

# VOLTMETERS

## **Basic meter:**

A basic d.c. meter uses a motoring principle for its operation. It states that any current carrying coil placed in a magnetic field experiences a force, which is proportional to the magnitude of current passing through the coil. This movement of coil is called D'Arsonval movement and basic meter is called D'Arsonval galvanometer.

## **D.C instruments:**

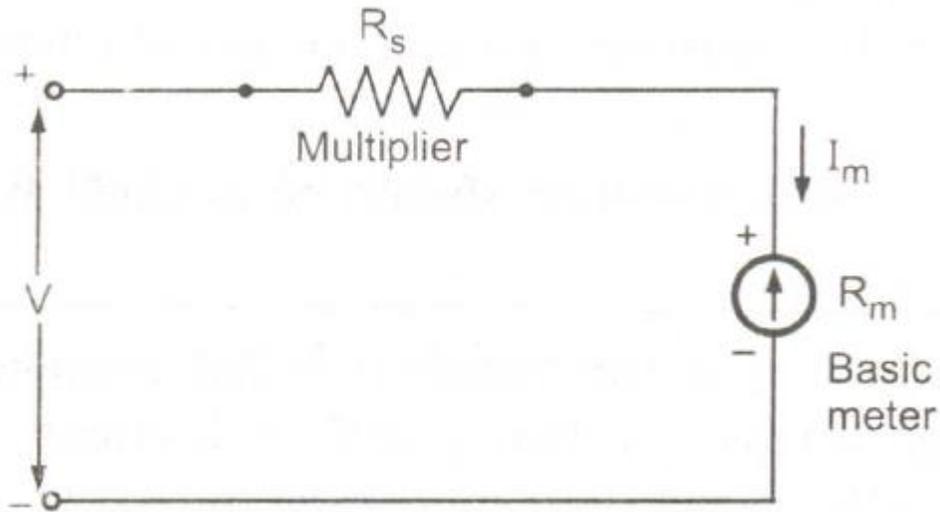
- a) Using shunt resistance, d.c. current can be measured. The instrument is d.c. microammeter, milliammeter or ammeter.
- b) Using series resistance called multiplier, d.c. voltage can be measured. The instrument is d.c. millivoltmeter, voltmeter or kilovoltmeter.
- c) Using a battery and resistive network, resistance can be measured. The instrument is ohmmeter.

## **A.C instruments:**

- a) Using a rectifier, a.c. voltages can be measured, at power and audio frequencies. The instrument is a.c. voltmeter.
- b) Using a thermocouple type meter radio frequency (RF) voltage or current can be measured.
- c) Using a thermistor in a resistive bridge network, expanded scale for power line voltage can be obtained.

## **Basic DC voltmeter:**

The basic d.c. voltmeter is nothing but a permanent magnet moving coil (PMMC) D'Arsonval galvanometer. The resistance is required to be connected in series with the basic meter to use it as a voltmeter. This series resistance is called a **multiplier**. The main function of the multiplier is to limit the current through the basic meter so that the meter current does not exceed the full scale deflection value. The voltmeter measures the voltage across the two points of a circuit or a voltage across a circuit component. The basic d.c. voltmeter is shown in the Fig.



The voltmeter must be connected across the two points or a component, to measure the potential difference, with the proper polarity.

The multiplier resistance can be calculated as:

- Let
- $R_m$  = internal resistance of coil i.e. meter
  - $R_s$  = series multiplier resistance
  - $I_m$  = full scale deflection current
  - $V$  = full range voltage to be measured

From Fig. 2.1,  $\therefore V = I_m (R_m + R_s)$

$\therefore V = I_m R_m + I_m R_s$

$\therefore I_m R_s = V - I_m R_m$

$\therefore R_s = \frac{V}{I_m} - R_m$

The multiplying factor for multiplier is the ratio of full range voltage to be measured and the drop across the basic meter.

Let  $v =$  drop across the basic meter  $= I_m R_m$

$\therefore m =$  multiplying factor  $= \frac{V}{v}$

$= \frac{I_m (R_m + R_s)}{I_m R_m}$

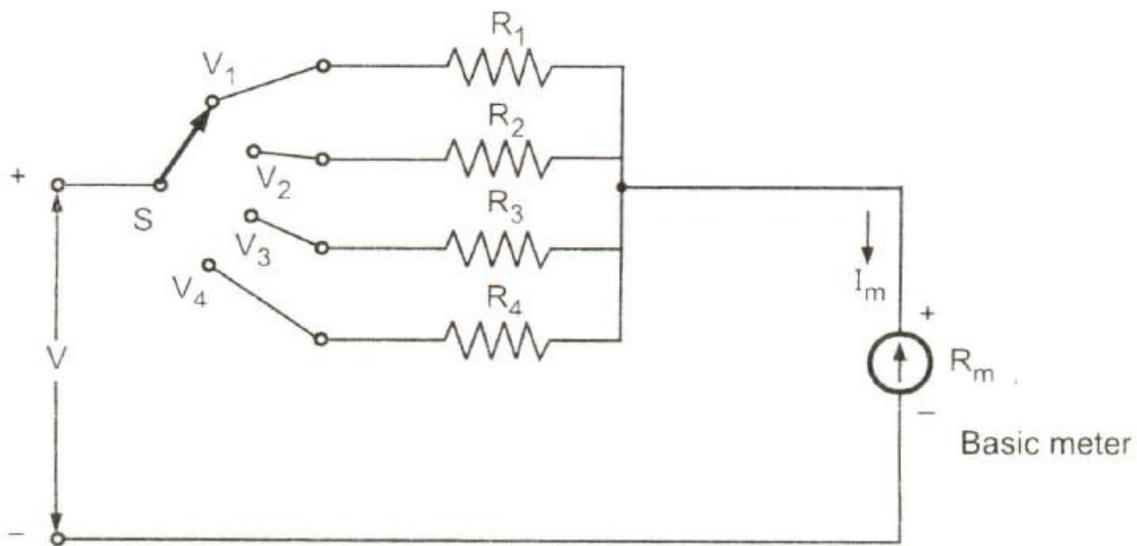
$m = 1 + \frac{R_s}{R_m}$

Hence multiplier resistance can also be expressed as,

$$R_s = (m - 1) R_m$$

**Multirange voltmeters:**

The range of the basic d.c. voltmeter can be extended by using number of multipliers and a selector switch. Such a meter is called **multirange** voltmeter



Source : <http://elearningatria.files.wordpress.com/2013/10/ece-iii-electronic-instrumentation-10it35-notes.pdf>