Measurement of High Resistance (>100kΩ)

Following are few methods used for measurement of high resistance values-

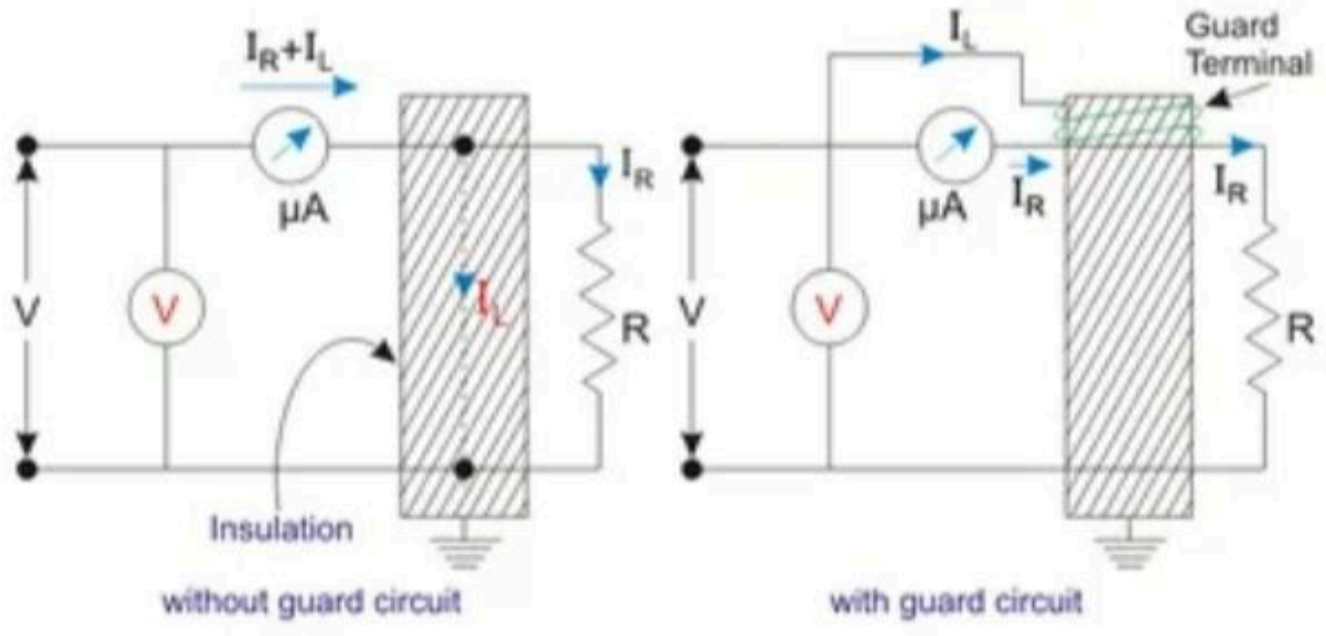
- Loss of Charge Method
- Megger
- Megohm bridge Method
- Direct Deflection Method

We normally utilize very small amount of current for such measurement, but still owing to high resistance chances of production of high voltages is not surprising. Due to this we encounter several other problems such as-

1. Electrostatic charges can get accumulated on measuring instruments
2. Leakage current becomes comparable to measuring current and can cause error
3. Insulation resistance is one of the most common in this category; however a dielectric is always modeled as a resistor and capacitor in parallel. Hence while measuring the insulation resistance (I.R.) the current includes both the component and hence true value of resistance is not obtained. The capacitive component though falls exponentially but still takes very long time to decay. Hence different values of I.R. are obtained at different times.

4. Protection of delicate instruments from high fields.

Hence to solve the problem of leakage currents or capacitive currents we use a guard circuit. The concept of guard circuit is to bypass the leakage current from the ammeter so as to measure the true resistive current. Figure below shows two connections on voltmeter and micro ammeter to measure R, one without guard circuit and one with guard circuit.



