UNIT-I

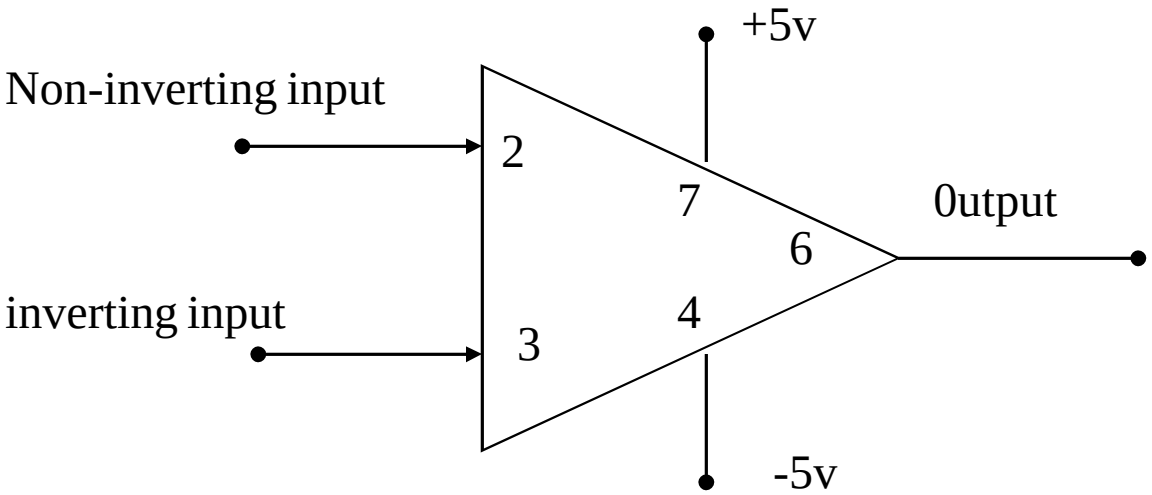
Characteristics of Op-Amp

OPERATION AMPLIFIER

An operational amplifier is a direct coupled high gain amplifier consisting of one or more differential amplifiers, followed by a level translator and an output stage.

It is a versatile device that can be used to amplify ac as well as dc input signals & designed for computing mathematical functions such as addition, subtraction ,multiplication, integration & differentiation

