

submitted by

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Experiment 5: Measurement of Self Inductance by Maxwell Bridge

Introduction

To determine the self-inductance of an unknown coil.

Theory

This bridge circuit measures an inductance by comparison with variable standard self inductance. The connections for balance condition is shown in Fig. 1.

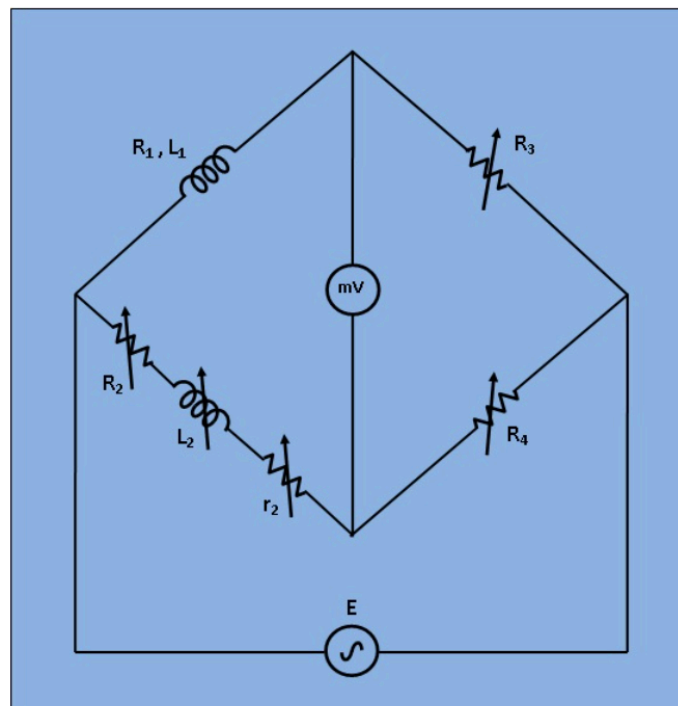


Fig 1: Circuit Diagram for Measurement of Self Inductance by Maxwell Bridge

Let, L_1 = Unknown self Inductance of resistance R_1 .

L_2 = variable inductance of fixed resistance r_2 .

R_2 = variable resistance connected in series with inductor L_2 .

R_3, R_4 = known non inductive resistances.

At balance condition,

$$(R_1 + j\omega L_1) * R_4 = (R_2 + r_2 + j\omega L_2) * R_3 \dots (1)$$

Equating both the real and imaginary parts in eq.(1) and seperating them,

$$L_1 = \left(\frac{R_3}{R_4}\right)L_2 \dots (2)$$

$$R_1 = \left(\frac{R_3}{R_4}\right) * (R_2 + r_2) \dots (3)$$

Resistors R_3 and R_4 are normally a selection of values from 10, 100, 1000 and 10,000 Ω . r_2 is a decade resistance box.

Procedure :

