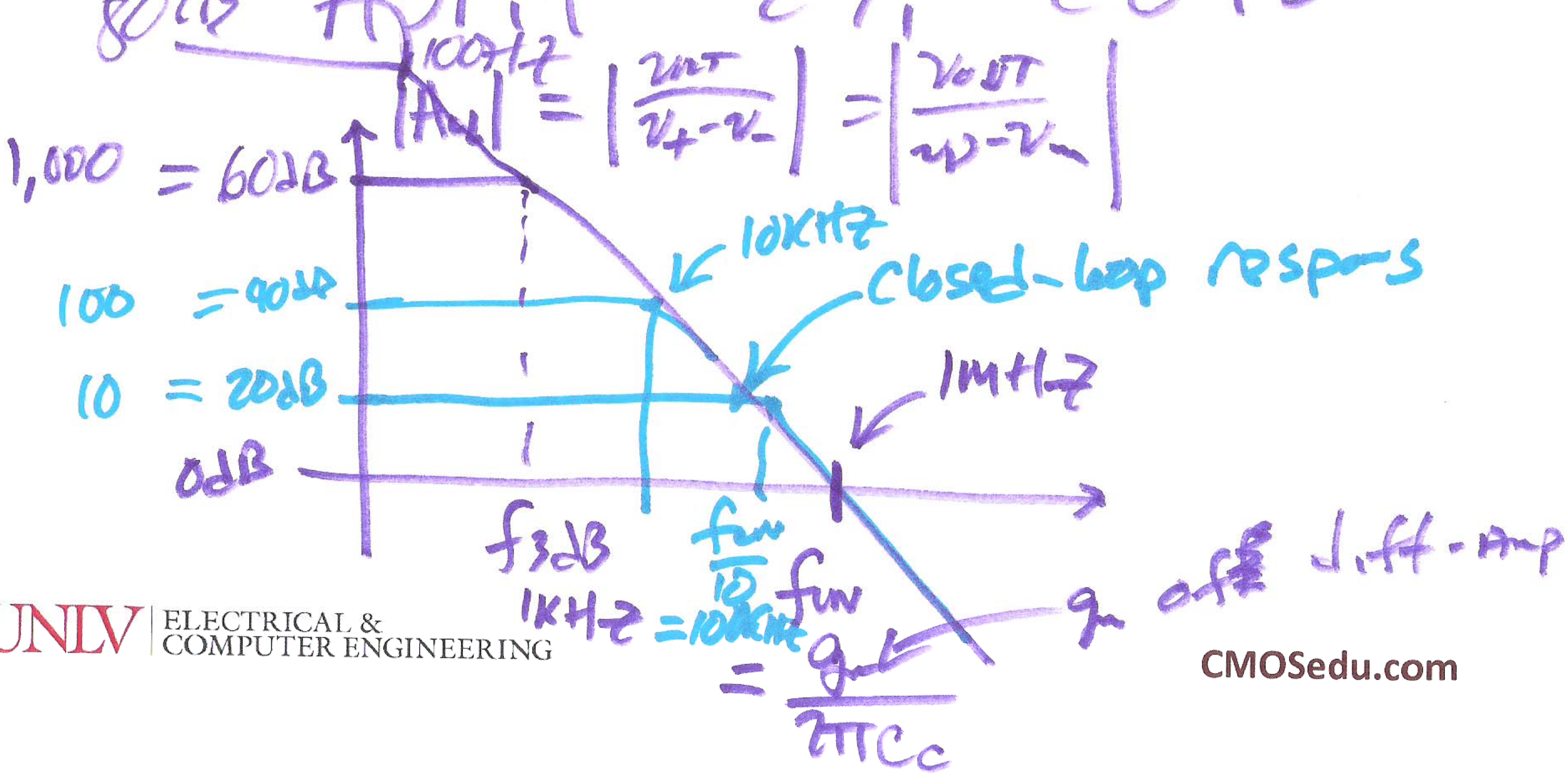
EE 420 / ECG 620

Analog IC Design

Lecture 26

April 27, 2015



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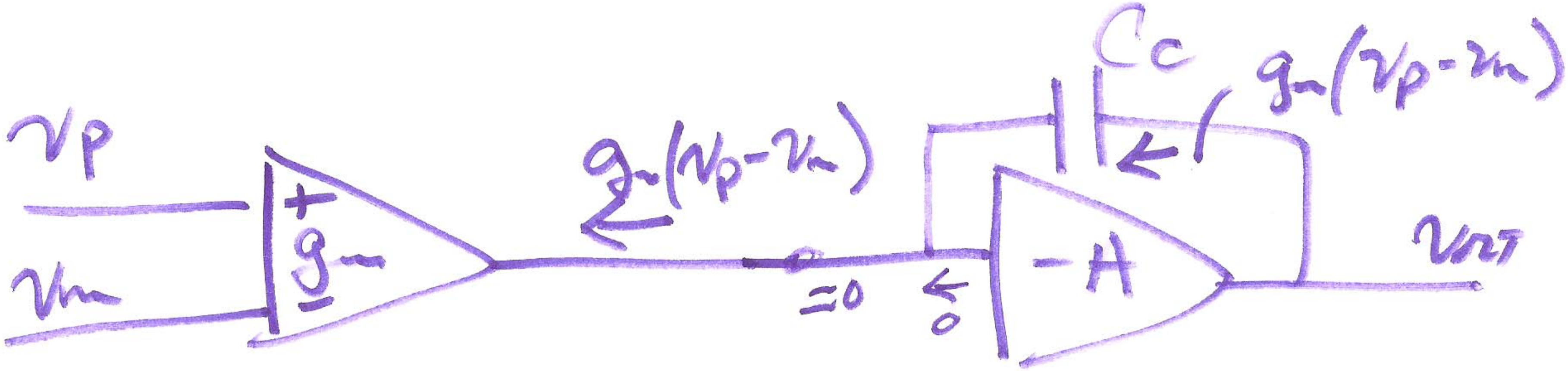
1)



