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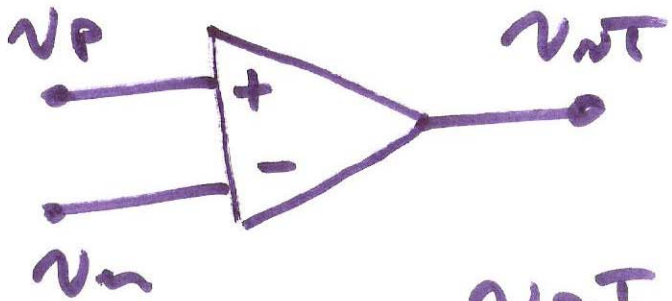
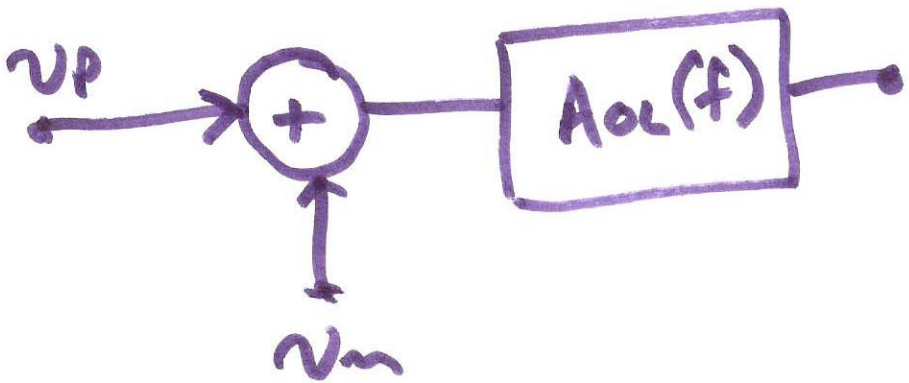
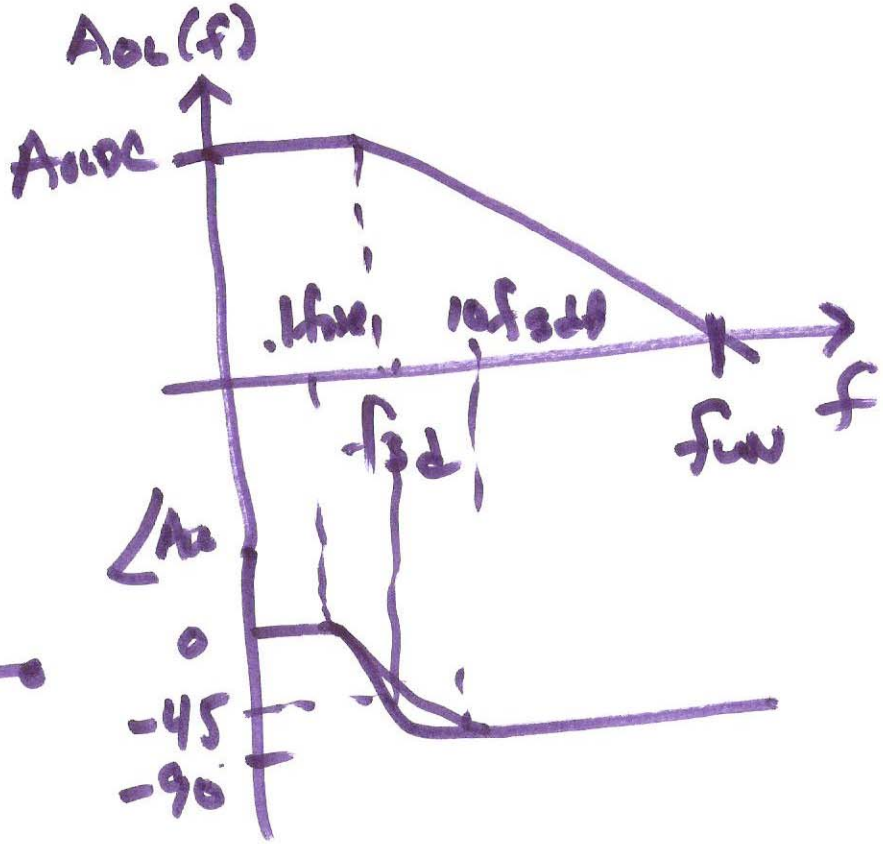
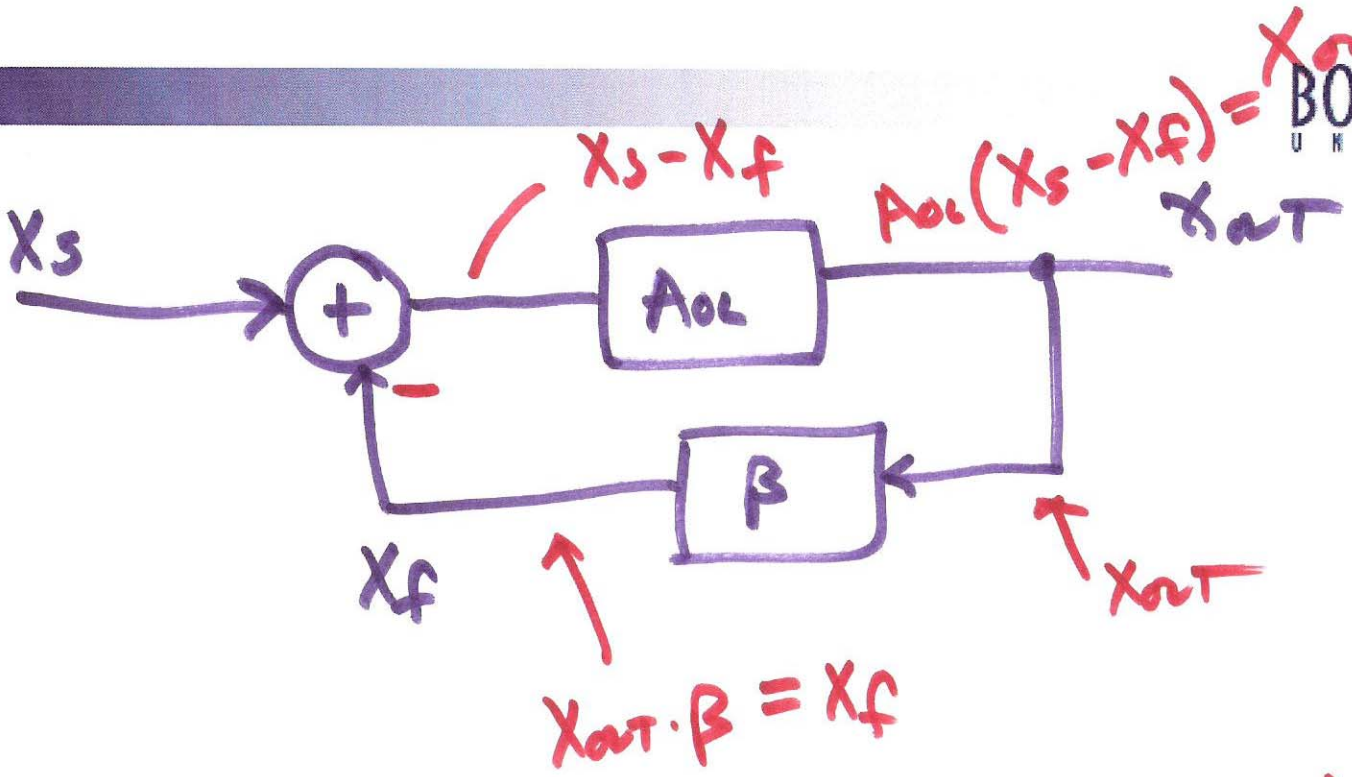
Feed back Ch. 31 Sec. 30.2



