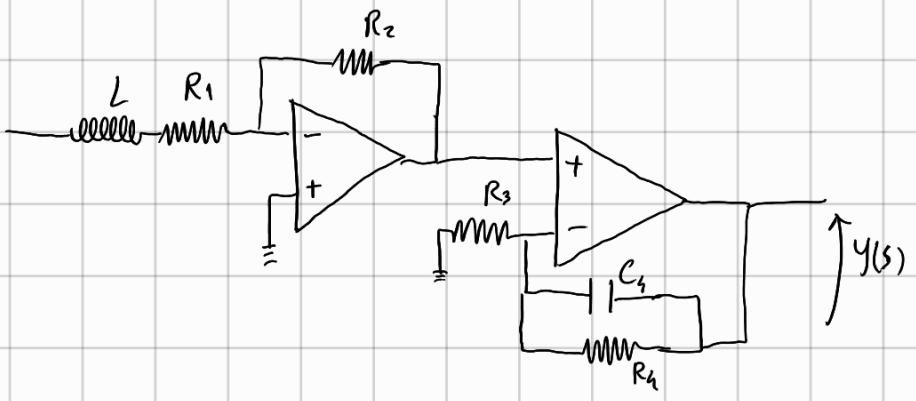
1)



$$Z_{1in}(s) = R_1 + sL$$

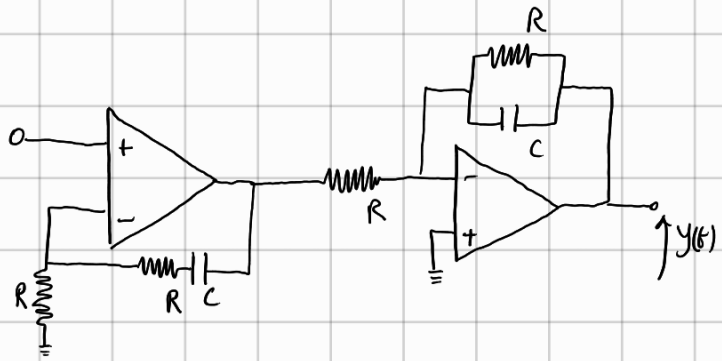
$$W_1(s) = -\frac{R_2}{R_1 + sL} = -\frac{R_2}{R_1} \cdot \frac{1}{1 + s\frac{L}{R_1}}$$

$$Z_{2in}(s) = R_3 \qquad Z_{2out}(s) = \frac{R_4}{1 + R_4 C_4 s} \qquad W_2(s) = 1 + \frac{R_4}{R_3} \cdot \frac{1}{1 + R_4 C_4 s} =$$

$$= \frac{R_4 + R_3(1 + R_4 C_4 s)}{R_3(1 + R_4 C_4 s)}$$

$$W(s) = -\frac{R_2}{R_1} \cdot \left(\frac{1}{1 + s\frac{L}{R_1}} \right) \cdot \frac{R_4 + R_3(1 + R_4 C_4 s)}{R_3(1 + R_4 C_4 s)}$$

2)



$$W_2(s) = -\frac{Z_{out}(s)}{Z_{in}(s)}$$

$$Z_{out}(s) = \frac{R}{1+RCs}$$

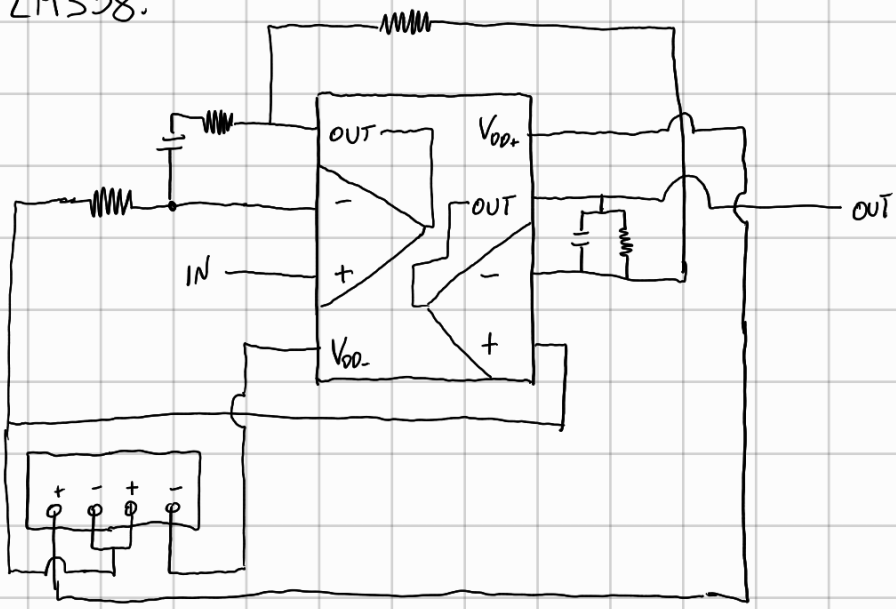
$$W_2(s) = -\frac{1}{1+RCs}$$

$$W_1(s) = 1 + \frac{Z_{out}(s)}{Z_{in}(s)} \qquad Z_{out}(s) = R + \frac{1}{sC} = \frac{1+RCs}{sC}$$

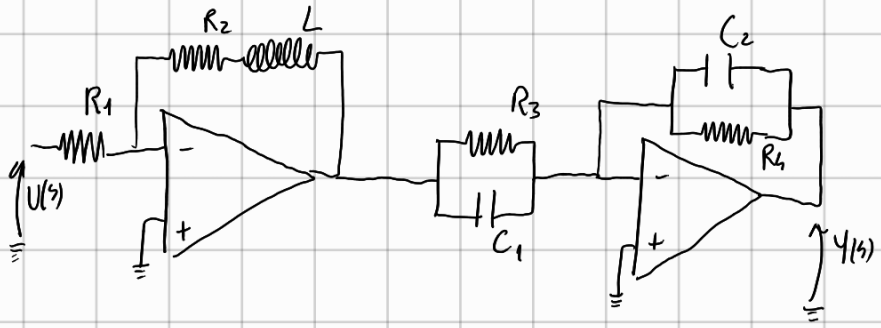
$$W_1(s) = 1 + \frac{1+RCs}{RCs} = \frac{1+2RCs}{RCs} \qquad W(s) = -\frac{1+2RCs}{(1+RCs)(RCs)}$$

$$\gamma_1 = \frac{1}{RC} \qquad \gamma_2 = 0.5\gamma_1$$

LM358:



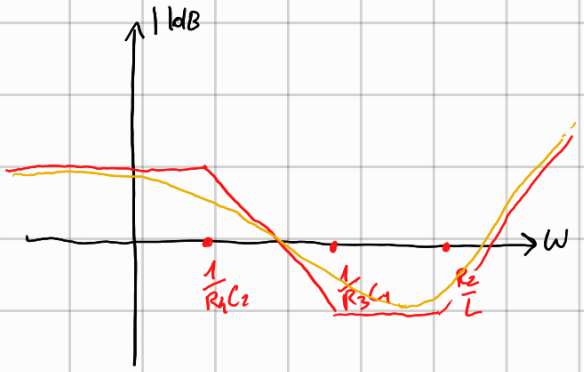
3)

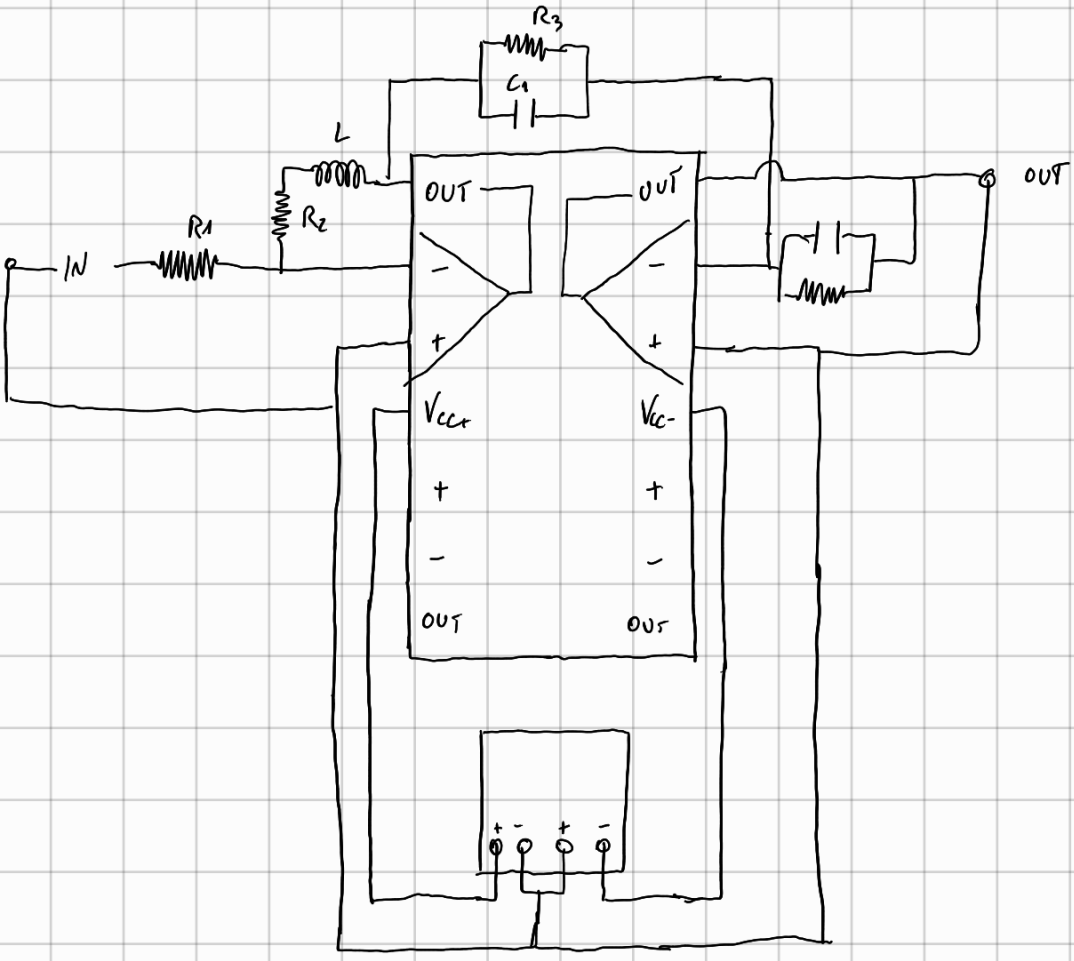


$$Z_{out_1}(s) = R_2 + sL \qquad W_1(s) = -\left(\frac{R_2}{R_1} + \frac{sL}{R_1}\right) = -\frac{R_2}{R_1}\left(1 + \frac{sL}{R_2}\right)$$

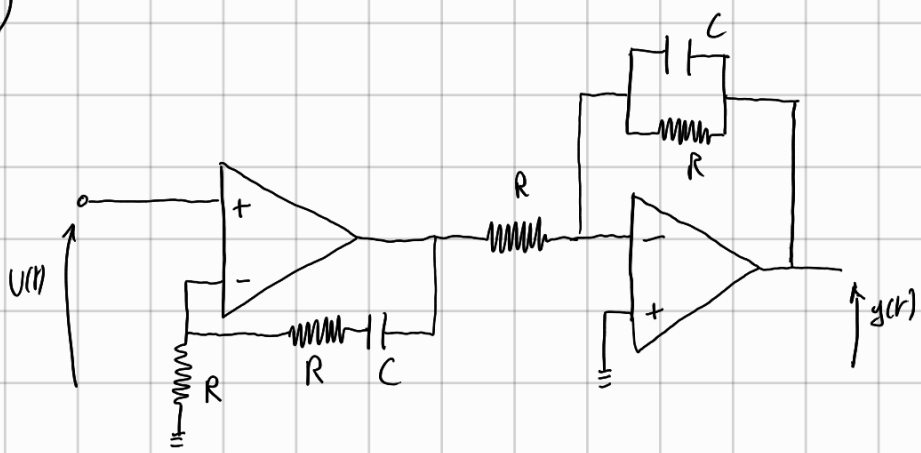
$$Z_{out_2}(s) = \frac{R_4}{1+R_4C_2s} \qquad Z_{in_2}(s) = \frac{R_3}{1+R_3C_1s} \qquad W_2(s) = -\frac{R_4}{R_3}\cdot\frac{1+R_3C_1s}{1+R_4C_2s}$$

$$W(s) = \frac{R_2}{R_1}\cdot\frac{\overset{1}{\left(1+s\frac{L}{R_2}\right)}\overset{2}{\left(1+R_3C_1s\right)}}{\underset{3}{1+R_4C_2s}}$$



