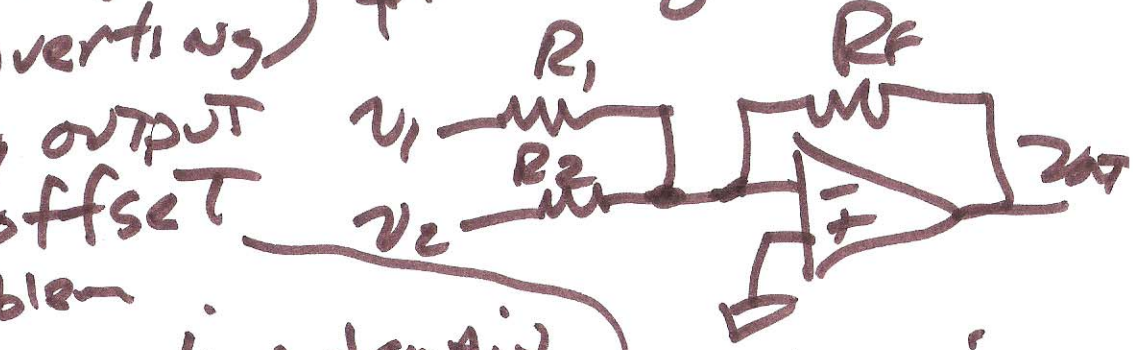
Lecture 27 May 8, 2013

Review for the final

Quizzes
Exams
H.W. problems

OP. Amps
inverting
non-inverting
Calculating output
with offset
B.W. problem
Integrators – time domain

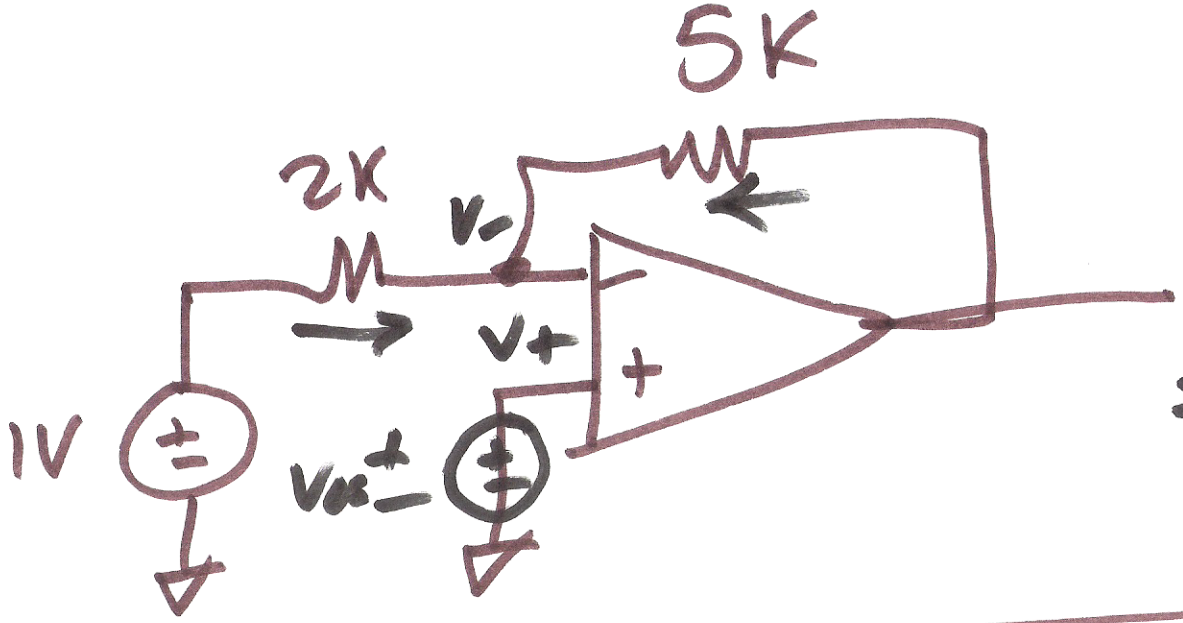
derive gain



1)

