Inverting Operational Amplifier

Student Group

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Gain of Op-Amp

Build the following circuit in figure 1 with the power supply and a multimeter.

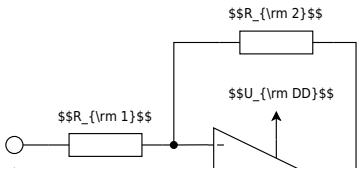

Fig. 1: Inverting Op-Amp

$U_{\rm DD}{\rm~=10~V},~U_{\rm SS}{\rm~=-10~V},~R_{\rm 1}{\rm~=10~k\Omega}$

Calculate the necessary value for $R_{\rm 2}$, so that the output $U_{\rm OUT}$ is +5 V. Use the supply voltage of the operational amplifier for $U_{\rm IN}$.

$U_{\rm IN}{\rm~=}$

$R_{\rm 2}{\rm~=}$

Analysis of inverting input currents

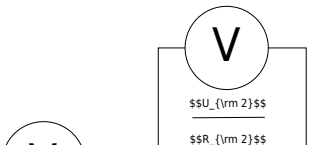

Fig. 2: Inverting Op-Amp: Analysis of currents of the inverting input

$U_{\rm DD}{\rm~=10~V},~U_{\rm SS}{\rm~=-10~V},~R_{\rm 1}{\rm~=10~k\Omega}$

Use the values from figure 1 for $U_{\rm IN},~U_{\rm OUT},~R_{\rm 2}$.

Complete the reference arrows in the scematic of the circuit.
Determine the the currents $I_{\rm 1}$ and $I_{\rm 2}$ indirectly by measuring the voltage across known resistors
and calculate the algebraic sum of the currents at node $N_{\rm {12}}$ using Kirchhoff's Current Law (KCL).

$U_{\rm 1}{\rm~=}$

$U_{\rm 2}{\rm~=}$

$I_{\rm 1}{\rm~=}$

$I_{\rm 2}{\rm~=}$

$I_{\rm N12}{\rm~=}$

Analysis of inverting input voltages

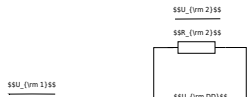

Fig. 3: Inverting Op-Amp: Analysis of virtual GND of the inverting input

$U_{\rm DD}{\rm~=10~V},~U_{\rm SS}{\rm~=-10~V},~R_{\rm 1}{\rm~=10~k\Omega}$

Use the values from figure 1 for $U_{\rm IN},~U_{\rm OUT},~R_{\rm 2}$.

Complete the reference arrows in the schematic of the circuit.
Take the values for $U_{\rm 1},~U_{\rm 2},~U_{\rm OUT}$ from figure 2.
Calculate the voltage U_{12} using Kirchhoff's Voltage Law (KVL) within the circuit loop.
Verify your calculated result by measuring U_{12}.

$U_{\rm 1}{\rm~=}$

$U_{\rm 2}{\rm~=}$

$U_{\rm OUT}{\rm~=}$

Calculated $U_{\rm 12}{\rm~=}$

Measured $U_{\rm 12}{\rm~=}$

Analyse the physical significance of the potential at N_{12} relative to GND (defined as U_{12}) in the context of the operational amplifier's input configuration. What do you observe?

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What happens if you short-circuit R_2 (the feedback resistor)?
Experimentally verify this effect and explain the observed behavior regarding the output voltage.

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