In the first circuit the micro ammeter measures both capacitive and the resistive current leading to error in value of R, while in the other circuit the micro ammeter reads only the resistive current.

Loss of Charge Method

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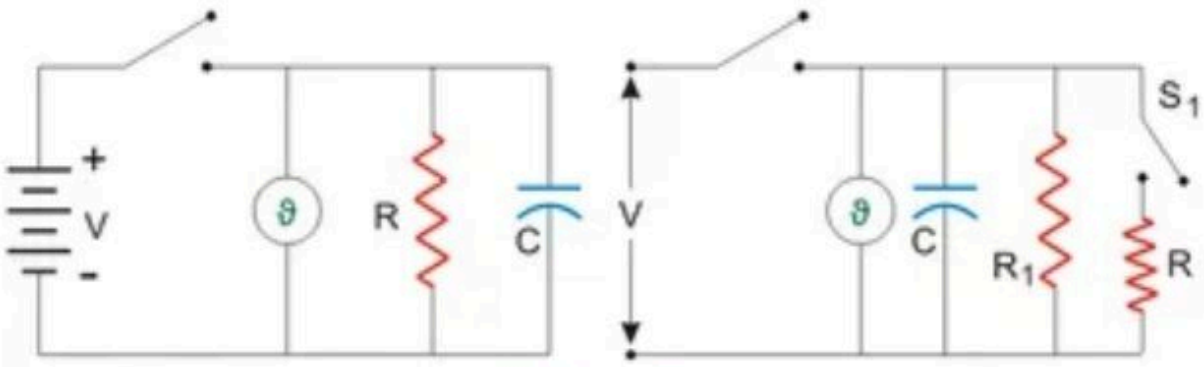

Loss of Charge Method

$$v = Ve^{\frac{-t}{RC}}$$

$$R = \frac{0.4343t}{C\ log_{10}V/v}$$

However the above case assumes no leakage resistance of the capacitor. Hence to account for it we use the circuit shown in the figure below. R_1 is the leakage resistance of C and R is the unknown resistance.

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We follow the same procedure but first with switch S_1 closed and next with switch S_1 open. For the first case we get