Example V_{OUT} = ? Assuming V_{OS} = 50mV

A_{OLDC} = 500



in steady

$V_{OUT} = A_{OLDC}(V_+ - V_-)$

$V_+ - V_- = 50mV = V_{OS}$

Diodes

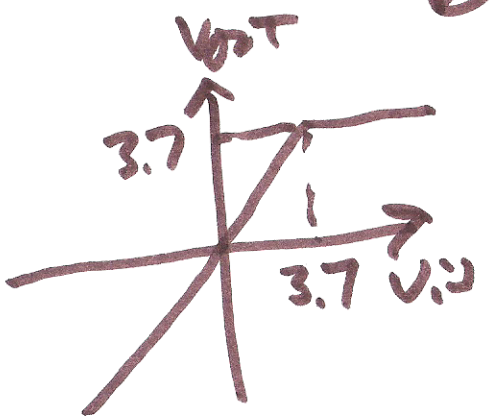
IV characteristics

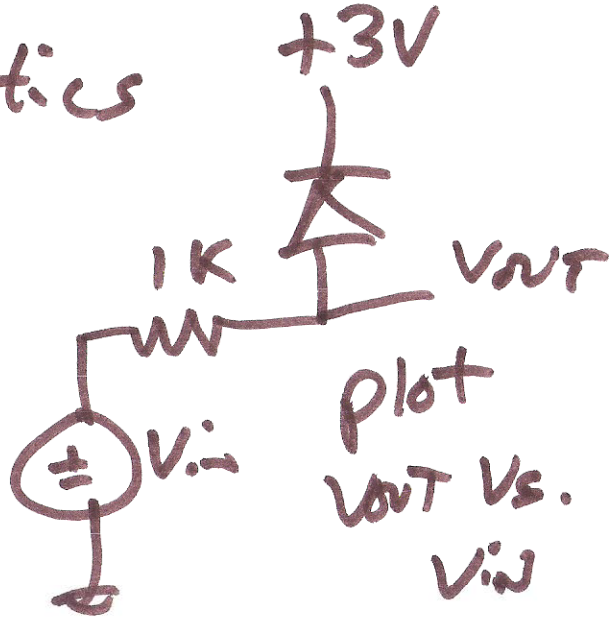
Diode equation

Rectifiers

Clamp/clipping

Diode/op-amp?





plot V_{OUT} vs. V_{in}

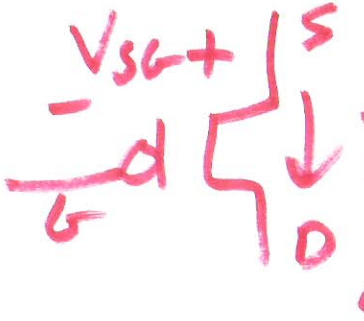
MOSFETS

IV curves (esp. pmos)

square-law equations

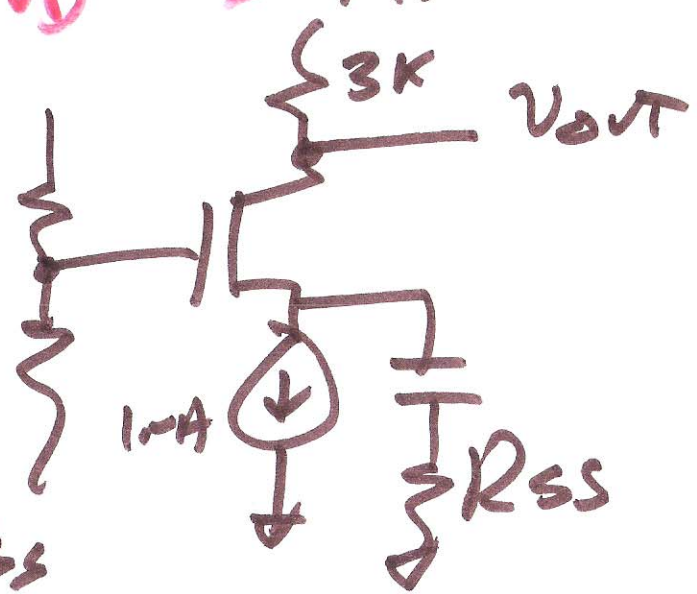
Amplifiers — study test quizzes

+1



$V_{SD} = V_S - V_D$

$V_{DS} = V_D - V_S$



$$\frac{v_{out}}{v_{in}} = \frac{-i_d \cdot 3K}{\frac{1}{g_m} + i_d \cdot R_{SS}}$$

$\frac{1}{g_m}$

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3)

