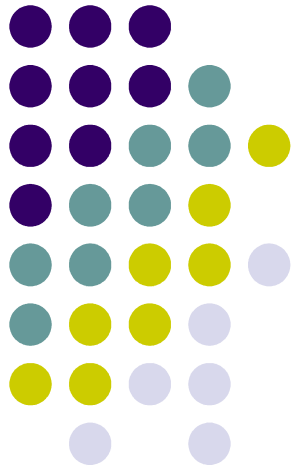
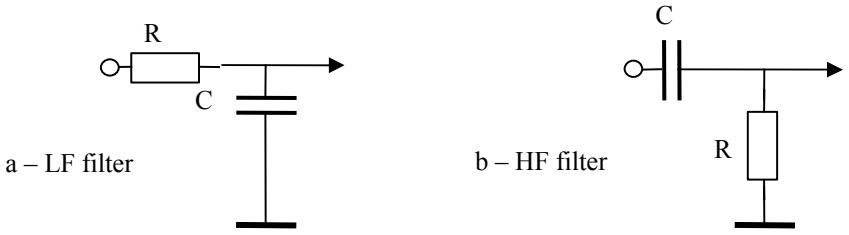
Filter Circuit

- First Order
- Second Order



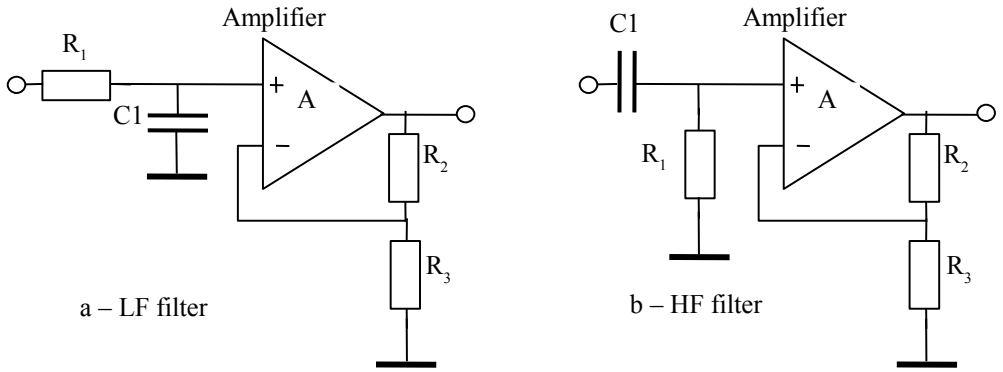
Ideal frequency filter

- is a device having a constant and nonzero transfer characteristic within a specific frequency range (called a filter passband), and a zero one in the rest range (called a suppressed band).



Passive filters

1st Order active filter..



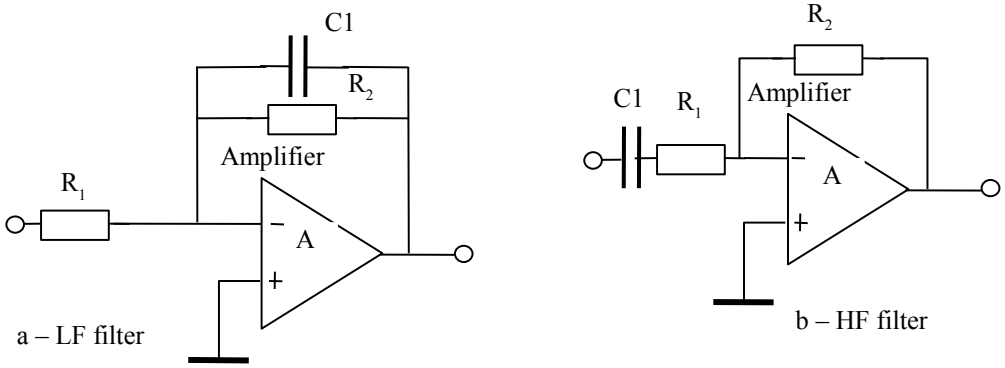
Elementary first-order active filters with an impedance converter

$$A(p) = \frac{A_0}{1 + a_1 p}$$

$$A(p) = \frac{(1 + R2/R3)}{1 + pR1 \cdot C1}$$

To obtain a HF filter, it is necessary to replace *p* with *1/p* in the expression. In the circuit it will be enough to interchange R1 and C1

1st Order active filter..

