EXPERIMENT-5

Measurement of Self Inductance by Maxwell Bridge

AIM: 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.

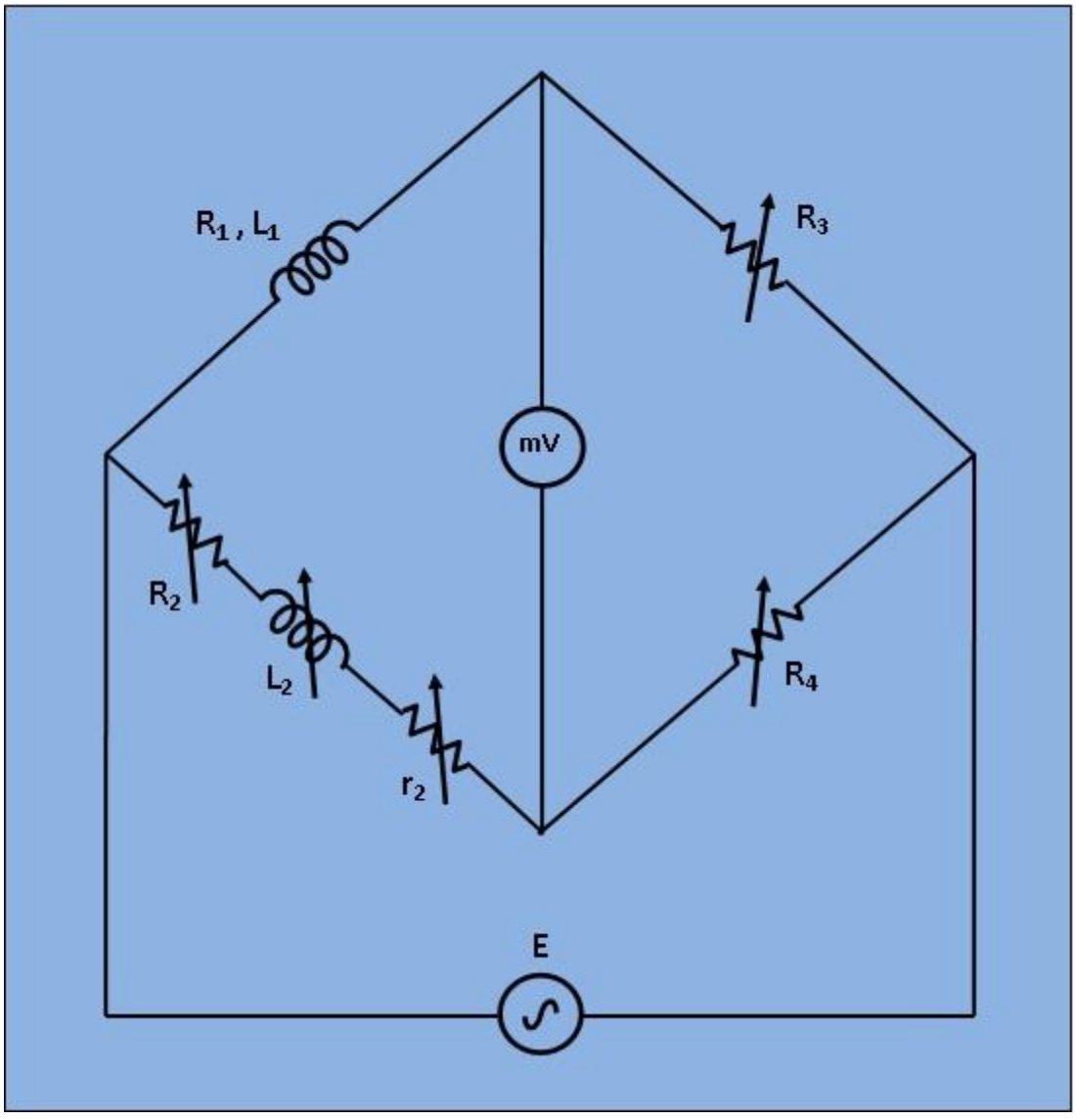


Fig 1: Circuit Diagram for Measurement of Self Inductance by Maxwell Bridge

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,

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

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

$$L_1 = (\frac{R_3}{R_4}) L_2 \ldots (2)$$

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

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

Procedure

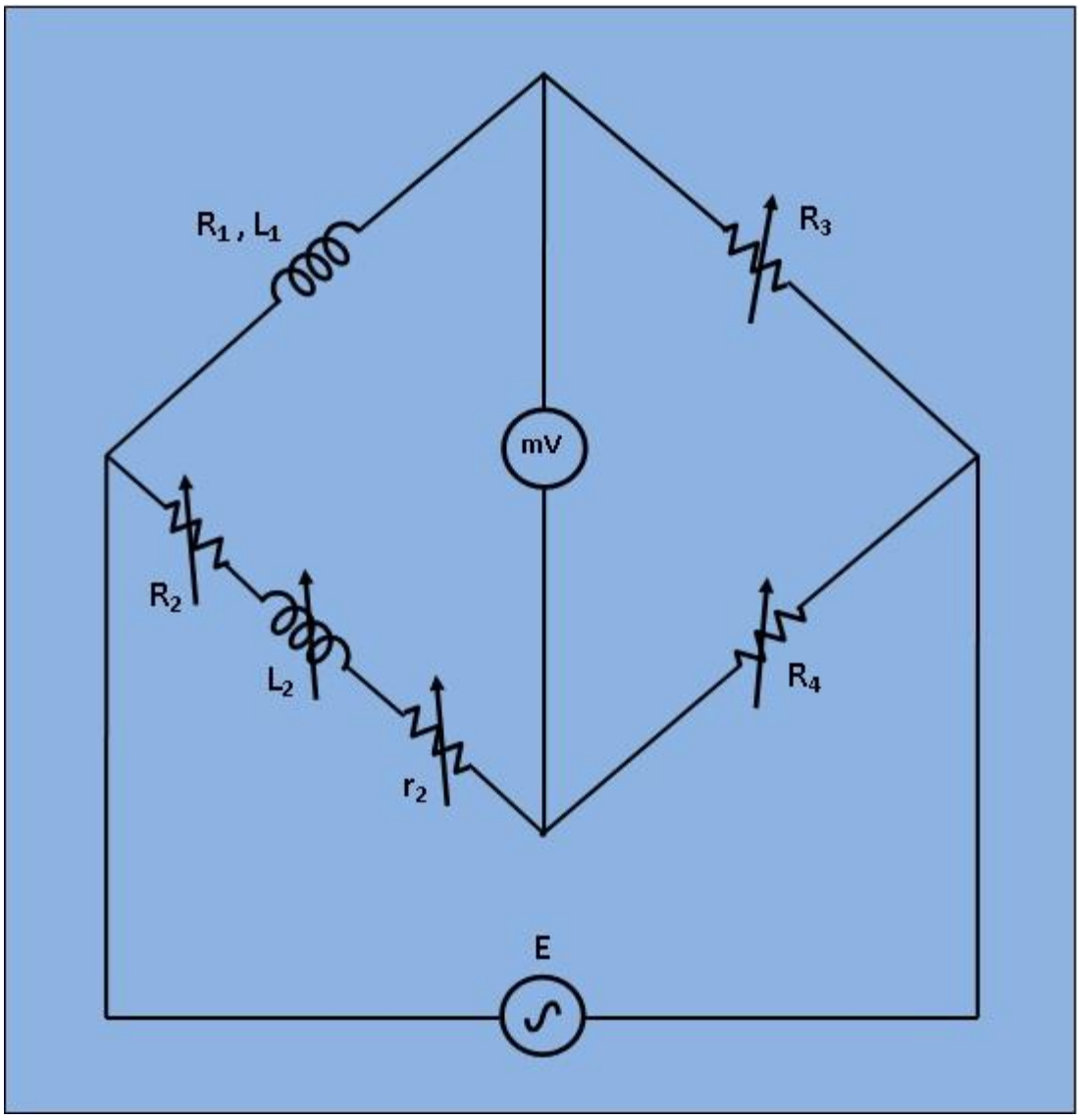


Fig 1: Circuit Diagram for Measurement of Self Inductance by Maxwell Bridge

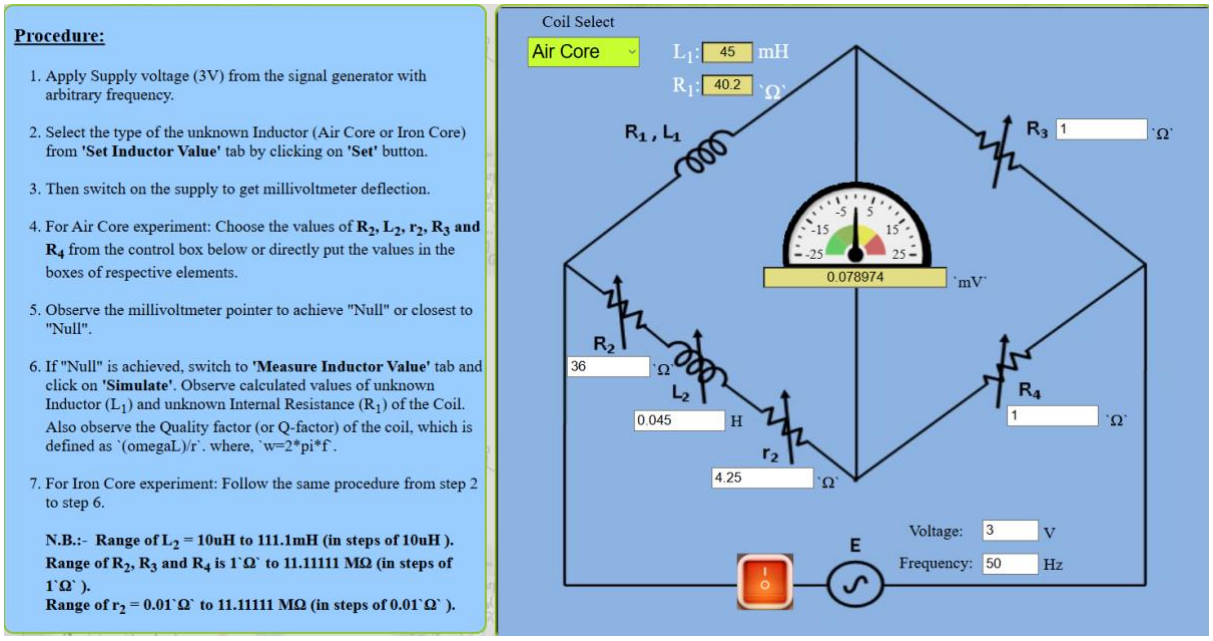
1. Apply Supply voltage from the signal generator with arbitrary frequency. (V =3v). Also set the unknown Inductance value from 'Set Inductor Value' tab.
