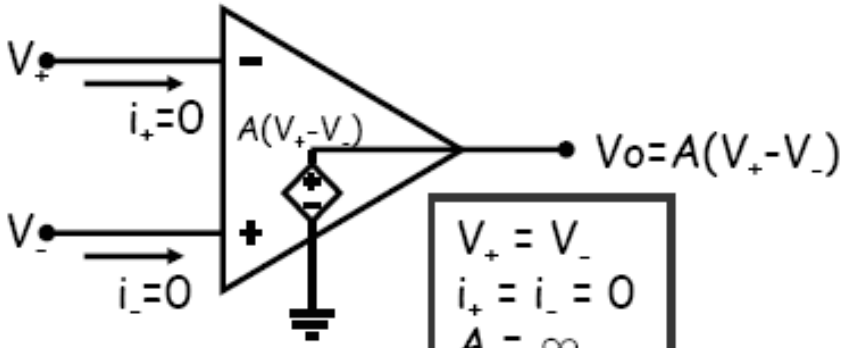
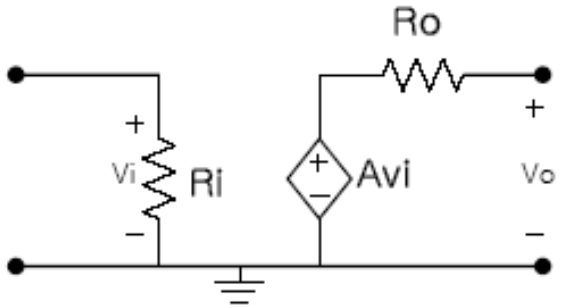
OP AMP – Active Filter

OP AMP Basic

Ideal Op-Amp

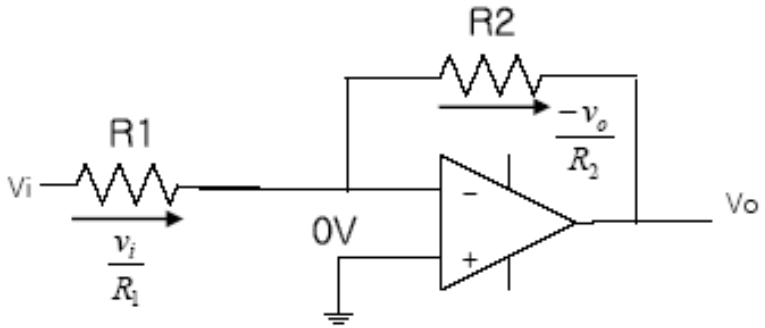


$V_+ = V_-$
$i_+ = i_- = 0$
$A = \infty$



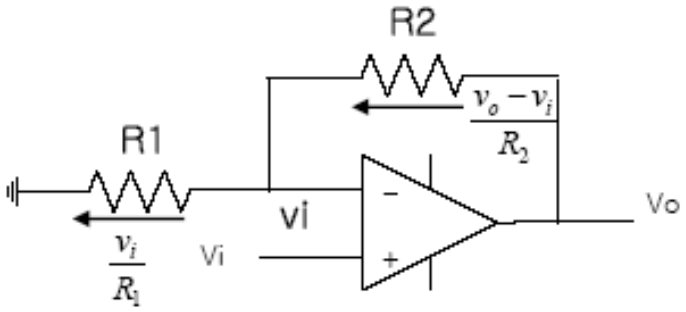
Rin = ∞
Rout = 0

Inverting Configuration



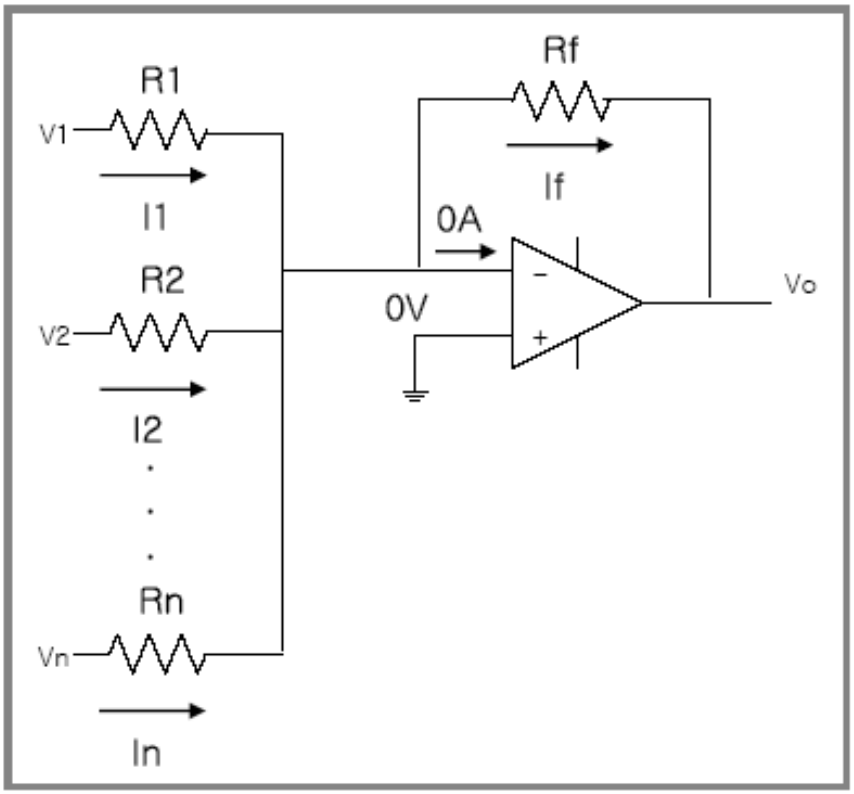
$$\frac{v_i}{R_1} = \frac{-v_o}{R_2} \Rightarrow \frac{v_o}{v_i} = -\frac{R_2}{R_1}$$

