HOW TO CALCULATE INDUCTANCE?

An inductor is a common electronic component that plays crucial roles such as filtering and energy storage in circuits. This article briefly introduces the calculation of inductance and relevant formulas.

Unit of Inductance

The unit of inductance is the Henry (abbreviated as H).

$$1\ \mathrm{H} = 10^3\ \mathrm{mH} = 10^6\ \mu\mathrm{H} = 10^9\ \mathrm{nH}$$

Calculation of Inductance

Inductance of a Single-Turn Coil (AL)

For an iron - core coil, the inductance L can be calculated using the formula:

$$L = N^2 \cdot AL$$

- where N is the number of turns.

Relationship between Voltage and Inductance in an AC Circuit

When an alternating current is passing through, the relationship be tween voltage and inductance is as follows:

$$U = I \cdot X_L$$

$$X_L = 2\pi f L$$

- U represents voltage.
- I represents current.
- X_L represents impedance.
- f represents frequency.
- L represents the inductance value.

Unit of Inductance

Inductors are widely used in various fields. In power supply circuits, they are used for filtering to smooth out voltage fluctuations. For example, in a computer power supply, inductors help remove high-frequency noise from the direct current output, ensuring stable power supply for the computer components.

In signal processing circuits, inductors can be used to separate different frequency signals. In a radio receiver, inductors are part of the tuning circuit, allowing the receiver to select a specific radio frequency signal from a wide range of electromagnetic waves.

HOW TO CALCULATE INDUCTANCE?

电感器作为无源电子元件，在电路中承担滤波、能量存储、信号选频等核心功能。本文从单位定义、计算模型及工程关联等维度，系统阐述电感的量化方法。

电感的量纲与单位换算

电感的国际标准单位是亨利（H），衍生单位按十进制倍率换算：

$$1\ \mathrm{H} = 10^3\ \mathrm{mH} = 10^6\ \mu\mathrm{H} = 10^9\ \mathrm{nH}$$

电感的量化计算模型

铁芯线圈的电感计算（基于AL值法）

对于铁芯磁芯构成的线圈，其电感值可通过磁芯的 “单匝电感系数（AL）” 推导，公式为：

$$L = N^2 \cdot AL$$

- N为线圈匝数；
- AL为磁芯的单匝电感（由磁芯材质、尺寸及气隙参数决定，通常由磁芯厂商提供）。

交流电路中电感与电压的关联（感抗模型）

在正弦交流电路中，电感的“感抗（X_L）”是表征其对交流电流阻碍作用的参数，其与电压、电流的关系满足：

$$U = I \cdot X_L$$

感抗的计算公式为：

$$X_L = 2\pi f L$$

- U：电感两端的正弦交流电压（有效值）；
- I：通过电感的正弦交流电流（有效值）；
- f：交流信号的工作频率；
- L：电感的标称电感值。

电感器的应用场景

电源滤波领域

通过滤波平滑电压波动，如电脑电源中去除直流输出高频噪声，保障组件供电稳定；

射频选频领域

可分离不同频率信号，如在收音机调谐电路中筛选特定无线电频率信号。