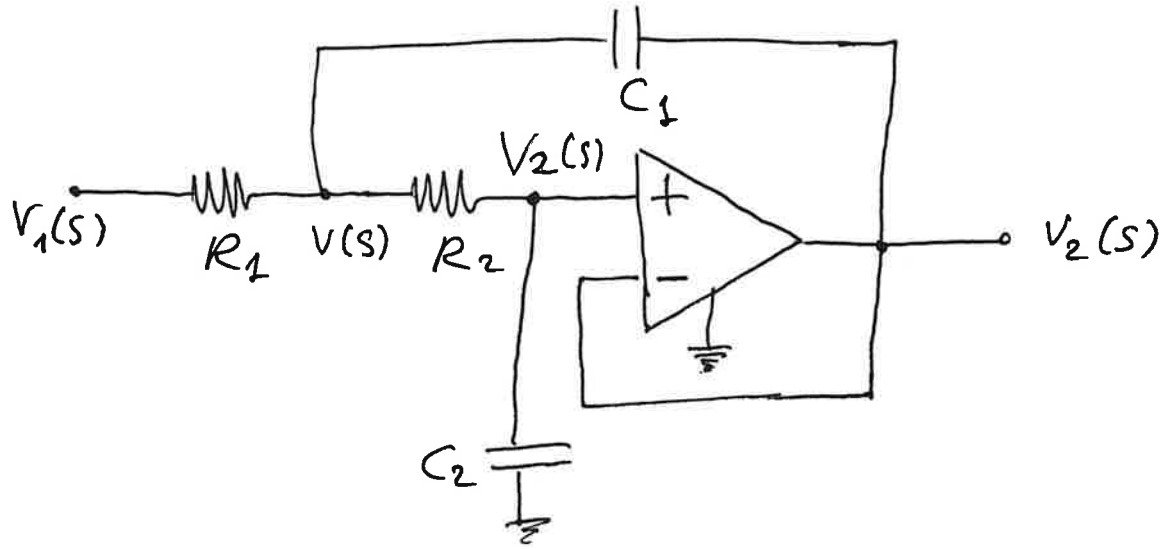
# RETE PASSA-BASSO DI SALLEN-KEY




$$\begin{cases} \dfrac{V(S)-V_1(S)}{R_1} + (V(S)-V_2(S))\,SC_1 + \dfrac{V(S)-V_2(S)}{R_2} = 0 \\ \dfrac{V_2(S)-V(S)}{R_2} + V_2(S)\,SC_2 = 0 \end{cases}$$

ELIMINANDO $V(S)$ SI OTTIENE:

$$H(S) = \frac{V_2(S)}{V_1(S)} = \frac{1}{1 + SC_2(R_1+R_2) + S^2 R_1 R_2 C_1 C_2}$$

$$\omega_0 = \frac{1}{\sqrt{R_1 R_2 C_1 C_2}} \qquad q = \frac{\sqrt{R_1 R_2 C_1 C_2}}{C_2(R_1+R_2)}$$

PONENDO: $\begin{cases} R_1 = mR \\ R_2 = R \end{cases}$ ; $\begin{cases} C_1 = nC \\ C_2 = C \end{cases}$

$$\Rightarrow \quad \omega_0 = \frac{1}{RC\sqrt{mn}} \; ; \quad q = \frac{\sqrt{mn}}{m+1}$$

# FILTRO P.B. DI BUTTERWORTH DEL 2° ORDINE

$$H(s) = \frac{1}{s^2 + \sqrt{2}s + 1} \qquad \omega_0 = 1 \quad q = 1/\sqrt{2}$$ NORMALIZZATO

$$H(s) = \frac{1}{1 + s\frac{\sqrt{2}}{\omega_0} + \frac{s^2}{\omega_0^2}} \qquad q = 1/\sqrt{2}$$

PONENDO: $m = 1$, $n = 2$

$$q = \frac{1}{\sqrt{2}} \quad , \quad \omega_0 = \frac{1}{RC\sqrt{2}}$$

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PONIAMO: $f_0 = 49\ Hz$

$$\omega_0 = 2\pi f_0 = 307\ rad/s$$

Se $R = 10\ k\Omega \Longrightarrow C = \frac{1}{\omega_0 \sqrt{2} \times 10^4} \approx 230\ nF$

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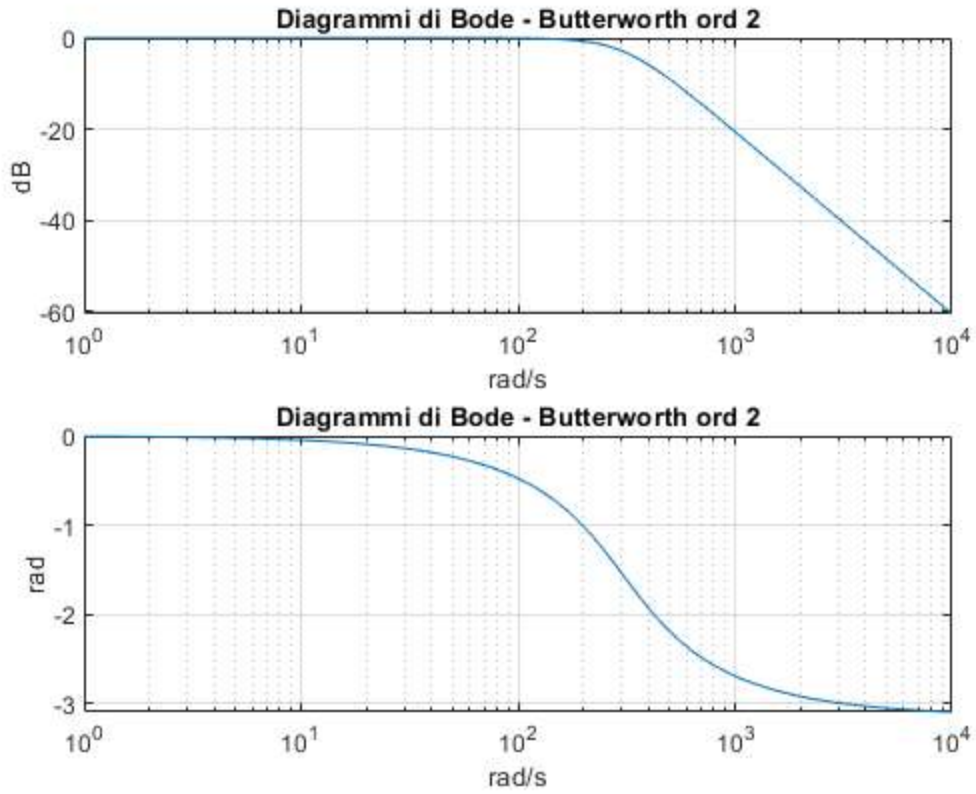
% Diagrammi di Bode di un filtro PB di Butterworth ord 2
s=logspace(0,4,1000)*j;
omega0 = 307; % f0=48.8 Hz
Num = 1;
Den = s.*s/(omega0^2) + s*sqrt(2)/omega0 + 1;
M = abs(Num./Den);
P = angle(Num./Den);
Pdeg = P*180/pi;
MdB = 20 .* log10(M);
subplot(2,1,1),semilogx(imag(s),MdB),grid on;
title('Diagrammi di Bode - Butterworth ord 2');xlabel('rad/s');
xlabel('rad/s');
ylabel('dB');
subplot(2,1,2),semilogx(imag(s),P),grid on;
xlabel('rad/s');
ylabel('rad');
title('Diagrammi di Bode - Butterworth ord 2');
```

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