$$A_{OL}(f) = \frac{v_{nT}}{v_p - v_m}$$







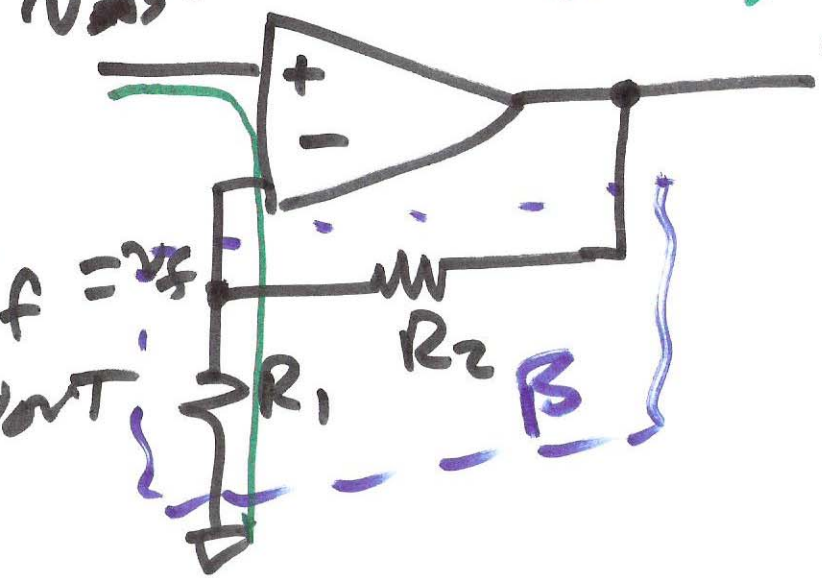
$$X_{OUT} = A_{OL}(X_S - X_{OUT} \cdot \beta)$$

$$A_{CL} = \frac{X_{OUT}}{X_S} = \frac{A_{OL}}{1 + A_{OL} \cdot \beta}, \quad A_{OL} \to \infty$$

$$A_{CL} \approx \frac{1}{\beta}$$

2)

NON-Inverting Amp



Voltage-Amplifier

Series-Shunt

$$V_S = V_{oUT} \cdot \frac{R_1}{R_1+R_2}$$

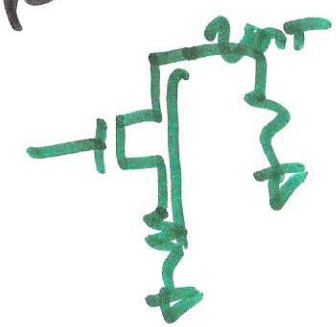
$$\frac{V_{oUT}}{V_S} = 1 + \frac{R_2}{R_1}$$

