



# ROHINI

## COLLEGE OF ENGINEERING & TECHNOLOGY

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(AUTONOMOUS)

### IDEAL OPERATIONAL AMPLIFIER :

The ideal op amp is an amplifier with infinite input impedance, infinite open-loop gain, zero output impedance, infinite bandwidth, and zero noise. It has positive and negative inputs which allow circuits that use feedback to achieve a wide range of functions.

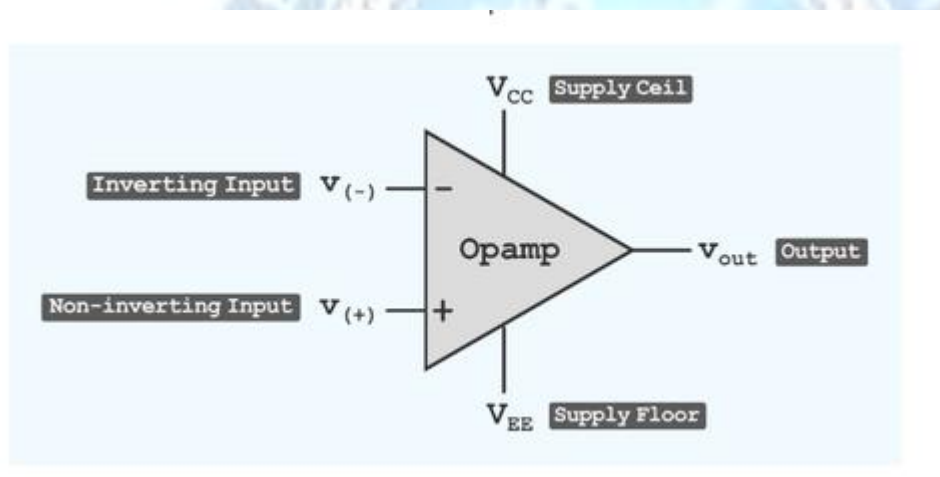
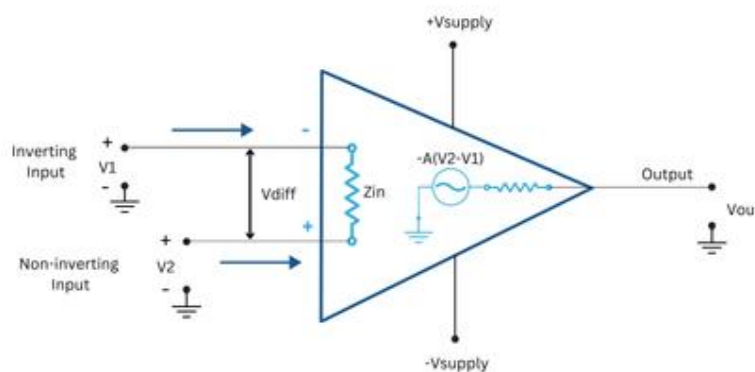


Figure: operational amplifier layout

### Equivalent Circuit of an Ideal Op-amp - Operational Amplifier



Equivalent Circuit of an Ideal Op-Amp

The equivalent circuit is useful in analyzing the basic operating principles of op-amps and in observing the effects of feedback arrangements. From the above figure we can say that the output voltage is

$$V_o = A V_{id} = A (V_1 - V_2) \quad \dots\dots\dots \text{equation 1}$$

where A = large-signal voltage gain

$V_{id}$  = difference input voltage

$V_1$  = voltage at the non-inverting terminal with respect to the ground

$V_2$  = voltage at the inverting terminal with respect to the ground

The equation 1 indicates that the output voltage  $V_o$  is directly proportional to the algebraic difference between the two input voltage and it does not amplify the input voltage themselves. For this reason, the polarity of the output voltage depends on the polarity of the difference voltage.

### **CHARACTERISTICS OF AN IDEAL OP AMP :**

#### **Infinite Open-Loop Voltage Gain ( $A_{OL}$ )**

- The open-loop gain is the gain of the op-amp without any feedback.
- In an ideal op-amp, this gain is infinite, which means even a very tiny difference between the inverting (-) and non-inverting (+) inputs produces a very large output voltage.
- This ensures that the op-amp can amplify extremely small input signals.

#### **Infinite Input Impedance ( $Z_{in}$ )**

- An ideal op-amp draws no current from the input signal source.
- Infinite input impedance prevents loading of the previous stage, ensuring the input signal is applied fully without any voltage drop across the input.

#### **Zero Output Impedance ( $Z_{out}$ )**

- The op-amp can deliver any amount of current to the load without reducing the output voltage.
- Zero output impedance ensures maximum voltage transfer to the load and allows the op-amp to drive heavy loads efficiently.

### **Infinite Bandwidth**

- An ideal op-amp can amplify signals of any frequency without attenuation or phase shift.
- This characteristic ensures that the op-amp does not distort signals in the frequency range of interest.

### **Infinite Slew Rate**

- The output voltage can change instantaneously in response to a rapid change in the input.
- Infinite slew rate prevents distortion in high-speed or rapidly changing signals.

### **Infinite Common-Mode Rejection Ratio (CMRR)**

- CMRR = ability of the op-amp to reject common signals applied to both inputs.
- An ideal op-amp completely ignores any signal that is common to both inputs, amplifying only the difference between the inverting and non-inverting inputs.

### **Zero Offset Voltage**

- When the input terminals are shorted together (zero differential input), the output is exactly zero volts.
- This ensures accurate amplification without any unwanted voltage appearing at the output.

### **Zero Noise and Perfect Stability**

- An ideal op-amp introduces no internal noise and its parameters do not change with temperature or time.
- This ensures clean amplification and predictable performance under all conditions.