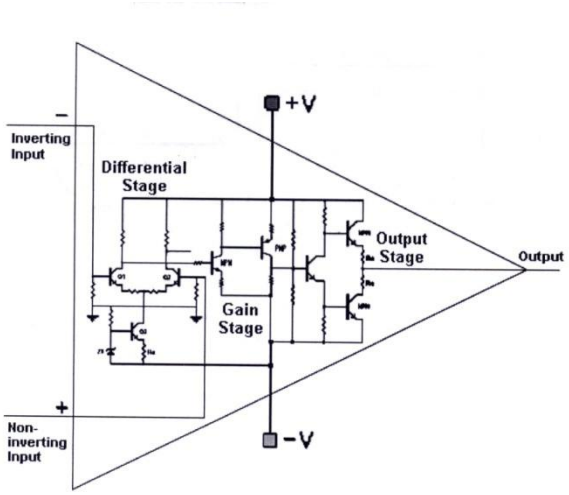
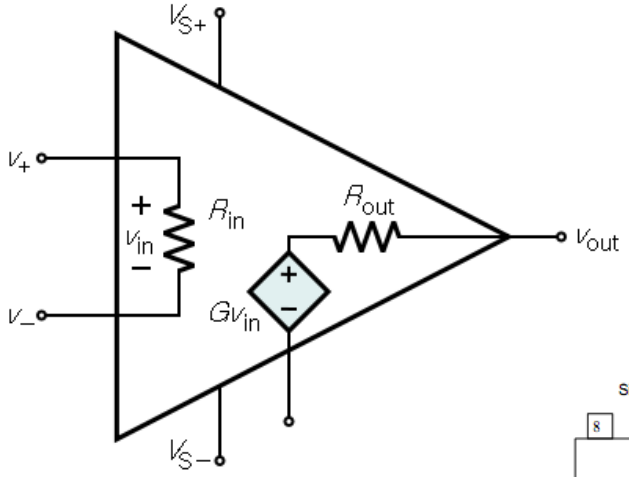
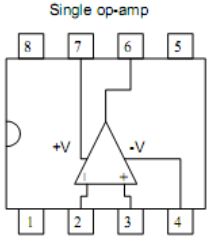
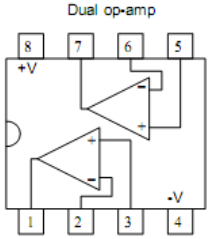
Electrical Systems II