Non-inverting Configuration



$$\frac{v_i}{R_1} = \frac{v_o - v_i}{R_2} \Rightarrow \frac{v_o}{v_i} = \left(1 + \frac{R_2}{R_1}\right)$$

Weighted Summer



Nodal Analysis @ V_

$$i_1 = \frac{v_1}{R_1} \quad i_2 = \frac{v_2}{R_2} \quad \cdots \quad i_n = \frac{v_n}{R_n}$$

$$\Rightarrow \quad i_f = i_1 + i_2 + \ldots + i_n = \frac{v_1}{R_1} + \frac{v_2}{R_2} + \ldots + \frac{v_n}{R_n}$$

$$\Rightarrow \quad v_o = -i_f R_f = -\left(\frac{R_f}{R_1} v_1 + \frac{R_f}{R_2} v_2 + \ldots + \frac{R_f}{R_n} v_n \right)$$

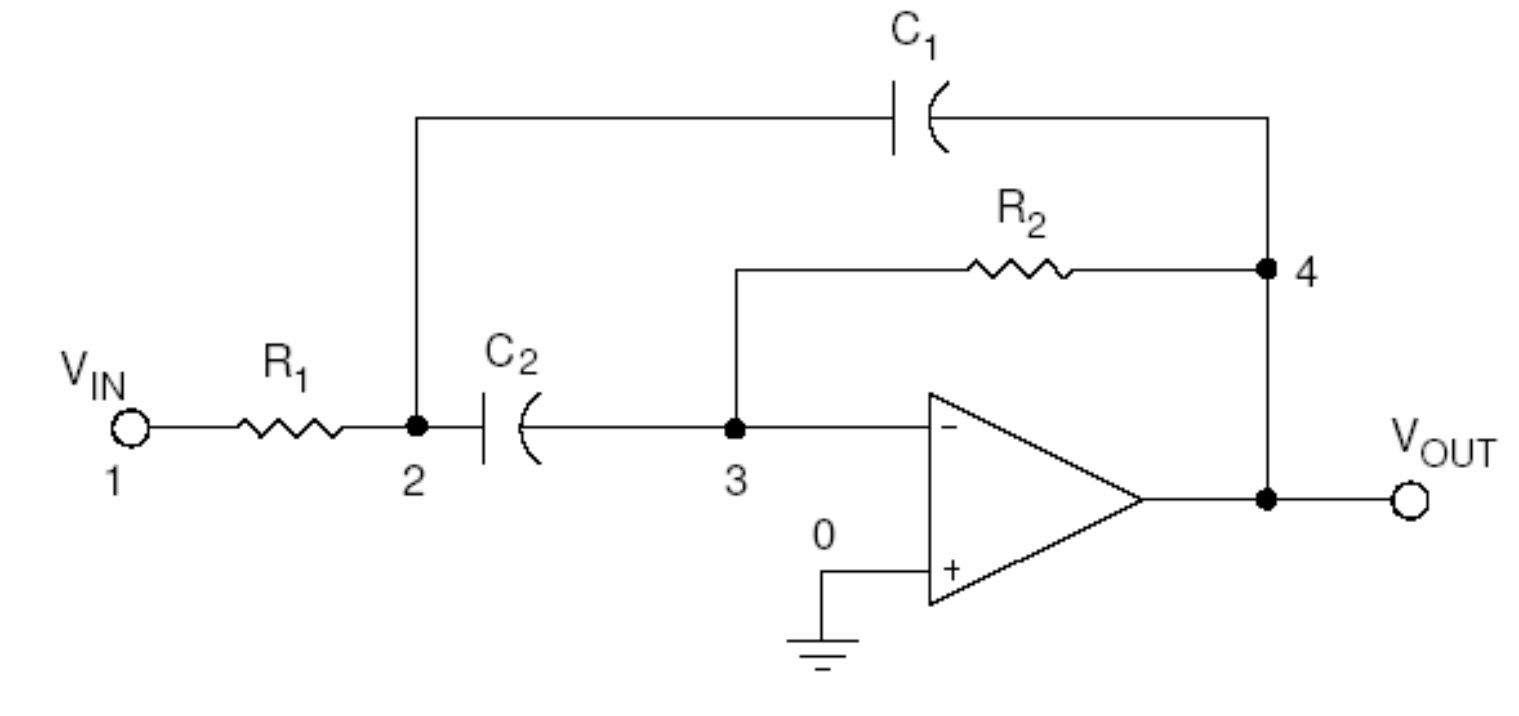
A weighted sum of the input signals !

Filters

- Passive Filters
  - ✓ the inability to generate a network with a gain > 1
  - ✓ the need for inductive elements

- Active Filter
  - ✓ a network with a gain
  - ✓ using only resistors, capacitors, and the OP-AMP

Active Filter



- ✓ Gain
- ✓ Filter Type