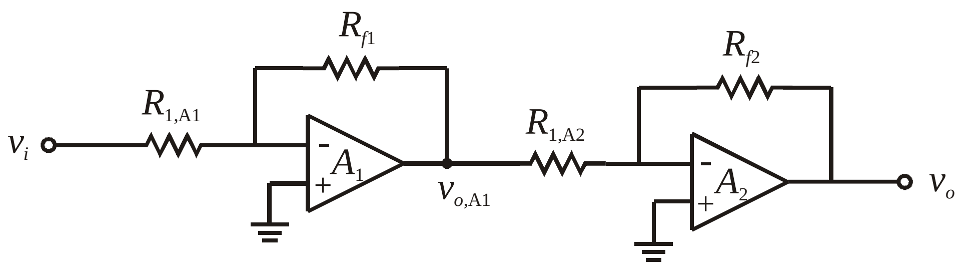
Example Two-stage amplifier consisting of two inverting amplifiers.



- Using equation (5.9) $v_o = \dfrac{-R_f}{R_1} v_i$ for an inverting amplifier, the closed-loop voltage gain of a single inverting amplifier is given by $A_v = \dfrac{v_o}{v_i} = \dfrac{-R_f}{R_1}$.

- If $R_{1,A1} = 3\,\mathrm{k}\Omega$ and $R_{f1} = 33\,\mathrm{k}\Omega$ for op-amp A_1, the gain for stage 1 is

$$A_{v1} = \frac{v_{o,A1}}{v_i} = \frac{-R_{f1}}{R_{1,A1}} = \frac{-33}{3} \quad \Rightarrow \quad \underline{A_{v1} = -11}, \text{ or}$$

$$A_{v1}(\mathrm{dB}) = 20\log_{10} |A_{v1}| = 20\log_{10} 11 \quad \Rightarrow \quad \underline{A_{v1}(\mathrm{dB}) = 20.82785\ (\mathrm{dB})}.$$

- If $R_{1,A2} = 10\,\mathrm{k}\Omega$ and $R_{f2} = 50\,\mathrm{k}\Omega$ for op-amp A_2, the gain for stage 2 is

$$A_{v2} = \frac{v_o}{v_{o,A1}} = \frac{-R_{f2}}{R_{1,A2}} = \frac{-50}{10} \quad \Rightarrow \quad \underline{A_{v2} - 5}, \text{ or}$$

$$A_{v2}(\mathrm{dB}) = 20\log_{10} |A_{v2}| = 20\log_{10} 5 \quad \Rightarrow \quad \underline{A_{v2}(\mathrm{dB}) = 13.97940\ (\mathrm{dB})}$$

- The output voltage ($v_{o,A1}$) of the stage 1 inverting amplifier is the input voltage for the stage 2 inverting amplifier. Therefore, the overall voltage gain is given by

$$A_v = \frac{v_o}{v_i} = \left(\frac{v_{o,A1}}{v_i}\right)\left(\frac{v_o}{v_{o,A1}}\right) = A_{v1}\, A_{v2} = (-11)(-5) \quad \Rightarrow \quad \underline{A_v = 55}.$$

- In decibels (dB), the overall voltage gain is

$$A_v(\mathrm{dB}) = 20\log_{10}(A_v) = 20\log_{10}(55) \quad \Rightarrow \quad \underline{A_v(\mathrm{dB}) = 34.807\ \mathrm{dB}}, \text{ or}$$

$$A_v(\mathrm{dB}) = A_{v1}(\mathrm{dB}) + A_{v2}(\mathrm{dB}) = 20.82785 + 13.9794 \quad \Rightarrow \quad \underline{A_v(\mathrm{dB}) = 34.80725\ (\mathrm{dB})}$$