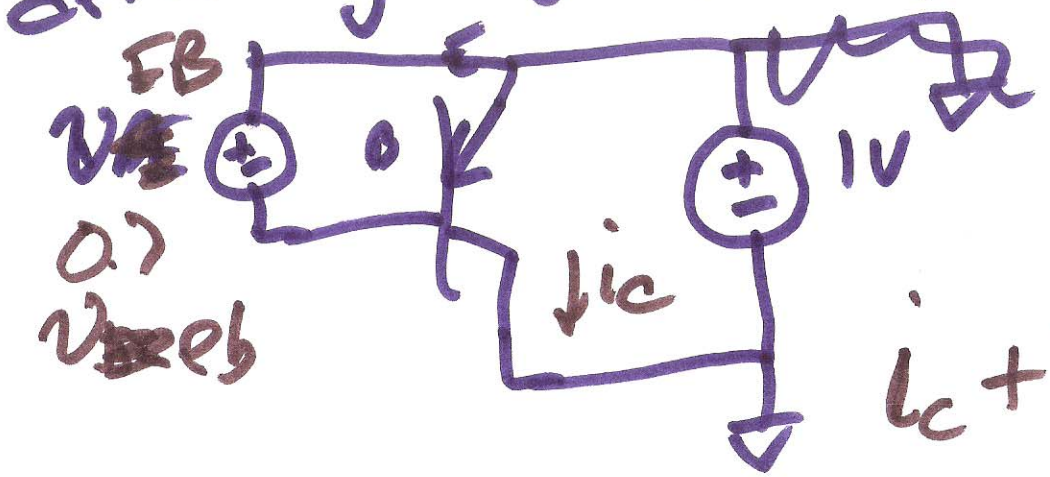
BJT

H.W. # 18 & 19

Examples in lecture

Show how to derive g_m for a BJT or MOSFET

derive g_m for PNP



V_{BE} or V_{EB}

$AC=0$

$M_{\frac{V_{be}+V_{BE}}{nV_T}}$

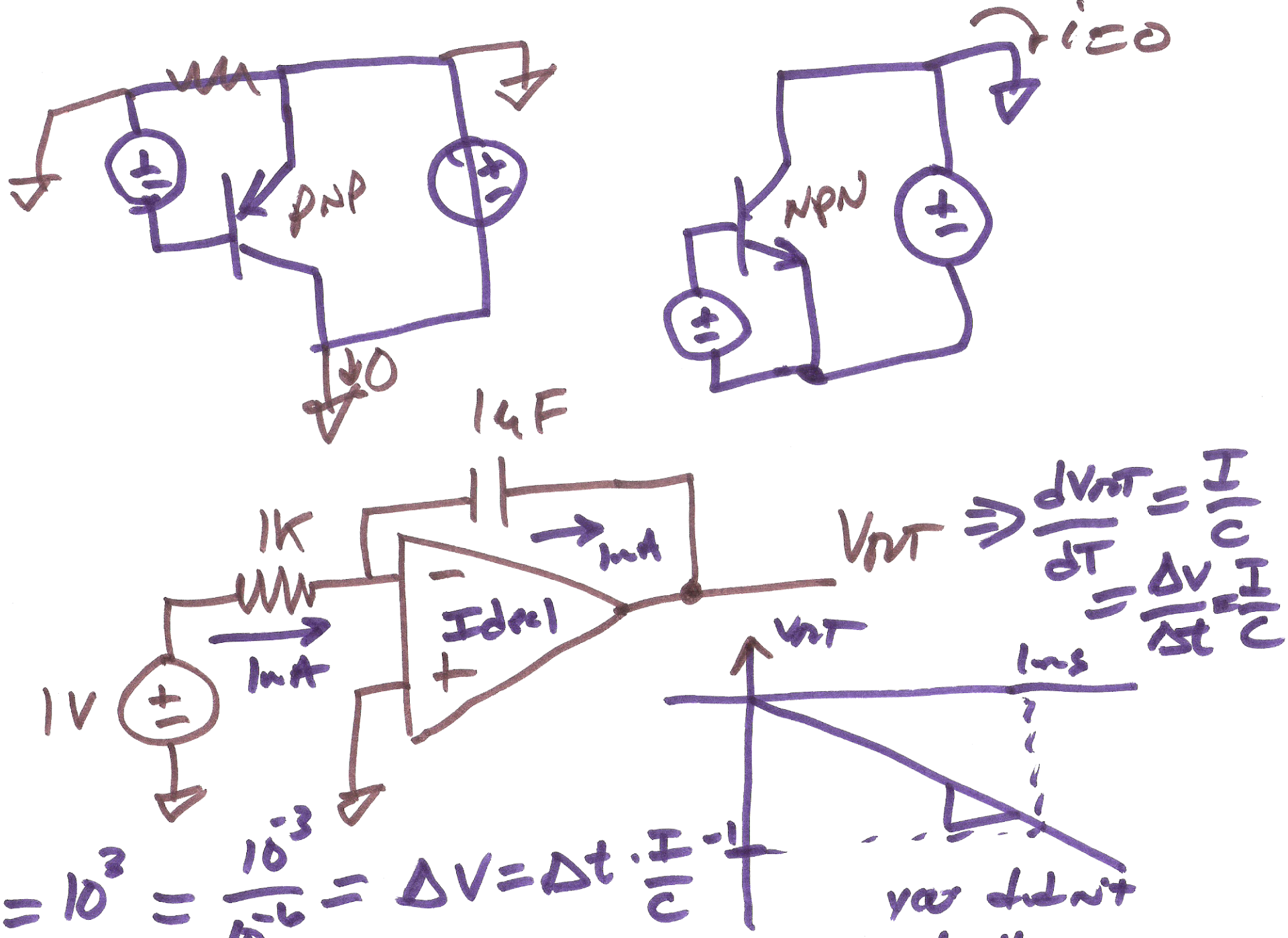
$i_c + I_C = I_S e^{\frac{V_{be}+V_{BE}}{nV_T}}$

