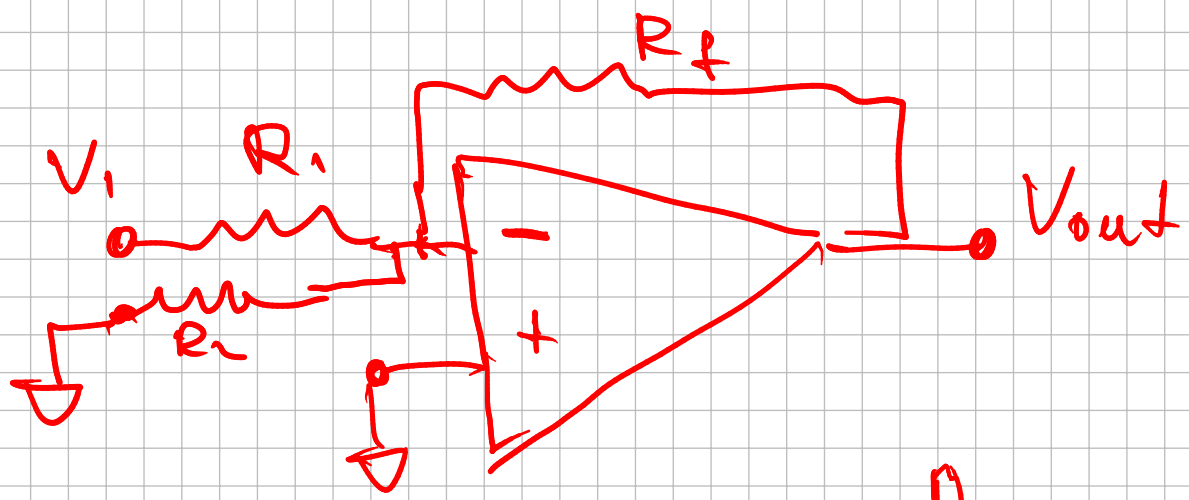
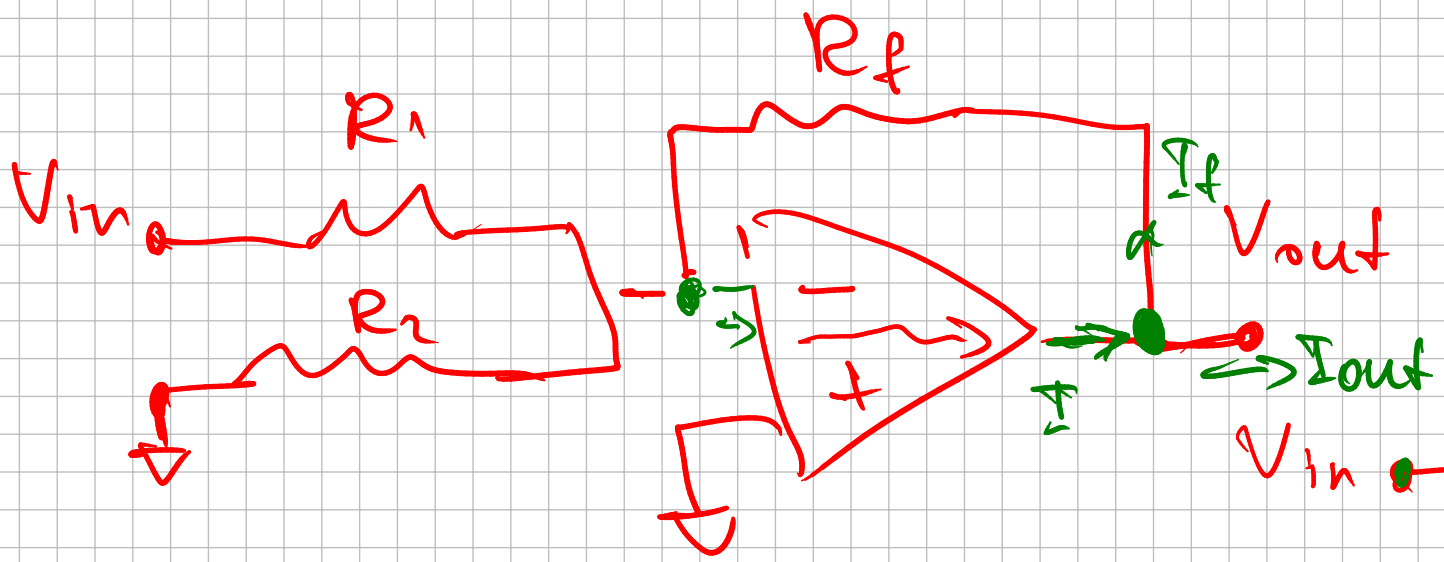
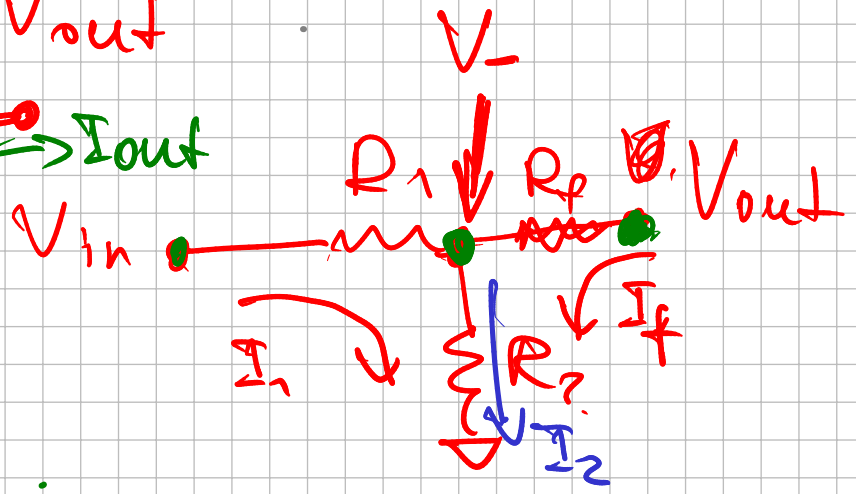
Variable bandwidth amplifier



$$V_{out} = -\frac{R_f}{R_1} \cdot V_1 + \overset{\to 0}{V_2}\left(1 + \frac{R_f}{R_{1\|2}}\right)$$