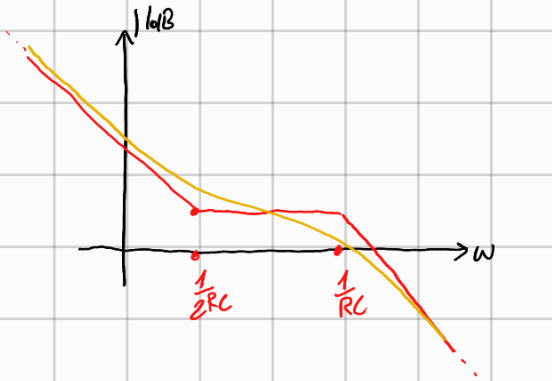

R3
C1
L
R1
R2
IN
OUT
OUT
OUT
−
+
−
+
Vcc+
Vcc-
+
−
+
−
OUT
OUT
+ − + −

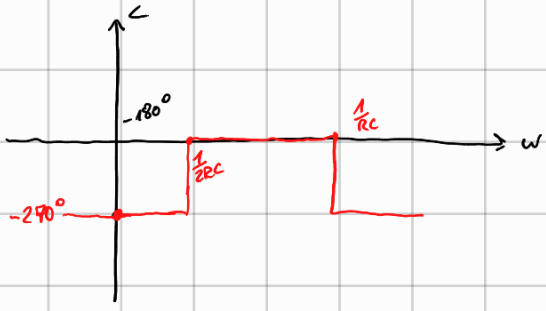
2)

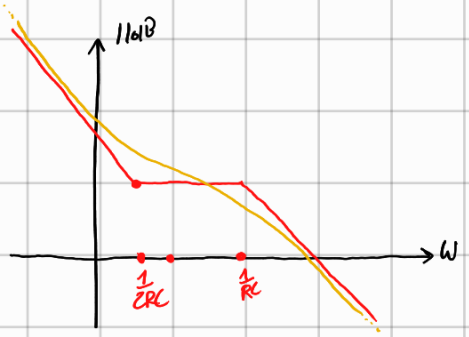


$$Z_{out_1}(s) = R + \frac{1}{sC} = \frac{1+RCs}{sC} \qquad W_1(s) = 1 + \frac{1+RCs}{RCs} = \frac{1+2RCs}{RCs}$$

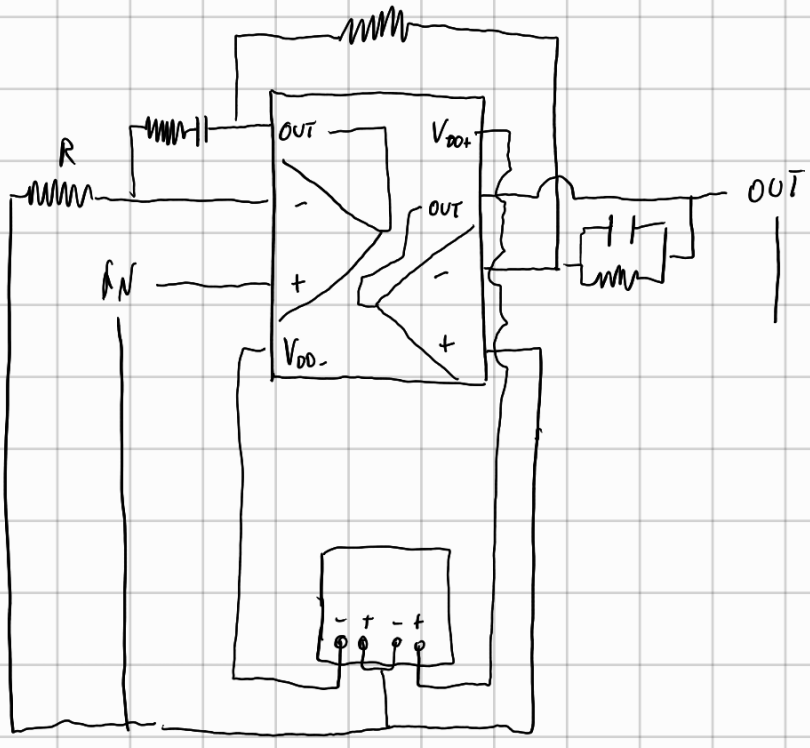
$$W_2(s) = -\frac{1}{1+RCs} \qquad W(s) = -\frac{1+2RCs}{1+RCs} \cdot \frac{1}{RCs}$$





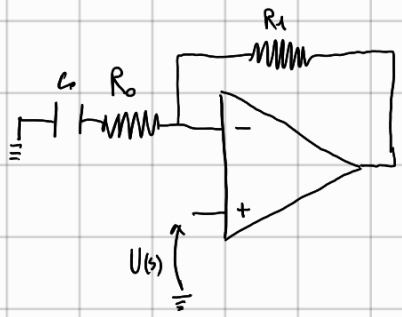

|H|dB
ω
1/2RC
1/RC


ω
0.1/2RC
1/2RC
1/RC


R
OUT
V_DD+
OUT
IN
V_DD-
OUT

1)

$\alpha = 2 \quad \varphi_1 = 0.7 \text{ (zero)} \qquad \varphi_2 = 0.2 \text{ (polo)} \qquad$ (non invertente)