$$v_{out} = \frac{1}{j\omega C_c}\, g_m (v_p - v_m)$$

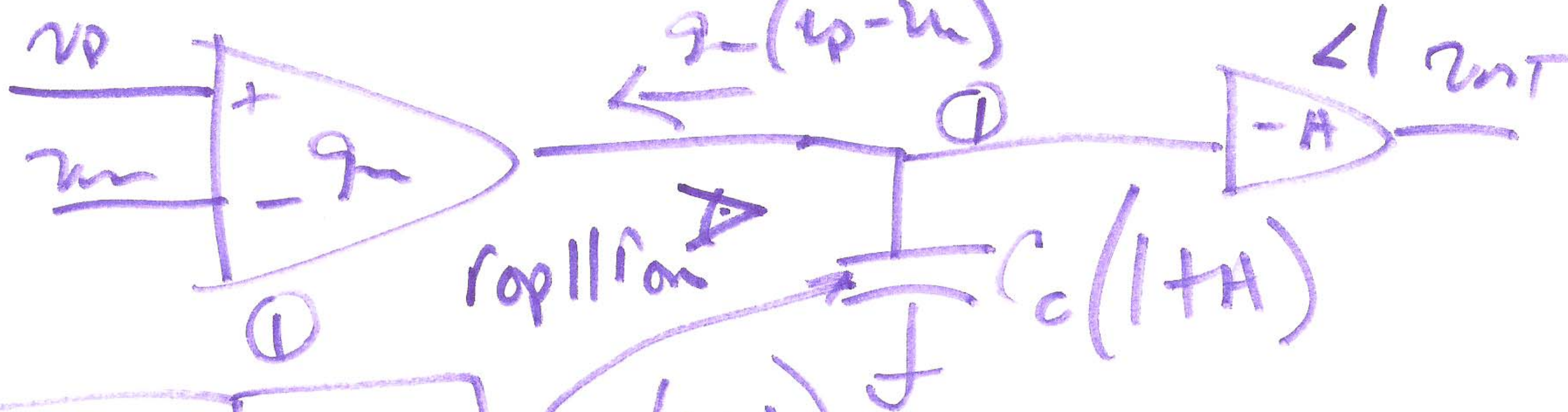
$$Z \cdot i$$

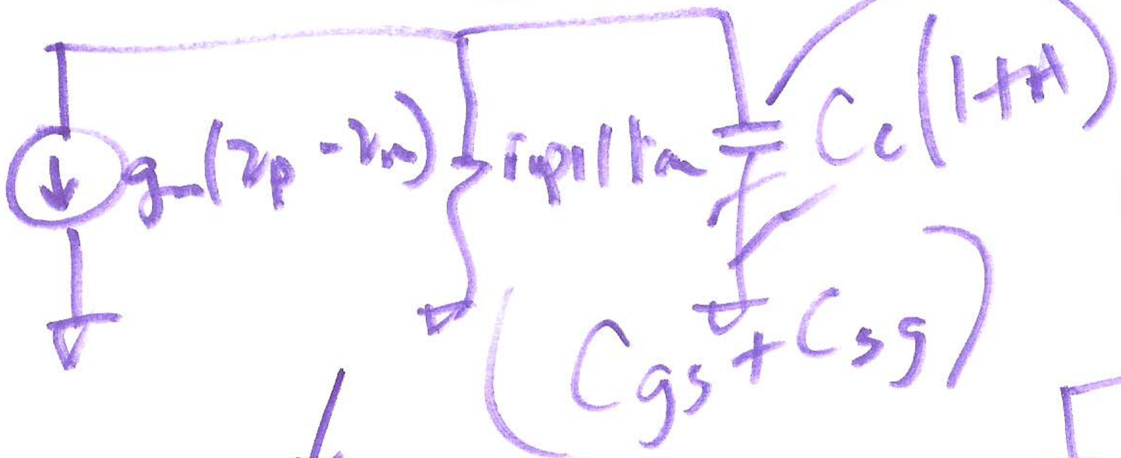
$$\boxed{f_{un} = \frac{g_m}{2\pi C_c}}$$

