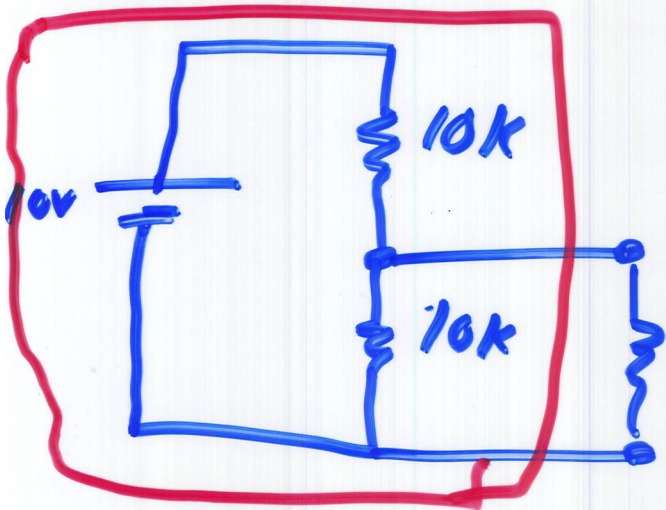
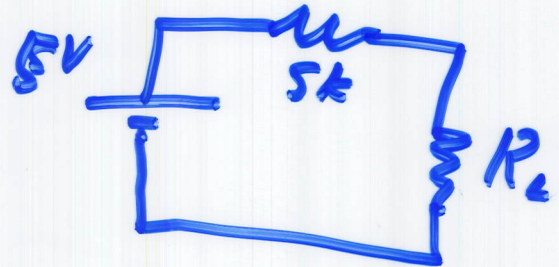


Output Impedance



$$Z_{out} = 5k\Omega$$

If $R_{LOAD} = 5k$



$$V_L = 2.5V$$

If $R_L = 100k$

$$V_L = 5V$$

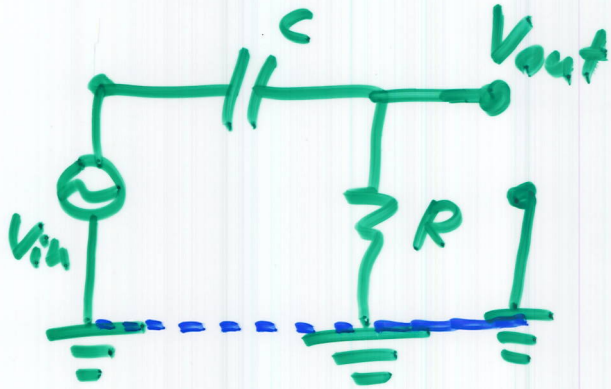
R_{LOAD} should be at least
 $10 \times Z_{out}$

Z_{out} for ① Voltage source $\Delta V = 0 \rightarrow Z_{out} = 0$
② Current source $\Delta I = 0 \rightarrow Z_{out} = \infty$

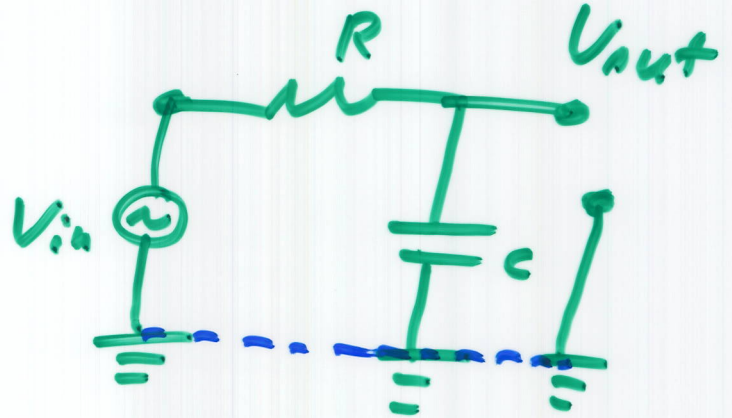
$$Z_{out} = \frac{\Delta V}{\Delta I}$$

RC filters

$$\chi_c = \frac{1}{\omega C} \begin{cases} \rightarrow \infty \text{ for a small } \omega \\ \rightarrow 0 \text{ for a large } \omega \end{cases}$$



