Notch Filters

The notch filter in Fig. 10 acts as a way to pass a wide range of frequencies, while attenuating (rejecting) a narrow band of frequencies.

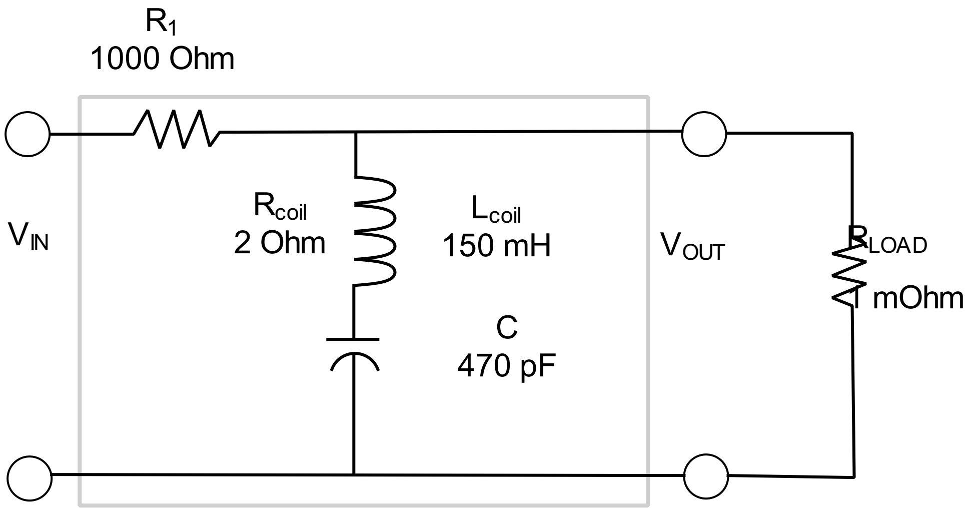

Figure 10.

Example:

To find the transfer function or attenuation of the unloaded RLC circuit, we set up the equations for V_{IN} and V_{OUT}:

$$V_{IN} = \left(R_1 + R_{coil} + j\varphi L - j \cdot \frac{1}{\varphi C}\right) \cdot I$$

$$V_{OUT} = \left(R_{coil} + j\varphi L - j \cdot \frac{1}{\varphi C}\right) \cdot I$$

The transfer function becomes:

$$H = \frac{V_{OUT}}{V_{IN}} = \frac{R_{coil} + j\left(\varphi L - \frac{1}{\varphi C}\right)}{(R_1 + R_{coil}) + j\left(\varphi L - \frac{1}{\varphi C}\right)}$$

This is the transfer function for an unloaded output. Now we get more realistic and have a load resistance attached to the output. However, in this case, the load resistance is so large that we can assume it draws inconsequential current, so we don't need to place it into the equation.

The magnitude of the transfer function is:

$$\left|H\right| = \left|\frac{V_{OUT}}{V_{IN}}\right| = \frac{\sqrt[2]{R_{coil}^{2} + \left(\varphi L - \frac{1}{\varphi C}\right)^{2}}}{\sqrt[2]{\left(R_1 + R_{coil}\right)^{2} + j\left(\varphi L - \frac{1}{\varphi C}\right)^{2}}}$$

Plugging in all component values and setting $\varphi = 2\pi f$, we get:

$$\left|H\right| = \left|\frac{V_{OUT}}{V_{IN}}\right| = \frac{\sqrt[2]{4 + \left(0.94\,f - 3.38 \cdot 10^{8}/f\right)^{2}}}{\sqrt[2]{10^{6} + \left(0.94\,f - 3.38 \cdot 10^{8}/f\right)^{2}}}$$