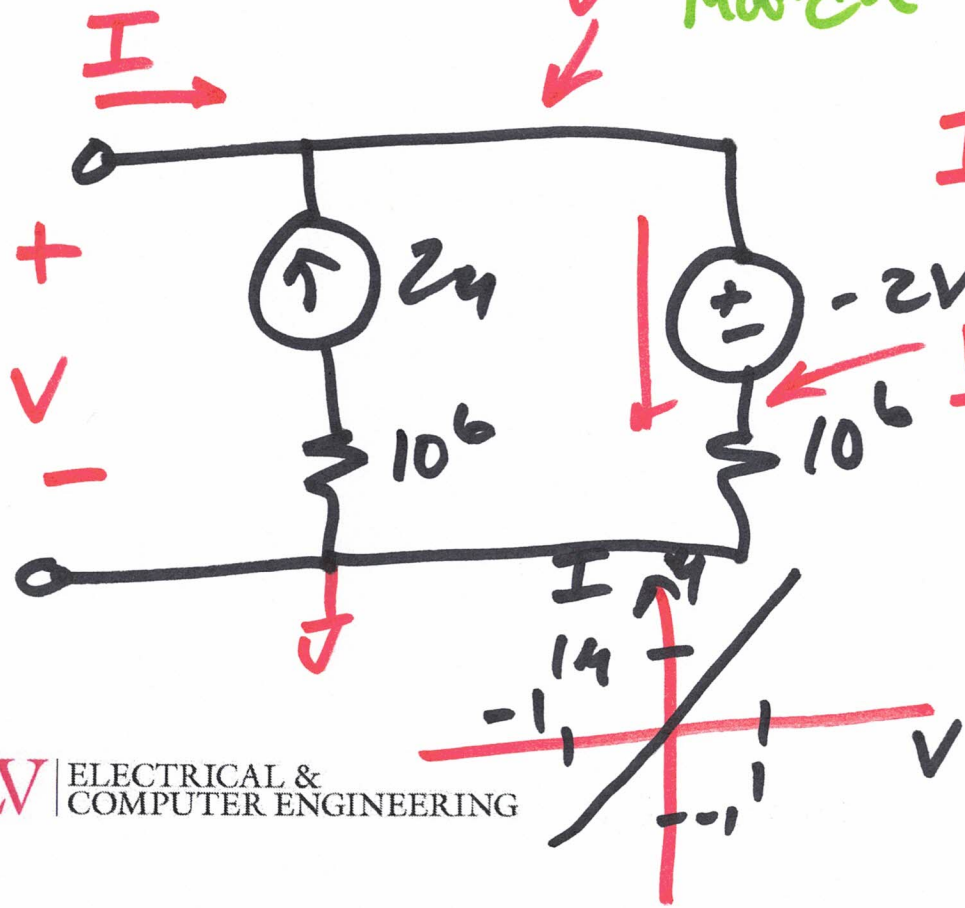
Sempre

Lecture 13

March 9, 2020



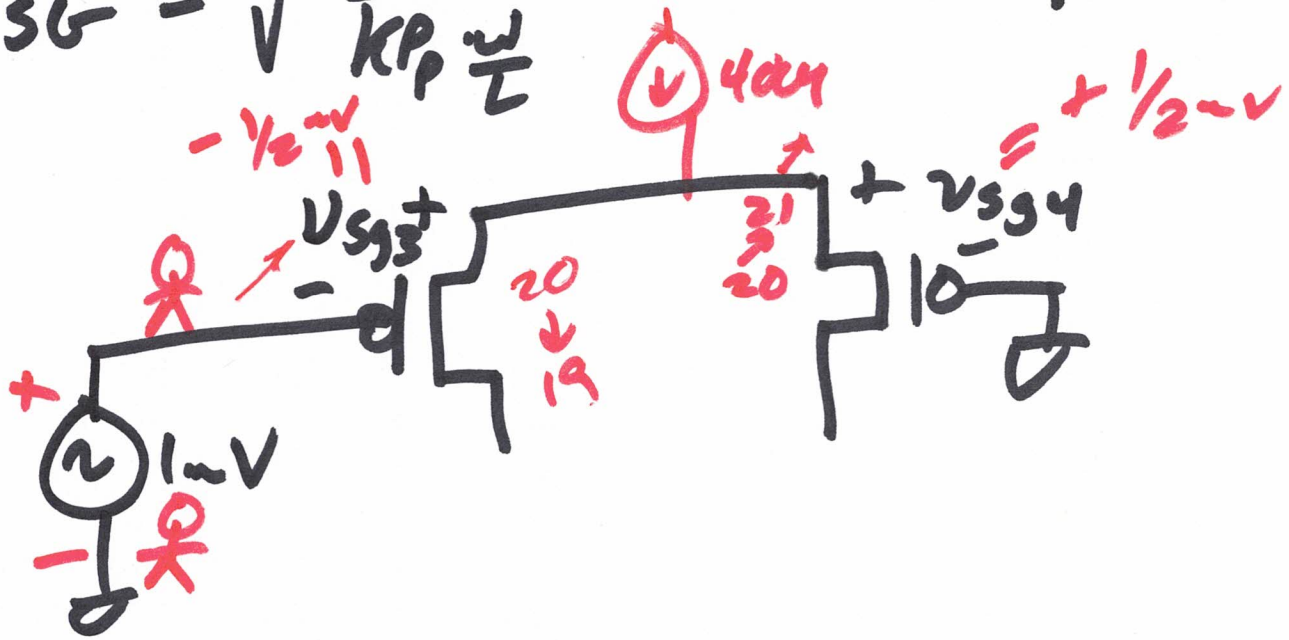
$$I + 2I = \frac{V-(-2)}{10^6}$$

$$\frac{V+2}{10^6}$$

