ESERCITAZIONE 3 03/04/2020

MODULO K :

$$R_{EP} = R_{EP\phi}\left(1 + k(L - L_0)\right)$$

$R_{EP\phi} = 50\ k\Omega$

$K = 0.2\ cm^{-1}$

$L_0 = 1.5\ cm$

$L \in [1.5 \div 2]\ cm$

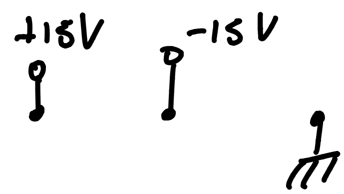
$$L = L_0 \Rightarrow R_{EP} = R_{EP\phi}\left(1 + k(L_0 - L_0)\right) = R_{EP\phi}$$

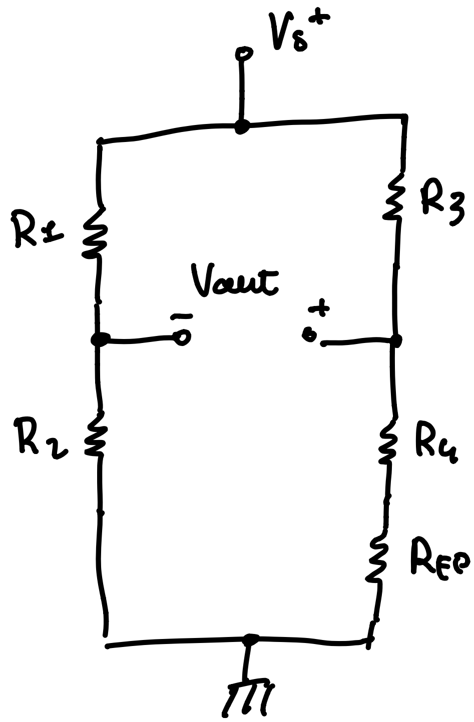
$$R_{EP} = R_{EP\phi} + \underbrace{R_{EP\phi} \cdot k(L - L_0)}_{\Delta R_{EP}}$$

$V_s = \pm 15V$

$V_s^+ = 15V$

$V_s^- = -15V$





1) $x \ll 1$

$$\frac{\Delta R_{EP}}{R_{EP0} + R_4} \ll 1$$

2) BILANCIAMENTO DEL PONTE

$$\frac{R_1}{R_2} = \frac{R_3}{R_{EP0} + R_4} = K$$

3) η_{MAX}

$K = 1$

$R_4 = 450 \text{ k}\Omega$

2) + 3) $\Rightarrow R_1 = R_2 = R_3 = R_4 + R_{EP0} = 300 \text{ k}\Omega$

$$\Rightarrow \quad V_{out_{diff}} = \frac{V_s}{4} \cdot \frac{1}{R_{EP0} + R_4} \cdot \Delta R_{EP0}$$

$$V_{out_c} = \frac{V_s}{2}$$

$$V_{out_c} = \frac{V_s}{2} = \frac{15}{2} = 7.5 \text{ V}$$

$$V_{out_{diff}} = \frac{V_s}{4} \cdot \frac{1}{R_{EP0} + R_4} \cdot R_{EP0}\, k\,(L - L_0)$$