2. Then switch on the supply to get millivoltmeter deflection.
3. Choose the values of L_2, r_2, R_2, R_3 and R_4 from the inductance and resistance box. Varry 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 unknwown inductor which is defined as.

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

Simulation:

Air Core:

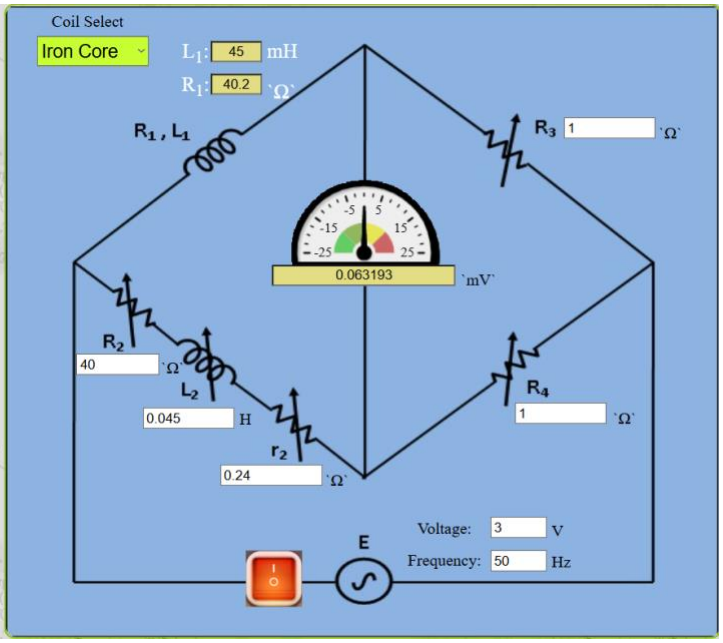


Iron Core:

Procedure:

1. Apply Supply voltage (3V) from the signal generator with arbitrary frequency.
2. Select the type of the unknown Inductor (Air Core or Iron Core) from **'Set Inductor Value'** tab by clicking on **'Set'** button.
3. Then switch on the supply to get millivoltmeter deflection.
4. For Air Core experiment: Choose the values of R_2, L_2, r_2, R_3 and R_4 from the control box below or directly put the values in the boxes of respective elements.
5. Observe the millivoltmeter pointer to achieve "Null" or closest to "Null".
6. If "Null" is achieved, switch to **'Measure Inductor Value'** tab and click on **'Simulate'**. Observe calculated values of unknown Inductor (L_1) and unknown Internal Resistance (R_1) of the Coil. Also observe the Quality factor (or Q-factor) of the coil, which is defined as `(omegaL)/r`. where, `w=2*pi*f`.
7. For Iron Core experiment: Follow the same procedure from step 2 to step 6.

N.B.:- Range of L_2 = 10uH to 111.1mH (in steps of 10uH). Range of R_2, R_3 and R_4 is 1`Ω` to 11.11111 MΩ (in steps of 1`Ω`). Range of r_2 = 0.01`Ω` to 11.11111 MΩ (in steps of 0.01`Ω`).



Result: Thus, The Unknown Inductance is Measured using Maxwell's Bridge.