$V_{be} \ll V_{BE}$

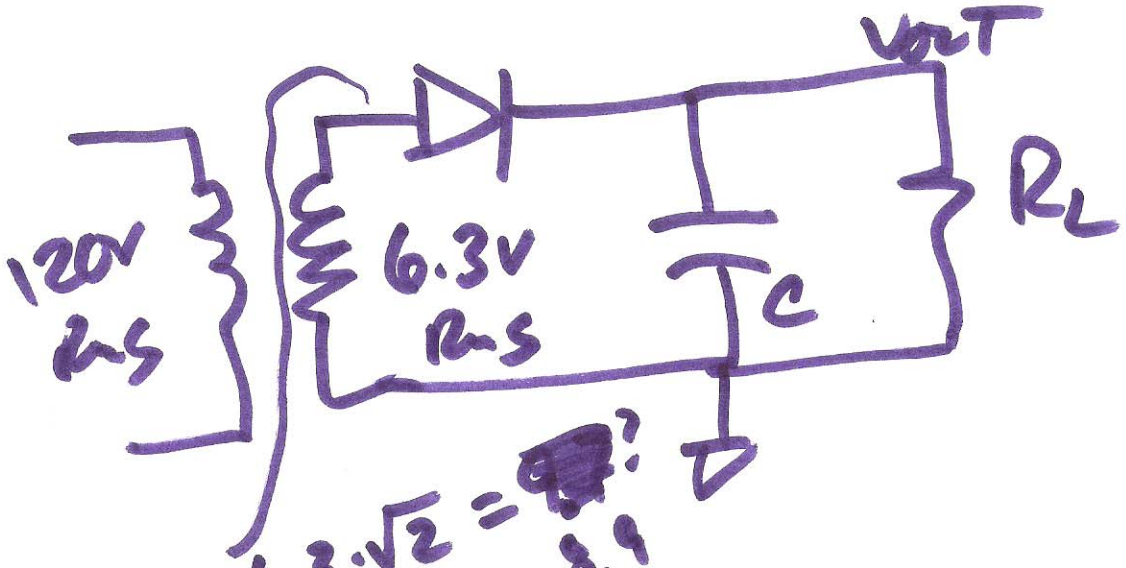
$$g_m = \frac{\delta i_c + I_C}{\delta V_{BE}}\Bigg|_{\substack{I_C=\text{const} \\ V_{BE}=\text{const}}} = \frac{I_S}{nV_T} e^{\frac{V_{be}+V_{BE}}{nV_T}} \cdot \frac{\delta V_{BE}}{\delta V_{BE}}$$

$$\simeq \frac{I_C}{nV_T}$$

4)