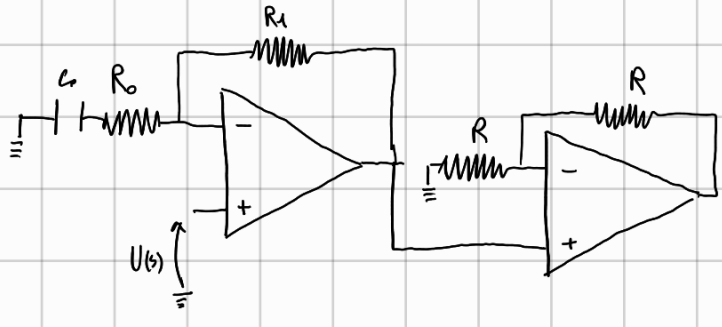
$Z_{out} = R_1 \qquad Z_{in}(s) = R_0 + \frac{1}{sC_0} = \frac{1+R_0C_0s}{sC_0} \qquad W(s) = 1 + \frac{R_1C_0s}{1+R_0C_0s} = \frac{1+(R_0+R_1)C_0s}{1+R_0C_0s}$

$(R_0+R_1)C_0 = 0.7$

$R_0C_0 = 0.2 \qquad R_0 = 100K\Omega$

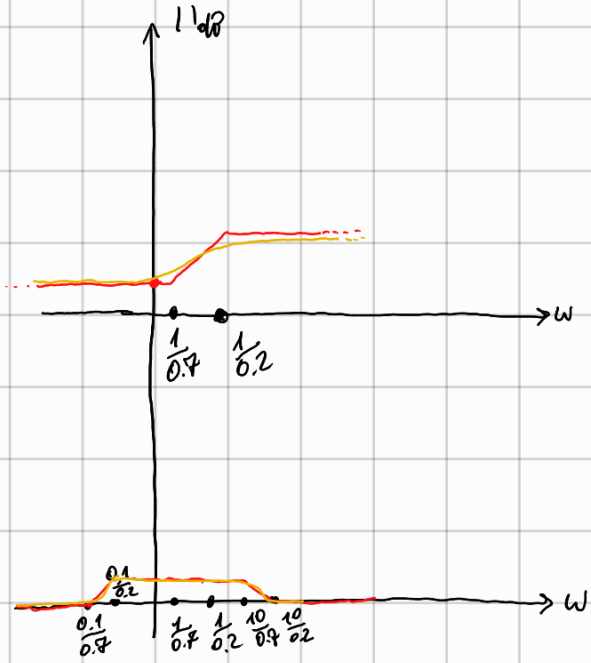
$C_0 = 2 \cdot 10^{-6} F = 2\mu F$

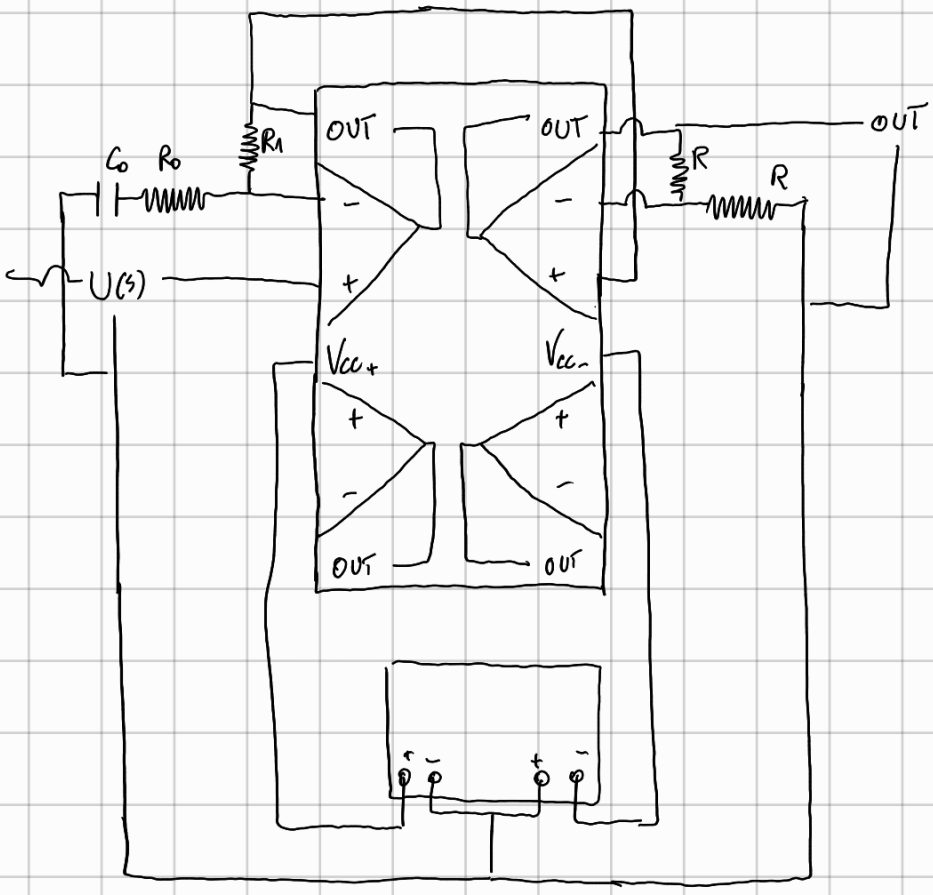