$= \beta \cdot V_{oUT}$

$$\frac{R_1}{R_1+R_2}$$

Series-Shunt

$$A_{CL} \simeq \frac{1}{\beta} = \frac{R_1+R_2}{R_1} = 1 + \frac{R_2}{R_1}$$

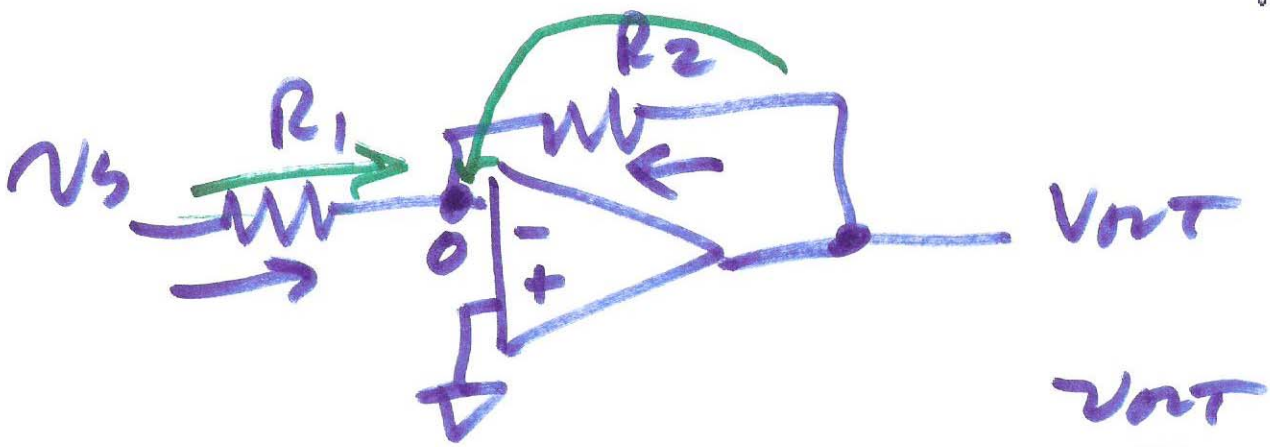


INPUT
Series - Voltage - Shunt
Shunt - current - Series

or

3)

Inverting Amplifier



$$\frac{v_{out}}{v_s} = -\frac{R_2}{R_1}$$

$$\frac{v_s}{R_1} + \frac{v_{out}}{R_2} = 0$$

INPUT OUTPUT

Shunt - shunt

i v

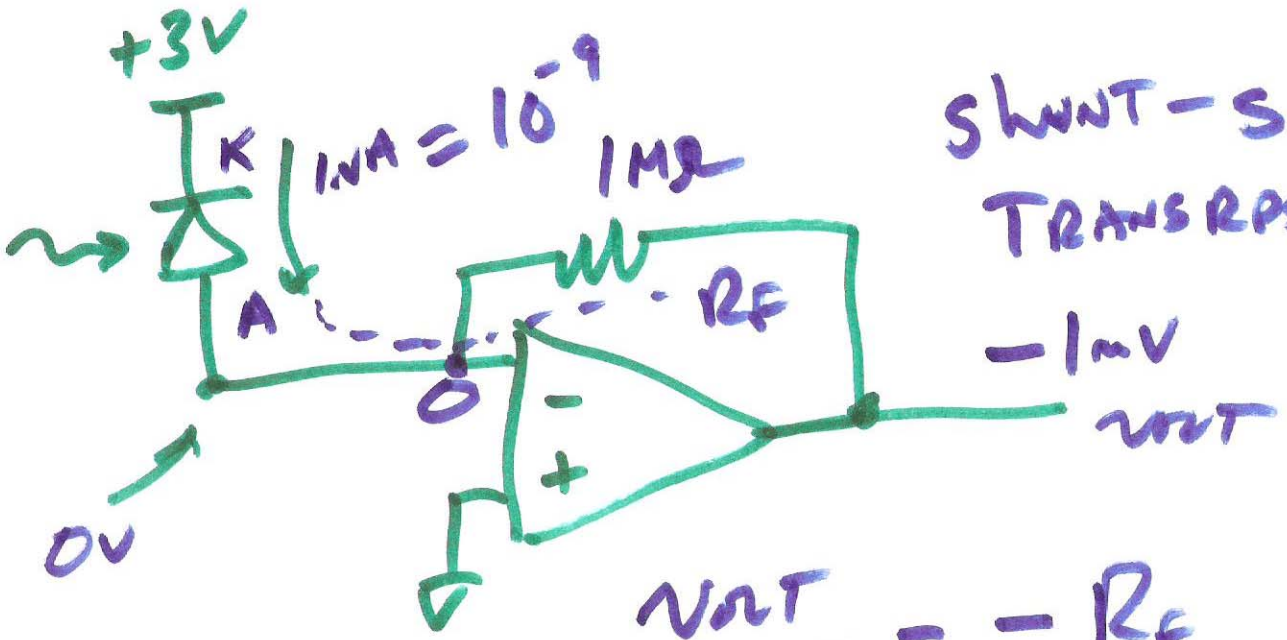
$$-R_2 = A_{CL} = \frac{v}{i} = \text{transresistance}$$

transimpedance

$$\frac{v_s}{R_1}$$

4)