$$R' = \frac{0.4343t}{C\ log_{10}V/v}$$

$$Where,\ R' = \frac{RR_1}{R+R_1}$$

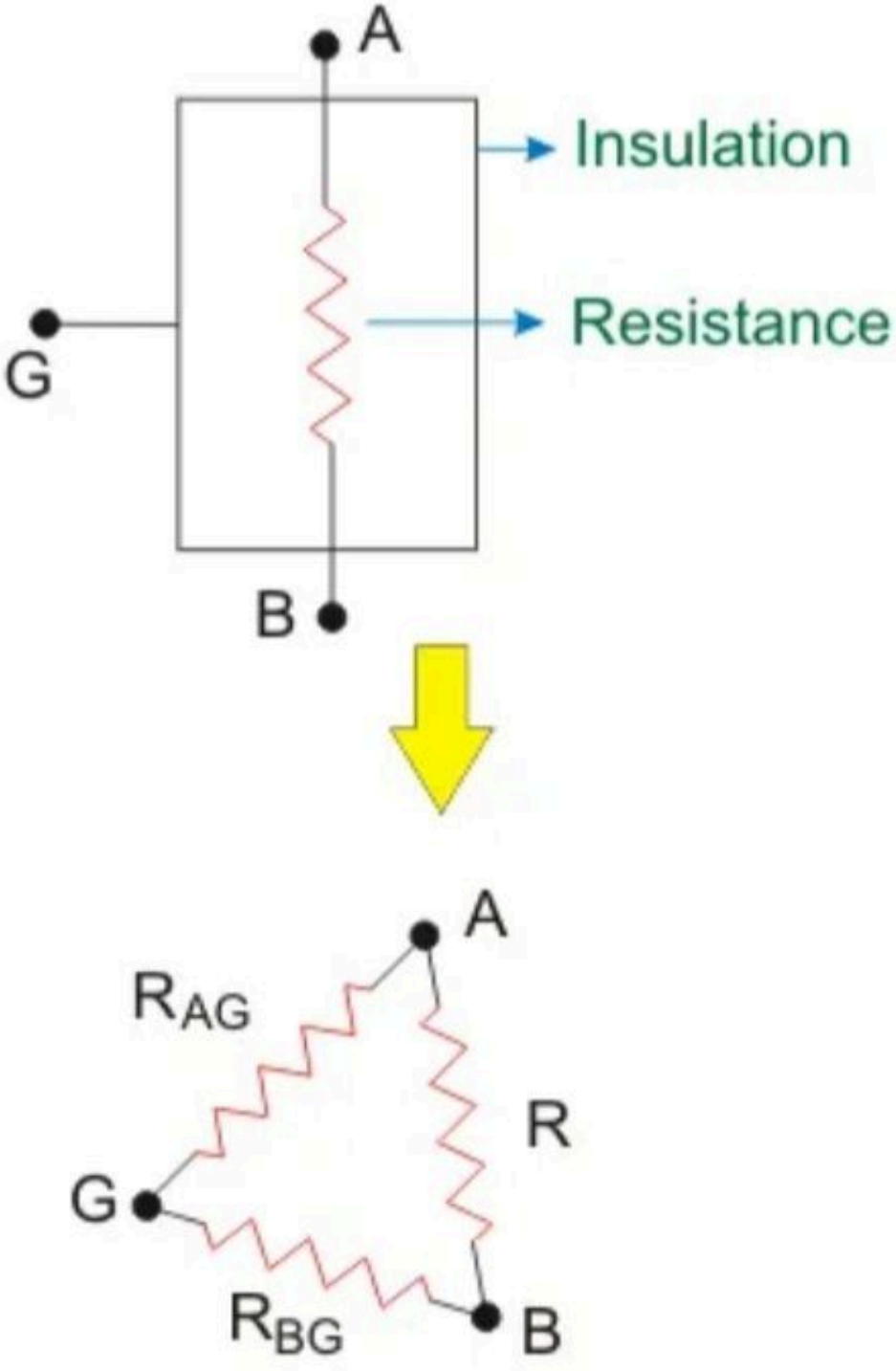
For second case with switch open we get

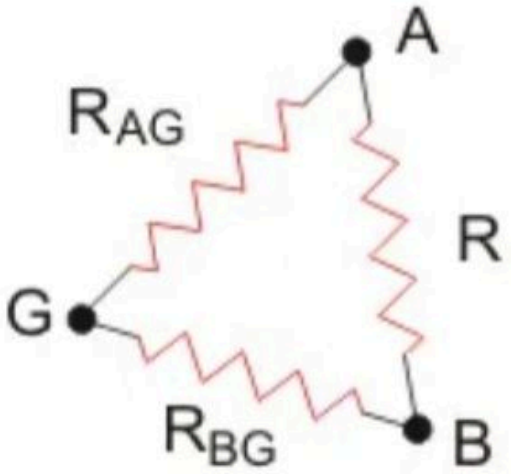
$$R_1 = \frac{0.4343t}{C\ log_{10}V/v}$$

Using R_1 from above equation in equation for R' we can find R.