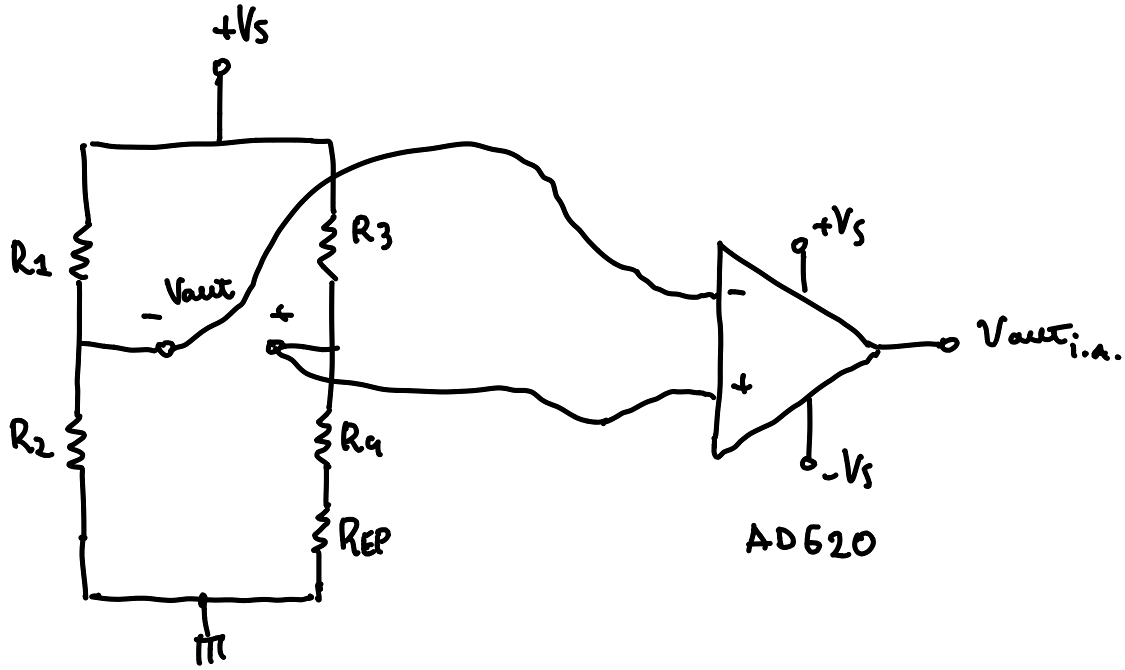
$L \in [1.5 \div 2]\ cm$

$L_0 = 1.8\ cm$

$L = L_0 \Rightarrow Vout_{diff} = Vout_{diff\ min} = \varnothing\ V$

$L = L_{MAX} = 2cm \rightarrow Vout_{diff} = Vout_{diff\ MAX} = 37.5\ mV$

$Vout_{diff} \in [\varnothing\ ;\ 37.5]\ mV$



IN. AMP A 3 OP. AMP

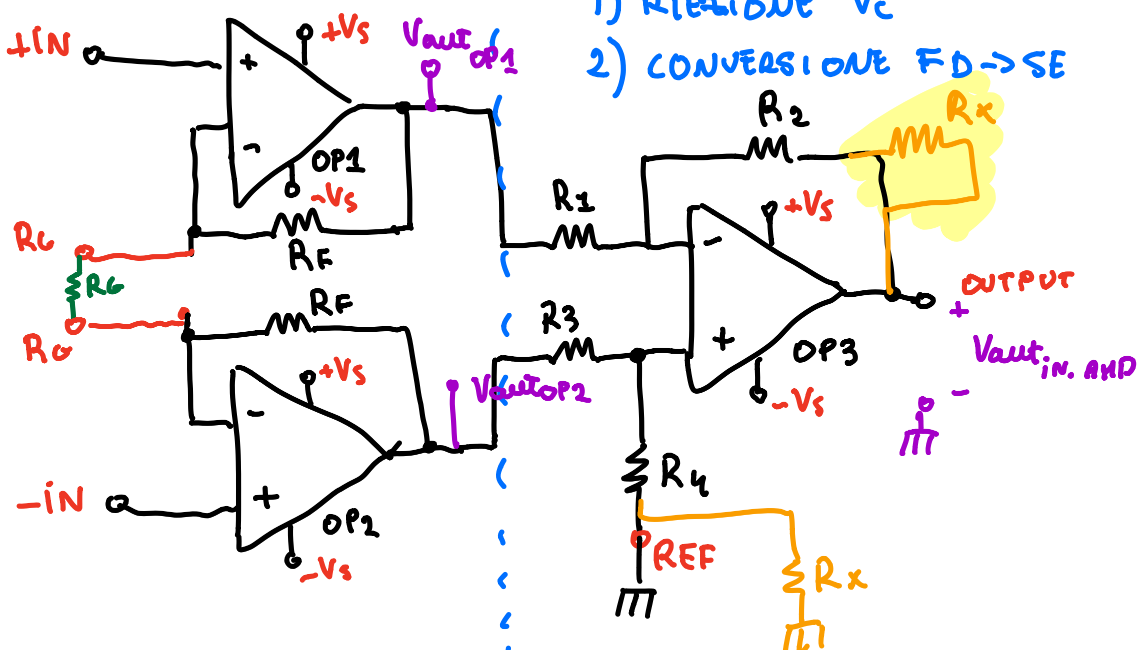
STADIO DI INGRESSO

$A_d = G$

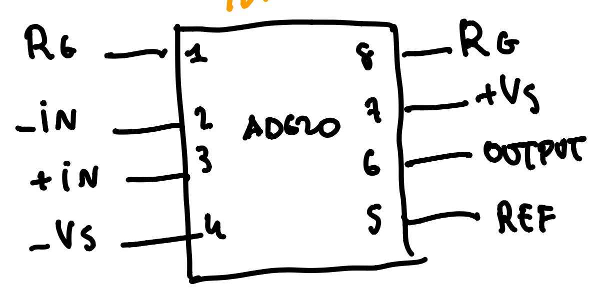
STADIO DI USCITA DIFFERENZIALE

1) REIEZIONE V_c

2) CONVERSIONE FD -> SE



$V_d = V_1 - V_2$



$Vout_c = Vout_{P.W.c} = 4.5\,V$

$Vout_{diff} = Vout_{P.W.diff} \in [\phi\ ;\ 37.5]\,mV$

1) SATURAZIONE DEL I° STADIO
2) SATURAZIONE DEL 2° STADIO
3) CONDIZIONE SULLA BANDA PASSANTE

1)

