

# Inverting Operational Amplifier

## Student Group

First Name	Surname	Matrikel Nr.

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## Inverting Operational Amplifier

### Gain of Op-Amp

Build the following circuit in [figure 1](#) with the power supply and a multimeter.



Fig. 1: Inverting Op-Amp

$U_{DD} = 10\text{ V}$ ,  $U_{SS} = -10\text{ V}$ ,  $R_1 = 10\text{ k}\Omega$

Calculate the necessary value for  $R_2$ , so that the output  $U_{OUT}$  is  $+5\text{ V}$ . Use the supply voltage of the operational amplifier for  $U_{IN}$ .

$U_{IN} =$

$$R_2$$

**Analysis of inverting input currents**



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

$$U_{DD} = 10\text{V}, U_{SS} = -10\text{V}, R_1 = 10\text{k}\Omega$$

Use the values from figure 1 for  $U_{IN}, U_{OUT}, R_2$ .

Complete the reference arrows in the schematic of the circuit.

Determine the the currents  $I_1$  and  $I_2$  indirectly by measuring the voltage across known resistors

and calculate the algebraic sum of the currents at node  $N_{12}$  using Kirchhoff's Current Law (KCL).

$$U_1$$

$$U_2$$

$$I_1$$

$$I_2$$

$$I_{N12}$$

**Analysis of inverting input voltages**



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

$$U_{DD} = 10V, U_{SS} = -10V, R_1 = 10k\Omega$$

Use the values from figure 1 for  $U_{IN}, U_{OUT}, R_2$ .

Complete the reference arrows in the scematic of the circuit.

Take the values for  $U_1, U_2, U_{OUT}$  from figure 2.

Calculate the voltage  $U_{12}$  using Kirchhoff's Voltage Law (KVL) within the circuit loop.

Verify your calculated result by measuring  $U_{12}$ .

$$U_1$$

$$U_2$$

$$U_{OUT}$$

$$\text{Calculated } U_{12}$$

Measured  $U_{12}$

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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Last update: **2026/05/04 14:57**

