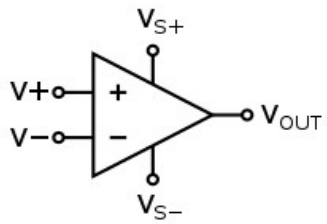
OPERATIONAL AMPLIFIER

An operational amplifier is a DC -coupled high gain electronic voltage amplifier with a differential input and a single ended output. An op-amp produces an output potential that is around 10^5 or 10^6 times larger than the input voltage.

Purpose of op-amp

An op-amp is an integrated circuit, which functions to amplify or improve the weak electric signals. An op-amp has two high impedance input terminals and one low output terminals where we get the amplified voltage signals. For example it is used in microphones, speakers, radio, etc.



Working of op-amp

Here we will explain you about how an op-amp works so as you can see from above figure there are three terminals namely V+, V- and Vout. The tow terminals i.e, V+ and V- are the two input terminals from where we give the input voltage to the device and these terminals are at the high impedance voltage. The terminal Vout is the output terminal from where we get the output voltage signals and these signals are at very low impedance and hence like this an op-amp amplifies the weak electric signals.

Inside of an amplifier there are number of diodes, transistors, resistors which functions to amplify the weak signals. Now we give input voltage from one terminal either its positive or negative and one terminal will remain grounded. Positive terminal (V+) is known as non-inverting terminal as it output voltage signal is in phase with the input voltage signal (it can be studied from the graph). If we give input to (V+) terminal then the (V-) terminal will connect to the ground. Negative terminal (V-) is known as inverting terminal as it output voltage signal is out of the phase with the input voltage signal (it can be studied from graph). If we give input to (V-) terminal then the (V+) terminal will connect to the ground. On supplying positive voltage to the (V+) terminal the current will flow through the transistor from emitter to collector and thus produces a positive (+) voltage at the output terminal. On the other hand if we supply positive voltage to the (V-) terminal then the transistor is in off stage but since it's a PNP transistor so its base activates them and provide a sinking path from emitter to collector and produces voltage at output terminal.

These operations can take place in two ways that is open loop and closed loop. In open loop operation the output signal is not given back to the input terminal i.e there is no feedback required and because of no feedback the output voltage gain is very high. This type of amplifier is used as comparator. In closed loop operation some of the output signal is given back to the input terminal which we call feedback. Its output gain is not that much high. Closed operation can be performed in two ways i.e positive feedback and negative feedback. Positive feedback is when the feedback is given to the positive terminal (V+) and negative feedback is when the feedback is given to the negative terminal (V-). (explained later)

Characteristics of op-amp

Offset voltage is zero

Infinite slew rate

Bandwidth is infinite with zero phase shift

High input impedance with zero input current

Open loop gain is infinite

Output impedance is zero

Characteristic curve of an op-amp

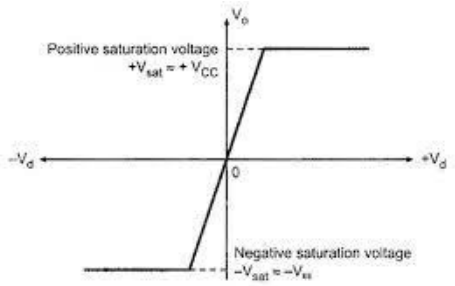


Fig. 2.7 Ideal voltage transfer curve

Symbol of op-amp

Types of op-amp

Inverting amplifier

Non-inverting amplifier

Differential amplifier

Summing amplifier

Voltage follower

Applications of op-amp

Operational amplifier are used to increase the voltage amplitude, oscillators, filters, circuits, etc.

Op-amp are used as voltage follower by giving some of the output voltage signals back to the input terminals.

Op-amp are used as the converter like- current to voltage and voltage to current converter.

Op-amp are used as active rectifiers.

Op-amp are used to perform mathematical stimulation like an adder.

Op-amp are used to isolate cascaded circuits.

Op-amp are used where high input impedance is necessary.

Op-amp are used in microphones, speakers, radios, etc.

Viva–voce Questions

Q1. How does transistors PNP and NPN work inside the op-amp. Explain?

Q2. Explain the differences in the functioning of an op-amp when the supply is given from (V+) terminal and then from (V-) terminal?

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