

The Operational Amplifier

Classification of circuit elements:

Active elements:

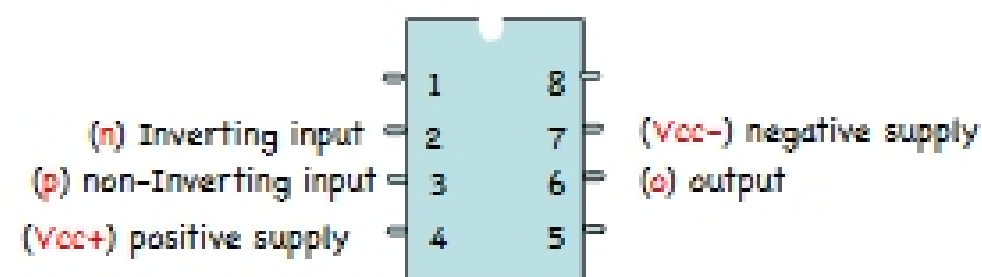
Elements capable of generating electric energy; e.g. voltage sources, current sources.

Passive elements:

Elements incapable of generating electric energy; e.g. Resistors.

Operational Amplifier

- It is an **active device** (circuit consisting of diodes and transistors)
- It has five terminals. (**two inputs**, **one output** and **two power supply** terminals)



- It is used in building bigger circuits by connecting the input and the output terminals to other circuit elements e.g. resistors , sources, capacitors and inductors

Operational Amplifier specifications

The gain (A) in the range of $A \approx 10^4$

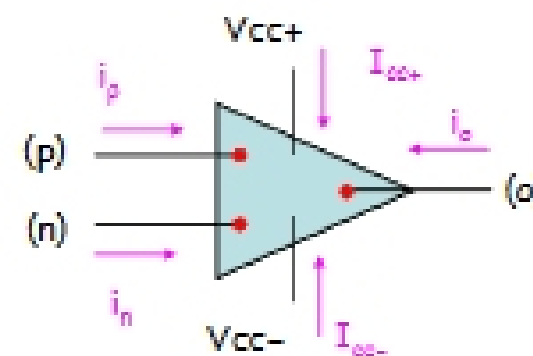
Supply voltages. (V_{cc}^{\pm}) can not exceed $\pm 20V$.

Ideal Operational amplifier

- gain is assumed to be infinite i.e. $A = \infty$
- the resistance seen by the input terminals is assumed to be infinite i.e. $R_{input} = \infty$

Operational Amplifier circuit symbol

- Non-inverting input (p)
- Inverting input (n)
- Output (o)
- Positive supply V_{cc}^+
- Negative supply V_{cc}^-



Operational Amplifier Terminal voltages:

Voltages at the different terminals are measured with respect to a **common reference node**. This node is usually an external node in the large circuit where the OP-Amp is used.

The potential of the different terminals (nodes) are defined as :

- V_p : Potential of node (p) with respect to the reference node
- V_n : Potential of node (n) with respect to the reference node
- V_o : Potential of node (o) with respect to the reference node

Operational Amplifier Terminal currents:

i_p : Current entering node (p)

i_n : Current entering node (n)

i_o : Current entering node (o)

i_{ζ^+} : Current entering node V_{ζ^+}

i_{ζ^-} : Current entering node V_{ζ^-}