

**University Diploma Program
Electrical Engineering Technology**

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EET 027, Experiment # 3

Ohm's Law Verification and Wheatstone Bridge

Objectives:

1. To experimentally verify the ohm's law.
2. To experimentally study the balanced bridge circuit.
3. To experimentally study Wheatstone bridge.
4. To experimentally measure resistance using Wheatstone bridge.

Apparatus:

DC Power Supply
DC current source
Few Resistors
Wheatstone bridge
Multimeter

THEORY:

Ohm's Law:

The voltage across an element is directly proportional to the current through it. The ohm's law can be written mathematically as:

$$V = IR$$

where R = Resistance

V = voltage across the resistance R

I = Current through the resistance R

Bridge Circuit:

Bridge circuits are used to convert impedance variations into voltage variations. One of the advantages of the bridge for this task is that it can be designed so the voltage produced varies

around zero. This means that amplification can be used to increase the voltage level for increased sensitivity to variation of impedance. Another application of bridge circuit is in the precise static measurement of impedance.

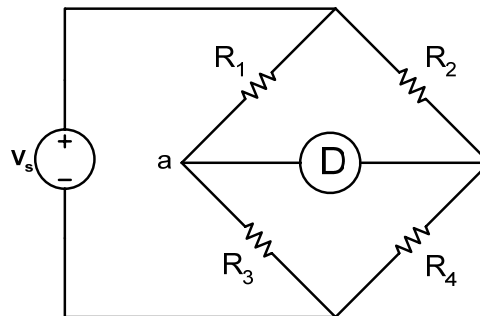


Figure 1: Bridge Circuit.

A basic type of bridge circuit is shown in figure 1, where four resistances are connected. A galvanometer or voltmeter is used to compare the potentials of points a and b of the circuit. If the current through the galvanometer is zero OR the potential difference across points a and b is zero then the bridge circuit is known as Balanced bridge circuit. In balanced bridge circuit the relation among the resistances is given as:

$$R_1 R_4 = R_2 R_3$$

Wheatstone Bridge Theory:

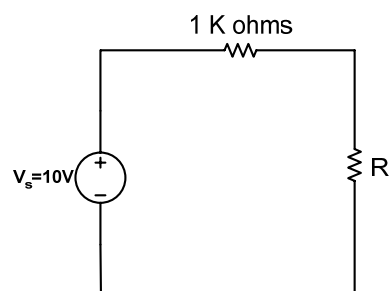
The Wheatstone Bridge is the most widely used circuit for precisely measuring resistance by the comparison method. The bridge is named after Charles Wheatstone who invented it in 1843.

Wheatstone Bridge Equipment Description:

The Wheatstone Bridge is designed to be used for precision resistance measurements in the laboratory. Values of resistance from 0.001 to 9,999,000 ohms can be measured with this instrument. When the instrument is used as a Wheatstone bridge, the Ratio Multiplier switch allows selection of seven multipliers from 0.001 to 1,000. Multiplying the reading obtained from the decade dials by the ratio selected yields the value, in ohms, of the unknown resistance. Ratio resistances are accurate to $\pm 0.05\%$. The zero-center, null-point-indicating galvanometer has a sensitivity of $0.5 \mu\text{A}/\text{div}$.

PROCEDURE:**A. Ohm's Law:**

1. Connect the circuit as shown in figure 2.
2. Set the DC voltage supply to 10 Volts.
3. Set the resistance R to 100 ohms.
4. Measure the voltage across the resistor and the current through the resistor and write the results in Table 1.
5. Determine the value of the resistance using Ohm's law $R=V/I$ and record in the Table 1.
6. Repeat step 2 to 5 for the other resistors (1000 ohms, 10 K ohms).

Figure 1: Ohm's Law**TABLE 1**

Resistor (Nominal Value)	100 Ω	1 KΩ	10 KΩ
Ohm-meter Reading			
$R = V / I$			
Percent Deviation from Nominal Value			

$$\text{Percent Deviation} = (\text{Nominal Value} - \text{Ohm-meter Reading}) / (\text{Nominal Value})$$

B. Balanced Bridge:

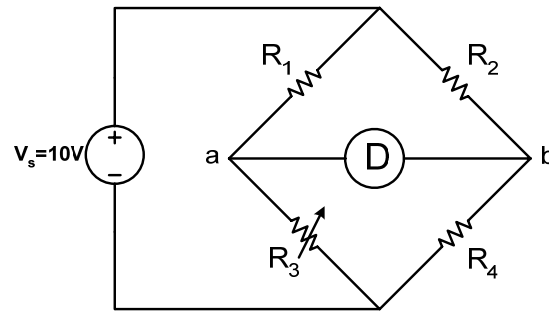


Figure 3: Balanced Bridge Circuit

1. Connect the circuit as shown in figure 3.
2. Set the DC voltage supply to 10 Volts.
3. Adjust the variable resistor R_3 until current through the volt-meter becomes zero.
4. Without altering R_3 , remove it from the circuit and measure its resistance using an ohm-meter.

C. Simplified Wheatstone Bridge:

A simplified Wheatstone bridge circuit is shown in Figure 4. In the figure, R_1 , R_2 and R_3 are precision, adjustable resistances and X is the unknown resistance. You are required to measure the unknown resistance X .

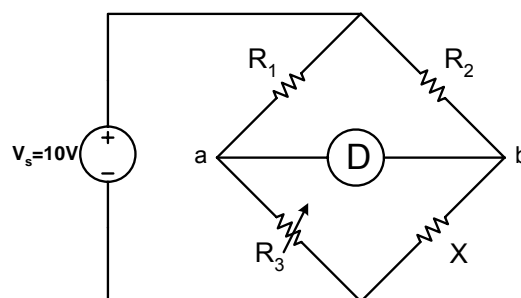


Figure 4: Simplified Wheatstone Bridge Circuit

1. Connect the power supply and resistances as shown in figure 4.
2. Now vary resistances R_3 until the volt-meter deflection is zero.
3. Now using the following formula, the unknown resistance X can be determined:

$$R_1 X = R_2 R_3$$

$$X = \frac{R_2 R_3}{R_1}$$

D. Measurement of Resistance using Wheatstone Bridge:

1. To measure the unknown resistance, set the Ratio Multiplier to “1.0” and set all decade dials to “5”.
2. Tap the “Low” Galvanometer Sensitivity key and note the direction of the galvanometer deflection.
3. When the direction of the galvanometer deflection is determined, change the Ratio Multiplier one step at a time until the galvanometer deflection reverses direction.
4. Vary the 1000-ohm decade dial to make the deflection a minimum. Continue to decrease the deflection by varying the 100-ohm decade dial, the 10-ohm decade dial and finally the 1-ohm decade dial.
5. Depress the “High” Galvanometer Sensitivity key and, if necessary, further adjust the decade dials for zero galvanometer deflection.
6. When the bridge is balanced the value of unknown resistance is equal to the product of the Ratio Multiplier and the decade reading.