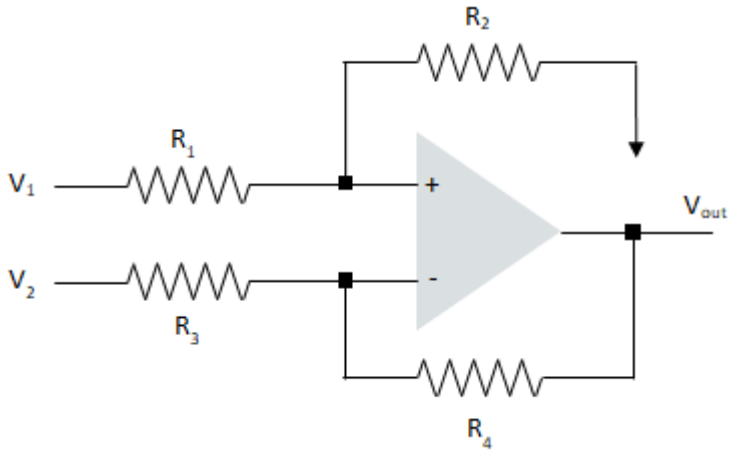
Differential Amplifier Design

A differential amplifier is to be used to design a unipolar to bipolar converter. The input and output voltage ranges are known. Given a voltage reference, the resistances are to be calculated



Reference voltage

$$V_2 := 2.5\,V$$

Known resistances

$$R_2 := 3\cdot 10^3\,\Omega \qquad R_3 := 10^3\,\Omega$$

Approach 1:
Define two expressions evaluated at different parameter values

$$\text{circuit} := V_{out} = V_1\cdot\frac{1}{1+\frac{R_1}{R_2}}\cdot\left(1+\frac{R_4}{R_3}\right) - V_2\cdot\frac{R_4}{R_3}$$

$$\text{eq1} := \text{eval}\left(\text{circuit}, \left[V_1 = 0\,V, V_{out} = -1\,V\right]\right)$$

$$\text{eq2} := \text{eval}\left(\text{circuit}, \left[V_1 = 2.5\,V, V_{out} = 1\,V\right]\right)$$

$$\text{fsolve}\left(\{\text{eq1}, \text{eq2}\}\right) = \left\{R_1 = 2.250\times 10^3\,\Omega, R_4 = 400.000\,\frac{V}{A}\right\}$$

Approach 2:
Define a function using arrow operators

$$V_{out} := \left(V_1, R_1, R_4\right) \rightarrow V_1\cdot\frac{1}{1+\frac{R_1}{R_2}}\cdot\left(1+\frac{R_4}{R_3}\right) - V_2\cdot\frac{R_4}{R_3}$$

$$\text{sol} := \text{fsolve}\left(\left\{V_{out}\left(0\,V, R_1, R_4\right) = -1\,V, V_{out}\left(2.5\,V, R_1, R_4\right) = 1\,V\right\}\right)$$

$$\text{sol} = \left\{R_1 = 2.250\times 10^3\,\Omega, R_4 = 400.000\,\frac{V}{A}\right\}$$