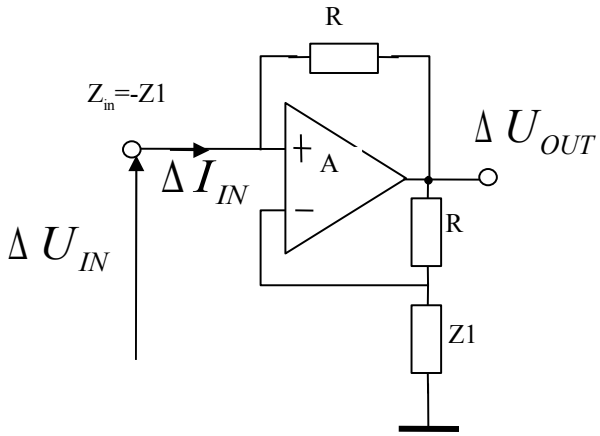


First-order active filters with a frequency-dependent feedback

$$A(p) = \frac{A_0}{1 + a_1 p}$$

$$A(p) = -\frac{R2/R1}{1 + pR2 \cdot C1}$$

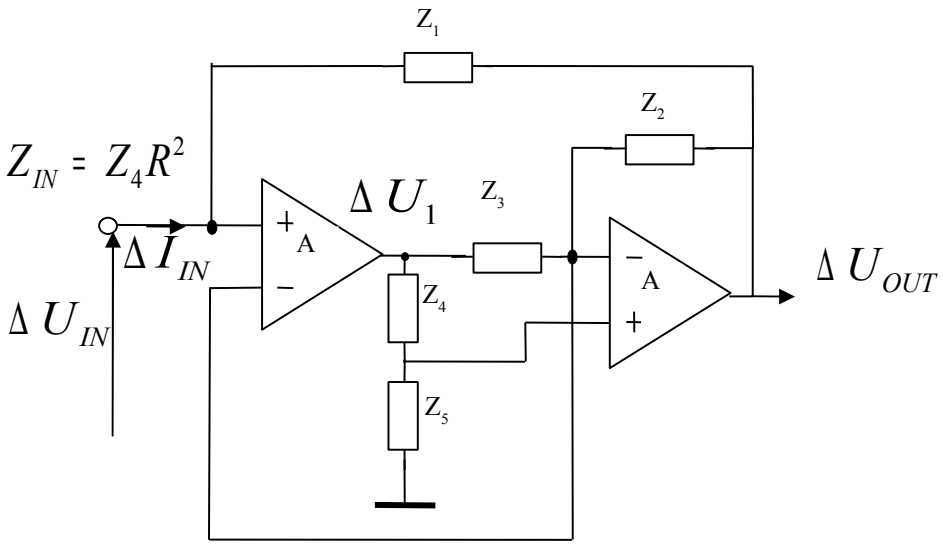
Negative Impedance Converter



Negative impedance converter Circuit

If Z1 is capacitor. Z=j/ωC

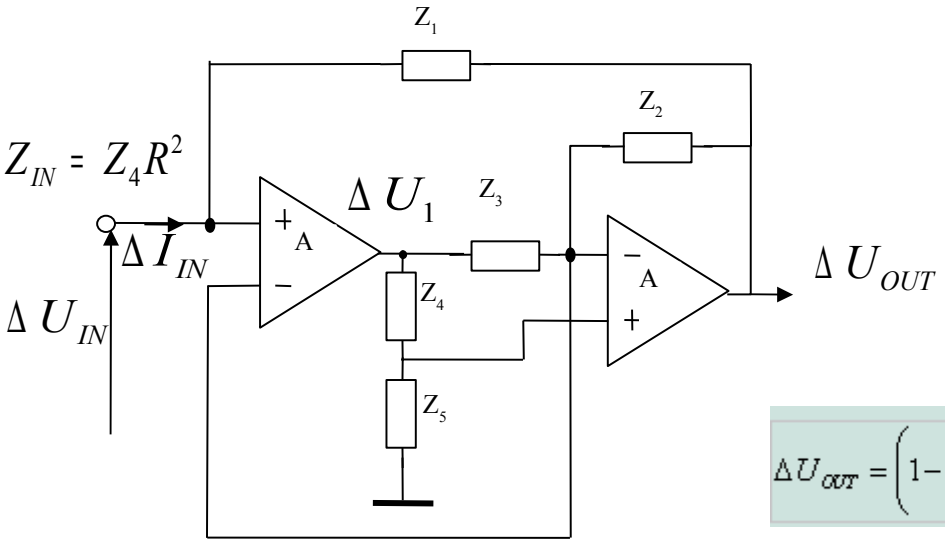
Gyrator



$$\Delta U_1 = \frac{\Delta U_{IN}(Z_4 + Z_5)}{Z_5}$$

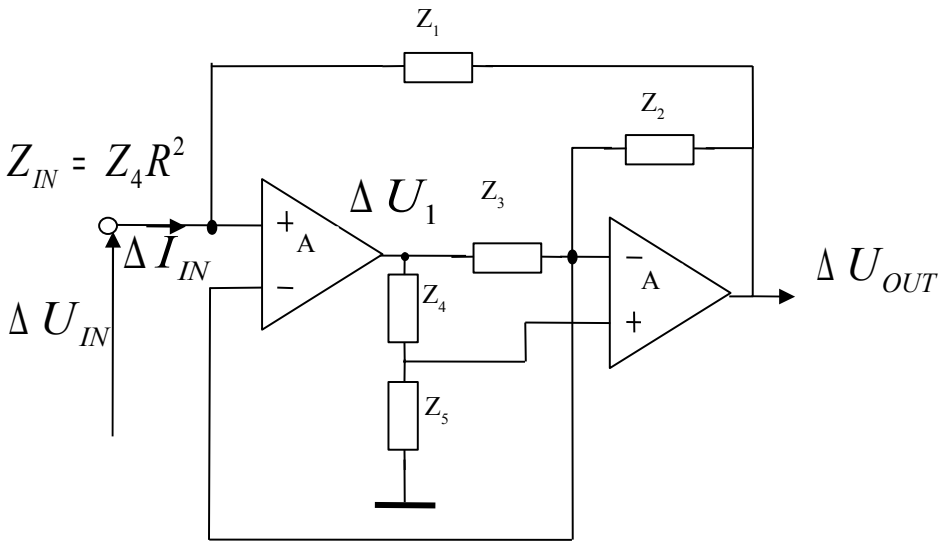
$$\frac{\Delta U_1 - \Delta U_{IN}}{Z_3} = \frac{\Delta U_{IN} - \Delta U_{OUT}}{Z_2}$$