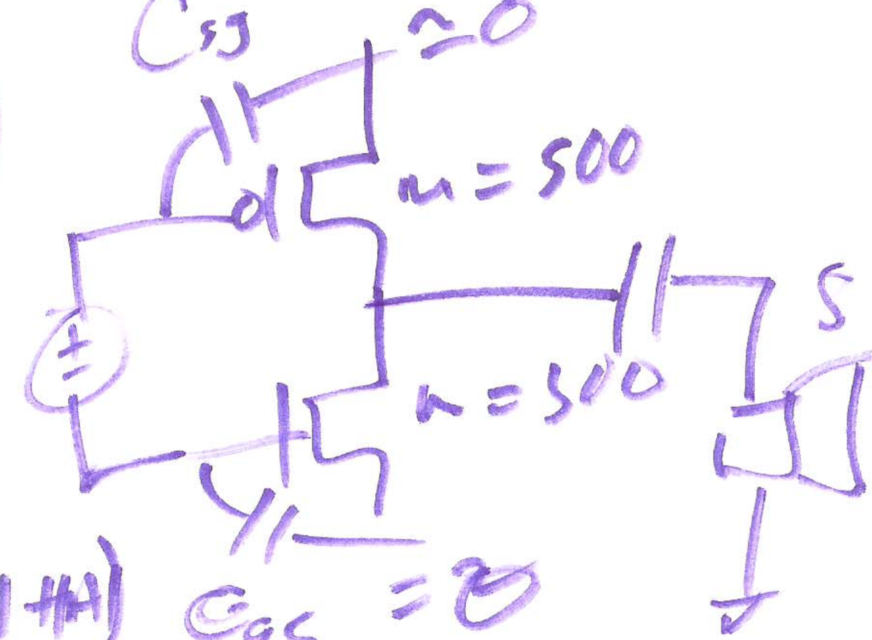
$$\left| \frac{v_{out}}{v_p - v_m} \right| = \left| \frac{g_m}{j \cdot \omega_{un} C_c} \right| = 1$$

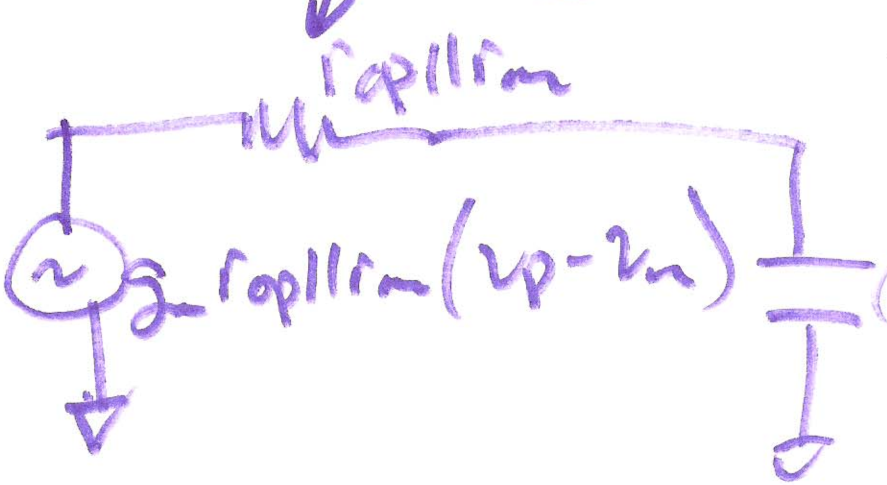
$$\frac{g_m}{2\pi f_{un} \cdot C_c} = 1$$