$R_1 = 250 K\Omega$

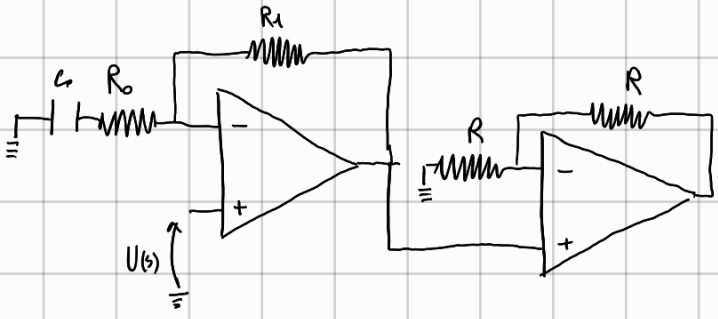


$R = 10K\Omega$

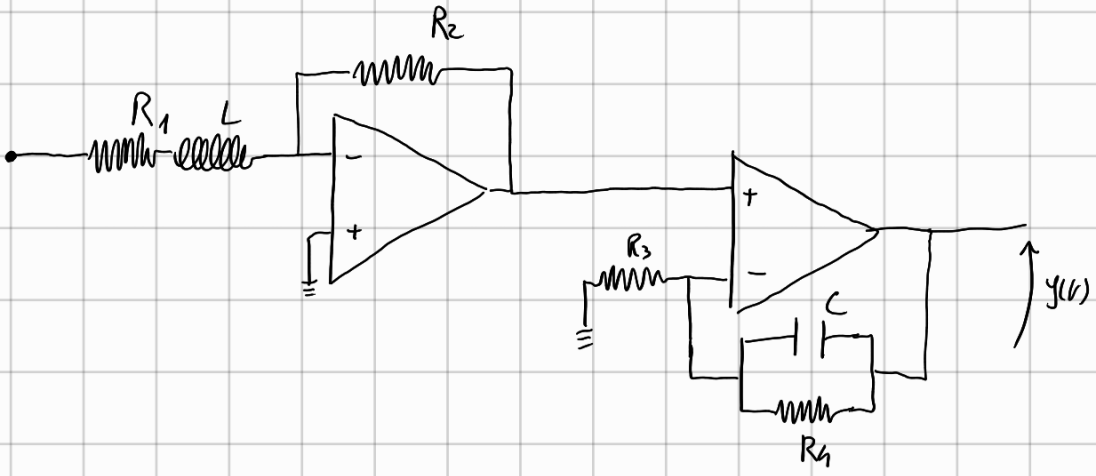
$W(s) = \left(1 + \frac{R}{R}\right) \cdot \frac{1+(R_0+R_1)C_0s}{1+R_0C_0s}$


|1|dB
ω
1/0.7
1/0.2
0.1/0.2
0.1/0.7
1/0.7
1/0.2
10/0.7
10/0.2
ω


C0
R0
R1
U(s)
OUT
OUT
OUT
R
R
Vcc+
Vcc-
OUT
OUT


C0
R0
R1
U(s)
R
R

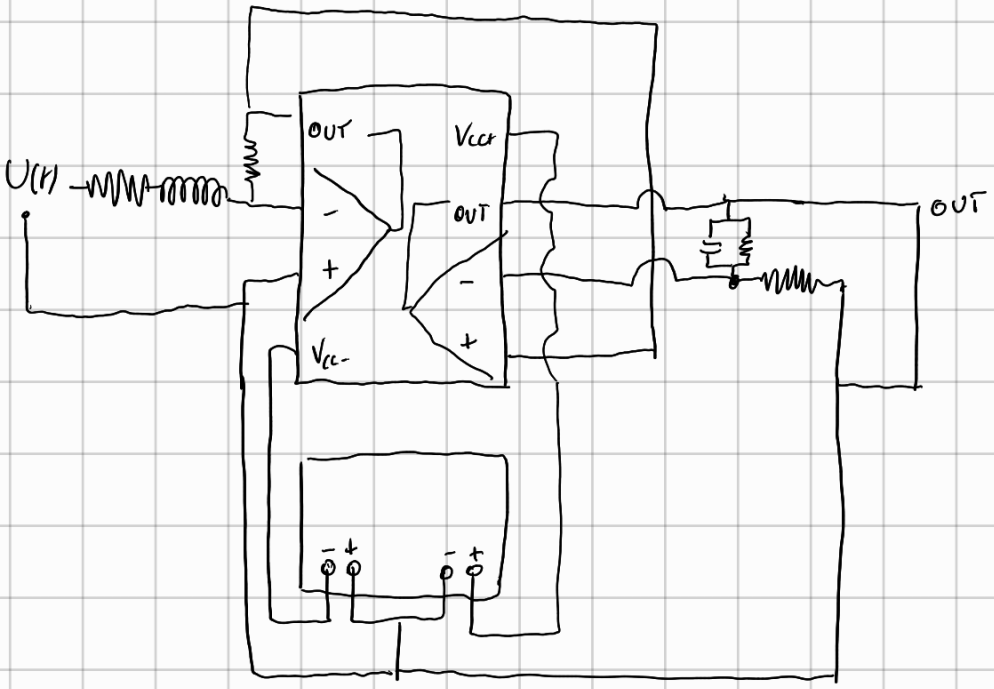
4)