Transimpedance Amp for a photodiode



dc bias is bad

shunt-shunt transresistance

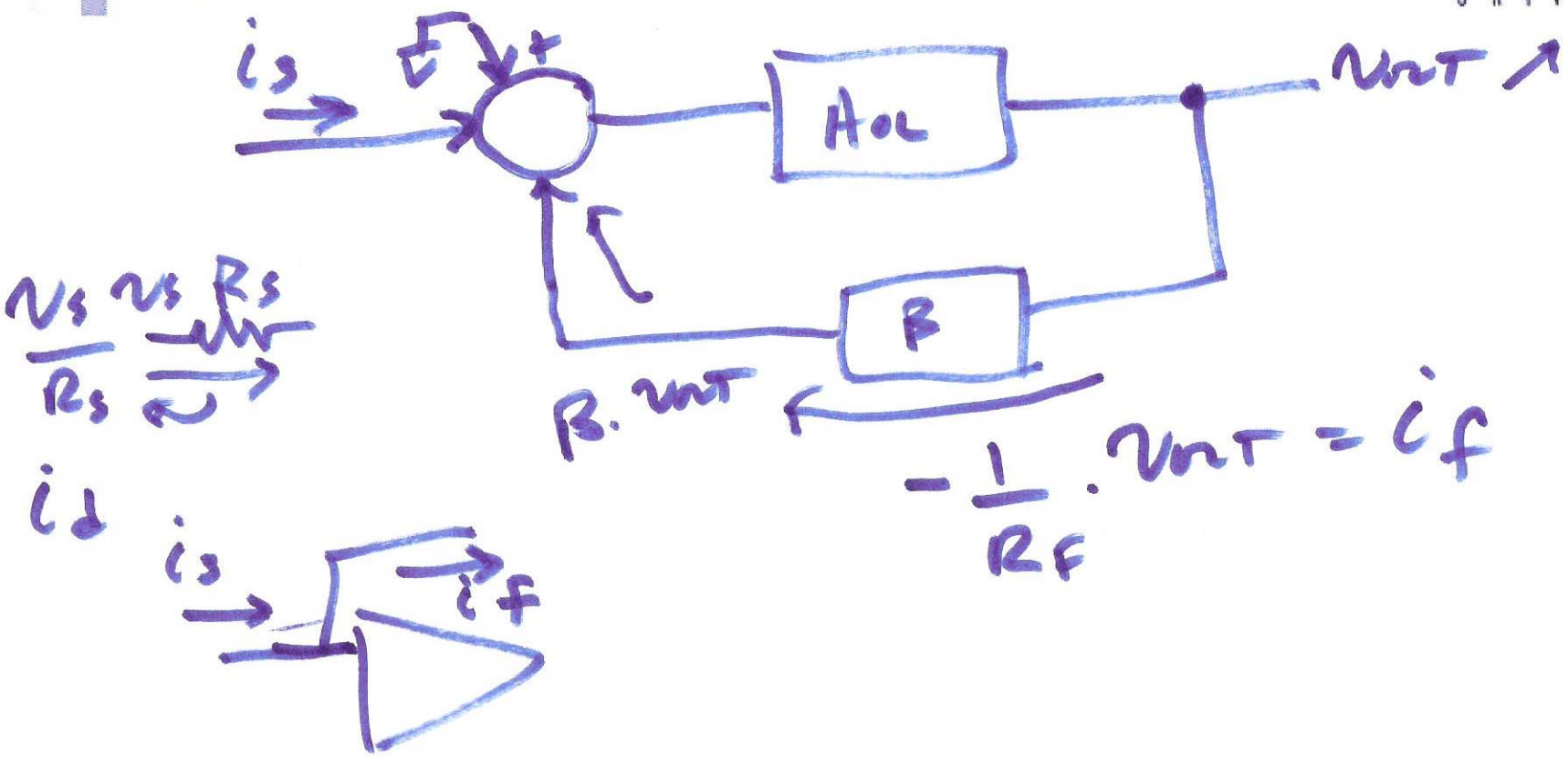
$$\frac{v_{RT}}{i_s} = -R_F$$

$$v_{RT} = -R_F \cdot i_s$$

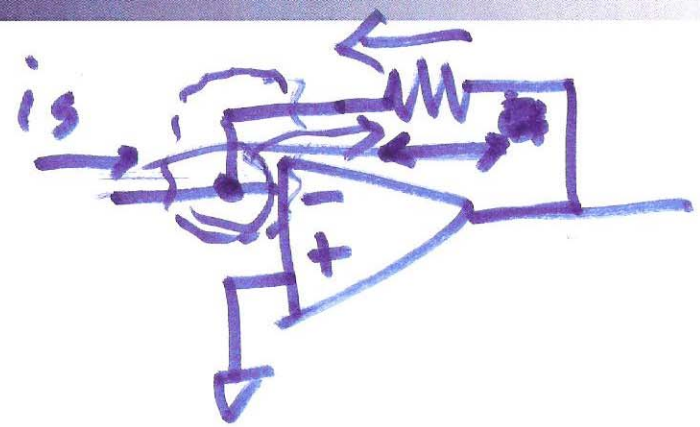
$$= -10^6 \cdot 10^{-9}$$

$$= -1mV$$

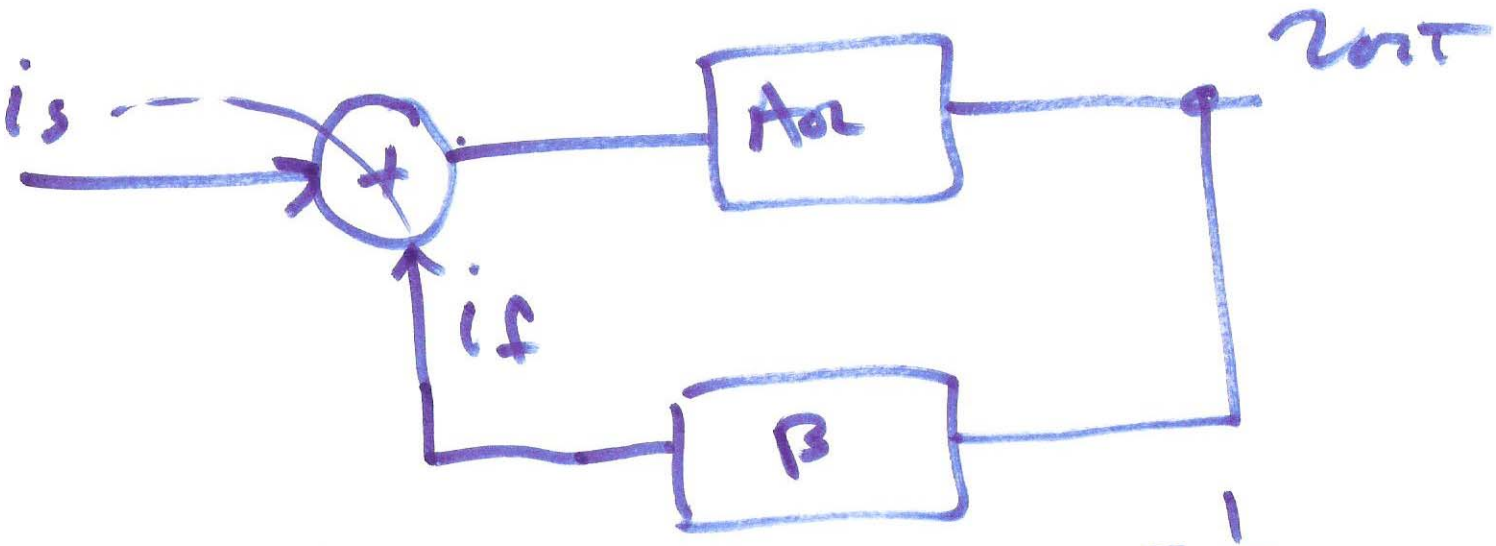
5)


i_s
A_{OL}
v_{out}
$\frac{v_s}{R_s}$ v_s R_s
B
$B \cdot v_{out}$
$-\frac{1}{R_F} \cdot v_{out} = i_f$
i_d
i_s
i_f

6)