2)









$\approx 1 < 1$

$$f_{3dB} = \frac{1}{2\pi\, r_o \| r_n\, C_c(1+A)}$$

$$A_{OL}(f) = \frac{v_{OUT}}{v_p - v_m} = \frac{g_{m1} \cdot R_1 \cdot g_{m2} \cdot R_2}{1 + j\frac{f}{f_1}}$$

$$f_1 = f_{3dB} = \frac{1}{2\pi C_c R_1 \cdot (1+A)} \qquad A = g_{m2} R_2$$

$$10^7 = 10\,MHz$$

$$A_{CL} = 200, \quad f_{CLBW} = \frac{10\,MHz}{200} = 50\,kHz$$

$$A_{OL}(f) = \frac{A_{OL}}{1 + j\frac{f}{f_{3dB}}} = \frac{10^3}{1 + j\frac{f}{10^3}}$$

$$f \gg 1\,KHz = \frac{10^3\,10^4}{j \cdot \frac{f_{un}}{10^3\,10^2}} \stackrel{?}{=} 1$$

$$f_{un} = 10^6$$

GAIN-BW

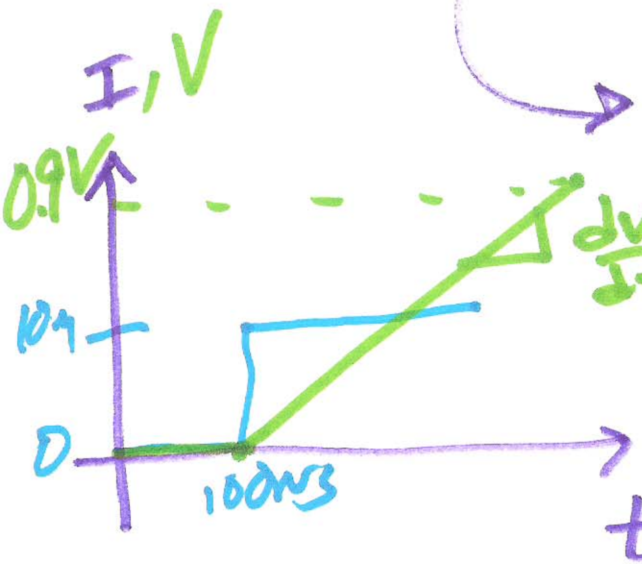
$$\boxed{f_{un} = A_{OL} f_{3dB}}$$

$L \rightarrow 2$ to 5

$$\frac{W}{L} = 5$$

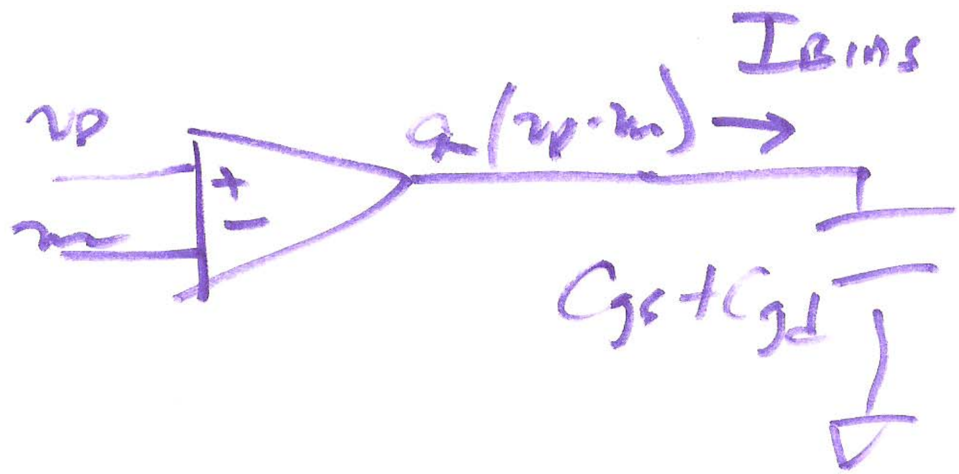
$$V_{ov} = 100mV = V_{DS,sat}$$
$$= V_{GS} - V_{THN}$$