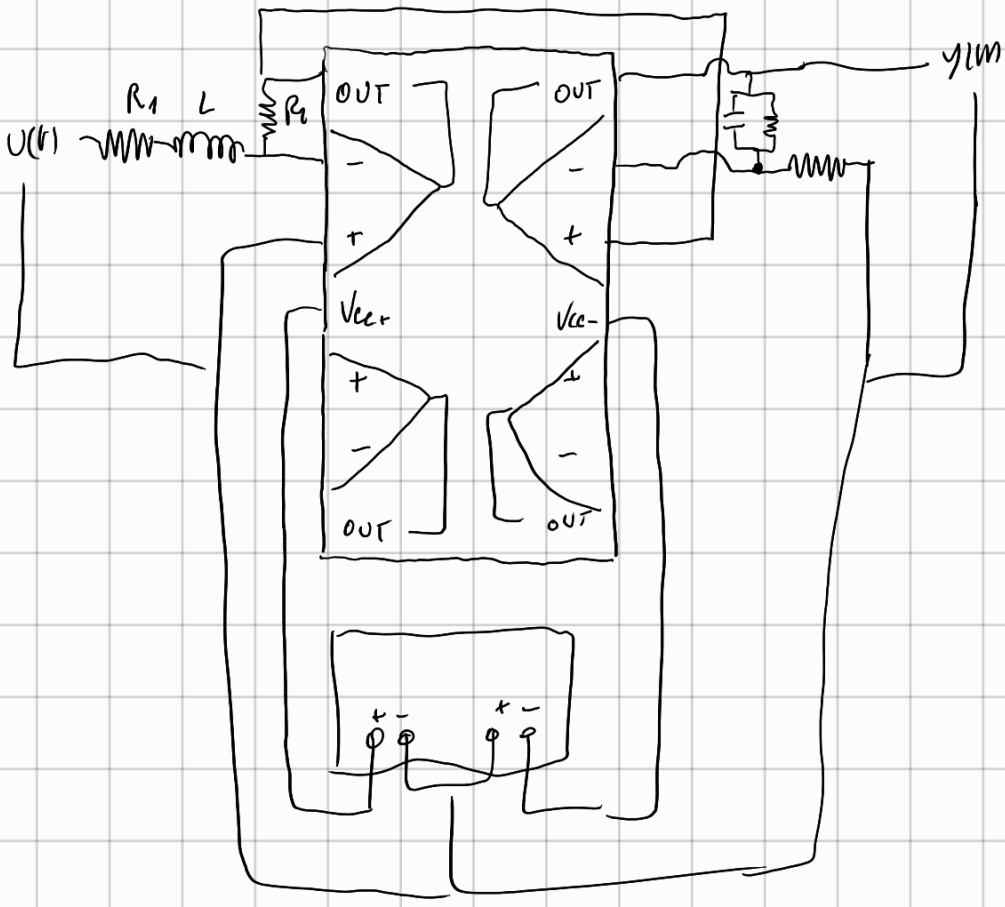


$$Z_{in_1}(s) = R_1 + sL \qquad W(s) = -\frac{R_2}{R_1 + sL} = -\frac{R_2}{R_1} \cdot \frac{1}{1 + s\frac{L}{R_1}}$$

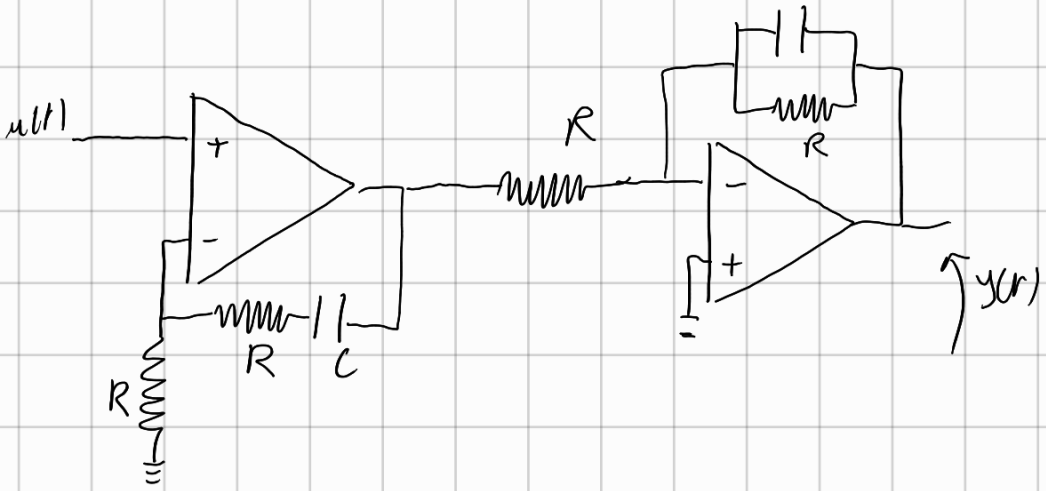
$$Z_{out_2}(s) = \frac{R_4}{1 + R_4 C s} \qquad Z_{in_2}(s) = R_3 \qquad W(s) = 1 + \frac{R_4}{R_3} \cdot \frac{1}{1 + R_4 C s} = \frac{R_3(1 + R_4 C s) + R_4}{1 + R_4 C s}$$

$$W(s) = -\frac{R_2}{R_1} \cdot \frac{1}{1 + \frac{L}{R} s} \cdot \frac{(R_4 + R_3) + R_3 R_4 C s}{1 + R_4 C s}$$




R1
L
U(t)
R1
OUT
OUT
Vcc+
Vcc-
OUT
OUT
y(t)

1)

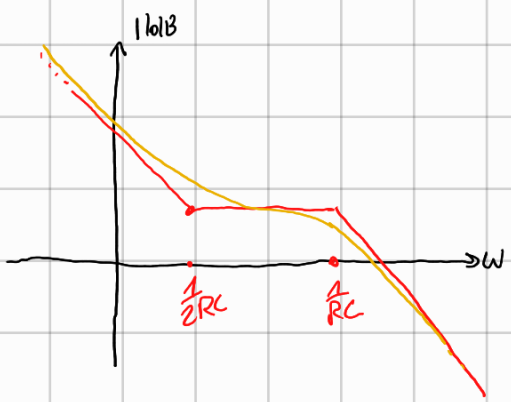


$$Z_{out_1}(s) = R + \frac{1}{sC} = \frac{1+RCs}{sC} \qquad Z_{in}(s) = R$$

$$W_1(s) = 1 + \frac{Z_{out}(s)}{Z_{in}(s)} = 1 + \frac{1+RCs}{RCs} = \frac{1+2RCs}{RCs}$$

$$W_2(s) = -\frac{1}{1+RCs} \qquad W(s) = -\frac{1+2RCs}{(1+RCs)\cdot RCs}$$

$$\gamma_1 = 2RC \text{ (zero)} \qquad \gamma_2 = RC \text{ (polo)}$$



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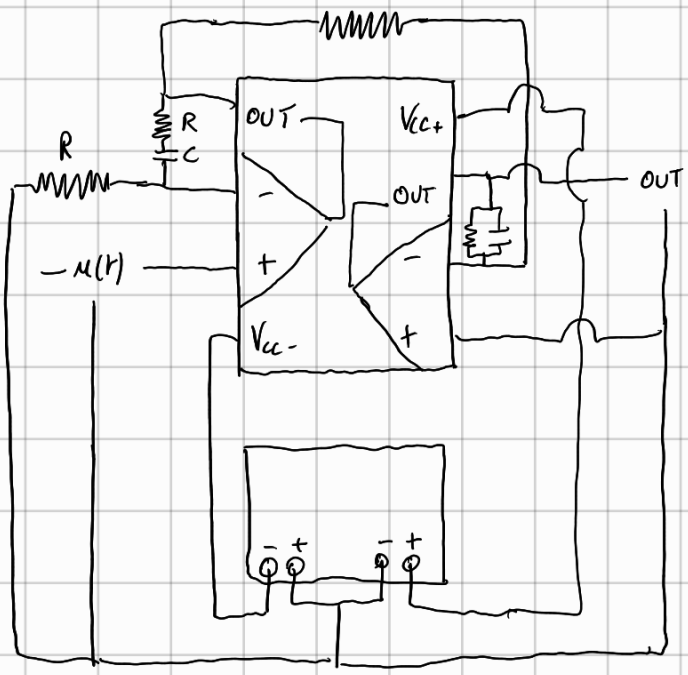
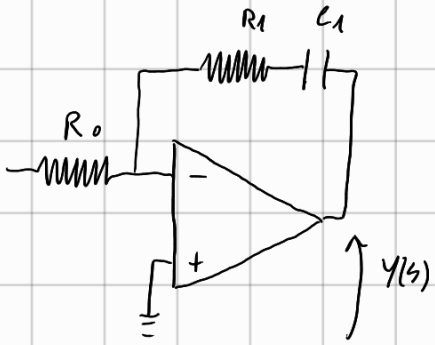


