COMSATS University, Islamabad

Conversion of Galvanometer into Voltmeter

By: Muhammad Mujtaba

SP22-BSE-036 1A

To: Mam Lubna Tabassum

Date: April 17, 2022

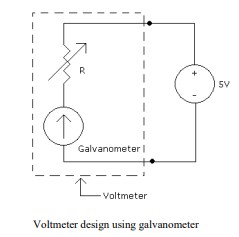
**EXPERIMENT**

**CONVERSION OF GALVANOMETER INTO VOLTMETER**

## **APPARATUS**

* Galvanometer.
* Variable Resistor/ Potentiometer.
* Resistors.
* DMM.
* Breadboard.
* DC Power supply.
* Connecting Wires.

**DIAGRAM**



**PROCEDURE**

By calculating the internal resistance of the Galvanometer and using ohm’s law we can use it to measure voltage across a circuit element. However, such a usage of galvanometer has two serious limitations. First, since the internal resistance of a galvanometer is usually small it would seriously affect the voltage reading across the element for which it is used. Second, as galvanometers can measure only small amounts of current (300 micro amperes) so the range of voltage which they can measure is very small as well.

The design of the voltmeter as explained in the theory section has two constraints:

* First, since the internal resistance of a galvanometer is usually small it would seriously affect the voltage reading across the element for which it is used.
* Second, as galvanometers can measure only small amounts of current (300 micro amperes) so the range of voltage which they can measure is very small as well.

So, to overcome these two constraints a circuit as shown in figure 1 is build. A variable resistance (1 MΩ) has to be attached in series with the galvanometer. The value of the variable resistance is slowly varied until maximum deflection of the galvanometer is achieved; thus, our voltmeter design is complete and calibrated for -5-to-+5-volt measurement.

**OBSERVATION AND CALCULATIONS**

To calculate the actual value of the internal resistance of the galvanometer: Measure the voltage across the sensitive galvanometer (vg), and record the value in Table Measure the current flowing through the galvanometer (ig), and record the value in Table Write down in the calculated and measured value of the internal resistance Rm. Determine the calculated value of R. Use DMM to measure the value of series resistance R and make a note in Table.

|  |  |  |  |
| --- | --- | --- | --- |
| ***vg***  **(Milli V)** | ***ig***  **(Micro A)** | ***Rm* meas.**  **(Ω)** | ***Rm* calc.**  **(Ω)** |
| 0.68 | 4.9 | 138.7 | 136.8 |

WE WILL BE USING 136.8(ohms) AS THE INTERNAL RESISTANCE OF THE GALVANOMETER

If v = 5V then i = 300µA. As the internal resistance *Rm* of the galvanometer is

132Ω, then

*v* = *iR* +*iRm*

*R* =

*R* =

*R* =16.5*k*Ω

The design of the voltmeter as explained in the theory section has two constraints:

* The actual value of the internal resistance (Rm) of the galvanometer is unknown.
* If found the actual value of internal resistance (Rm) still it would be really fortuitous if the calculated value of the resistance R is actually present in the laboratory.

So, to overcome these two constraints a circuit as shown in figure 1 is build. A variable resistance (1 MΩ) has to be attached in series with the galvanometer. The value of the variable resistance is slowly varied until maximum deflection of the galvanometer is achieved; thus, our voltmeter design is complete and calibrated for -5-to-+5-volt measurement.

|  |  |  |  |
| --- | --- | --- | --- |
| **Nominal value**  **resistance (KΩ)** | **of** | **Voltage measured by the designed voltmeter (V)** | **Voltage measured by the DMM (V)** |
| ***R1 = 3.2*** |  | **1.5** | **1.56** |
| ***R2 = 2.96*** |  | **1.33** | **1.56** |
| ***R3 = 3.2*** |  | **1.5** | **1.56** |

**THEORETICAL CALCULATIONS:**

Equivalent resistance of the three resistors = R1 + R2 + R3

**Req= 3.2 KΩ + 2.96 KΩ + 3.2 KΩ**

Req=9.36 **KΩ**

Current = Voltage/ Resistance

I =

**I=** **A**

Voltage Across Each Resistor:

V1 (original)= IxR1 = x x = **1.56 V**

V2(original) = IxR2 = x = **1.56 V**

V3(original)= IxR3 = x = **1.56 V**