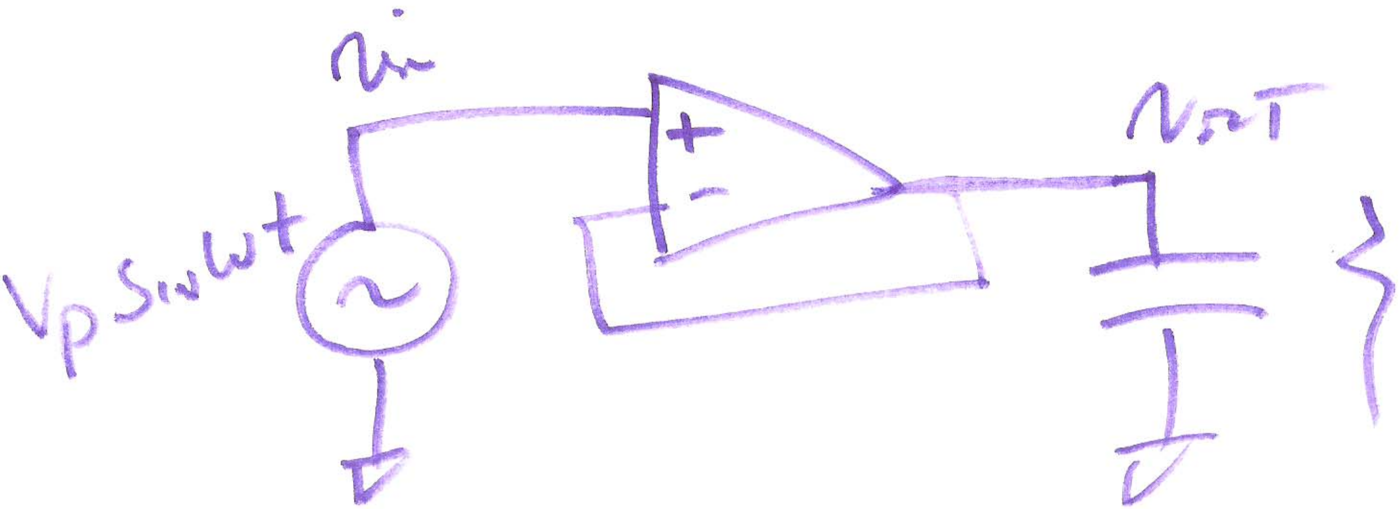
→ current



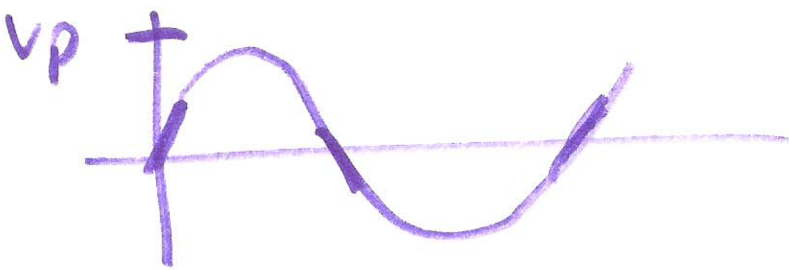
$$\frac{dv}{dt} = \frac{I}{C} = \frac{10\mu A}{10pF} = \frac{1V}{\mu s}$$

