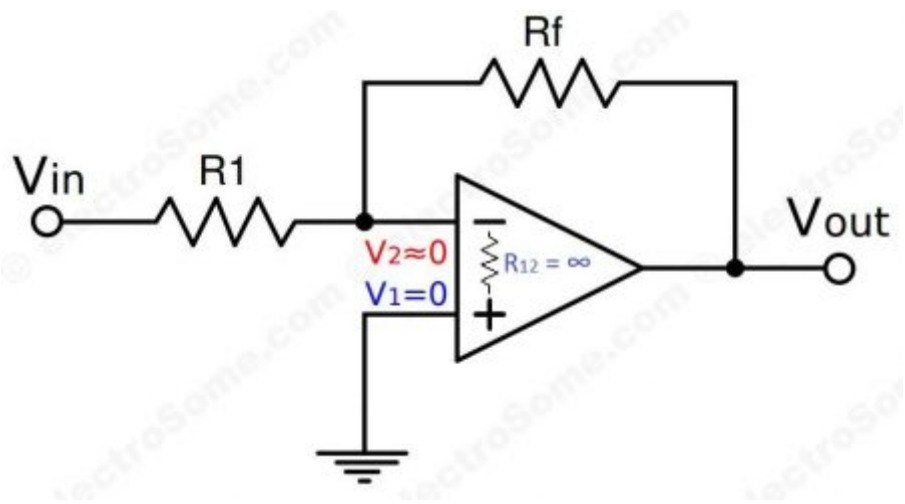
What is Virtual Ground ?

As the name indicates it is virtual, not real ground. For some purposes we can consider it as equivalent to ground. In opamps **the term virtual ground means that the voltage at that particular node is almost equal to ground voltage** (0V). It is **not** physically connected to ground. This concept is very useful in analysis of opamp circuits and it will make a lot of calculations very simple.

Lets see how the virtual ground concept is employed in inverting amplier.



Virtual Ground – Inverting Amplifier using Opamp

We can explain this concept in two different ways using two different characteristics of an ideal opamp.

Using Infinite Voltage Gain

We already know that an ideal opamp will provide infinite voltage gain. For real opamps also the gain will be very high such that we can consider it as infinite for calculation purposes.

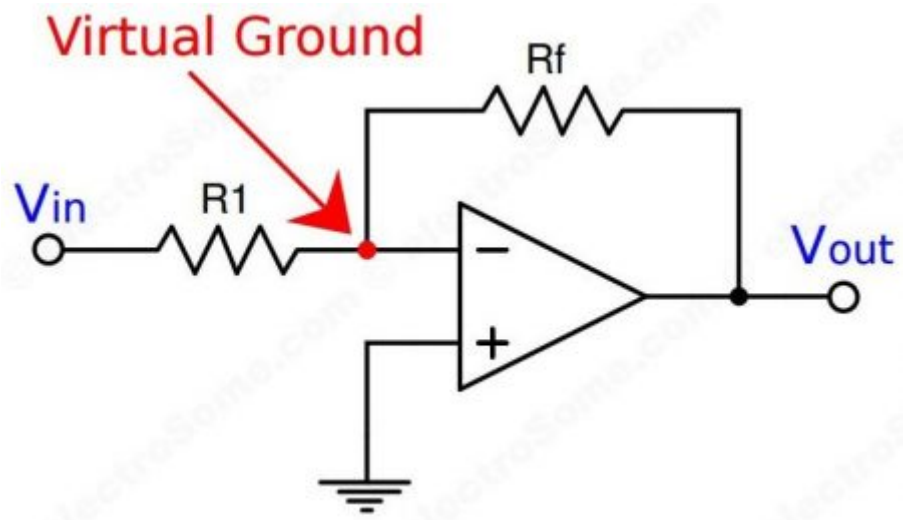
- **Gain = Vo/Vin**

As gain is infinite, **Vin = 0**

- Vin = V2 – V1

In the above circuit V1 is connected to ground, so V1 = 0. Thus V2 also will be at ground potential.

- **V2 = 0**



Virtual Ground – Inverting Amplifier using Opamp

Why we need Virtual Ground ?

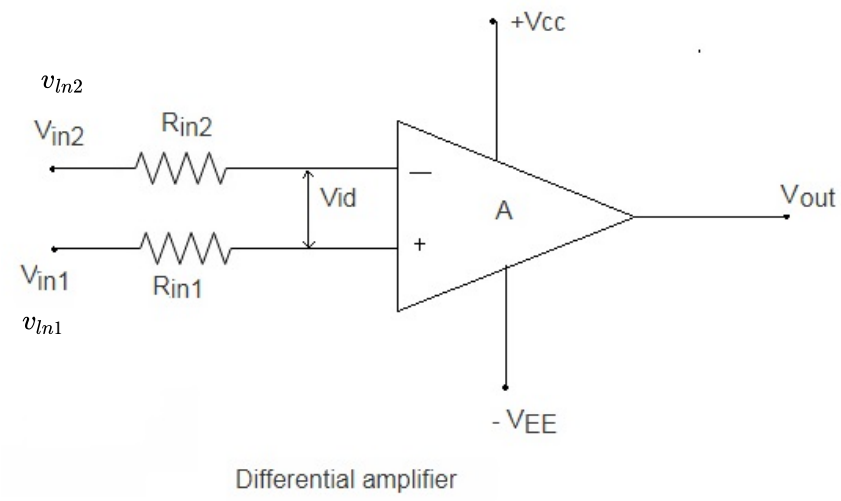
Virtual Ground concept is very useful in analysis of an opamp when negative feedback is employed. It will simply a lot of calculations and derivations.

Equivalent Circuit – Inverting Amplifier – Virtual Ground – Opamp

Virtual Ground vs Real Ground

Virtual Ground	Real Ground
Virtual Ground is a concept that made for easy explantaion and calculation purposes.	Real Ground is a terminal which is physically connected to ground or earth which acts as the reference point for the entire circuit.
Voltage is **approximately** Zero	Voltage is Zero
Not able to sink infinite current	It is an infinite current sink
Not electrically connected to Ground	Electrically connected to Ground

Explain the concept of virtual ground in operational amplifiers?



Differential amplifier

Concept of virtual ground : This means that the differential input voltage v_{1d} between the non inverting and inverting input terminals is essentially zero.

This is obvious because even if output voltage is few volts, due to large open loop gain of op-amp, the difference voltage v_{id} at the input terminals is almost zero.

This means that if output voltage is 10 v and the A i.e. open loop gain is 10^4 then, we have

$v_{out} = A\, v_1\, d$

Therefore, we have $v_{1d} = \frac{v_{out}}{A} = \frac{10}{10^4} = l\, m\, v$

Hence, v_{1d} is very small, as $A \to w$, the difference voltage $v_1 d \to c$ and realistically assumed to be zero for analyzing the circuits.

$\therefore v_{1d} = \frac{v_{out}}{A}$

$(v_{lnl} - v_{ln2}) = \frac{v_{out}}{\infty} = 0$

$v_{lnl} = v_{ln2}$

Thus, we can say that under linear range of operation, there is virtually short ckt between the two input terminals, in the sense that their voltage are same.