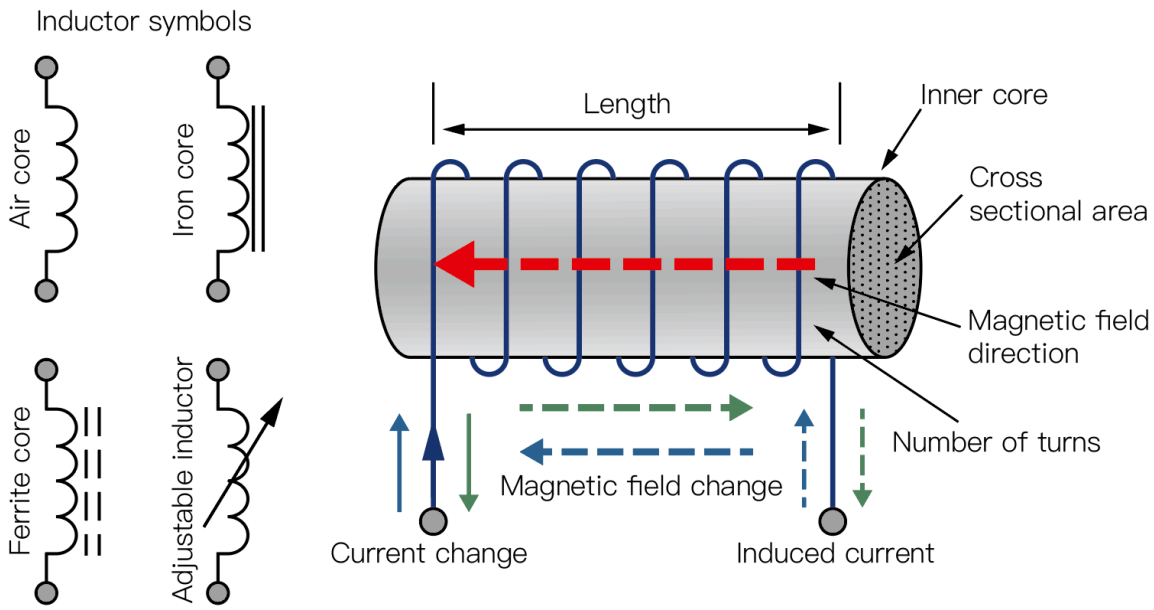
How to Select Inductors and Types of Inductors



In electronic circuits, inductors serve a wide range of purposes, which has led to the existence of numerous types. This article briefly presents the methods for selecting inductors.

Common - Mode Inductors

Common - mode inductors are utilized for common - mode filtering in circuits. They are mainly categorized into ferrite common - mode inductors and amorphous common - mode inductors.

1. **Ferrite Common - Mode Inductors**:
    1. **Advantages**: They exhibit excellent high - frequency filtering characteristics.
    2. **Disadvantages**: However, they are relatively large in size and have poor temperature stability.
2. **Amorphous Common - Mode Inductors**:
    1. **Advantages**: They are small in size, require fewer winding turns, and have good temperature stability.
    2. **Disadvantages**: Their high - frequency attenuation characteristics are not as good.

The design of common - mode inductors mainly involves two considerations:

1. Select the cross - sectional area of the copper wire to prevent excessive heating of the wire. For example, in a high - power circuit with a large current, a thicker copper wire with a larger cross - sectional area should be chosen to ensure that the wire can withstand the current without overheating.
2. Choose a Core of an appropriate size to facilitate the winding of the copper wire. The

Core size needs to be compatible with the number of winding turns and the thickness of the wire. If the Core is too small, it may be difficult to wind enough turns, while if it is too large, it will take up excessive space in the circuit.

Differential - Mode Inductors

When selecting differential - mode inductors, the situation is more complex as it is mainly influenced by two factors: magnetic saturation and temperature rise.

During the design process, it is required that the inductor does not saturate and the temperature rise is reasonable.

3. **Magnetic Saturation**: The saturation of the inductor is mainly restricted by the saturation magnetic flux density of the core material. Different core materials have different saturation magnetic flux densities. For instance, materials with a high saturation magnetic flux density are more suitable for applications where large - current and high - magnetic - field environments are involved.
4. **Temperature Rise**: The temperature rise is related to the selection of the thickness of the copper wire and the core loss characteristics. Thicker copper wires generally have lower resistance, which can reduce the heat generated by the current passing through the wire. Additionally, core materials with low core losses also contribute to minimizing the temperature rise.

Under sinusoidal alternating current, the formula for calculating the differential - mode inductor is as follows:

U = 4.44NBSF

U = 2I\pi FL=XL\times I

where XL is the inductive reactance, U is the voltage, N is the number of winding turns, B is the magnetic induction intensity, S is the cross - sectional area of the core, F is the frequency, I is the current, and L is the inductance value.

From the formula, it can be seen that the most crucial aspect in the design of the inductor is to select an appropriate B value. For different materials, the Bs value determines the upper limit of the selected B value. Moreover, when there is a high - frequency current present, considering the existence of Core Loss, the selected B value is much lower than Bs.

Our company's iron - silicon series inductors have a Bs value reaching 1.6T, and they also have low high - frequency losses. They are excellent choices for applications such as differential - mode inductors, filter inductors, BOOST inductors, and PFC inductors. The high Bs value provides the conditions for product miniaturization. At the same time, the low high - frequency losses enable the inductor to perform better under high - frequency conditions.

Applications of Different Inductors in Various Scenarios

Applications of Common - Mode Inductors

5. **Power Supply Circuits**: In computer power supplies, common - mode inductors are used to filter out common - mode interference signals. This helps to ensure that the power supplied to the computer's motherboard and other components is clean and stable, reducing the risk of electromagnetic interference affecting the normal

operation of the computer.

6. **Communication Circuits**: In high - speed data transmission lines, such as Ethernet cables, common - mode inductors are used to suppress common - mode noise. This improves the signal - to - noise ratio of the transmitted data, ensuring reliable data communication.

Applications of Differential - Mode Inductors

7. **Switching Power Supplies**: In a buck - type switching power supply, differential - mode inductors are used to store and release energy during the switching process. They help to smooth the output current and voltage, reducing the ripple in the power supply output.

8. **Motor Drive Circuits**: In motor drive circuits, differential - mode inductors are used to limit the inrush current when the motor starts. They also help to suppress the voltage spikes generated during the motor's operation, protecting the motor and the drive circuit from damage.