$$V_{out\,OP1} = A_d \cdot \frac{V_d}{2} + V_c$$
$$V_{out\,OP2} = A_d \cdot \left(-\frac{V_d}{2}\right) + V_c$$

$$V_{SAT\,min} \leq V_{out\,OP1} \leq V_{SAT\,MAX} \leftarrow$$
$$V_{SAT\,min} \leq V_{out\,OP2} \leq V_{SAT\,MAX} \leftarrow$$

$V_{SAT\,MAX}$, $V_{SAT\,min}$ dal datasheet !

$$V_{SAT\,MAX} = V_S - 1.4\ V = 15 - 1.4 = 13.6\ V$$
$$V_{SAT\,min} = -V_S + 1.9\ V = -15 + 1.9 = -13.1\ V$$

$$V_{out\,OP1} = \underset{\uparrow \atop 7.5V}{V_c} + A_d \cdot \underset{\uparrow \atop V_d \in [\phi\,;\,37.6]\ mV}{\frac{V_d}{2}}$$

$$V_c + A_d \cdot \frac{V_{d\,MAX}}{2} \leq V_{SAT\,MAX}$$

$$\rightarrow \quad A_d \cdot \frac{V_{d\,MAX}}{2} \leq V_{SAT\,MAX} - V_c$$

$$A_d \leq 2 \cdot (V_{SAT\,MAX} - V_c) / V_{d\,MAX} = 325$$

$$V_{out\,OP2} = \underset{\uparrow \atop 7.5V}{V_c} - A_d \cdot \underset{\uparrow \atop V_d \in [\phi\,;\,37.5]\ mV}{\frac{V_d}{2}}$$

$$V_{S\,MAX\,min} \leq V_C - A_d \cdot \frac{V_{dMAX}}{2}$$

$$V_{S\,MAX\,min} - V_C \leq -A_d \cdot \frac{V_{dMAX}}{2}$$

$$-\frac{2 \cdot (V_{S\,MAX\,min} - V_C)}{V_{dMAX}} \geq A_d$$

$$A_d \leq 1098$$

$$\begin{cases} A_d \leq 325 \\ A_d \leq 1098 \end{cases} \Rightarrow \underline{A_d \leq 325}$$

$$G = A_d = 1 + \frac{2R_F}{R_G}$$

$$2 \cdot R_F = 49.4\,k\Omega$$

$$G = 1 + \frac{49.4\,k\Omega}{R_G}$$

$$A_d \leq 325 \Rightarrow A_d = 325$$

$$325 = 1 + \frac{49.4\,k\Omega}{R_G}$$

$$325 - 1 = \frac{49.4\,k\Omega}{R_G}$$

$$R_G = \frac{49.4\ K\Omega}{325 - 1} = 152\ \Omega$$

2) $V_{SAT_{min}} \le V_{out_{I.A}} \le V_{SAT_{MAX}}$

$$V_{SAT\,MAX} = +V_S - 1.4V = 15 - 1.4 = 13.6\ V$$

$$V_{SAT\,min} = -V_S + 1.2V = -15 + 1.2 = -13.8\ V$$

$$V_{out_{i.A}} = A_{d1} \cdot A_{d2} \cdot V_d = G \cdot V_d$$

$A_d = G$ $\quad\quad 1 \quad (R_1 = R_2 = R_3 = R_4)$

$$V_{SAT\,min} \le G \cdot V_d \le V_{SAT\,MAX}$$

$$\downarrow$$

$$V_d \in [\phi\ ;\ 37.5]\ mV$$

$\rightarrow \quad G \cdot V_{d_{MAX}} \le V_{SAT\,MAX}$

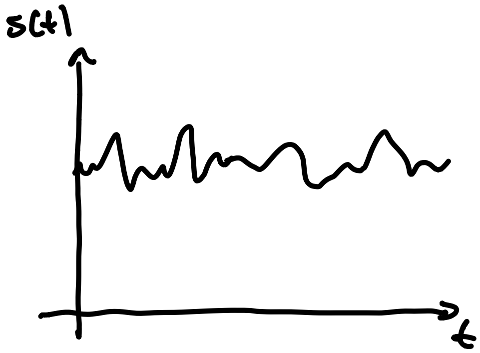
$$G \le \frac{V_{SAT\,MAX}}{V_{d\,MAX}} = 362$$

$$\begin{cases} G \le 325 \\ G = 362 \end{cases} \Rightarrow \underline{G \le 325} \rightarrow R_G = 152\ \Omega$$