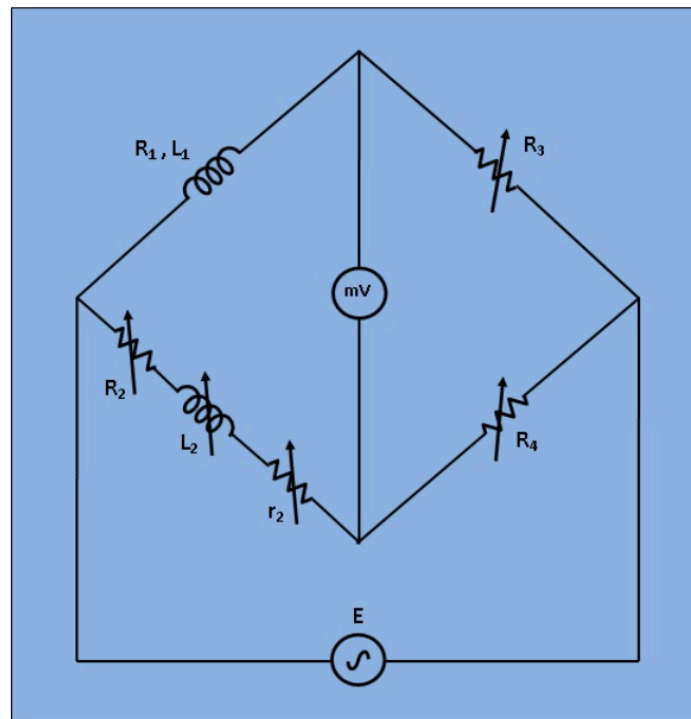


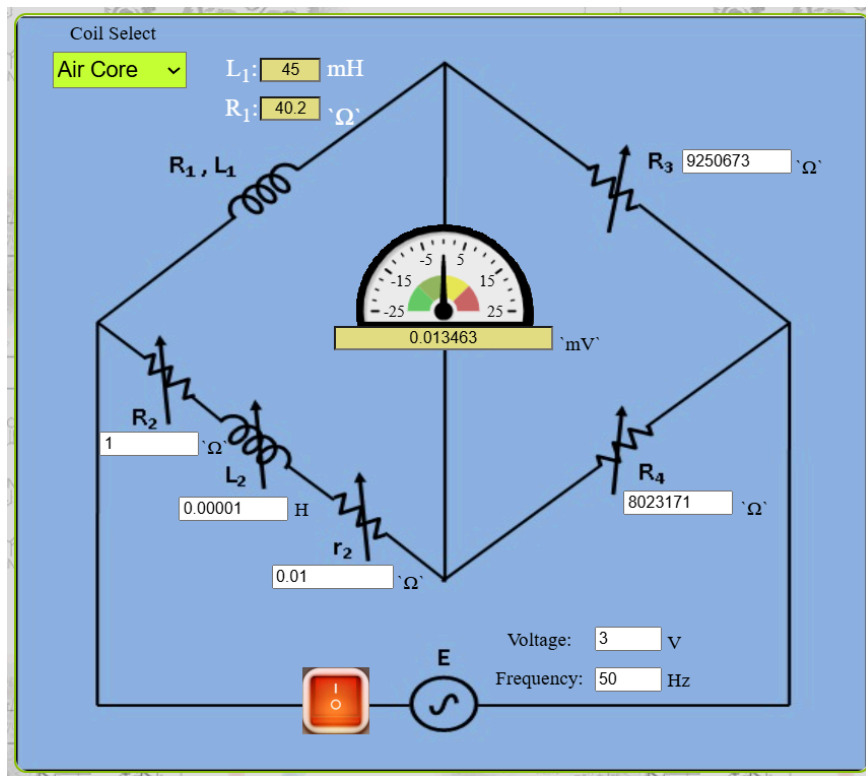
Fig 1: Circuit Diagram for Measurement of Self Inductance by Maxwell Bridge

1. Apply Supply voltage from the signal generator with arbitrary frequency. ($V = 3V$). Also set the unknown Inductance value from 'Set Inductor Value' tab.
2. Then switch on the supply to get millivoltmeter deflection.
3. Choose the values of L_2 , r_2 , R_2 , R_3 and R_4 from the inductance and resistance box. Vary the values to some particular values to achieve 'NULL'.
4. Observe the millivoltmeter pointer to achieve 'NULL'.
5. If 'NULL' is achieved, switch to 'Measure Inductor Value' tab and click on 'Simulate'. Observe the calculated values of unknown inductance (L_1) and it's internal resistance (R_1) of the inductor.
6. Also observe the Dissipation factor of the unknown inductor which is defined as

$$\frac{\omega L}{R} \text{ Where, } \omega = 2\pi f$$

Simulation:

Aircore:



Set Inductor Value

Measure Inductor Value

The current voltmeter reading is: 0.013463 mv.