↑ True only if $A \to \infty$





$$V_{out} = A(V_+ - V_-)$$

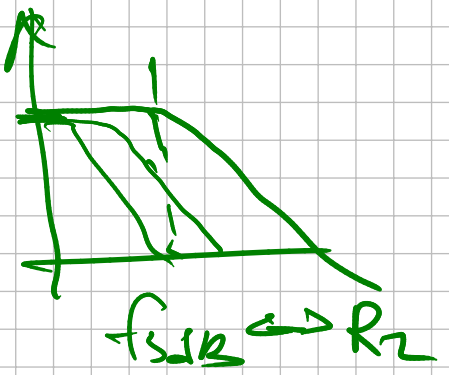
$V_+ = 0$

$$I_1 + I_f = I_2$$

$$\begin{cases} V_{out} = A_0(-V_-) & (1) \\ V_- = V_{in} - I_1 R_1 & (2) \\ I_1 + I_f = I_2 = \dfrac{V_-}{R_2} & (3) \Rightarrow \\ V_- = V_{out} - I_f \cdot R_f & (4) \end{cases}$$

$$V_- = V_{in} - I_1 R_1$$

$G_{final}(f)$



eq. 1 :

$$\vec{I}_1 = \frac{V_{in} - V_-}{R_1}$$

eq. 4:

$$I_f = \frac{V_{out} - V_-}{R_f}$$

eq 3.

$$\vec{I}_1 + \vec{I}_f = \frac{V_{in} - V_-}{R_1} + \frac{V_{out} - V_-}{R_f} = \frac{V_-}{R_2}$$

$$\boxed{V_- \approx 0}\left(\frac{1}{R_2} + \frac{1}{R_1} + \frac{1}{R_f}\right) = \frac{V_{in}}{R_1} + \frac{V_{out}}{R_f}$$

↳ eq 1

$$V_{out} = -A \cdot V_- = -\frac{A \cdot \left(\frac{V_{in}}{R_1} + \frac{V_{out}}{R_f}\right)}{\left(1/R_2 + 1/R_1 + 1/R_f\right)}$$

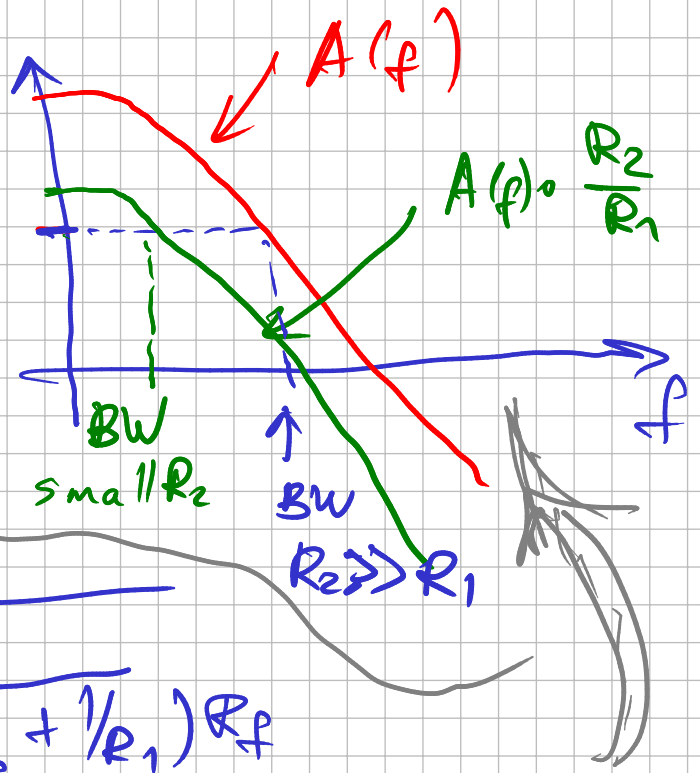
$$V_{out} = -\frac{A\left(V_{in}\frac{R_f}{R_1} + V_{out}\right)}{\left(1/R_2 + 1/R_f + 1/R_1\right)R_f}$$

$$V_{out} = \frac{-A\cdot\frac{R_f}{R_1}\cdot V_{in}}{\left(1/R_2 + 1/R_f + 1/R_1\right)R_f}$$

$$\therefore V_{out} = \frac{-A\cdot\frac{R_f}{R_1}\,V_{in}}{R_f\left(\frac{1}{R_2} + \frac{1}{R_f} + \frac{1}{R_1}\right) + A}$$

$$\frac{1}{1 + \frac{A}{\left(1/R_2 + 1/R_f + 1/R_1\right)R_f}}$$

$|G| = \frac{R_f}{R_1}$



$A \to \infty$

$$G_{final} = -\frac{R_f}{R_1}$$

$R_2 \to 0$

$\frac{R_f}{R_2} \to A(f)$

$$G_{final} = -\left(A\cdot\frac{R_2}{R_f}\right)\cdot\frac{R_f}{R_1} = -A\,\frac{R_2}{R_1}$$