High pass



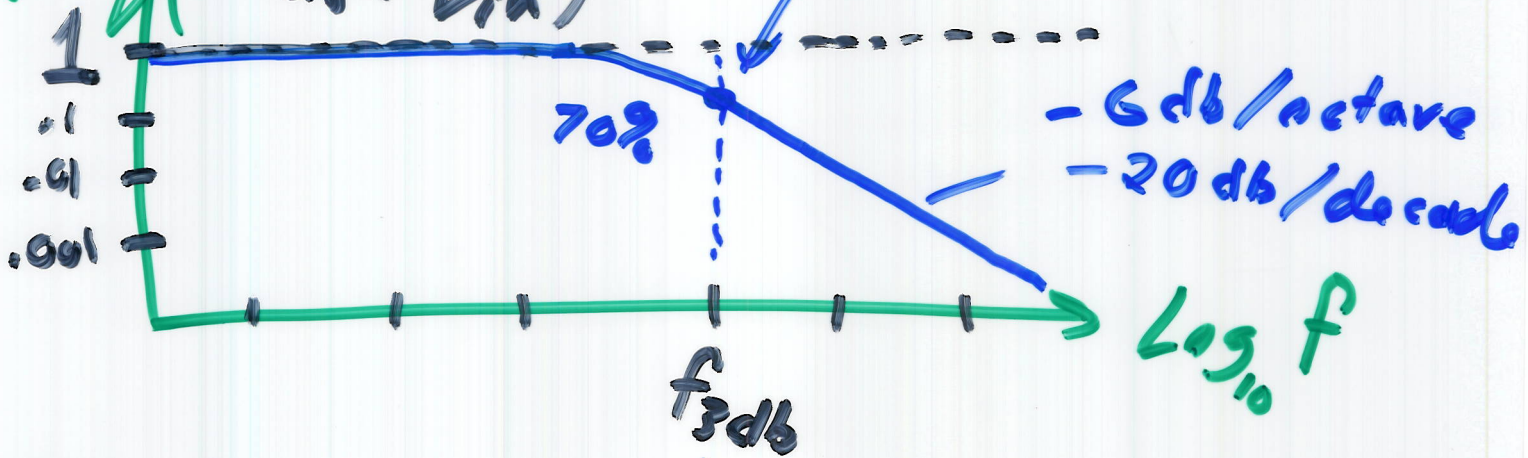
Low pass

Bode Plots

e.g. Low pass

Log Amplitude

$$\log_{10} \left(\frac{V_{out}}{V_{in}} \right)$$



Phase

180°

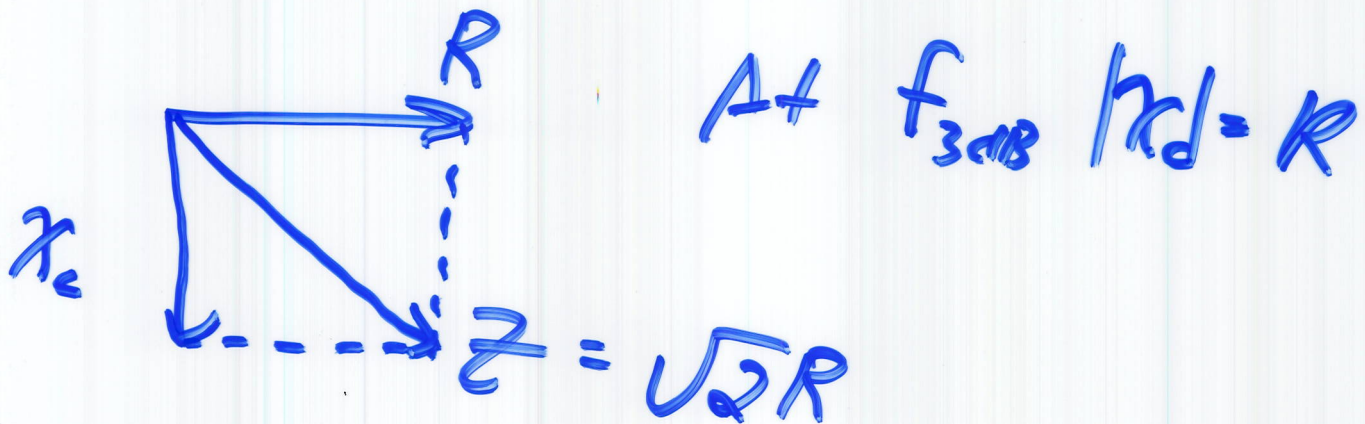
90°

0

Log₁₀ f

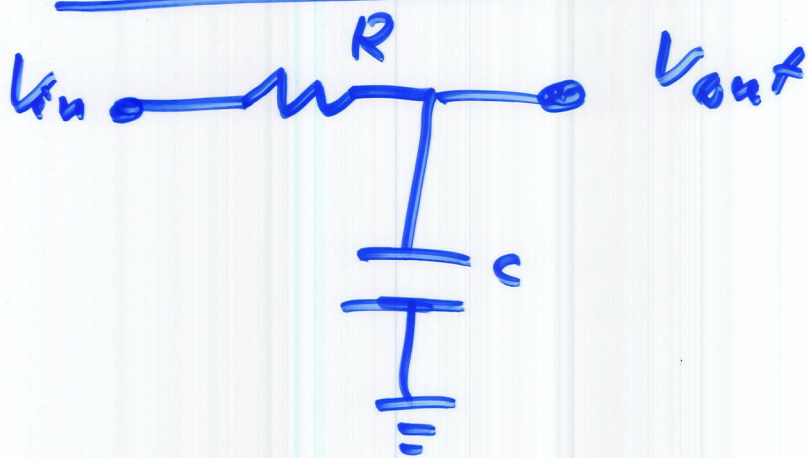
f_{3db}

$$f_{-3dB} \equiv \frac{1}{2\pi fRC} = \frac{1}{\omega RC}$$



$$V_{out} = \frac{V_{in}}{\sqrt{2}} \approx 70\% V_{in} \leftrightarrow -3dB$$

$$50\% = \frac{1}{2} \approx -6dB$$



$$\omega \approx 0$$

$$Z_{in} = \infty$$

$$Z_{out} = R$$

$$\omega \approx \infty$$

$$Z_{in} = R$$

$$Z_{out} = 0$$