**LOW PASS FILTERS**

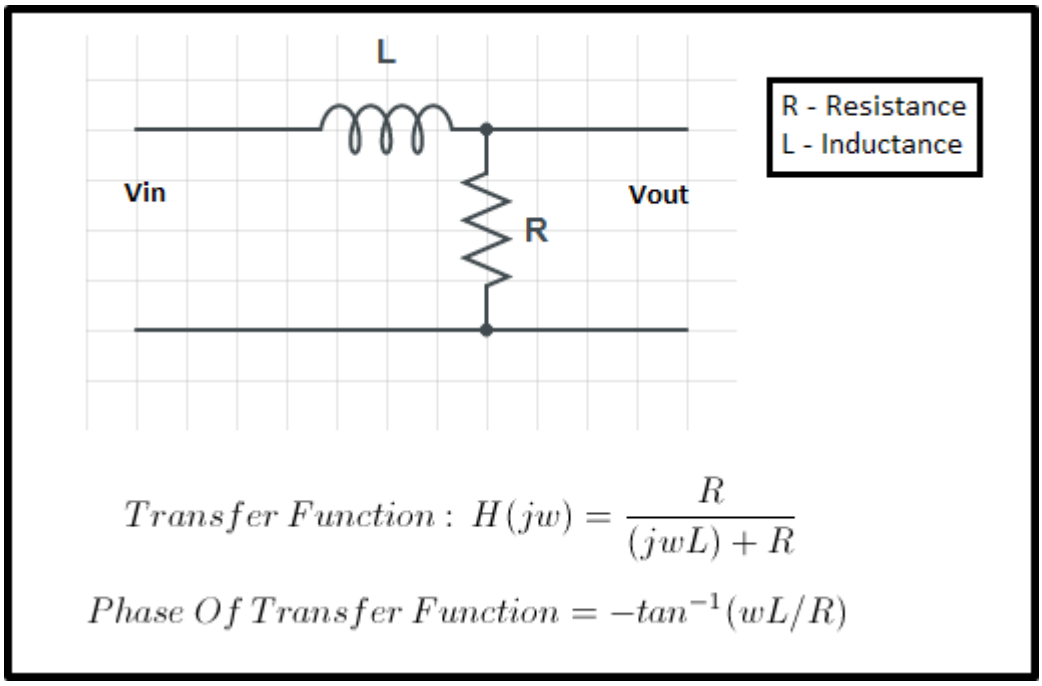
Low Pass filters are filters that allow the passage of low frequency signals and attenuate high frequency signals.

**How is this possible?**

- A first order low pass filter consists of an inductor in series with the load resistor or a capacitor in parallel with the load resistor.

    - **Inductive Model of a First Order Low Pass Filter**

      As the frequency at the input increases, the impedance of the inductor increases. Hence, the high frequency signals do not pass through the inductor onto the load. However, the low frequency signals pass through.