Operational Amplifiers



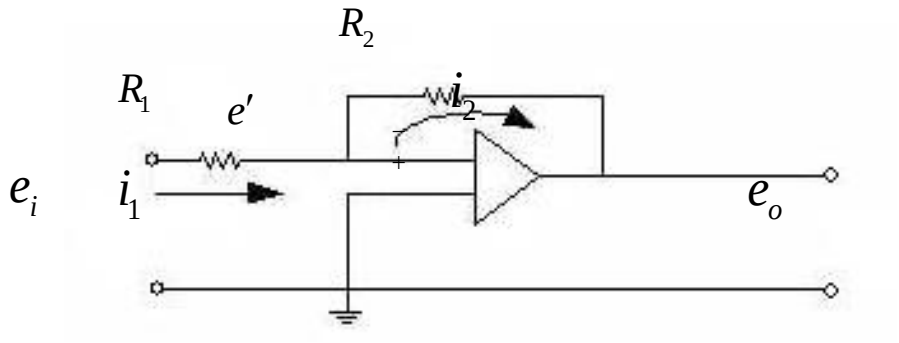




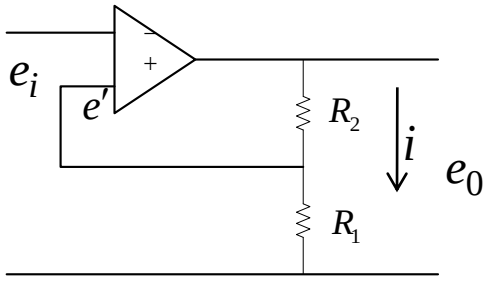


Golden Rules of OP Amp

Inverting Amplifier

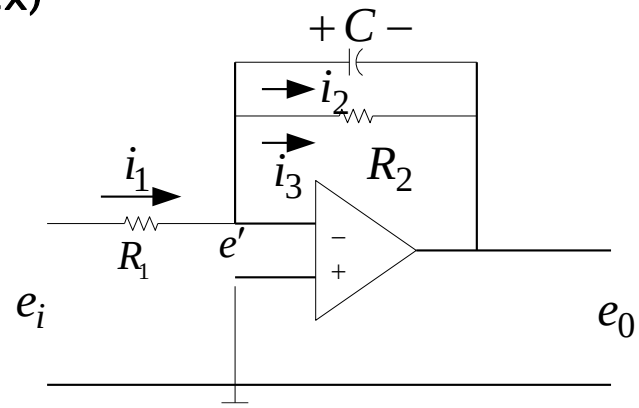


Non-inverting Amplifier



Example of Operational Amplifier Circuit

ex)

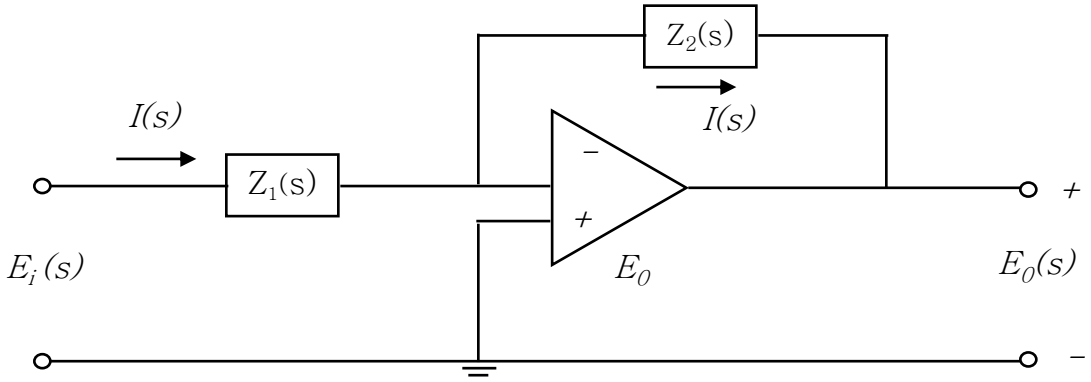


Examples of Operational Amplifiers

Laplace Transform :

Step input response :

Examples of Complex Impedance

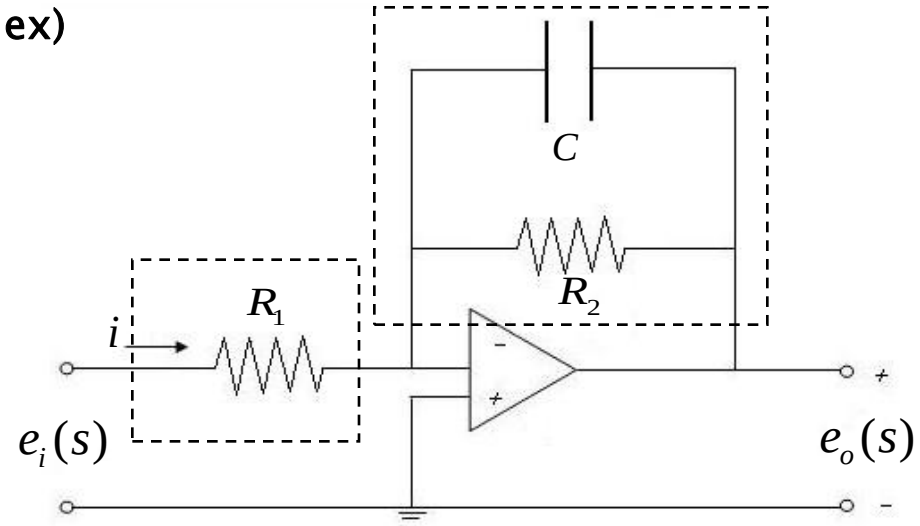


$$E_i(s) = Z_1(s)I(s), \qquad E_o(s) = Z_2(s)I(s)$$

$$\frac{E_o(s)}{E_i(s)} =$$

Examples of Complex Impedance

ex)