OUT	OUT
−	−
+	+
V_{CC+}	V_{CC-}
+	+
−	−
OUT	OUT

4) REGOLATORE PI con K_p a 10, $T_i = 10$



$$Z_{out}(s) = R_1 + \frac{1}{sC_1} = \frac{1 + R_1C_1s}{sC_1}$$

$$W(s) = -\frac{1 + R_1C_1s}{R_0C_1s} = -\frac{R_1}{R_0}\left(1 + \frac{1}{R_1C_1s}\right)$$

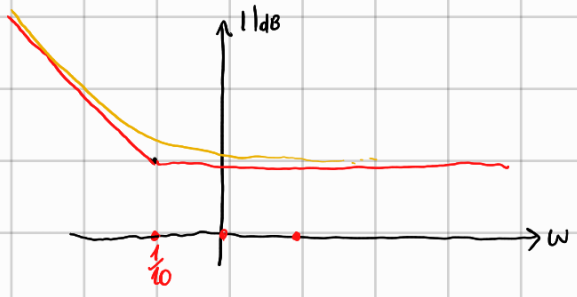
$$-\left(\frac{1}{R_0C_1s} + \frac{R_1}{R_0}\right)$$

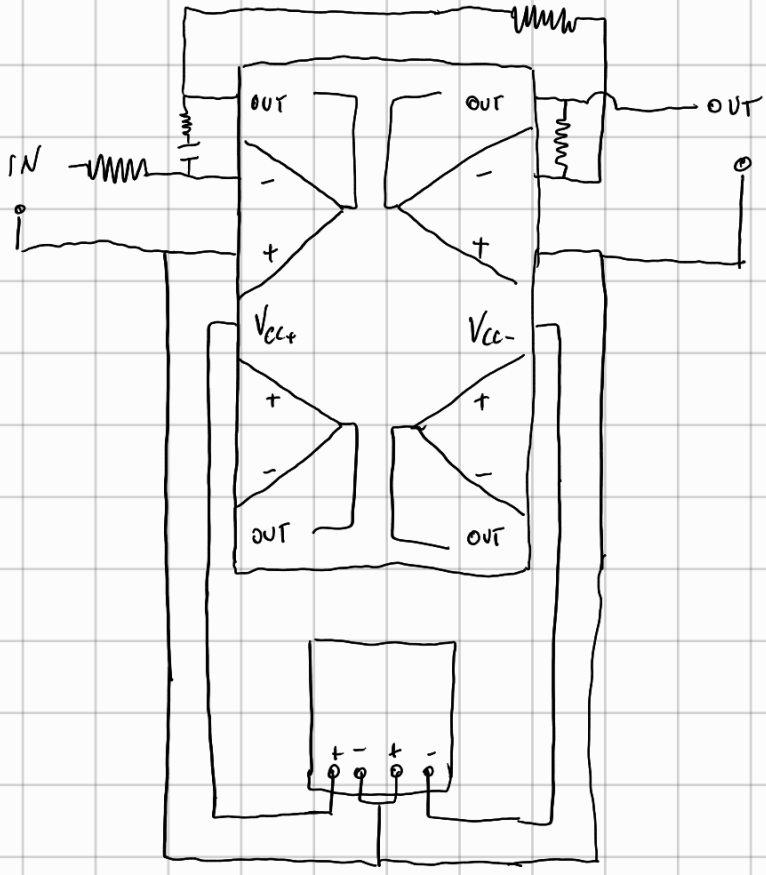
$$K = \frac{R_1}{R_0} \qquad T_i = R_1C_1$$

$R_1 = 500k\Omega$

$R_0 = 50k\Omega$

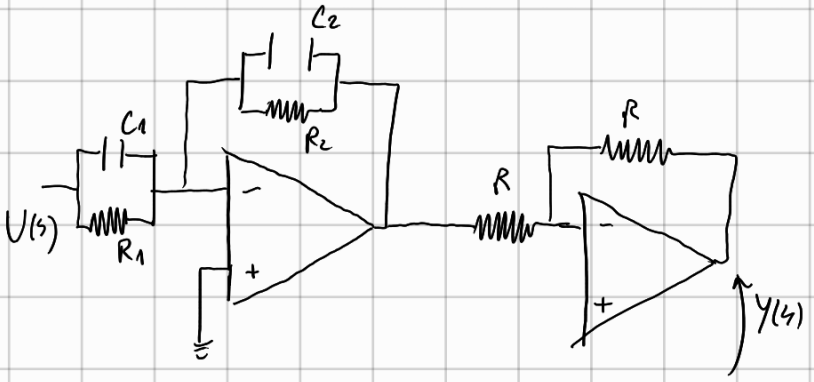
$$C_1 = \frac{10}{500 \cdot 10^3} = 20\mu F$$




IN
OUT
OUT
OUT
V_{CC+}
V_{CC-}
OUT
OUT
+ − + −

RETE RITARDATRICE CON POLO CON $\varphi = 0.5$, ZERO CON $\varphi = 0.1$

(GUADAGNO UNITARIO)



$$Z_{out_1}(s) = \frac{R_2}{1+R_2C_2s} \qquad Z_{in_1}(s) = \frac{R_1}{1+R_1C_1s}$$

