

## Tips for COIL users (2)

### ● Introduction

Following the first issue, the second topic is about "parameters of a coil (electrical specifications)". We'll focus mainly on inductors (fixed coils) for a while.

### ● Parameters (factors) to define specifications of an inductor

Major parameters of an inductor include, but not limited to, followings, and required parameters depend on an application. Our catalog provides only essential parameters for an application that we assume.

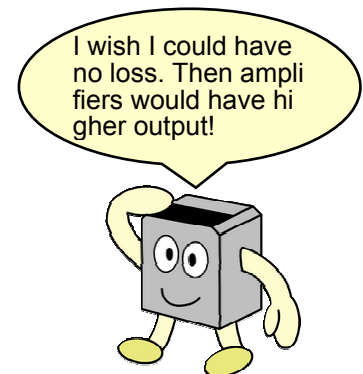
① Inductance:	Essential
② DC Resistance:	Essential to inductors for power supply
③ DC superposition current:	Essential to inductors for power supply
④ Allowable current:	Essential to an inductor for power supply
⑤ Q:	Often used in inductors for high frequency
⑥ Self resonance frequency:	Often used in inductors for high frequency
⑦ Impedance:	Often used in particular inductors
⑧ Temperature rising:	Essential to inductors for power supply

### ● Summary of each parameter

"An ideal inductor" may have following characteristics;

- The inductance is stable
- The loss is zero (DC resistance is zero, Q is infinity  $\infty$ )
- Unlimited current can be supplied
- Zero temperature rise
- The self resonance frequency is infinity  $\infty$

However, these characteristics are only in a theoretical circuitry or simulation. In fact, the all values for inductors are all finite. To identify differences from the ideal inductor, various parameters are applied.



#### 1. Inductance:

Represents an electrical value of inductance, and its unit is H (Henry).

Practically,  $\mu\text{H}$  (micro Henry:  $\times 10^{-6}$ ) or  $\text{mH}$  (milli Henry:  $\times 10^{-3}$ ) is often used.

#### 2. DC resistance:

It is equivalent to resistance of windings (copper wire). The smaller resistance is, the less loss becomes.

It is an important parameter for the application of power circuit.

#### 3. DC saturation allowable current:

When the direct current is supplied to the inductor, inductance decreases. It represents a point that inductance begins to decrease. The decreased inductance returns to the normal value when the current becomes small.

#### 4. Temperature rise allowable current:

Represents a maximum current which can be applied to the inductor based on the heat generation of the inductor. If the current is supplied exceeding spec, the inductor may be damaged. Use conditions are limited depending on the current, because the inductor is a current-fed device.

**5. Q:**

Represents an inductor performance at specified frequency by following formula as an index.

It has no unit because it is an absolute number.

$$Q = \omega L / r \quad r : r \text{ is resistance which represents losses in its frequency.}$$

**6. Self-resonance frequency:**

Small amount of stray capacitance exist in an inductor. The inductor resonates by stray capacitance and inductance. It represents the frequency when this occurs.

**7. Impedance:**

To represent impedance at specified frequency. This is used in special case.

**● Current specification of inductors**

We would like to explain about current specification, which is one of the most complicated specifications. There are two main types of current specifications:

- (1) If the (DC) current is supplied exceeding spec, the heat generation will damage the inductor.
  - >> It is generally called " Temperature rise allowable current".
- (2) If the (DC) current is supplied exceeding spec, the heat generation does not damage the inductor but causes the inductance reduction.
  - >> It is generally called "DC saturation allowable current".

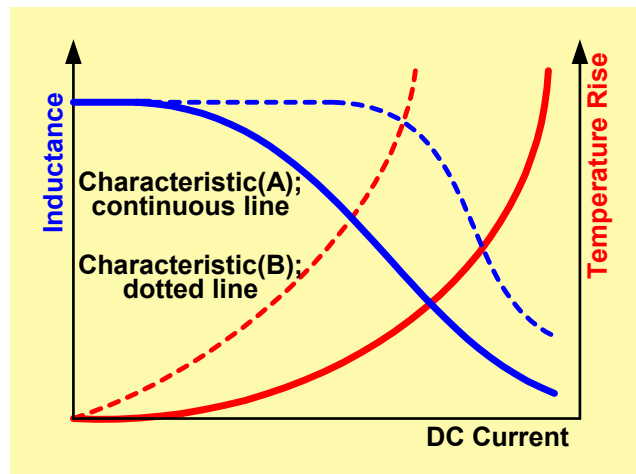
There is a case that smaller one of 1 or 2 is specified as "Allowable current".

We would appreciate if you could take a closer look at current specification while checking required characteristics.

There are two types of characteristics, one is low heat generation (A : continuous line) and the other is high saturation current (B : dotted line). Please refer to the figure on the right side.

In the case of DC/DC power supply, the inductor with the characteristic (A) (standard inductor) is used generally, because the current flows continuously in most case.

For digital amplifier, which is popular in the market recently, mostly the large current flows momentarily. So, the characteristic (B) may be used, that is not saturated at peak current rather than heat generation.



Graph-1



For a reference, we are showing an example of the characteristics of "7G17B", which is for a digital amplifier.

Photo-1 7B17B

Table-1

Part Number	Inductance (uH)	DC Resitance (mohm) max.	DC saturation allowable current (A)	Temperature rise allowable current (A)
7G17B-100M-R	10+/-20%	10.7	26.0	8.2
7G17B-220M-R	22+/-20%	10.7	13.0	8.2
7G17B-330M-R	33+/-20%	10.7	7.5	8.2

\*Please take a look at the differences of current specifications.

In addition, regarding the characteristics of the DC saturation allowable current, some products have a sharp reduction curve of inductance, some have a gentle curve of inductance (due to differences of construction/material). Therefore, please also take these characteristics into consideration according to your application when choosing the inductor.

● **How to select the inductor**

Inductor is electronic component, so above "electrical parameters" are to be fixed first. Also, the inductor is to be selected in consideration of conditions such as form, construction and use environment. We can provide documents of characteristics that are not on the specification, please feel free to contact us.

● **DC superposition characteristic (saturation of inductance)**

Although we can make a coil by only winding wire (this is so called "air core coil"), we usually use the combination of magnetic materials to decrease the size. When the "air core coil" is combined with the ferrite core that is one of magnetic materials, the inductance can increase several times to several hundreds of times. However, the magnetic materials have the characteristic of magnetic saturation. When the magnetic saturation occurs, it decreases the effect of enhancing inductance. As the result, the inductance of the coil decreases. Generally, among coils with the same inductance, magnetic saturation occurs quickly in smaller form, which leads to the drastic decrease of DC superposition current (less current is supplied). Nevertheless, material improvements enabled us to reduce an inductor size.

April.2.2009

**Notes**

While we pay sufficient attention to this description in preparing this, if you have any questions or doubts in this description, please contact following address.

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