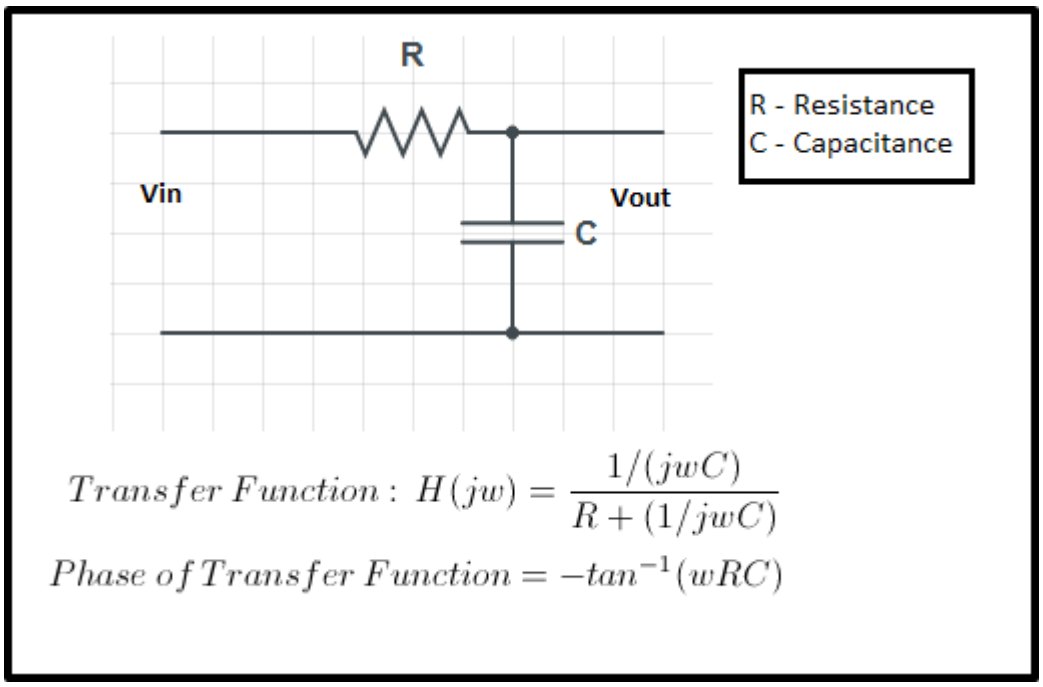



$$Transfer\ Function:\ H(jw) = \frac{R}{(jwL) + R}$$

$$Phase\ Of\ Transfer\ Function = -tan^{-1}(wL/R)$$

    - **Capacitive Model of a First Order Low Pass Filter**

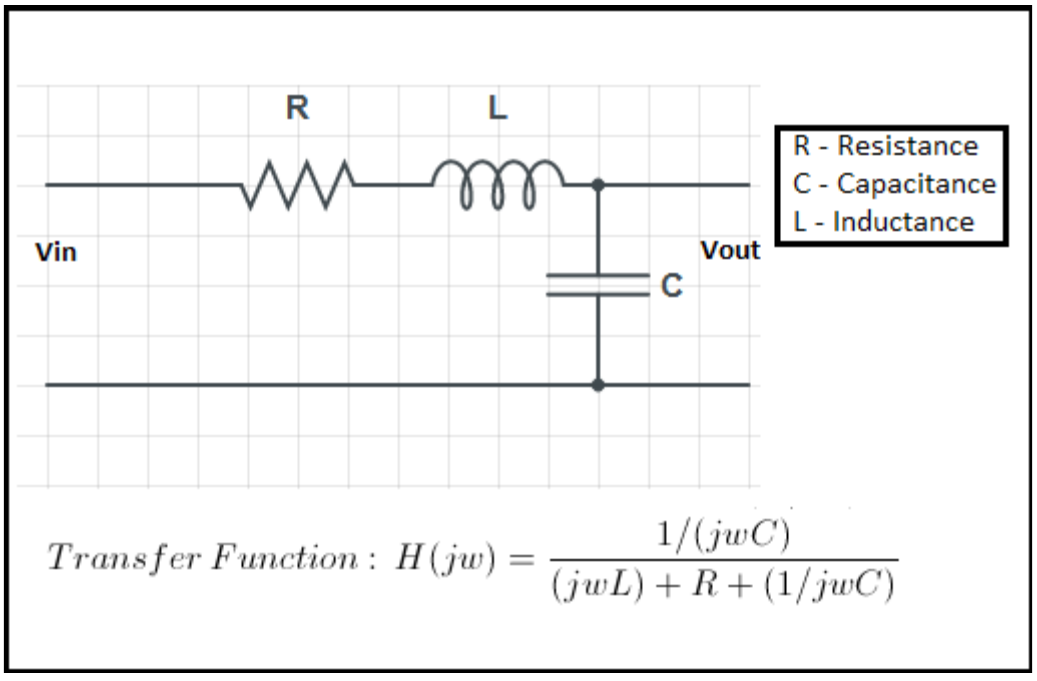
      As the frequency at the input increases, the impedance of the capacitor decreases. Hence, the high frequency signals go through the capacitor and most of the voltage is dropped across the load.