$$10^6 \cdot I + 2 = V + 2$$

$$I = V \cdot 10^{-6}$$

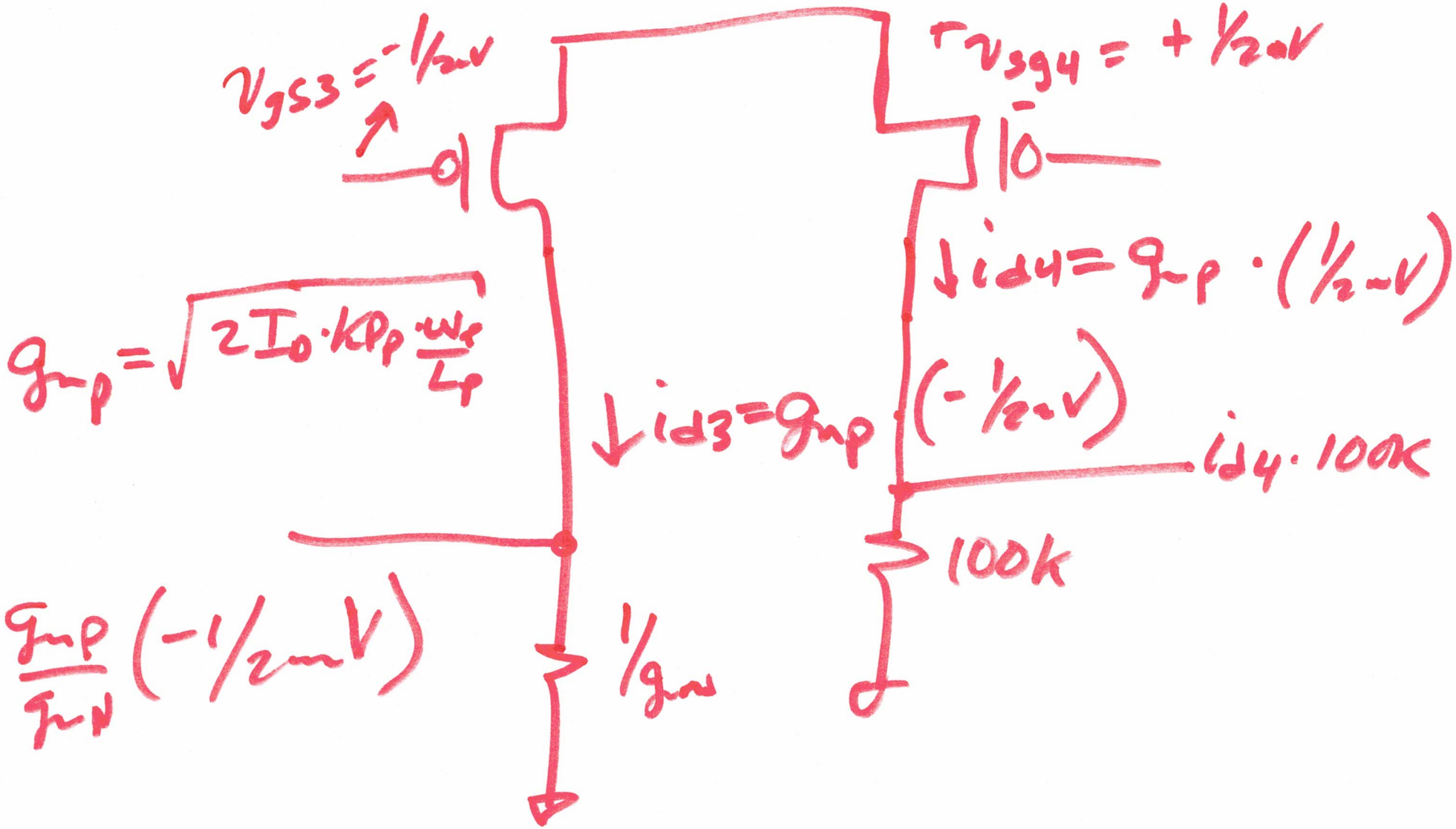
$$V_{SG} = \sqrt{\frac{2I_D}{K_P \frac{W}{L}}} + V_{THP}$$