Now click on simulate to get:

Inductor value (in mH): 0.01152994620206

Resistance value (in Ohm): 1.16452456640896

Quality Factor: 0.0031089

Simulate

CONTROLS

R2 : 1 Ohm 11.11111 M Ω

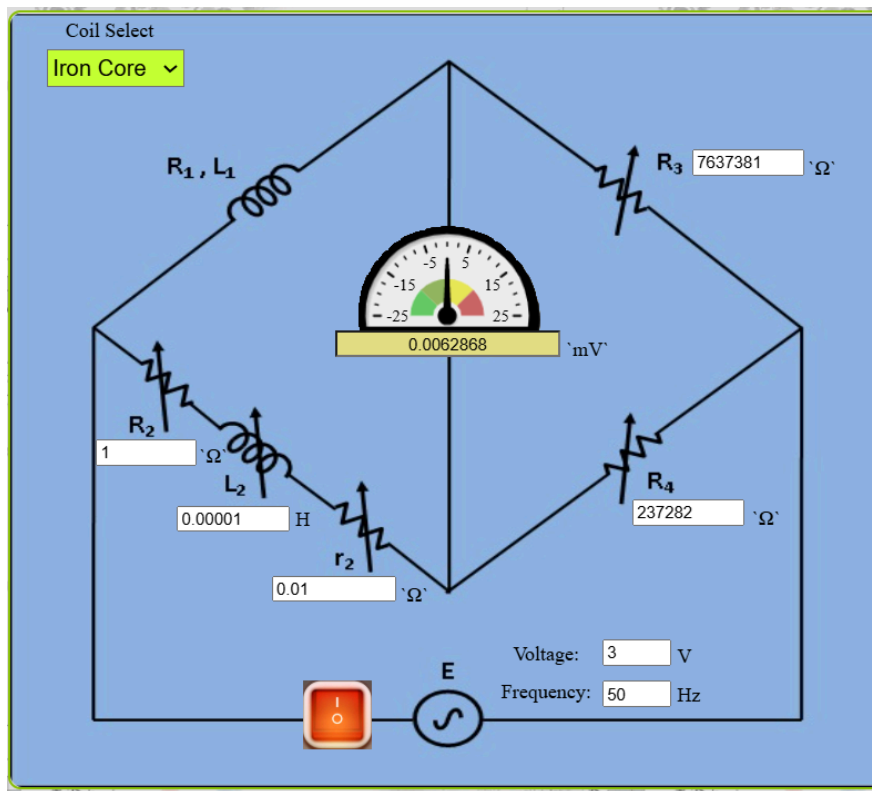
L2 : 10 uH 111.1mH

r2 : 1 Ohm 11.11111 M Ω

R3 : 1 Ohm 11.11111 M Ω

R4 : 1 Ohm 11.11111 M Ω

Iron core:



Set Inductor Value
Measure Inductor Value

The current voltmeter reading is: 0.0062868 mv.

Now click on simulate to get:

Inductor value (in mH): 0.32186937905108

Resistance value (in Ohm): 32.5088072841597

Quality Factor: 0.0031089

Simulate

CONTROLS

R2 : 1 Ohm	<div style="width: 100%; height: 10px; background: linear-gradient(to right, black, black); position: relative;"><div style="position: absolute; left: 0; top: -5px; width: 10px; height: 10px; background-color: #008080; border-radius: 50%;"></div></div>	11.11111 MΩ
L2 : 10 uH	<div style="width: 100%; height: 10px; background: linear-gradient(to right, black, black); position: relative;"><div style="position: absolute; left: 0; top: -5px; width: 10px; height: 10px; background-color: #008080; border-radius: 50%;"></div></div>	111.1mH
r2 : 1 Ohm	<div style="width: 100%; height: 10px; background: linear-gradient(to right, black, black); position: relative;"><div style="position: absolute; left: 0; top: -5px; width: 10px; height: 10px; background-color: #008080; border-radius: 50%;"></div></div>	11.11111 MΩ
R3 : 1 Ohm	<div style="width: 100%; height: 10px; background: linear-gradient(to right, black, black); position: relative;"><div style="position: absolute; left: 0; top: -5px; width: 10px; height: 10px; background-color: #008080; border-radius: 50%;"></div></div>	11.11111 MΩ
R4 : 1 Ohm	<div style="width: 100%; height: 10px; background: linear-gradient(to right, black, black); position: relative;"><div style="position: absolute; left: 0; top: -5px; width: 10px; height: 10px; background-color: #008080; border-radius: 50%;"></div></div>	11.11111 MΩ

Result:

Thus the self inductance of unknown coil is determined by maxwell bridge