5)



$$V_{RMS} = \frac{V_{peak}}{\sqrt{2}}$$

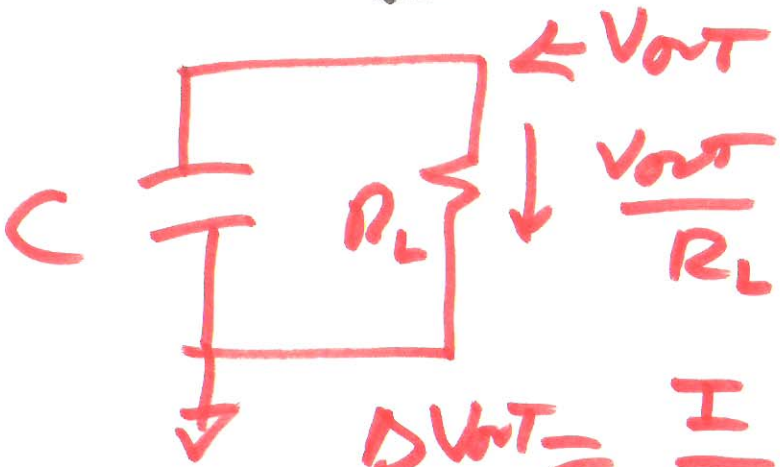
$$V_{pp} = 2V_{peak}$$

6)