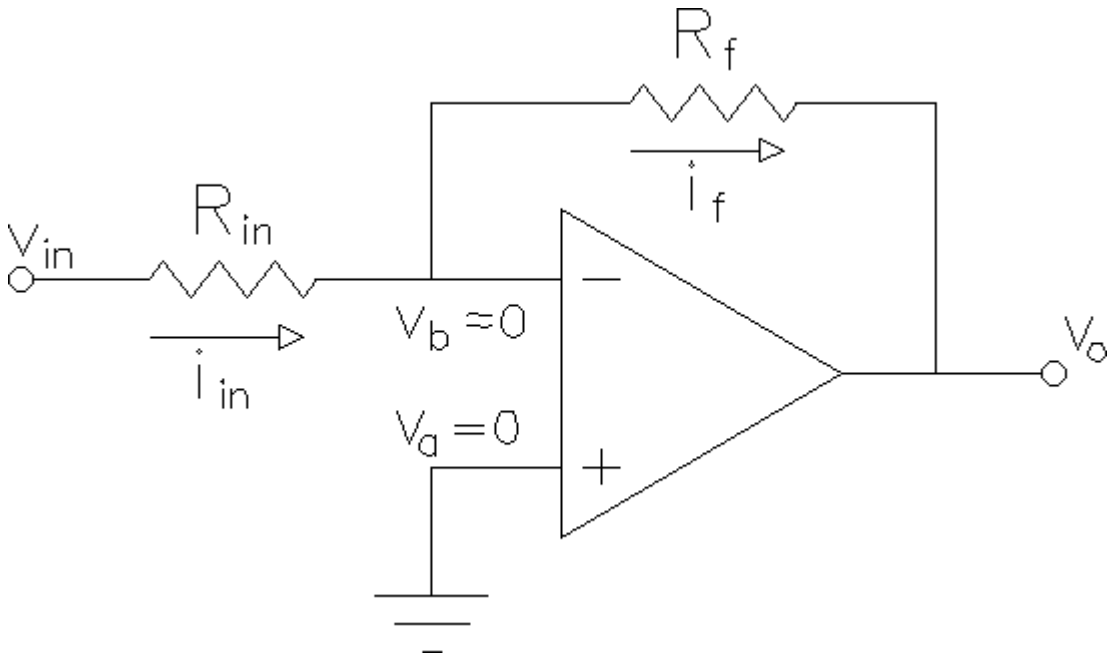
Op-amp symbol



Ideal characteristics of OPAMP

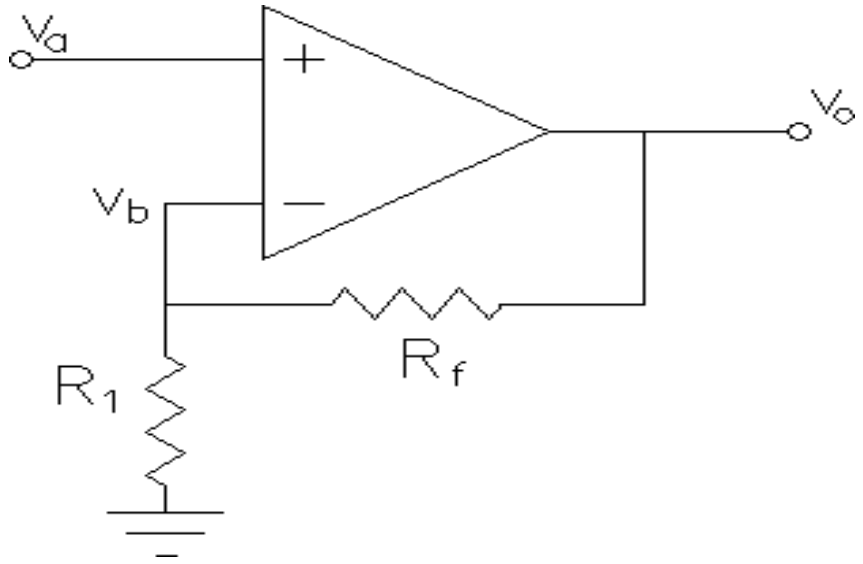
1. Open loop gain infinite
2. Input impedance infinite
3. Output impedance low
4. Bandwidth infinite
5. Zero offset, ie, Vo=0 when V1=V2=0

Inverting Op-Amp



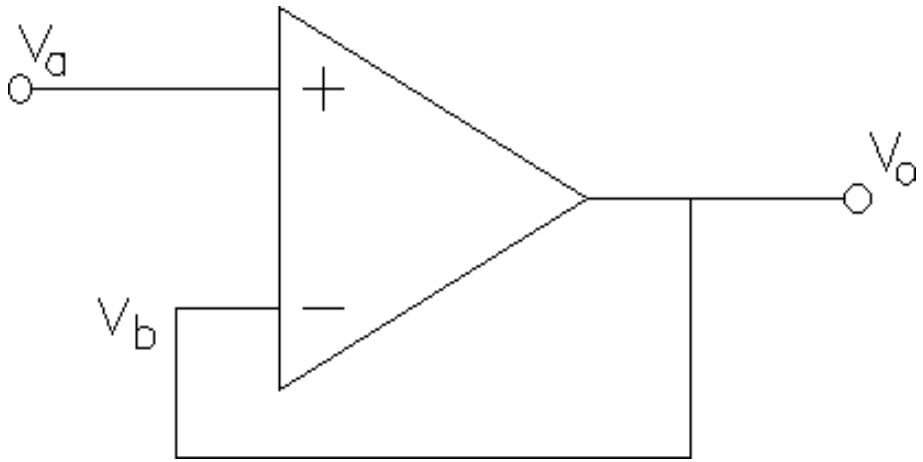
$$V_{OUT} = -V_{IN} \frac{R_f}{R_1}$$

Non-Inverting Amplifier



$$V_{OUT} = V_{IN}\left(1 + \frac{R_1}{R_2}\right)$$

Voltage follower



$$V_{OUT} = V_{IN}$$

DC characteristics

Input offset current

The difference between the bias currents at the input terminals of the op- amp is called as input offset current. The input terminals conduct a small value of dc current to bias the input transistors. Since the input transistors cannot be made identical, there exists a difference in bias currents

DC characteristics

Input offset voltage

A small voltage applied to the input terminals to make the output voltage as zero when the two input terminals are grounded is called input offset voltage

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DC characteristics

Input bias current

Input bias current IB as the average value of the base currents entering into terminal of an op-amp

