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The Different Types of Inductors and Their Affecting Factors

The Different Types of Inductors and Their Affecting Factors

Introduction:

- Inductors are one of the basic components used in electronics, inductors are extensively used in much wider application areas like signal controlling, noise elimination, voltage stabilization, power electronic equipment's, automobile operations etc. Now a day’s, improvement of inductor design techniques enhances significant performance on rest of the circuit.

The Different Types of Inductors and Their Affecting Factors

What is Inductor?

- An inductor is also named as a reactor, coil and choke. It is a two terminal electrical component used in various electrical and electronic circuits. An inductor is used to store energy in the form of a magnetic field. It comprises of a wire, usually twisted into a coil. When a current passes through it, energy stored temporarily in the coil. A supreme inductor is equal to a short circuit for DC, and grants an opposite force to AC that depends on the frequency of the current.

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Types of Inductors

- A diverse electronic component used in a wide range of applications requires various types of inductors. These are of different shapes, sizes including the wire wound and multilayer inductors. Different types of inductors include **high-frequency inductors, power supply line inductors or power inductors and inductors for general circuits**. Differentiation of the inductors is based on the type of winding as well as the core used.

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Different Types of Inductors

- Air Core Inductors
- Ferro Magnetic or Iron Core Inductors
- Ferrite Core Inductors
- Toroidal Core Inductors
- Bobbin based Inductors
- Multi Layer Inductors
- Thin Film Inductors

The Different Types of Inductors and Their Affecting Factors

Air Core Inductors

- In this inductor, core is completely absent.
- These inductors offer high reluctance path for the magnetic flux, hence less inductance.
- The air core inductors have larger coils to produce higher flux densities.
- These are used in high frequency applications including TV and radio receivers.

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Ferro Magnetic or Iron Core Inductors

- Due to their higher magnetic permeability these have high inductance property.
- These are high power inductors but limited in higher frequency capacity due to the hysteresis and eddy current losses.

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Ferrite Core Inductors

- These are the different types of inductors which offer advantages of decreased cost and low core losses at high frequencies.
- Ferrite is a metal oxide ceramic based around a mixture of Ferric Oxide Fe2O3.
- Soft ferrites are used for the core construction to reduce the hysteresis losses.

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Toroidal Core Inductors

- In these inductors, a coil is wounded on a toroid circular former.
- Flux leakage is very low in this type of inductor.
- Special winding machines are required to design this type of inductor.
- Sometimes ferrite core is also used to decrease the losses in this design.

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Bobbin based Inductors

- In this type of Inductor coil is wounded on the bobbin.
- Bobbin wound inductor designs vary widely in terms of power rating, voltage and current levels, operating frequency, etc.
- These are mostly used in switch mode power supplies and power conversion applications.

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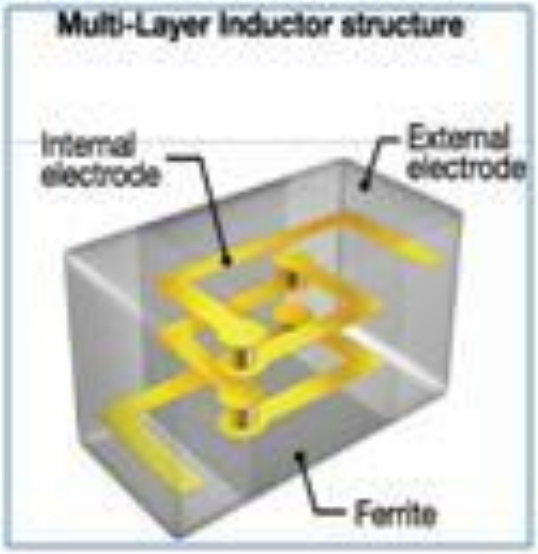
Multi Layer Inductors

- A multilayer inductor contains two conductive coil patterns.
- It is arranged in two layers in the upper part of a multi-layered body.
- The coils are connected electrically in a consecutive manner in series to two more conductive coil patterns disposed in the lower part of the multi-layered body.
- These are mainly used in mobile communication systems and noise suppression applications.



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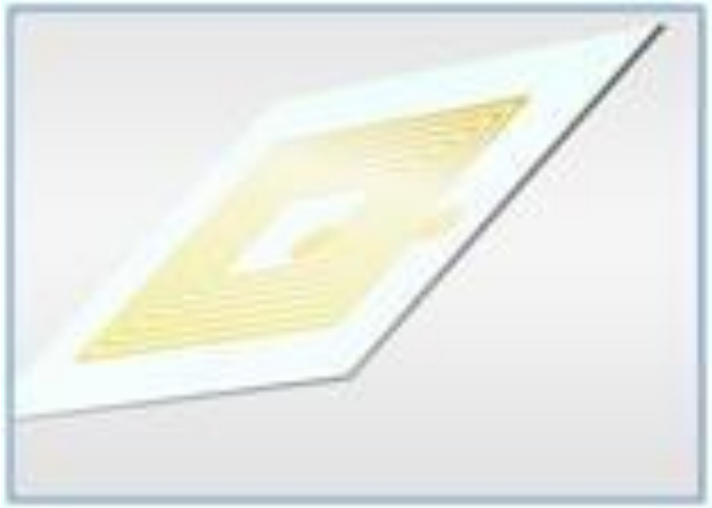
Thin Film Inductors

- These are completely different from the conventional chip-type inductors wound with copper wire.
- In this type of inductors , tiny inductors are formed using thin-film processing to create the chip inductor for high-frequency applications, which ranges from about nano Henry.