1) estimate V_{OUT} peak

$= V_{peak} - .7$

$= 8.2V$

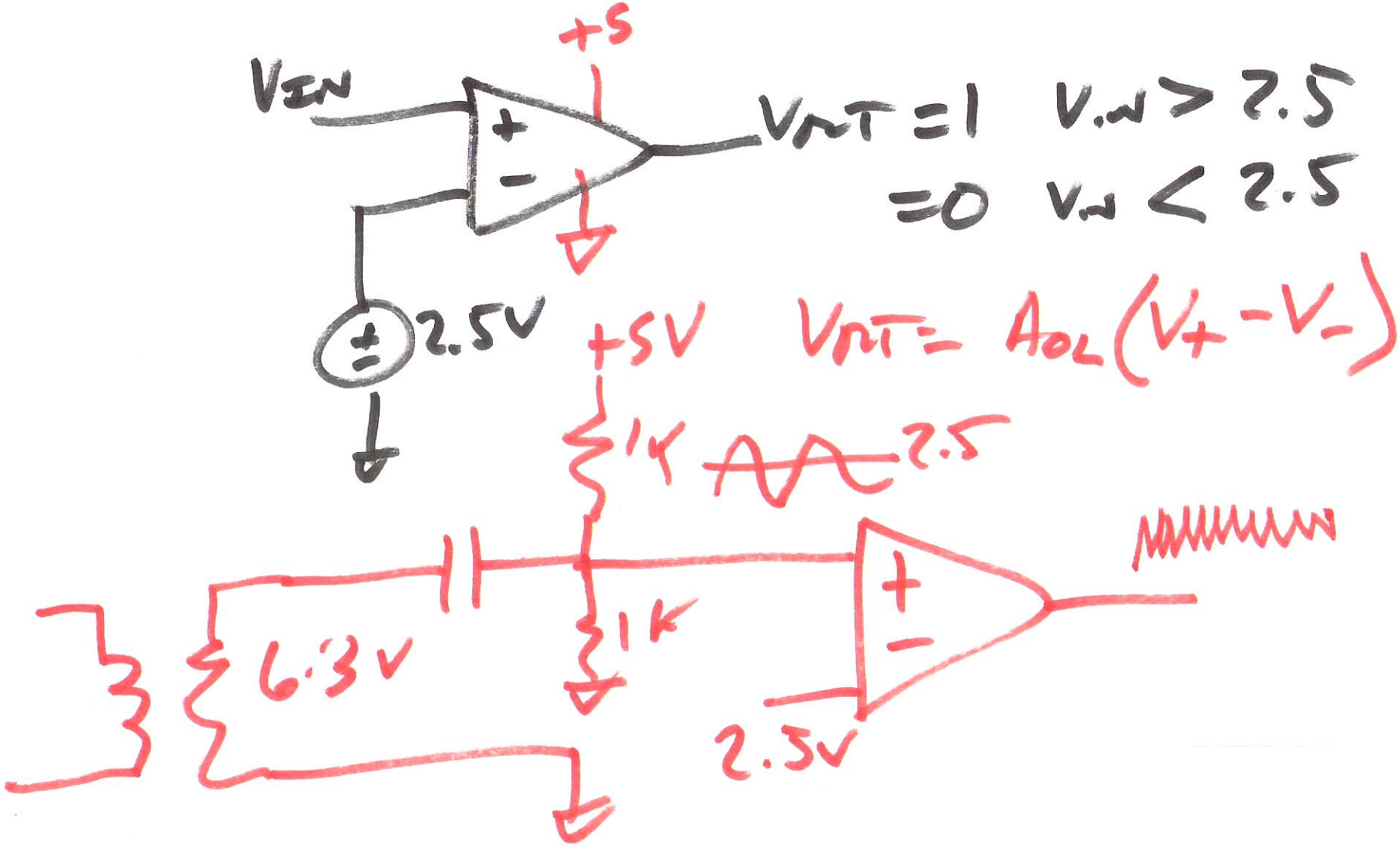


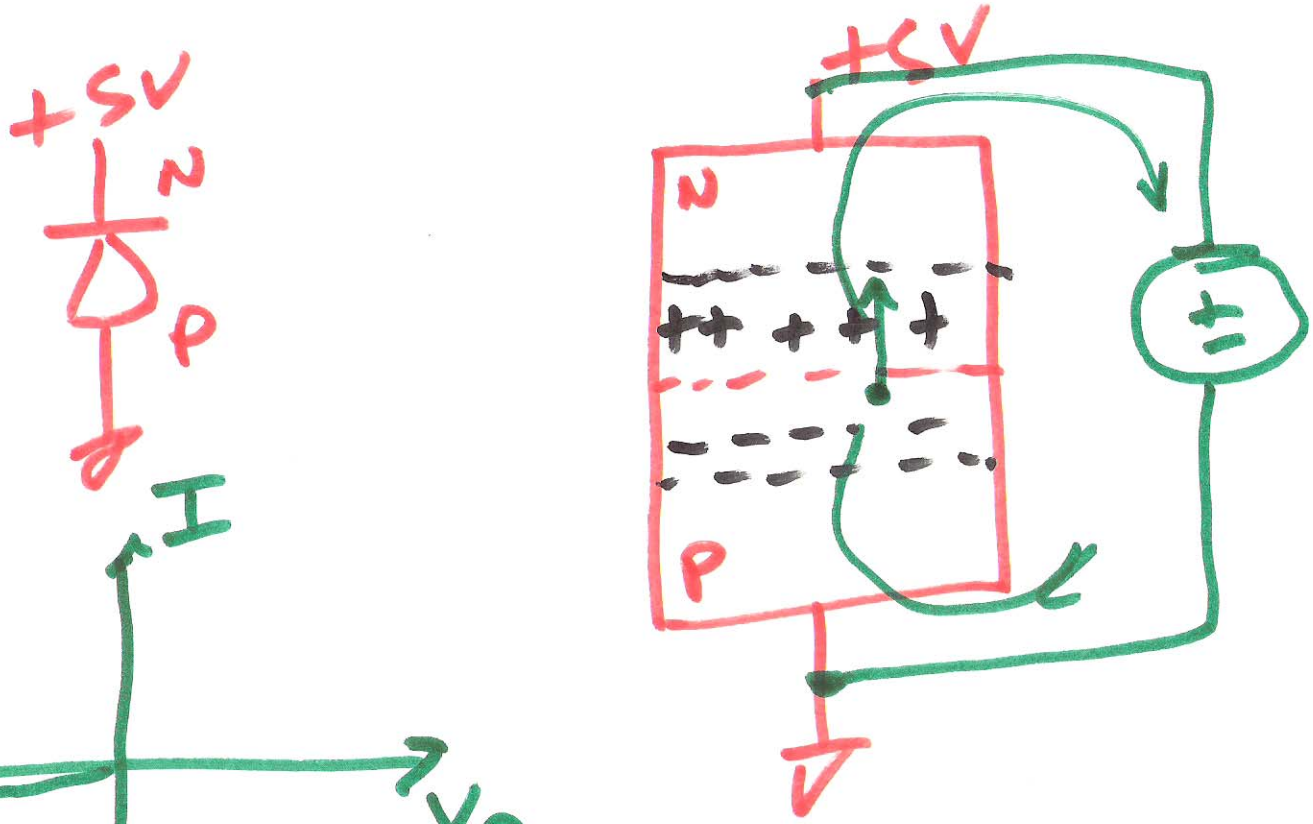
$$\frac{\Delta V_{OUT}}{\Delta t} = \frac{I}{C} = \frac{V_{OUT}}{R_L \cdot C}$$