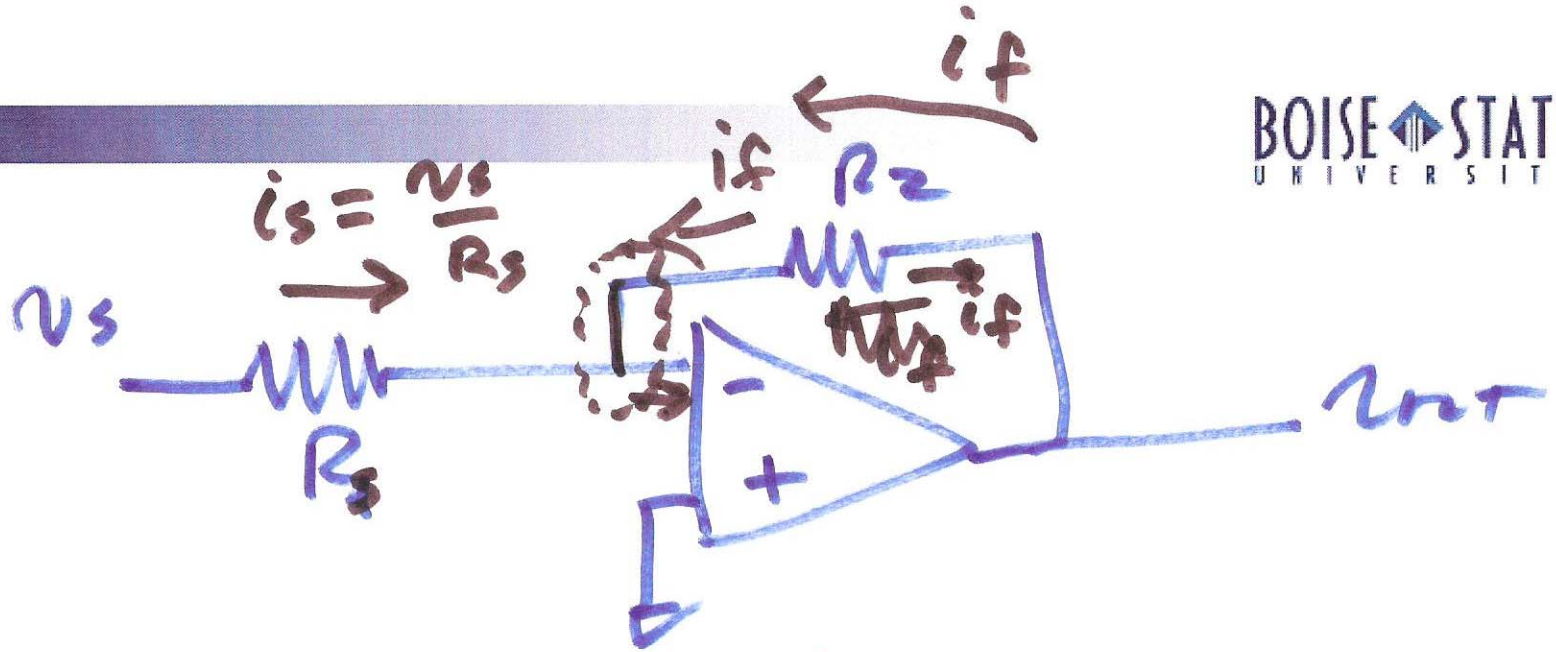


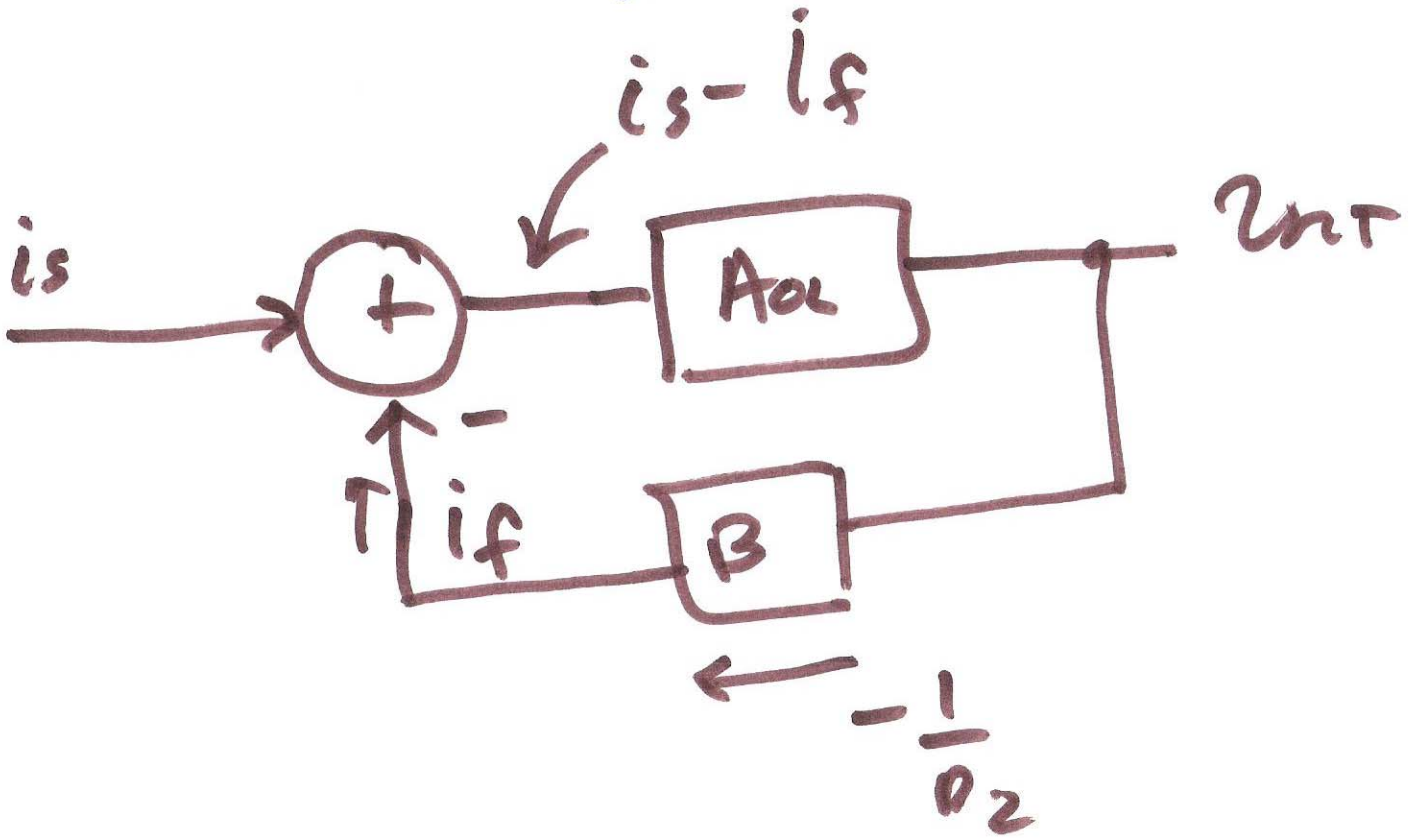
$$A_{CL} = \frac{1}{\beta}\Big|_{ideal}$$



$$i_s = \frac{v_{out}}{\beta} = -i_f \Rightarrow \beta = -\frac{1}{R_2}$$

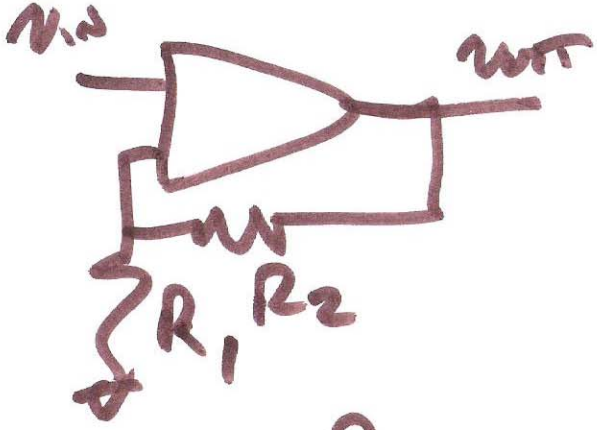
7)