$$\frac{dV}{dT} = \frac{I_{BIAS}}{C_{gs}+C_{gd}}$$





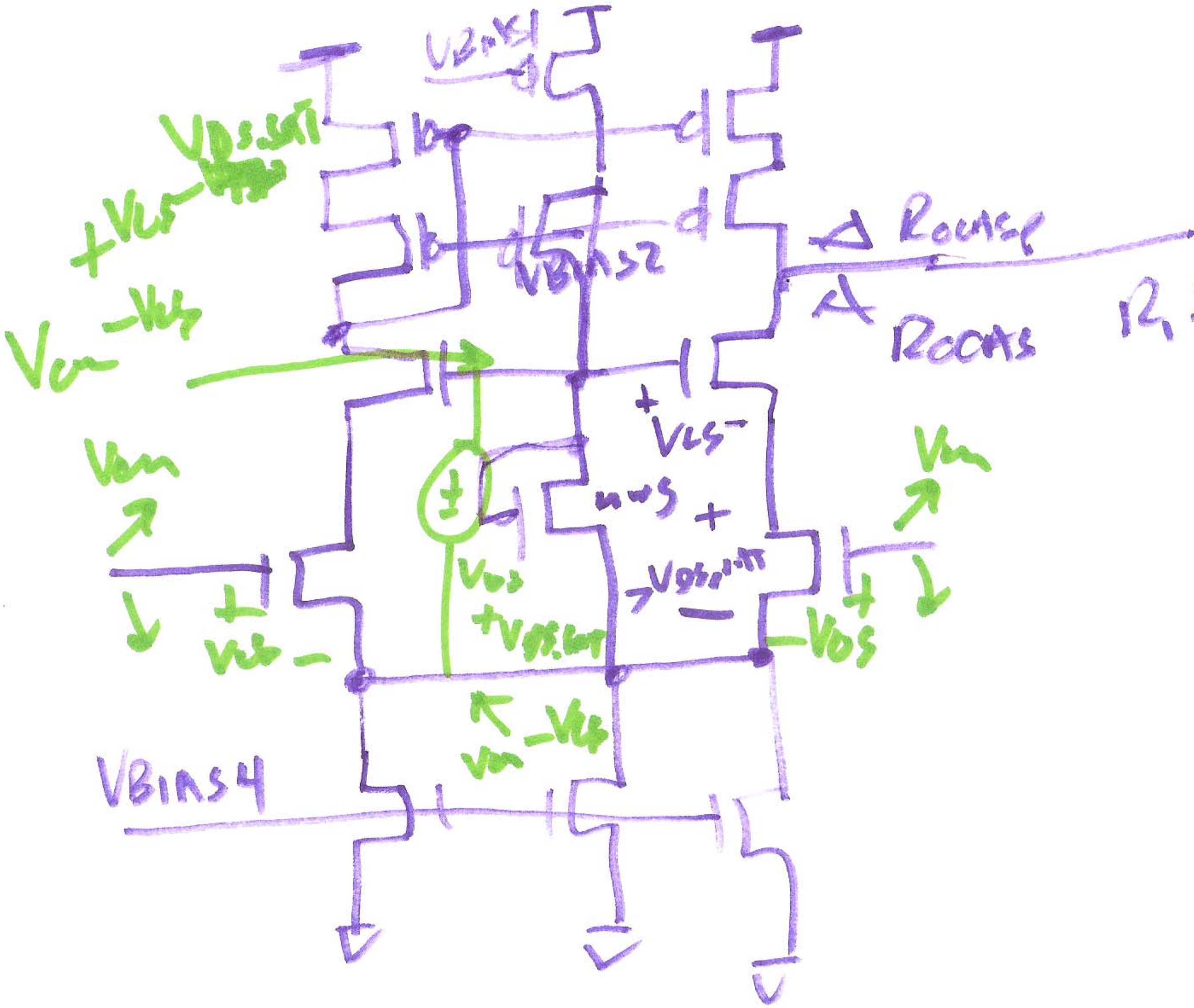
$$\frac{2V}{8} = I$$



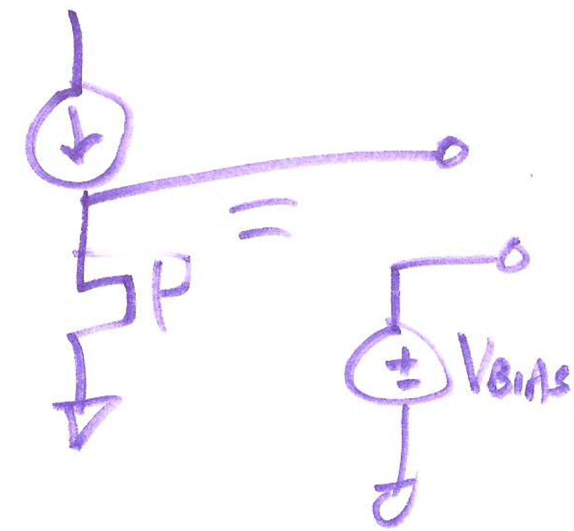
$$SR\Big|_{MAX} = V_p 2\pi \cdot f = \frac{I_{BIAS}}{C_{gs}+C_{gd}}$$