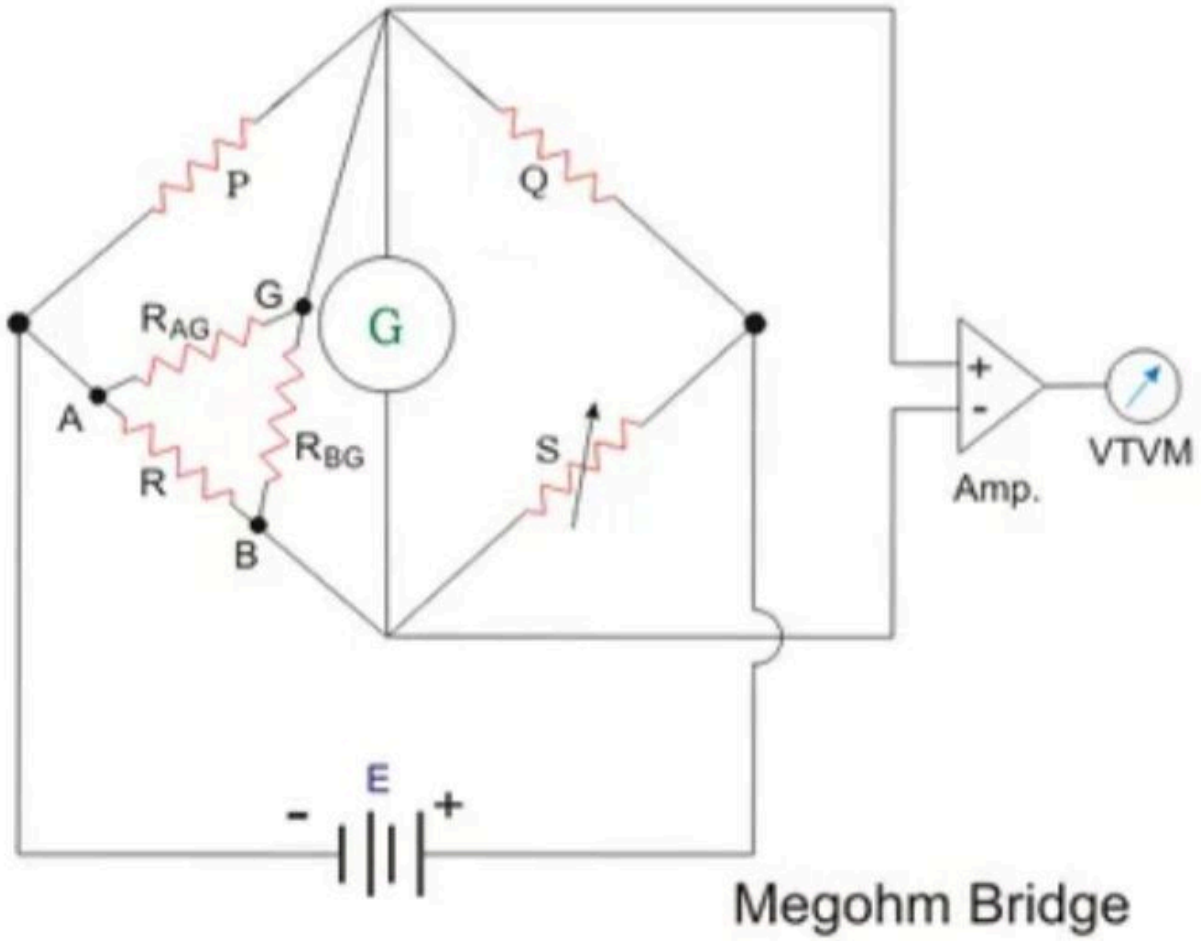
Megohm Bridge Method

In this method we use the famous Wheatstone bridge philosophy but in a slightly modified way. A high resistance is represented as in the figure below.





G is the guard terminal. Now we can also represent the resistor as shown in the adjoining figure, where R_{AG} and R_{BG} are the leakage resistances. The circuit for measurement is shown in the figure below.



It can be observed that we actually obtain the resistance which is parallel combination of R and R_{AG}. Although this causes very insignificant error.

Megger

Megger is one of the most important measuring device used by electrical engineers and is essentially used for measuring insulation resistance only. It consists of a generator which can be hand driven or nowadays we have electronic megger. Details of megger have been discussed in a separate article.