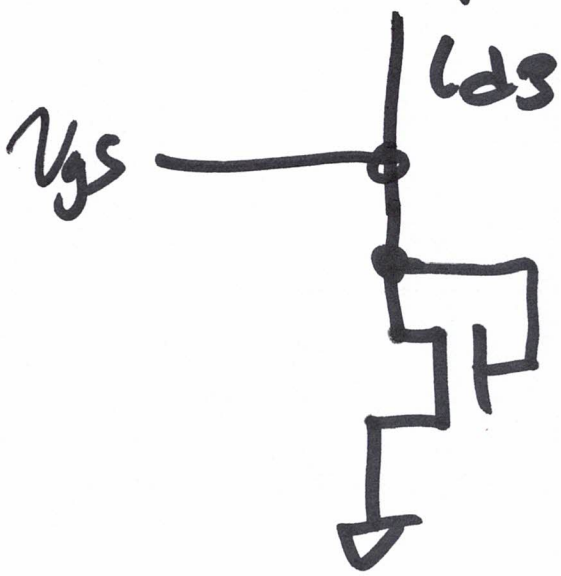
$$1mV + v_{SG3} - v_{SG4}$$

$$1mV = v_{SG4} - v_{SG3}$$

½mV -½mV

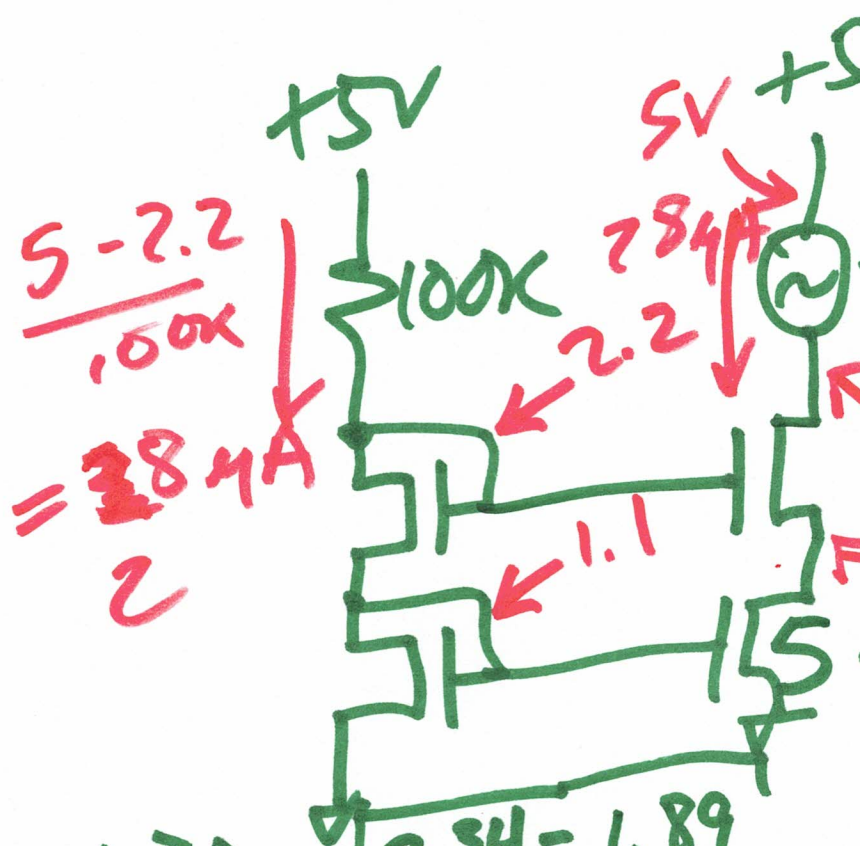

$v_{gs3} = -\frac{1}{2}v_{in}$
$v_{sg4} = +\frac{1}{2}v_{in}$
$g_{mp} = \sqrt{2I_D \cdot KP_p \frac{W_p}{L_p}}$
$i_{d4} = g_{mp} \cdot (\frac{1}{2}v_{in})$
$i_{d3} = g_{mp}$
$(-\frac{1}{2}v_{in})$
$i_{d4} \cdot 100K$
100k
$\frac{g_{mp}}{g_{mN}}(-\frac{1}{2}v_{in})$
$\frac{1}{g_{mN}}$

3)