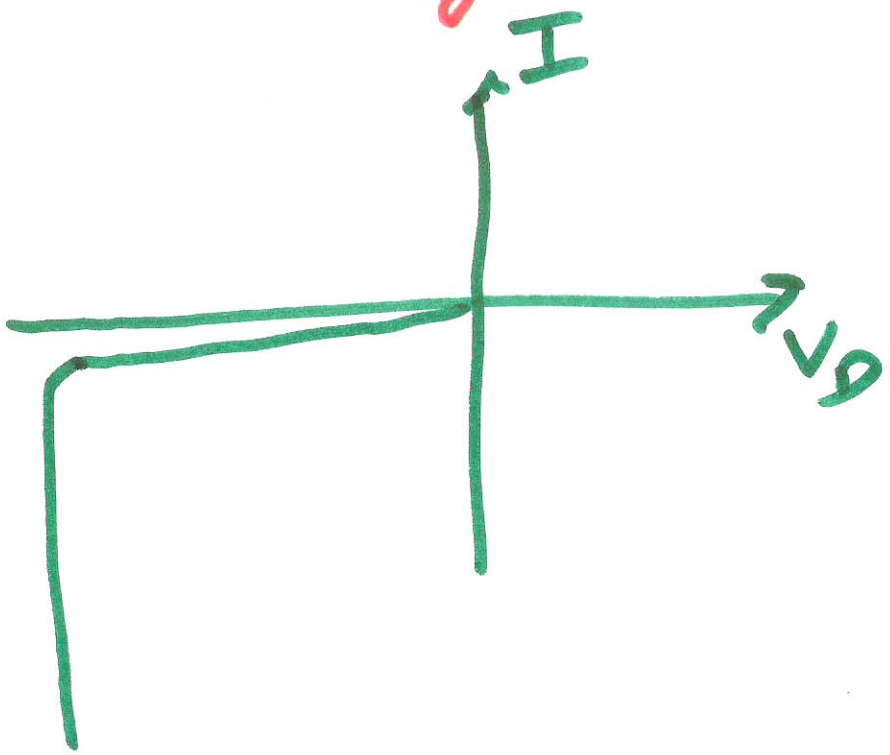
$$\Delta V_{OUT} = \Delta t \cdot \frac{V_{OUT}}{R_L \cdot C}$$