Gyrator



$$\Delta U_{OUT} = \left(1 - \frac{Z_4 Z_2}{Z_3 Z_5}\right) \Delta U_{IN}$$

Gyrator

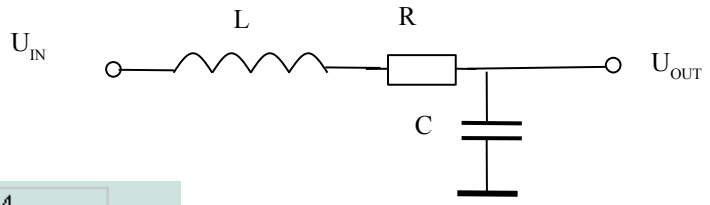


$$Z_{IN} = Z_4 R^2$$

$$\Delta I_{IN} = \frac{\Delta U_{IN} - \Delta U_{IN}\left(1 - \frac{Z_4 Z_2}{Z_3 Z_5}\right)}{Z_1} = \frac{Z_4 Z_2}{Z_1 Z_3 Z_5}\Delta U_{IN}$$

$$Z_{IN} = \frac{\Delta U_{IN}}{\Delta I_{IN}} = \frac{Z_1 Z_3 Z_5}{Z_2 Z_4}$$

2nd order Filter



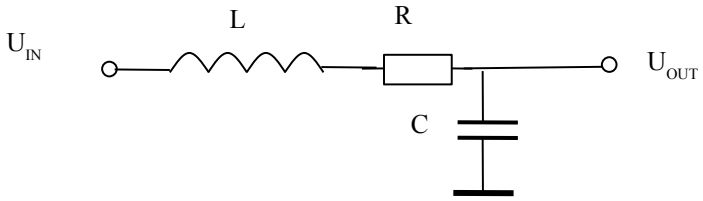
$$A(p) = \frac{A_0}{1 + a_1 p + a_2 p^2}$$

