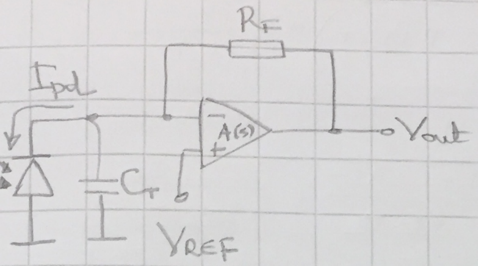


$$A(s) = \frac{A_0}{1+\frac{s}{\omega_b}}$$

$$T(s) = \frac{V_{out}}{i_{pd}} = ?$$

$$V_{out} = A(s)\left(v^+ - v^-\right) = -A(s)\,v^-$$

$$\frac{V_{out} - v^-}{R_F} = i_{pd} + sC_T v^-$$

$$\frac{V_{out}}{R_F} - i_{pd} = \left(\frac{1}{R_F} + sC_T\right)v^-$$

$$V_{out} - R_F i_{pd} = \left(1 + sR_F C_T\right)v^-$$

$$v^- = \frac{V_{out} - R_F i_{pd}}{\left(1 + sR_F C_T\right)}$$

$$V_{out} = -A(s)\,\frac{V_{out} - R_F i_{pd}}{1 + sR_F C_T}$$

$$V_{out}\left(1 + sR_F C_T\right) = -A(s)\,V_{out} + A(s) R_F i_{pd}$$

$$V_{out}\left[1 + sR_F C_T + A(s)\right] = A(s)\,R_F i_{pd}$$

$$V_{out}\left(1 + sR_F C_T + \frac{A_0}{1+\frac{s}{\omega_b}}\right) = \frac{A_0}{1+\frac{s}{\omega_b}} R_F i_{pd}$$

$$V_{out}\left(1 + \frac{s}{\omega_b} + sR_F C_T + s^2\frac{R_F C_T}{\omega_b} + A_0\right) = A_0 R_F i_{pd}$$

$$\frac{V_{out}}{I_{pd}} = \frac{A_0 R_F}{1 + A_0 + s\left(\frac{1}{\omega_b} + R_F C_T\right) + s^2 \frac{R_F C_T}{\omega_b}}$$

$$\frac{V_{out}}{I_{pd}} = \frac{A_0 \omega_b}{C_T} \frac{1}{s^2 + s\,\frac{1 + \omega_b R_F C_T}{R_F C_T} + \frac{(A_0+1)\omega_b}{R_F C_T}}$$

$$\omega_0 = \sqrt{\frac{(A_0+1)\omega_b}{R_F C_T}}$$

$$\frac{\omega_0}{Q} = \frac{1 + \omega_b R_F C_T}{R_F C_T} \Rightarrow Q = \frac{\omega_0 R_F C_T}{1 + \omega_b R_F C_T} = \sqrt{\frac{(A_0+1)\omega_b}{R_F C_T}}\,\frac{R_F C_T}{1 + \omega_b R_F C_T}$$

$$Q = \frac{\sqrt{(A_0+1)\,\omega_b R_F C_T}}{1 + \omega_b R_F C_T}$$

Im

$Q < \frac{1}{\sqrt{2}}$ (da ne bi bilo maksimuma u ampl.-frek. karakteristici)

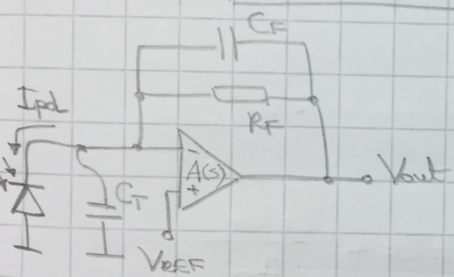
$$\frac{\sqrt{(A_0+1)\omega_b R_F C_T}}{1+\omega_b R_F C_T} < \frac{1}{\sqrt{2}}$$

$$\sqrt{2\underbrace{(A_0+1)}_{\approx A_0}\omega_b R_F C_T} < 1+\omega_b R_F C_T$$

$$2A_0\omega_b R_F C_T < \underbrace{1+2\omega_b R_F C_T}_{\ll 2A_0\omega_b R_F C_T} + \omega_b^2 R_F^2 C_T^2$$

$$2A_0\cancel{\omega_b}\cancel{R_F}\cancel{C_T} < \omega_b^{\cancel{2}} R_F^{\cancel{2}} C_T^{\cancel{2}}$$

$$\boxed{\omega_b > \frac{2A_0}{R_F C_T}}$$



$$R_F \rightarrow \frac{R_F\cdot\frac{1}{sC_F}}{R_F+\frac{1}{sC_F}} = \frac{R_F}{1+sR_FC_F}$$

$$T(s) = \frac{A_0\frac{R_F}{1+sR_FC_F}}{1+A_0+s\left(\frac{1}{\omega_b}+\frac{R_FC_T}{1+sR_FC_F}\right)+s^2\frac{R_FC_T}{(1+sR_FC_F)\omega_b}}$$

$$T(s) = \frac{A_0R_F\omega_b}{(1+A_0)\omega_b(1+sR_FC_F)+s(1+sR_FC_F+\omega_bR_FC_T)+s^2R_FC_T}$$

$$T(s) = \frac{A_0R_F\omega_b}{(1+A_0)\omega_b+s\left[\underbrace{(1+A_0)}_{\approx A_0}\omega_bR_FC_F+1+\omega_bR_FC_T\right]+s^2(R_FC_F+R_FC_T)}$$

$$T(s) = \frac{A_0\omega_b}{C_F+C_T}\cdot\frac{1}{\frac{(1+A_0)\omega_b}{R_F(C_F+C_T)}+s\frac{1+\omega_bR_F(C_FA_0+C_T)}{R_F(C_F+C_T)}+s^2}$$

$$\omega_0 \approx \sqrt{\frac{A_0\omega_b}{R_F C_T}} \quad ; \; A_0 \gg 1 , \; C_T \gg C_F$$

$$\frac{\omega_0}{Q} \approx \frac{1 + \omega_b R_F (C_T + A_0 C_F)}{(C_T + C_F) R_F} \approx \frac{1 + \omega_b R_F (C_T + A_0 C_F)}{C_T R_F}$$

$$Q = \sqrt{\frac{A_0\omega_b}{R_F C_T}} \cdot \frac{C_T R_F}{1 + \omega_b R_F C_T} = \frac{\sqrt{A_0 \omega_b C_T R_F}}{1 + \omega_b R_F (C_T + A_0 C_F)}$$

$$Q = \frac{\sqrt{\frac{C_T R_F}{A_0 \omega_b}}}{\frac{1}{A_0 \omega_b} + R_F \left(C_F + \frac{C_T}{A_0}\right)}$$

$$Q < \frac{1}{\sqrt{2}}$$

$$\frac{\sqrt{\frac{C_T R_F}{A_0 \omega_b}}}{\frac{1}{A_0 \omega_b} + R_F \left(C_F + \frac{C_T}{A_0}\right)} < \frac{1}{\sqrt{2}}$$

$$\sqrt{\frac{2 C_T R_F}{A_0 \omega_b}} < \frac{1}{A_0 \omega_b} + R_F C_F + \frac{R_F C_T}{A_0}$$

$$C_F > \sqrt{\frac{2 C_T}{A_0 \omega_b R_F}} - \frac{1}{A_0 \omega_b R_F} - \frac{C_T}{A_0}$$