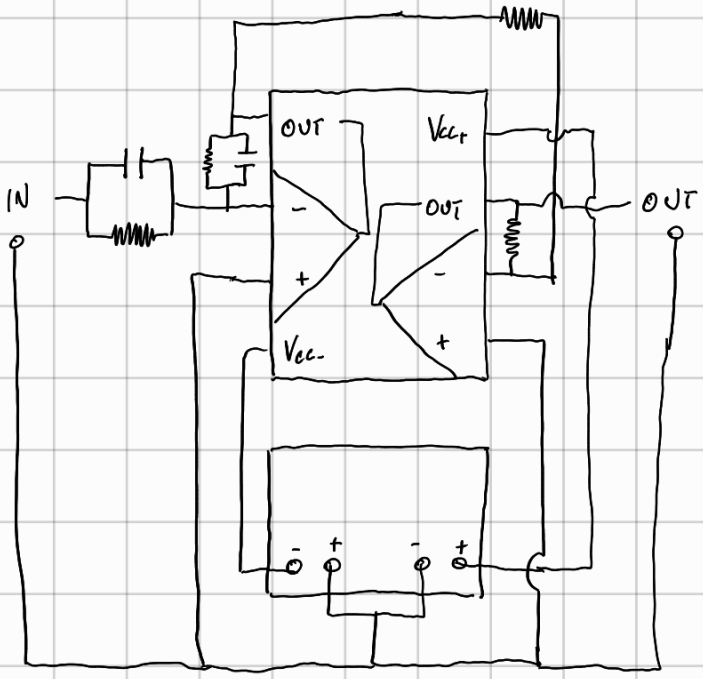
$$W(s) = \frac{R_2}{R_1} \cdot \frac{1+R_1C_1s}{1+R_2C_2s}$$

$R_1C_1 = 0.1$

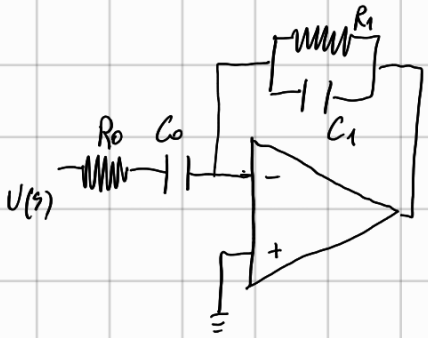
$R_2C_2 = 0.5$

$R_1 = 100K\Omega = R_2$

$C_2 = 5\mu F \quad C_1 = 1\mu F$


IN
OUT
Vcc+
OUT
Vcc-
OUT
-
+
-
+
-
+
-
+

PASSA BANDA 10Hz - 100Hz



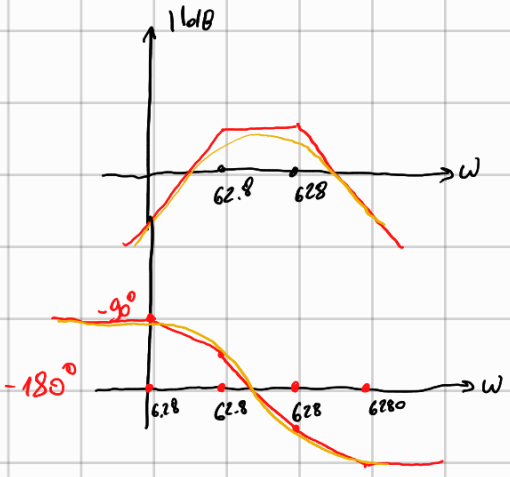
$$Z_{out}(s) = \frac{R_1}{1+R_1C_1s} \qquad Z_{in}(s) = R_0 + \frac{1}{C_0 s} = \frac{1+R_0C_0s}{C_0 s}$$

$$W(s) = -\frac{R_1C_0s}{(1+R_1C_1s)(1+R_0C_0s)}$$

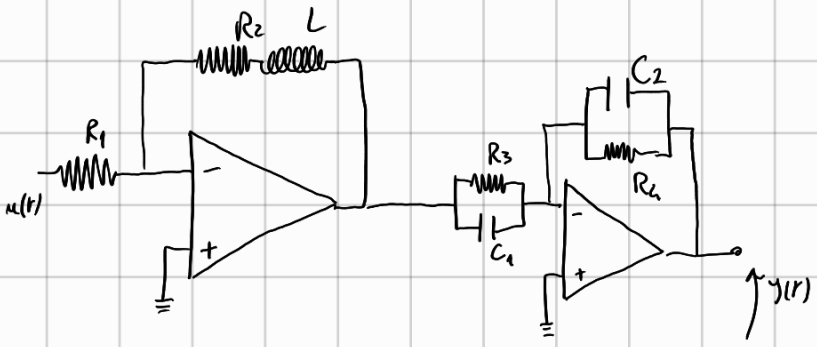
$$R_0C_0 = \tau_1 \qquad \frac{1}{\tau_1} = 2\pi f_0 = 62.8 \Rightarrow \frac{1}{R_0C_0} = 6.28$$

$R_0 = 100K\Omega$ $C_0 = 159\,\mu F$

$R_1 = 10K\Omega$ $C_1 = 159\,nF$



3)



$$Z_{out_1}(s) = R_2 + sL$$

$$W_1(s) = -\frac{R_2 + sL}{R_1} = -\left(\frac{R_2}{R_1} + \frac{sL}{R_1}\right)$$

$$Z_{out_2}(s) = \frac{R_4}{1 + R_4 C_2 s} \qquad Z_{in_2}(s) = \frac{R_3}{1 + R_3 C_1 s} \qquad W(s) = -\frac{R_4}{R_3} \cdot \frac{1 + R_3 C_1 s}{1 + R_4 C_2 s}$$

$$W(s) = \frac{R_4}{R_1 \cdot R_3} \cdot \frac{(R_2 + sL)(1 + R_3 C_1 s)}{(1 + R_4 C_2 s)} = \frac{R_4 R_2}{R_1 R_3} \cdot \frac{\left(1 + \frac{L}{R_2} s\right)(1 + R_3 C_1 s)}{(1 + R_4 C_2 s)}$$

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