$$Transfer\ Function:\ H(jw) = \frac{1/(jwC)}{R + (1/jwC)}$$

$$Phase\ of\ Transfer\ Function = -tan^{-1}(wRC)$$

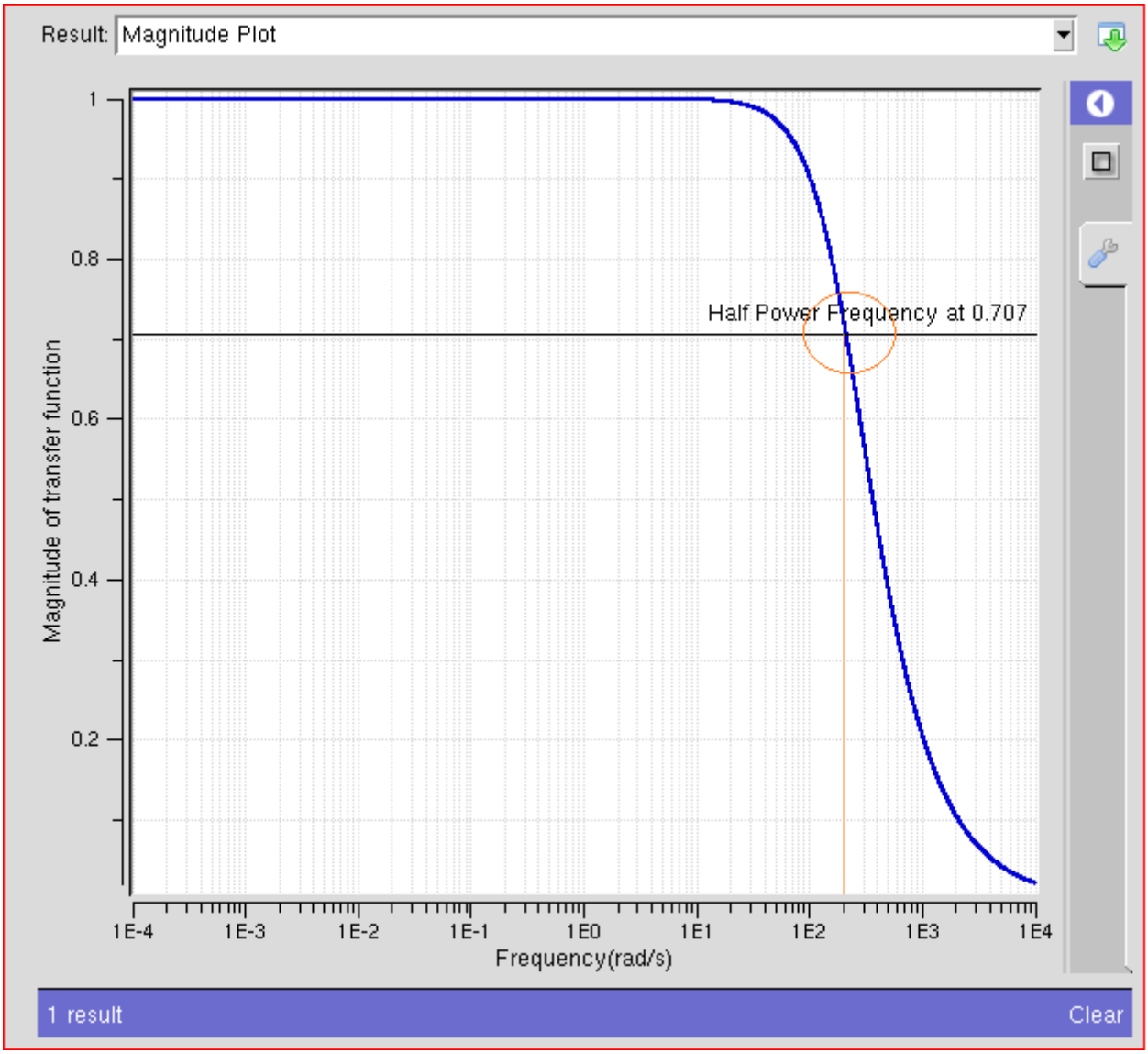
- A second order low pass filter blocks high pass frequencies more effectively due to the presence of two energy storing elements (capacitor and inductor).




$$Transfer\ Function:\ H(jw) = \frac{1/(jwC)}{(jwL) + R + (1/jwC)}$$

**What are some practical applications of low pass filters?**

- Low pass filters are used to filter noise from a circuit. 'Noise' is a high frequency signal. When passed through a low pass filter most of the noise is removed and a clear sound is produced.
- Low pass filters are also used in various audio applications and are sometimes known as high-cut or treble cut filters.



**Cut off Frequency**

This is the frequency at which the magnitude of the transfer function is 0.707 which is $1/\sqrt{2}$

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