OP-AMP

OVERVIEW

An op-amp or an operational amplifier is a high voltage gain amplifier. Op-ams are used for a variety of purposes in the field of electronics. We use amplifier to convert a weak signal to a high (amplified signal). However, we need operational amplifiers for various of operational purposes like performing mathematical operations.

An op-amp has two high impedance input terminals (one is positive and other is negative). The is output terminal is one and the voltage supply is given to the op-amp which varies between 3V to 5V.

An op-amp has 2 input terminals and 1 output terminal. The opamp also has 2 voltage supply terminals. Two input terminals form a differential input. We call the terminal which is marked with negative (-) sign as inverting terminal and the terminal which is marked with positive (+) sign as the non-inverting terminal of the operational amplifier.

There are various kinds of opamps used for various purposes and most widely they are used as voltage amplifiers and integrated circuits. Operational amplifiers or opamps are the amplifiers that have the properties required for an ideal DC amplification and they are used in mathematical operations such as addition, subtract, multiplication and division , etc.

WORKING OF OPAMPS:

When two signals from the inverting and non inverting terminal of the opamp is applied, an ideal opamp amplifies the difference between the applied input signals this difference is called as the

differential input voltage. The inverting opamp(practical) will amplify and changes the phase by 180degrees and the non-inverting will amplify without changing any phase.

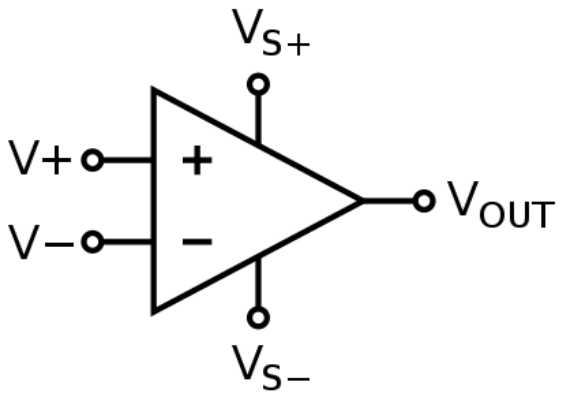
The equation below shows the output of an opamp.

$$V_{OUT} = A_{OL}(V_1 - V_2)$$

V_{OUT} is voltage at the output terminal of the opamp. A_{OL} is the open-loop gain for the op-amp which is constant (ideal).

V_1 = voltage at the non-inverting terminal.
V_2 = voltage at the inverting terminal.
($V_1 - V_2$) =differential input voltage.
It is clear that the output will be non-zero only if the differential input voltage is non-zero (V_1 and V_2 aren't equal), and will be zero if both V_1 and V_2 are equal. Note that this is an ideal condition. In practical, there are small imbalances in the operational amplifier. The open loop gain of an opamp is very high. Hence, an open loop op-amp amplifies a small applied differential input voltage to a very high value.
The operational amplifier amplifies input to a significant value at the output that cannot go beyond the supply voltage of the opamp. Hence the law of conservation of energy isn't violated.

SYMBOL OF OP-AMP:

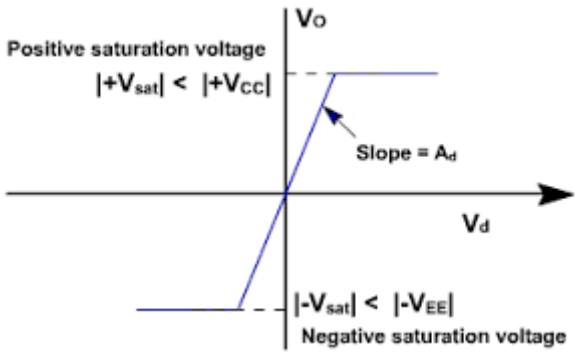


V_+ = voltage at the non-inverting terminal.
V_- = voltage at the inverting terminal.

Vs = supply voltage

V_{out}= output terminal

CHARACTERISTIC CURVE OF AN APMLIFIER:



Ideal Voltage Transfer Curve of an Op-Amp

TYPES OF OPAMPS:

Some of the different types of op-amps are:

Inverting op-amps

Non inverting op-amps

Differential op-amps

Summing op-amps

APPLICATIONS:

Op-amps ha a wide range of applications. Some of them are:

Differentiator, Integrators, Rectifiers, Wave Generators, Signal Amplifications, Analog & Digital Converters, etc.

1.Differentiator: The differentiator opamp configuration produces an output voltage that is proportional to the rate of change of the input voltage by measuring the current through a capacitor.

2.Integrators: It performs integration calculations with respect to time.

3.Rectifiers: Half wave precision rectifier is implemented using an opamp.

4.Wave Generators: Op-amps are excellent in generating amplified sine waves.

5.Signal Amplifications: op-amps convert weak signal to amplified strong signals.

6.Analog & Digital Converters: A ladder is used along with an opamp the circuit of analog and digital converters.

Similarly, there are so many uses of opamp in the field of electronics which ranges from small devices to smart Ai devices.