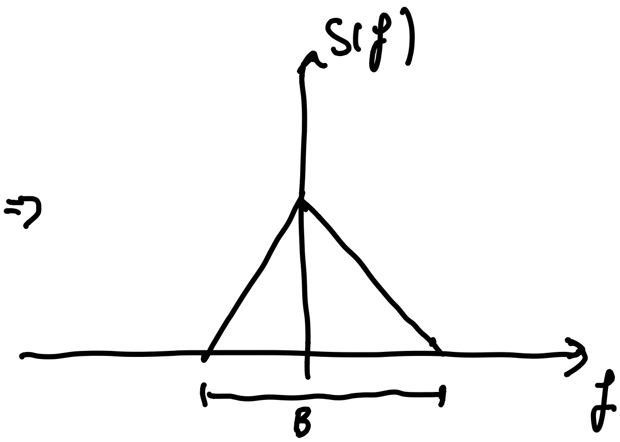
$$V_{out_{i.A.}} = G \cdot V_d = 325 \cdot V_d \in [\phi\ ;\ 37.5 \cdot 325]\ mV$$

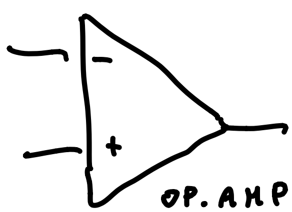
$$\in [\phi\ ;\ 12.2]\ V$$

3) Banda Passante := Comportamento in frequenza

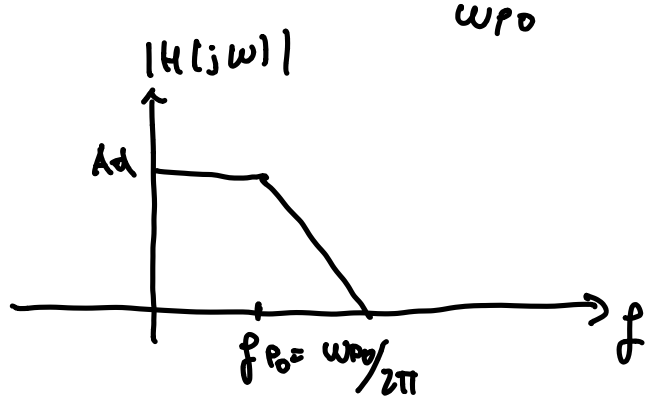


$\Rightarrow$

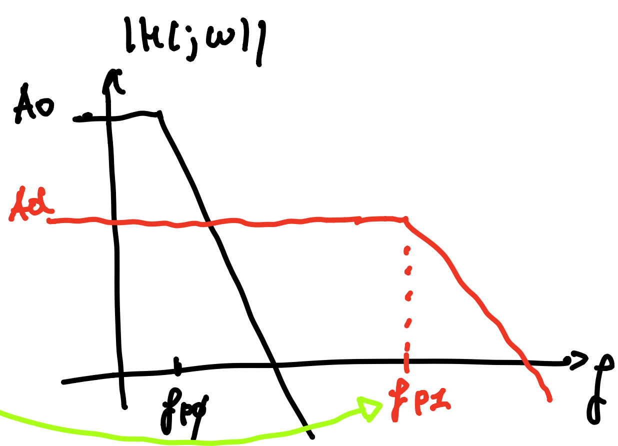




$$H(j\omega) = \frac{A_d}{1 + j\frac{\omega}{\omega_{p0}}}$$



$PGB_{o.l.} = A_0 \cdot f_{p0}$



$PGB_{c.l.} = A_d \cdot f_p$

$PGB_{o.l.} = PGB_{c.l.}$

$\rightarrow A_0 \cdot f_{p0} = A_d \cdot f_p$

$$\frac{A_0}{A_d} \cdot f_{p0} = f_p$$

3) $B = 100$ Hz

$G = 325$

quando $G = 100 \rightarrow f_P = 40$ KHz

quando $G = 1000 \rightarrow f_P = 4$ KHz

Essendo $B < f_{P_{G=1000}} \Rightarrow$ condizione della banda passante è rispettata!