$$i_{ds} = \mu_p C_{ox} \left(-\tfrac{1}{2} v_{ov}\right) = g_m \cdot v_{gs}$$

$$v_{gs} = \frac{\mu_p C_{ox}}{g_m} \left(-\tfrac{1}{2} v_{ov}\right)$$



$\frac{5-2.2}{100K} = 28\mu A$

$= \frac{28\mu A}{2}$

$\frac{5-2V_{GS}}{10^5} = \frac{120\cdot10^{-5}}{2}\frac{}{2}(V_{GS}-0.8)^2$

$5-2V_{GS} = 30(V_{GS}^2 - 1.6V_{GS} + .64)$

$V_{GS} = \frac{1.53 \pm \sqrt{2.34-1.89}}{2}$

$30V_{GS}^2 - 1.6V_{GS} + 19.2 = 5-2V_{GS}$

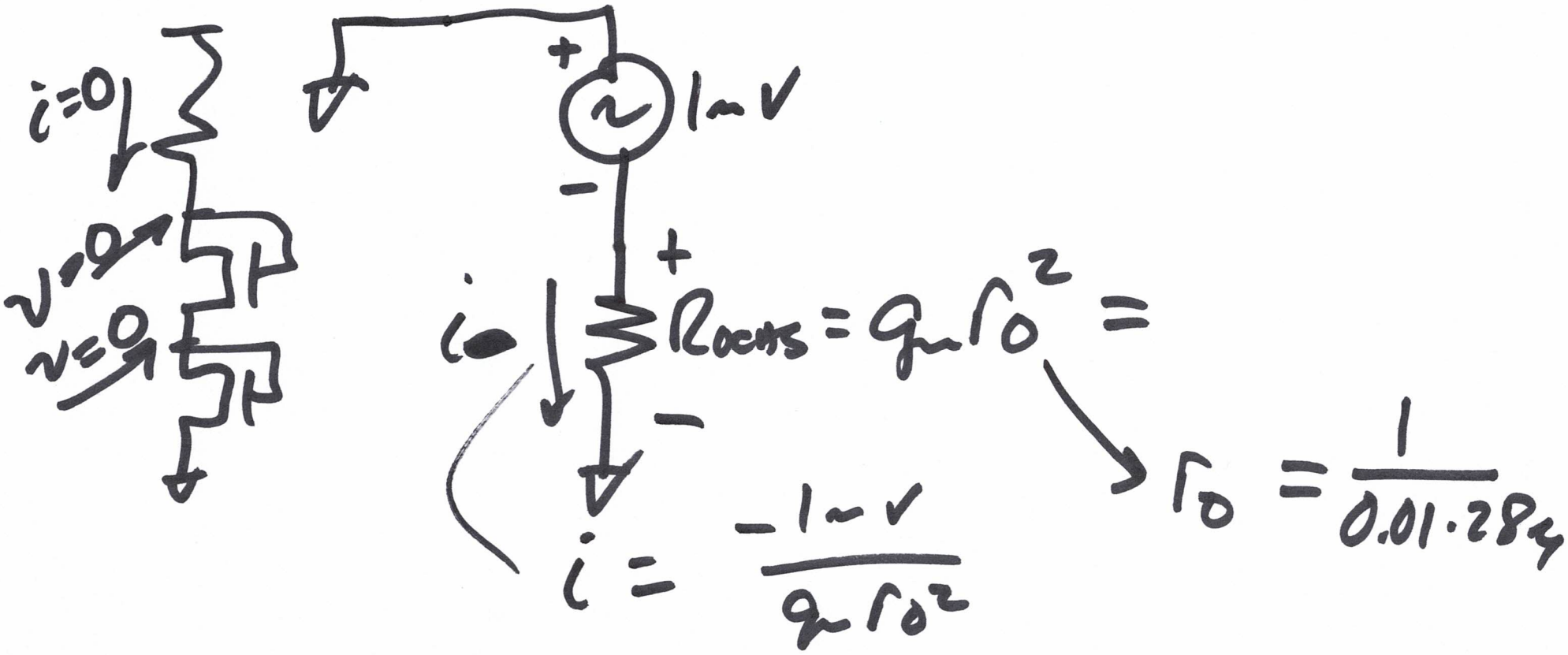
$30V_{GS}^2 - 46V_{GS} + 14.2 = 0$

$= \frac{1.53 \pm .67}{2}$