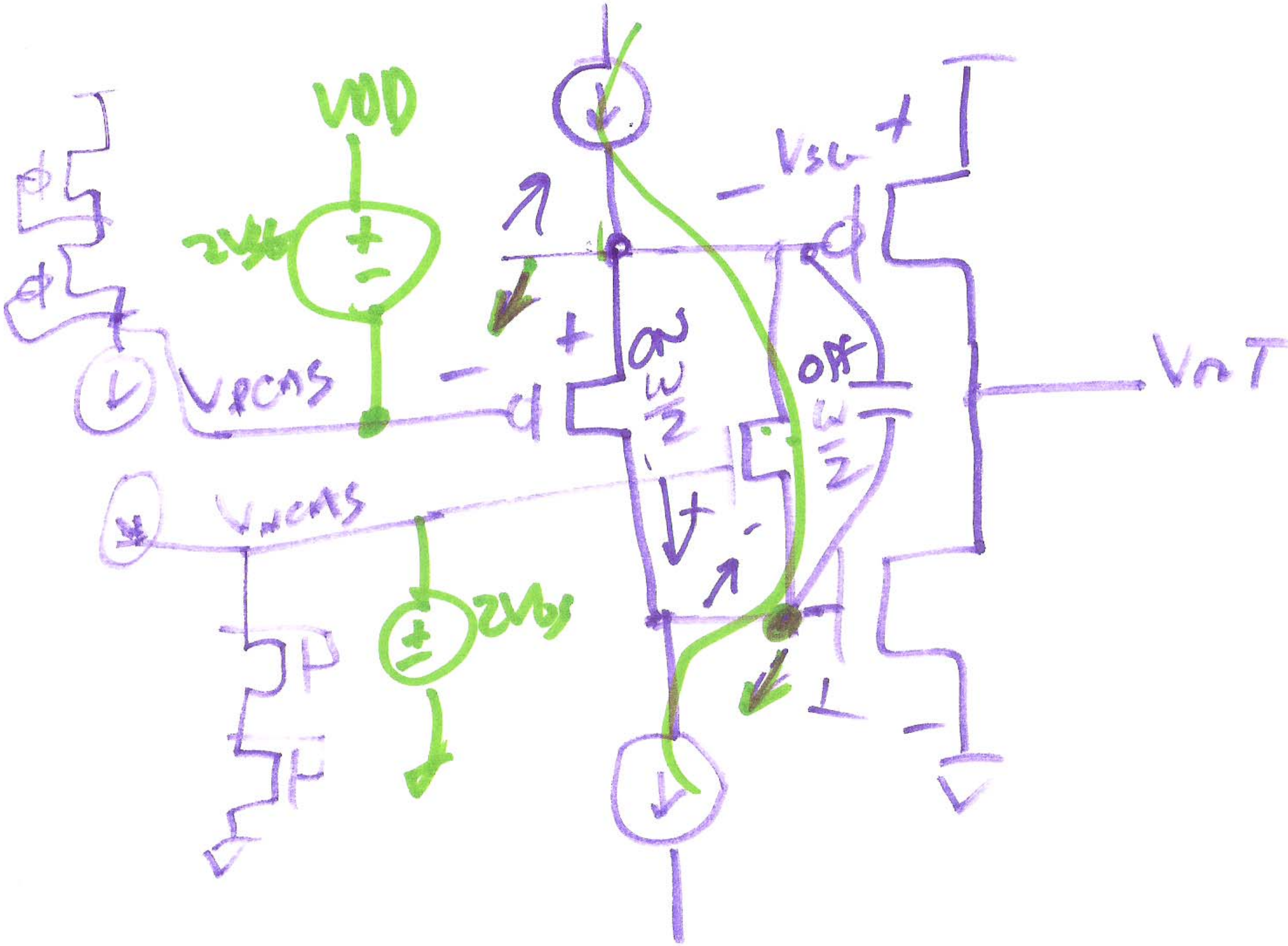
$$\frac{d}{dt} V_p \sin 2\pi f \cdot t$$

