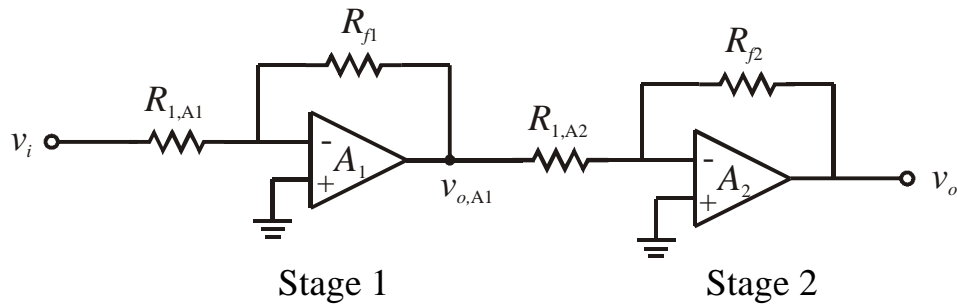


Example Two-stage amplifier consisting of two inverting amplifiers.



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

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

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

$$\text{or } A_{v1}(\text{dB}) = 20 \log_{10} |A_{v1}| = 20 \log_{10}(11) \Rightarrow \underline{A_{v1}(\text{dB}) = 20.828 \text{ (dB)}}.$$

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

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

$$\text{or } A_{v2}(\text{dB}) = 20 \log_{10} |A_{v2}| = 20 \log_{10}(5) \Rightarrow \underline{A_{v2}(\text{dB}) = 13.979 \text{ (dB)}}.$$

- 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

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

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

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

$$\text{or } A_v(\text{dB}) = A_{v1}(\text{dB}) + A_{v2}(\text{dB}) = 20.828 + 13.979 \Rightarrow \underline{A_v(\text{dB}) = 34.807 \text{ (dB)}}$$