$$I_B = \frac{I_B^+ + I_B^-}{2}$$

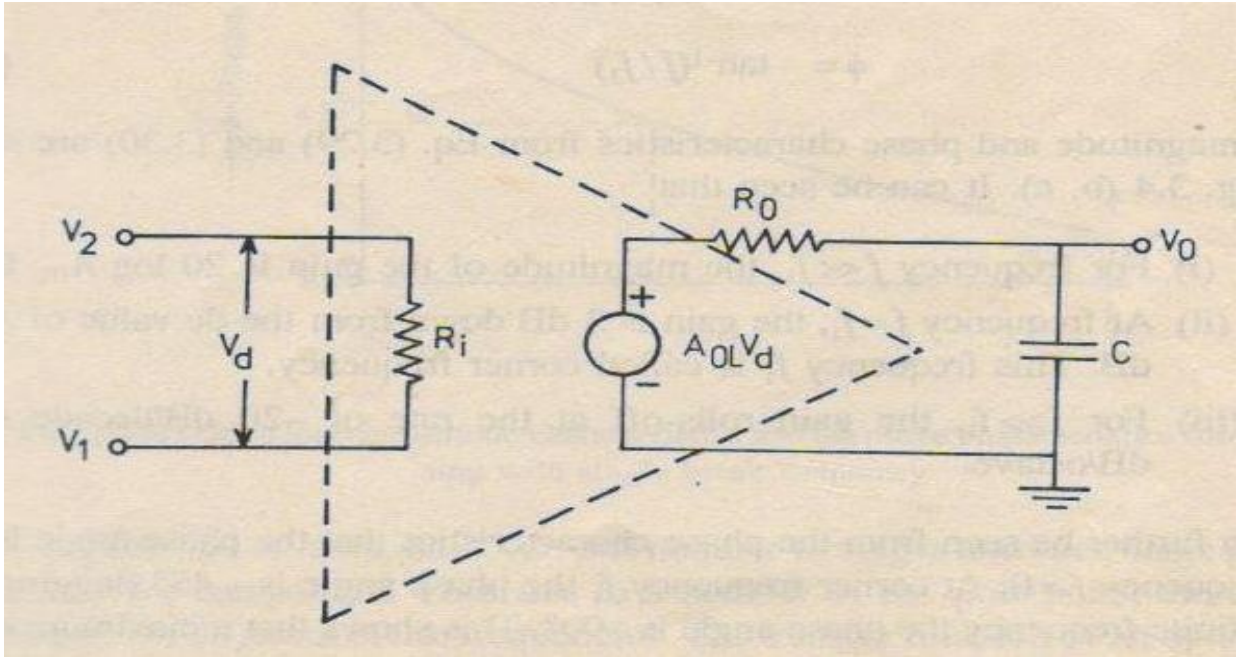
DC characteristics

THERMAL DRIFT

Bias current, offset current and offset voltage change with temperature. A circuit carefully nulled at $25^{o}c$ may not remain so when the temperature rises to $35^{o}c$. This is called drift.

AC characteristics

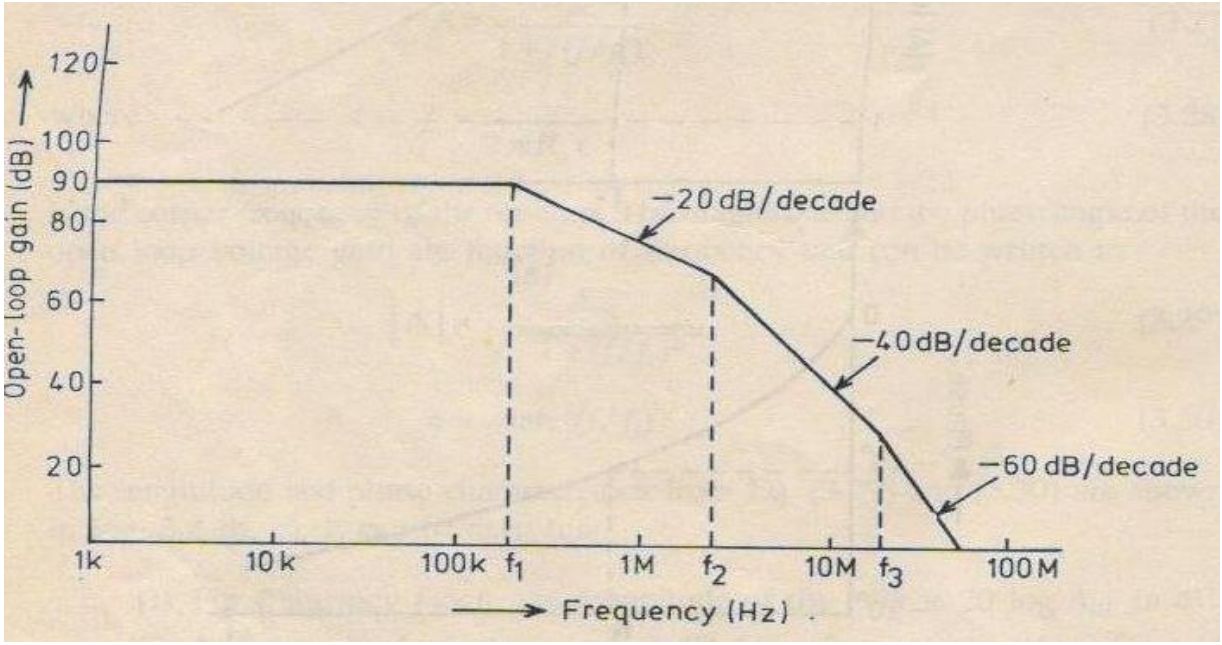
Frequency Response



HIGH FREQUENCY MODEL OF OPAMP

AC characteristics

Frequency Response



OPEN LOOP GAIN VS FREQUENCY

Need for frequency compensation in practical op-amps

- Frequency compensation is needed when large bandwidth and lower closed loop gain is desired.
- Compensating networks are used to control the phase shift and hence to improve the stability

Frequency compensation methods

- Dominant- pole compensation
- Pole- zero compensation

Slew Rate

- The slew rate is defined as the maximum rate of change of output voltage caused by a step input voltage.

- An ideal slew rate is infinite which means that op-amp's output voltage should change instantaneously in response to input step voltage