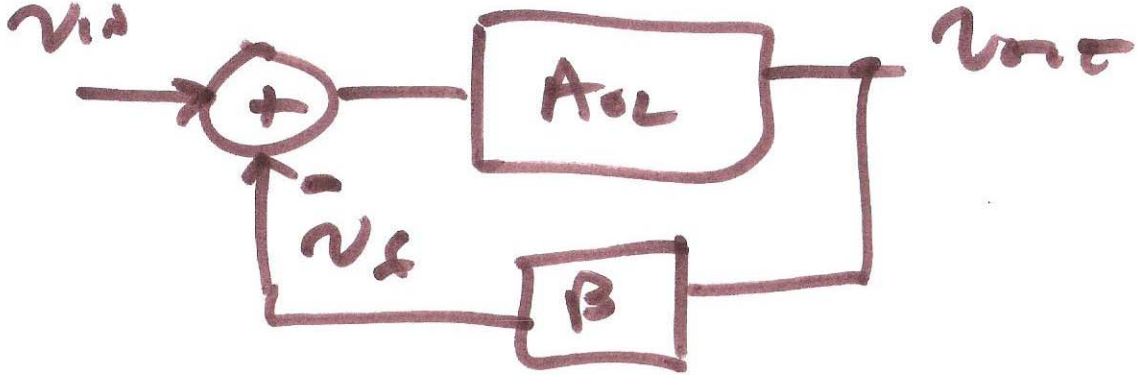

i_f
i_f
R_2
$i_s = \frac{v_s}{R_s}$
v_s
R_s
i_f
v_{out}


$i_s - i_f$
i_s
+
A_{OL}
v_{out}
−
T
i_f
B
$-\frac{1}{D_2}$

8)

Non-Inverting





$$B = \frac{R_1}{R_1 + R_2}$$

$$A_{OL} = \frac{A_{OLDC}}{1 + j\frac{f}{f_{3dB}}}$$

$$A_{CL} = \frac{A_{OL}}{1 + B \cdot A_{OL}}$$

$$|A_{OL}| = \frac{f_{UN}}{f} \quad f >> f_{3dB}$$

$f >> f_{3dB}$

$$A_{OL} \simeq \frac{1}{j \cdot \frac{f}{f_{UN}}}$$

100MHz

$$f_{UN} = f_{3dB} \cdot A_{OLDC}$$

10^3

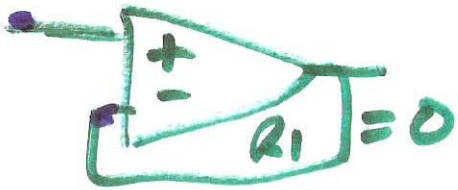
100kHz

9)

$$A_{CL}\Big|_{DC} = \left(1 + \frac{R_2}{R_1}\right) = \frac{1}{\beta}, \quad f_{UN}$$

$$1 + \frac{R_1}{R_2}$$

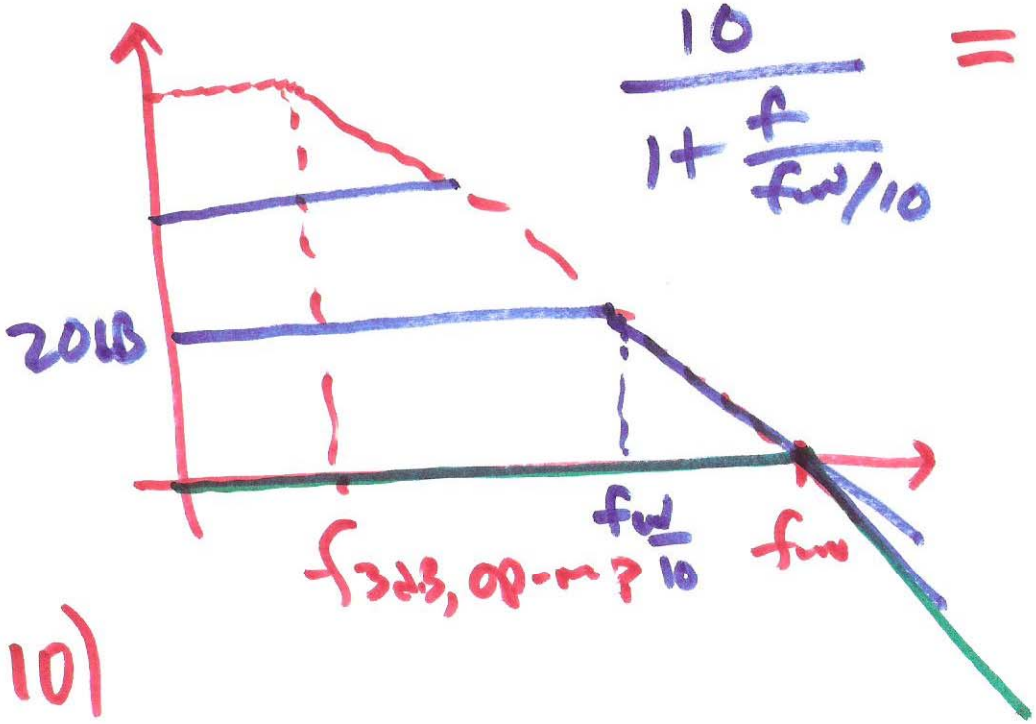
$$A_{CL}\Big|_{f >> f_{3dB}}(f) = \frac{1}{\frac{f}{f_{UN}} + \beta}$$