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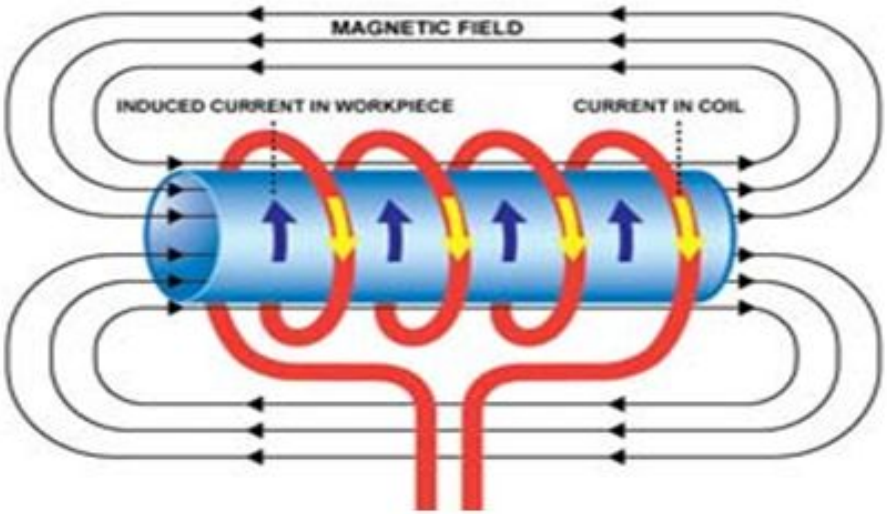
How Inductor Works?



- An inductor is often referred to as AC resistor. It resists the changes in the current and stores energy in the form of the magnetic field. These are simple in construction, consisting of the coils of copper wire wounded on a core. This core might be magnetic or air.

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How Inductor Works?

- Magnetic cores may be toroidal or E-type cores.
- Materials like ceramic, ferrite, powered iron are used for this core.
- The coil carrying the electric current produces the magnetic field around the conductor.
- More magnetic lines are produced if the core is placed inside the coil, provided high permeability of the core is used.

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How Inductor Works?

- The magnetic field induces EMF in the coil which results in flow of current.
- According to Lenz's law, the induced current opposes the cause, which is the applied voltage.
- Hence inductor opposes the change in input current that leads to change in the magnetic field.
- This reduction of the current flow due to the induction is called inductive reactance.

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How Inductor Works?

- The Inductive reactance will increase if the number of turns in the coil is increased.
- It also stores the energy as magnetic field through charging and discharging processes.
- It releases the energy while switching the circuit.
- Application areas of inductors include analog circuits, signal processing, etc.

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Factors affecting the Inductance of an Inductor

- Capability of producing magnetic lines is referred as inductance. Standard unit of inductance is **Henry**. The amount of magnetic flux developed or inductance of different types of inductors depends on four basic factors discussed below.
  - **Number of turns in a coil**
  - **Material of the Core**
  - **Cross section area of the Coil**
  - **Length of the Coil**

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Power loss in an Inductor

- Power dissipated in inductor is mainly due to the two sources
  - Inductor Core.
  - Inductor Windings.

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Power loss in an Inductor

Inductor core:

- Energy loss in inductor core is due to the hysteresis and eddy current losses.
- Magnetic field applied to the magnetic material is increased, goes to the saturation level and then decreases.
- While decreasing it doesn't traces the original path and it causes the hysteresis losses.
- Smaller value of the hysteresis coefficient of the core materials results in the low hysteresis losses.

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Power loss in an Inductor

Inductor core:

- The other type of core loss is eddy current loss.
- These eddy currents are induced in the core material due to the rate change of magnetic field according to the Lenz's law.
- Eddy current losses are much less than the hysteresis loss.
- These losses are minimized by using the low hysteresis coefficient materials and laminated core.

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Power loss in an Inductor

Inductor core:

- In inductors, losses occur not only in the core, but also in the windings. Windings have their own resistance.
- When the current passes through these windings, heat losses (I^2*R) will takes place in the windings.
- Skin effect causes the current to concentrate on the surface of conductor than centers.
- The effective area of the current carrying area decreases.

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Power loss in an Inductor

Inductor core:

- Eddy currents induced in the windings causes the current to be induced in the neighbouring conductors which is called proximity effect.
- Due the overlapping conductors in the coils.
- Proximity effect causes to increase the resistance of the conductor higher than in case of the skin effect.
- Windings losses are reduced with the advanced winding technologies like shaped-foil and litz wire windings.
  http://www.elprocus.com/different-types-of-inductors/

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Advantages

- An inductance freely passes DC current while restricting AC current
- Tuned radio circuits or loud speaker cross-over filter networks.
- Smoothing raw rectified DC to make a smoother DC output (less ripple).
- Limiting maximum current in fluorescent tubes.

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Disadvantages

- There is the restriction to passing AC current when an easy passage is required.
- Such as not easily passing high frequency in small wires.

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Applications

- Inductors have a wide variety and important applications in electronics.

- High power applications
- Transformers
- Suppressing noise signals
- Sensors
- Filters
- Radio frequency
- Energy Storage
- Isolation
- Motors

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Conclusion

- To meet the needs of these diverse applications several types of inductors have been developed and are in a variety of form factors from small surface mount inductors to chassis mount.

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