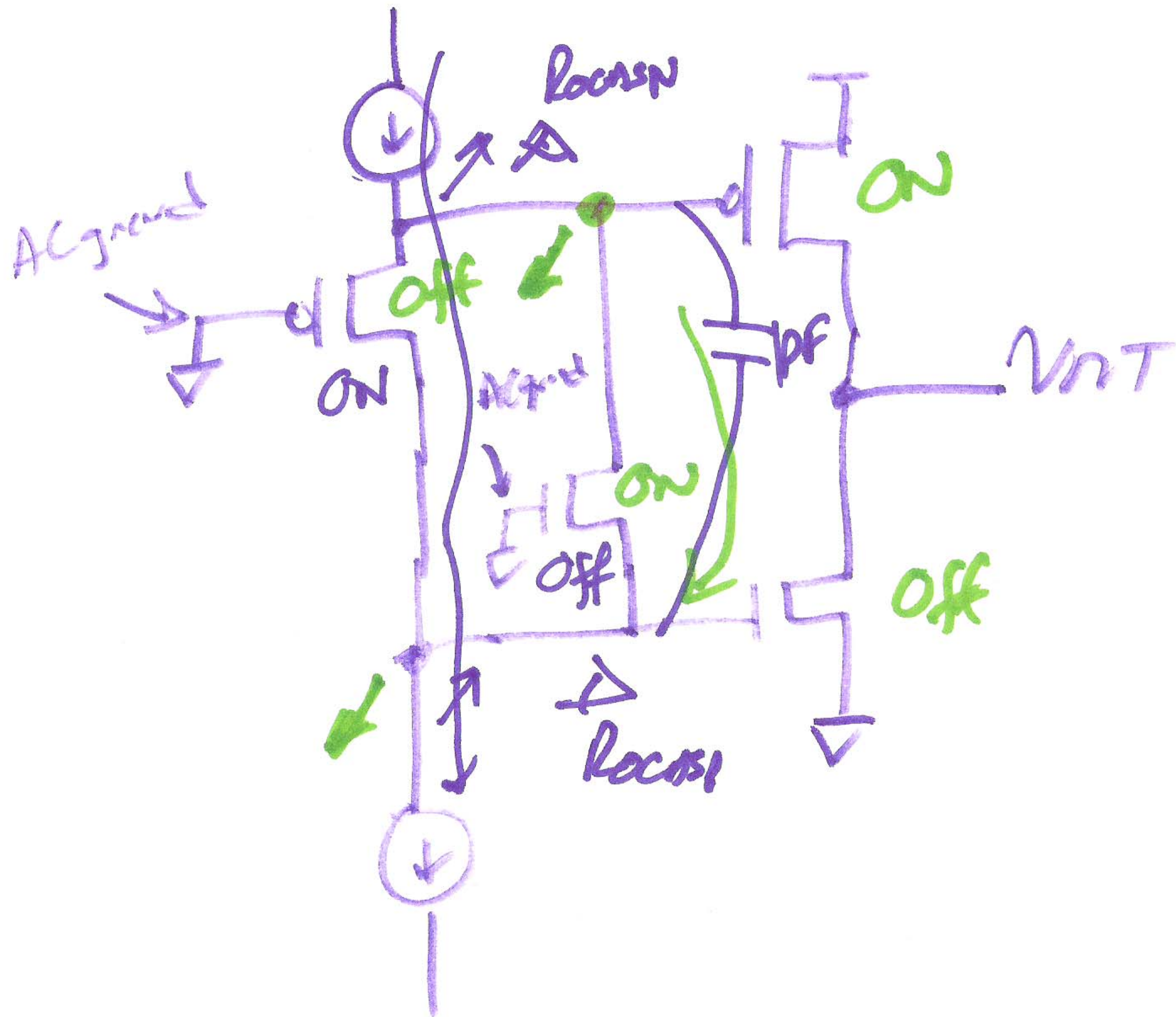
$$\underset{\text{SR}}{\text{MAX}} = V_p \cdot 2\pi f \cdot \cos 2\pi f t$$



$R_1 = R_{ocasp} || R_{ocasn}$




VDD
2Vsd
Vpcas
Vncas
2Vds
ON
W/2
OFF
W/2
Vsg
VnT



9)

OTA – operational transconductance Amp

two high impedance nodes

$$f_{3dB} = \frac{1}{2\pi r_{o}||r_{op}\, C_L}$$