ELECTRONIC WORKSHOP # 05

Inductors and Transformers

Roll. No:	**Date:**
Checked by:	**Grade:**

Object: To become familiar with inductors and transformers

Apparatus:

1). A Digital Multimeter (DMM)
2). Few inductors
3). Few transformers

Theory:

An inductor is a coil of wire usually wound over a Ferro-magnetic material which can store energy in the form of a magnetic field. The ability of an inductor to store energy is given by its Inductance having the unit Henry (H). Once again Henry is a very large unit and we usually talk about inductance in mH or µH. The symbol of an inductor is shown in figure-1.

Figure-1: Symbol of an inductor

An ideal inductor would exhibit zero resistance but a real inductor has some finite resistance. Inductors which have become open will show infinite resistance, whereas shorted inductors will show a resistance of zero Ohms. Although one can wind inductors, conventional inductors come in a resistor like shape with color bands on them. The procedure to decode inductor values is shown in figure-2.

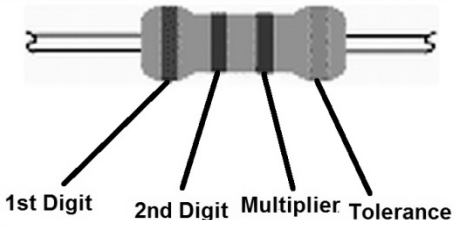


Figure-2: Inductor color bands

$$(1^{st}\ \text{Digit})(2^{nd}\ \text{Digit}) \times 10^{(\text{Multiplier})}\ \mu\text{H}$$

The color codes are given in the table-1.

Color	Value	Multiplier	Tolerance
Black	0	0	±20%
Brown	1	1	±1%
Red	2	2	±2%
Orange	3	3	±3%
Yellow	4	4	±4%
Green	5	-	-
Blue	6	-	-
Violet	7	-	-
Grey	8	-	-
White	9	-	-
Gold	-	-1	±5%
Silver	-	-2	±10%

Table-1: Color codes for Inductors

For example if an inductor has the band color sequence Blue, Grey, Black and Silver, the value of the inductor would be decoded as,

Blue	Grey		Brown	Gold
6	8	x	10^1	±5% µH

So, the rated value of the inductor is 680 µH, its minimum value can be 646 µH and its maximum value can be 714 µH. An inductor is like an electromagnet, when supplied with a current, it energizes up thus creating a magnetic field, in fact this is the reason they find applications in Speakers, Bells etc.

Variable inductors are those inductors whose inductance can be varied. This is accomplished either by a movable core or by having a movable contact that can be moved along the coil. Both these mechanisms are housed inside a small casing. These are used in radios along with capacitors for tuning purpose. The symbol of the variable inductor is shown in figure-3:

Figure-3: Symbol of a variable inductor

A transformer is a device that uses a pair of coils/windings to manipulate AC voltage and current. It uses the principle of mutual induction to either decrease or increase the voltage/current at its input. The input winding is known as Primary winding and the Output winding is known as Secondary winding.

Transformers are used at Powerhouses to increase the voltage for transmission and near homes to decrease it to a usable value. The voltage/current at the output of the transformer is given by the following equation:

$$\frac{Vs}{Vp} = \frac{Ns}{Np} = \frac{Ip}{Is}$$

Where Vs, Vp, Is and Ip represent Primary Voltage, Secondary Voltage, Secondary Current and Primary Current respectively.

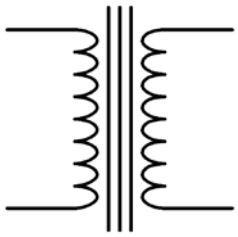


Figure-4: Symbol of a transformer

These are two types of transformers:

1. Step Up Transformer: Increases the voltage and decreases the current

2. Step Down Transformer: Decreases the voltage and increases the current

Step Up transformers have more number of turns in the Secondary winding as compared to the Primary winding while the opposite is true for Step Down transformers. This can also be checked by measuring the resistance. For a step up transformer, the primary (greater no of turns) winding resistance would be greater than the secondary winding resistance and vice versa. There is also a special type of transformer in which there a wire that protrudes out from the middle of the secondary coil thus allowing for the secondary voltage to be taken in two halves. This type of transformer is known as a Centre-Tapped transformer (shown in figure-5).

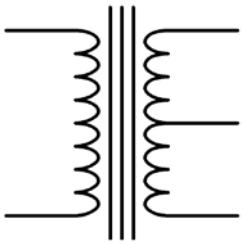


Figure-5: Symbol of a Centre-Tapped transformer

Some real inductors are shown in figure-6.

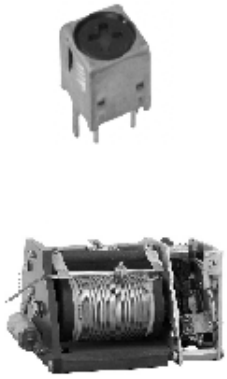
Fixed Inductors	Variable Inductors
	

Figure-6: Some real inductors

Procedure:

1. Pick up an inductor.
2. Setting the multimeter to measure Resistance with a range of 200Ω find out whether the inductor is faulty or not.
3. Pick up few transformers. Set the multimeter to measure voltage with a range of 400V AC. Measure the voltage in the mains socket and write down in the table. Now connect the transformers primary winding to the mains socket.
4. Set the multimeter to a range of 50V, measure the voltage at the secondary of the transformer and write down in the table. Use the formula given in the theory to find out the number of turns of the transformer.
5. Repeat steps (3) and (4) for a few more transformers.

Observation:

S N.o	Peak to Peak Input Voltage	Output Voltage	Turn Ratio
1.			
2.			
3.			
4.			
5.			

Table-2: Determining the turn ratio of a transformer

Questions:

1. What happens to the overall inductance if we connect two inductors in series or in parallel?

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_____

2. Decode the following inductor values:

i. Red Violet Brown Gold

_____

ii. Yellow Blue Brown Gold

_____

3. What does one mean by inductive kick?

_____

_____

4. Comment on the role of the Inductor on an LC tank circuit.

_____

_____

5. Enlist some applications of a transformer?

_____

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6. Describe briefly (in terms of the turn ratio and purpose) the functioning of the Current and Potential transformers?

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