Appendix A: Low Pass Filter Design

(for a detailed Tutorial see https://www.electronics-tutorials.ws/filter/filter_2.html)

The simple RC low-pass filter of Figure 3 works like a voltage divider. **The "resistance" of a capacitor depends inversely on frequency** and is referred to as *reactance*,

$Z_c = \frac{1}{2\pi fC}$.

Considering the RC circuit as a voltage divider:

$V_{out} = V_{in} \frac{Zc}{R+Zc}$ (for EE's it should be $|V_{out}| = |V_{in}| \frac{|Zc|}{|R+Zc|}$)

Point is, as Z_c gets smaller V_{out} gets smaller. Since Z_c gets smaller as frequency goes up, V_{out} gets smaller as frequency goes up. It's useful to determine the frequency where $V_{out} = V_{in}/2$. We call this the "cutoff" frequency.
Solving:

$$F_{CO} = \frac{1}{2\pi RC}$$

The RC circuit "passes through" frequencies below F_{CO} and "blocks" frequencies above F_{CO}.

Example:
We want to cut off frequencies above 1000Hz and R = 1000 Ohms, find C.

Solution:
$F_{CO} = 1000Hz = \frac{1}{2\pi 1 \quad C}$, $C = \frac{1}{2\pi 10^6} = 1.6 \times 10^{-7}\ Farads = 0.16\mu F$