$Z_1(s) =$

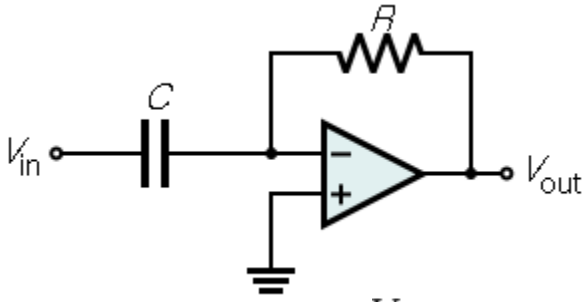
$Z_2(s) =$

$I(s) =$

$$\frac{E_o(s)}{E_i(s)} = -\frac{Z_2(s)}{Z_1(s)} =$$

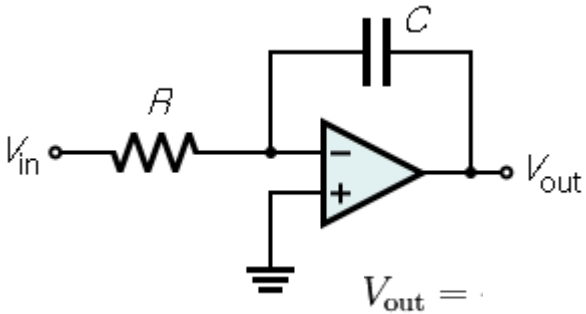
Other Examples

Differentiator/High Pass Filter



$$V_{out} =$$

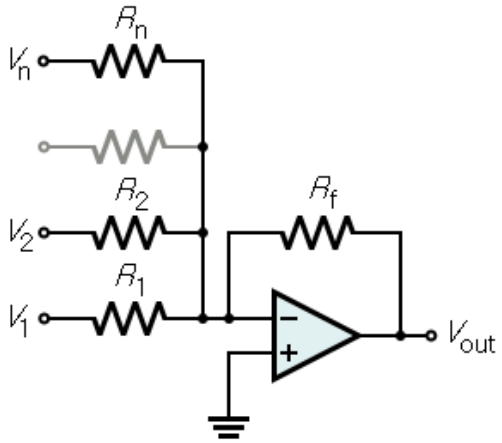
Integrator/Low Pass Filter



$$V_{out} =$$

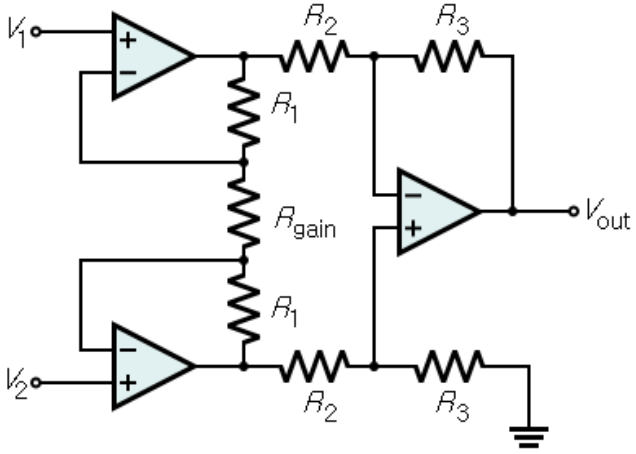
Other Examples

Summing Amplifier



$$V_{\text{out}} = -R_{\text{f}} \left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \cdots + \frac{V_n}{R_n} \right)$$

Instrumentation Amplifier



$$\frac{V_{\text{out}}}{V_2 - V_1} = \left(1 + \frac{2R_1}{R_{\text{gain}}} \right) \frac{R_3}{R_2}$$

http://en.wikipedia.org/wiki/Operational_amplifier_applications