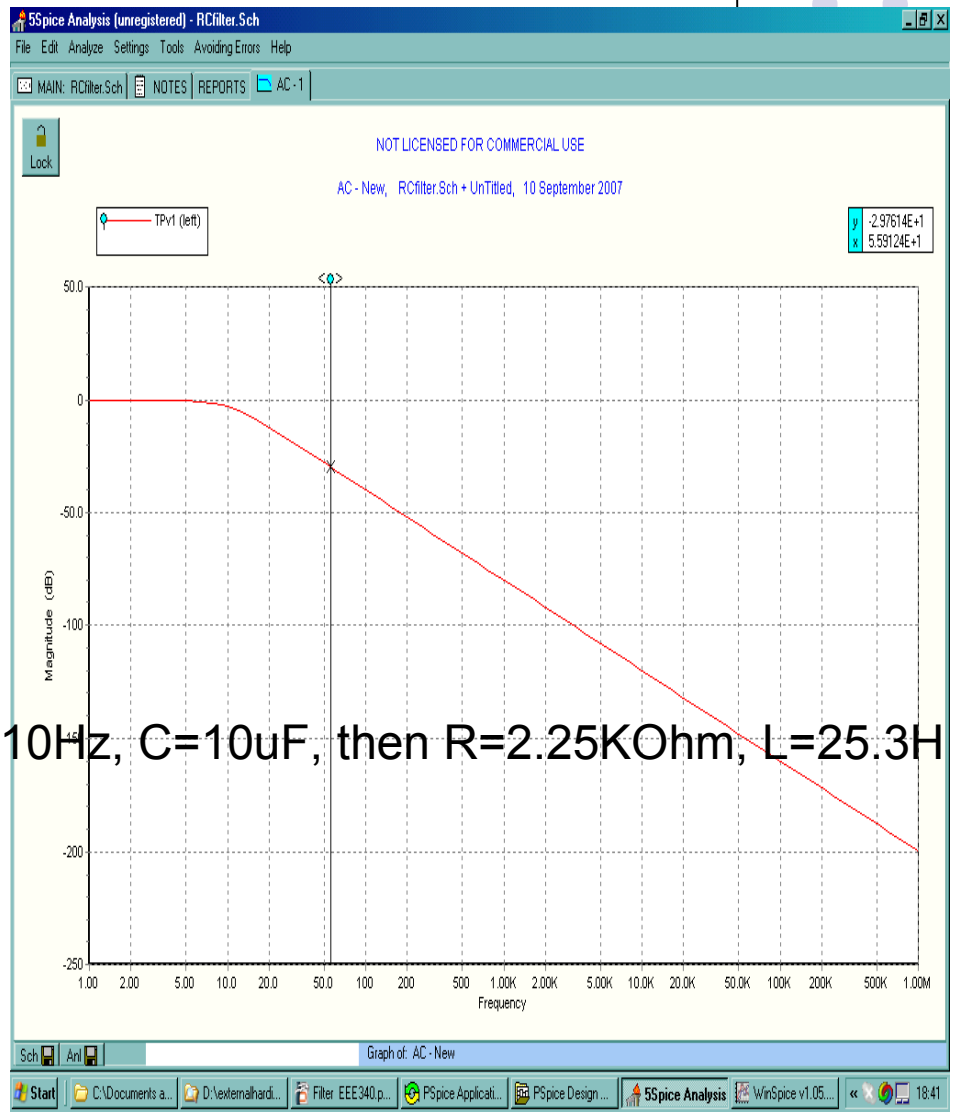
$$A(p) = \frac{1}{1 + \omega_c RCp + \omega_c^2 LCp^2}$$

$$R = \frac{a_1}{2\pi f_c C} \qquad L = \frac{a_2}{4\pi^2 f_c^2 C}$$

IF fc=10Hz, C=10uF, then R=2.25KOhm, L=25.3H

2nd order Filter





IF fc=10Hz, C=10uF, then R=2.25KOhm, L=25.3H