$$T = \frac{1}{f}$$

Comparator

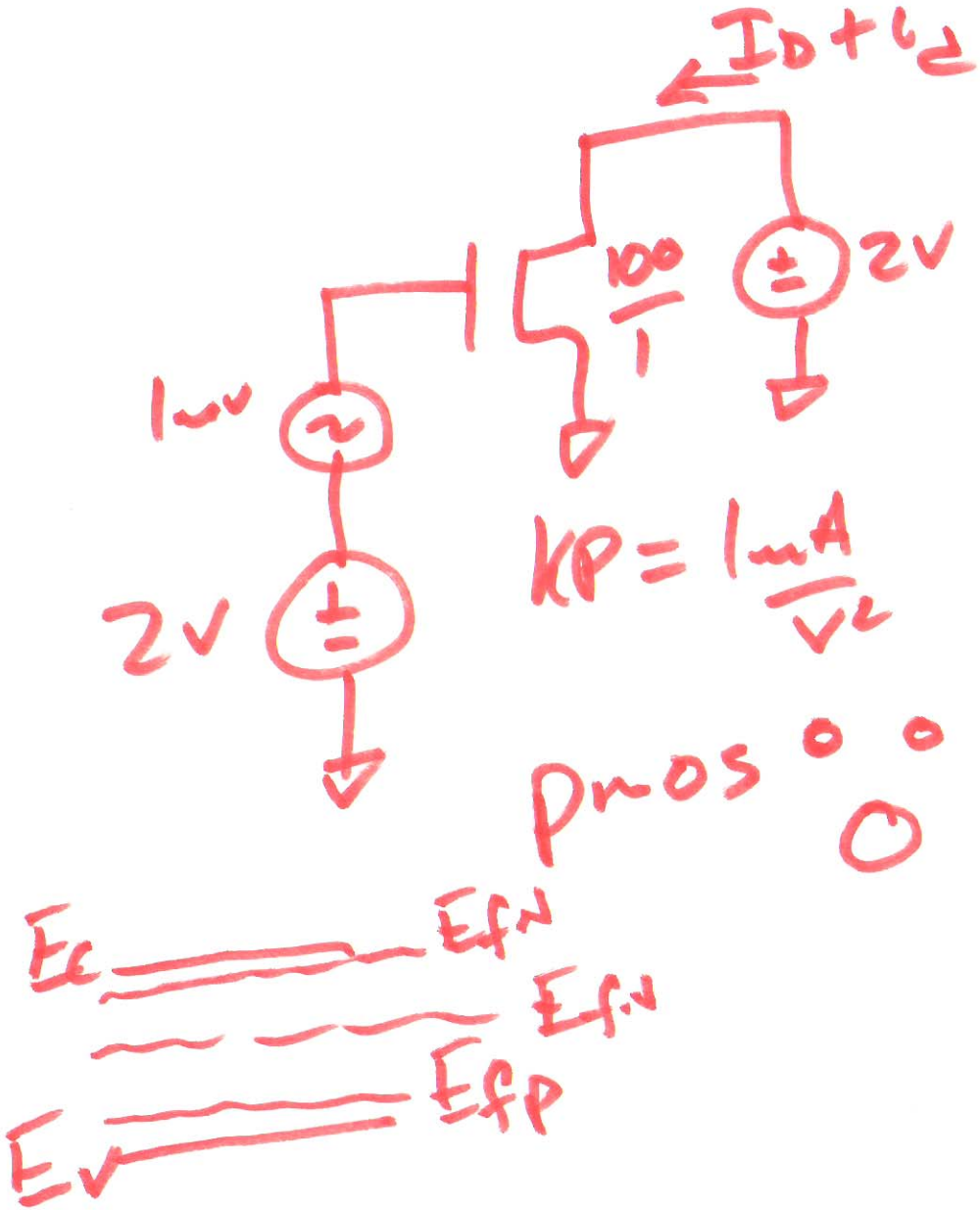






$$I_D = \frac{K_N'}{2}\frac{W}{L}\left(V_{GS} - V_{THN}\right)^2$$

8)



$V_{DS} \geq V_{GS} - V_{THN}$ for sat.

$I_D = \frac{KP}{2}\frac{W}{L}(V_{GS} - V_{THN})^2$

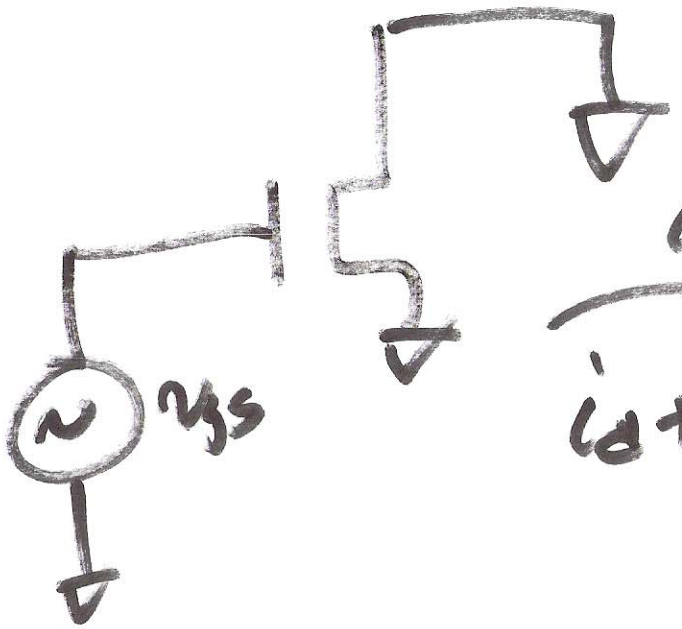
$i_d = g\, v_{gs}$

$V_{THN} = 1V$

$g_m = KP \cdot \frac{W}{L}(V_{GS} - V_{THN})$

$= \sqrt{2 I_D \cdot KP \cdot \frac{W}{L}}$

$= \frac{2 I_D}{V_{GS} - V_{THN}}$



$$\overbrace{i_d + I_D}^{i_D} = \frac{KP}{2}\cdot\frac{W}{L}\left(\overbrace{V_{GS}}^{V_{GS}} + v_{gs} - V_{TON}\right)^2$$

$$g_m = \left.\frac{\delta\, i_d + I_D}{\delta V_{GS}}\right| = KP\cdot\frac{W}{L}\left(V_{GS} - V_{TON}\right)$$

$I_D = CONST$

$V_{DS} = CONS$