$R_2 = \infty$

$$\frac{10}{1 + \frac{f}{f_{UN}/10}} = \frac{\frac{1}{\beta}}{1 + \frac{f}{f_{UN}\beta}}$$

$A_{CL} = 1$



$A_{CL} = 10$

$$= \frac{A_{CL}\Big|_{DC}}{1 + \frac{f}{f_{UN}/A_{CL}}}$$

10)

Inverting topology

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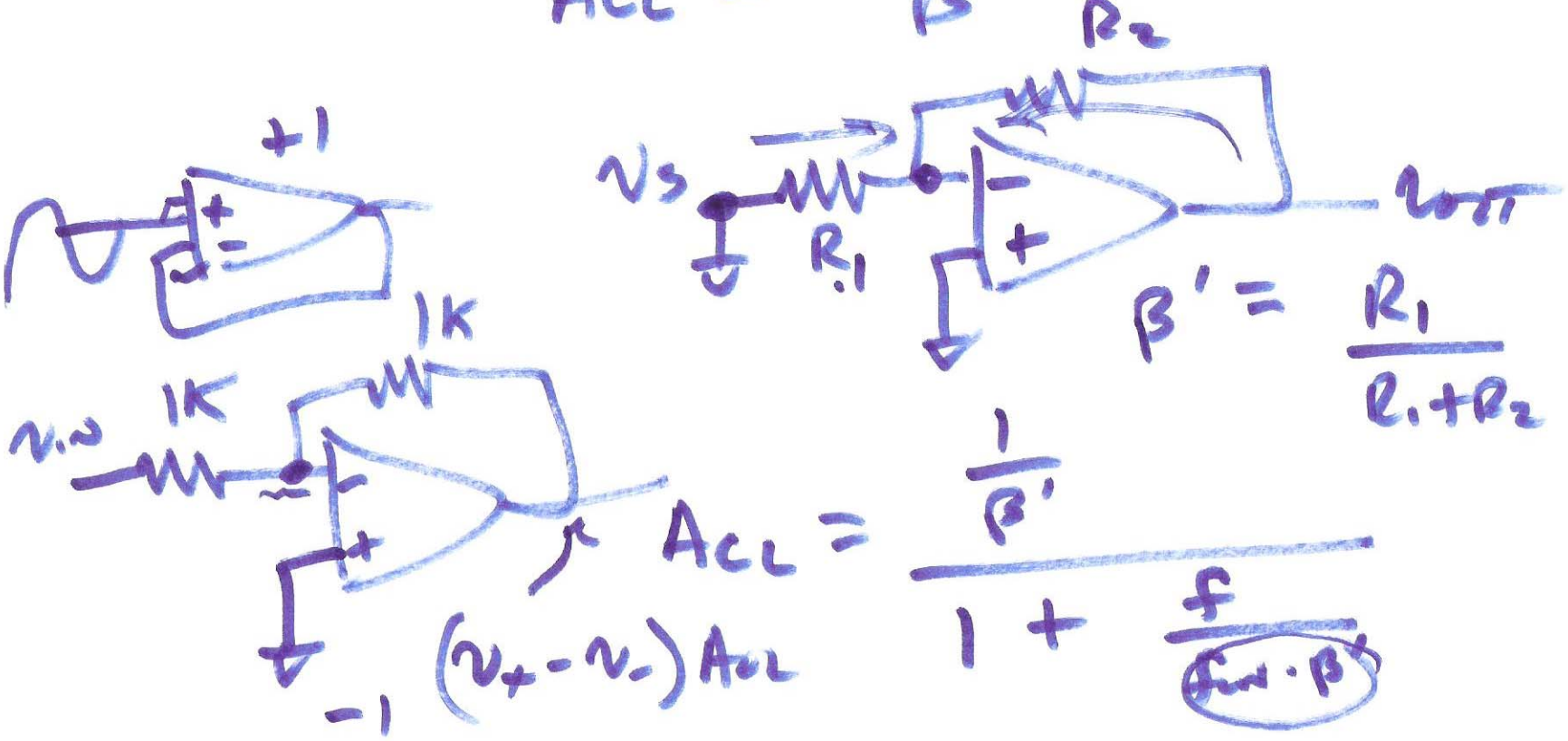
$$A_{CL} = \frac{1}{\beta}$$



$$\beta' = \frac{R_1}{R_1 + R_2}$$

$$A_{CL} = \frac{\frac{1}{\beta'}}{1 + \frac{f}{f_{ol} \cdot \beta'}}$$

$$(V_+ - V_-) A_{CL}$$

$$A_{CL}\Big|_{inverting} = \frac{1}{\beta} = -R_2$$

11)