$V_{GS}^2 - 1.53V_{GS} + .473 = 0$

$V_{GS} = 1.1V$

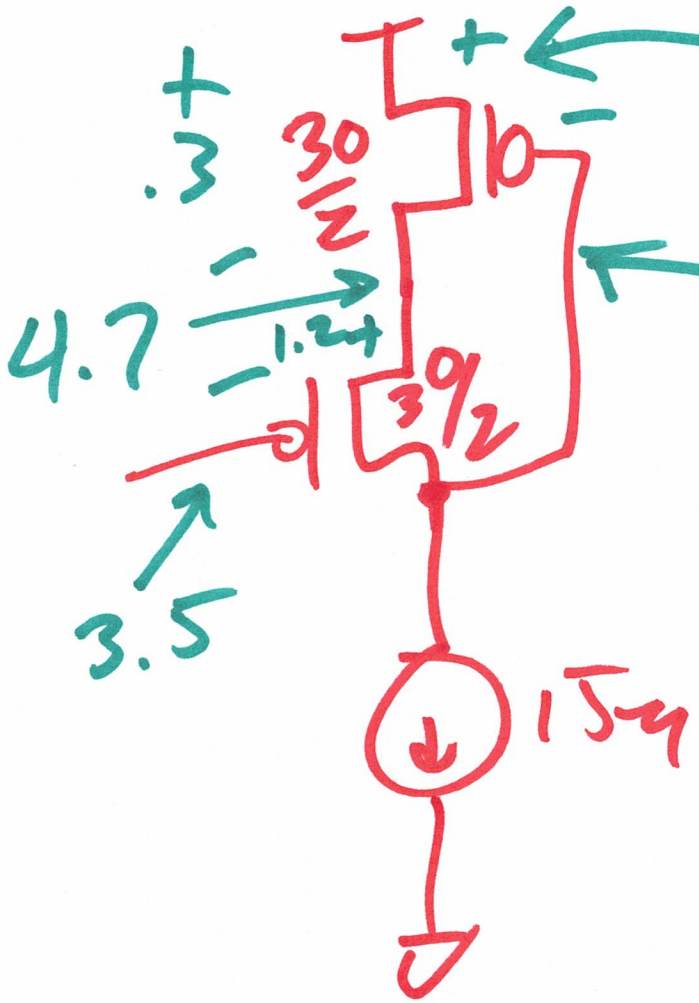
5)


i=0
v=0
v=0
+
1mV
−
+
i
Rocms = gm ro² =
−
i = −1mV / gm ro²
ro = 1 / 0.01·28μ

$$V_{GS1} = \sqrt{\frac{4I \cdot 2}{KP \cdot \frac{10}{2}}} + 0.8$$

$$V_{GS2} = \sqrt{\frac{2I}{KP \cdot \frac{40}{2}}} + 0.8$$

$$I = \frac{V_{GS1} - V_{GS2}}{R}$$



$$V_{SG} = \sqrt{\frac{2 \cdot 15\mu}{40\mu \cdot \frac{30}{2}}} + .9 = 1.2$$

$V_{DD} - V_{SG}$

$$V_{DS,SAT} = V_{GS} - V_{THP}$$

$$= 1.2 - .9$$

$$= .3$$