

2-2 Choke coil design

The switching regulator's secondary side choking circuit is superimposed with direct current; hence, to prevent saturation of the core a choke coil with good direct current superimposition characteristics must be selected.

Through gap processing of the middle legs of FEI, FEE, FEER, FQK and FPQ cores, TOKIN has produced a series of coils for use in choke coils.

For designing choke coils, the necessary data is provided for each core size, including the relationship between gap and AL value, and direct current superimposition characteristics.

First let's see how to read the table when making a choke coil.

Table 4 Air gap-AL characteristics (FEI 40, BH2)

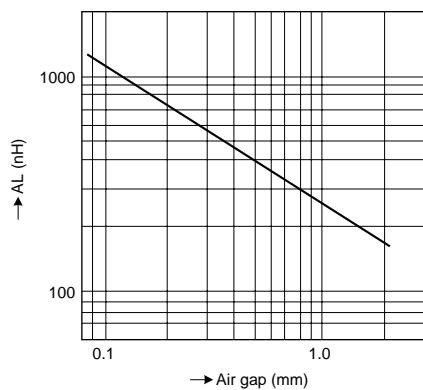
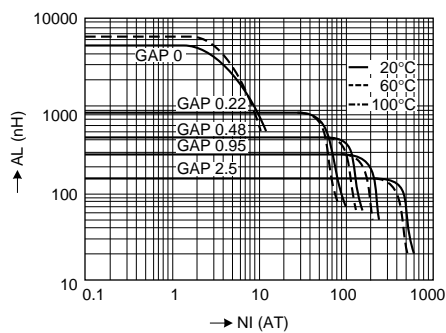


Table 5 Direct current superimposition characteristics (FEI 40, BH2)



For example, if the gap of the FEI 40 (BH2) is 0.2mm, then from the relationship of the FEI 40's air gap AL, the AL value is 720nH. In this case, from the direct current superimposition characteristics it is understood that the 40 AT is range in which the direct current magnetic field's magnetic permeability does not decrease.

For making a choke coil, the following formula must apply between the actual number of windings N_1 and the maximum direct current superimposition current I_0 .

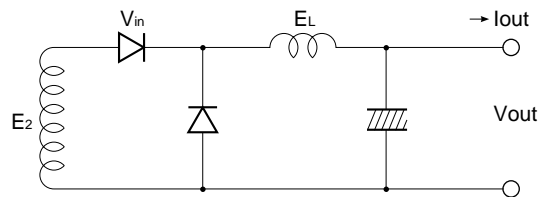
Thus, in this case the number of windings and current capacity are selected according to $40AT > N_1 I_0$.

On the other hand, inductance is represented by the following formula.

$$L = AL \times N^2 \times 10^{-9} \text{ [H]}$$

$$N = \sqrt{\frac{L \times 10^9}{AL}} \text{ (Turn)} \dots\dots\dots \textcircled{7}$$

For choosing the choke with the switching regulator, and with from the previous example in mind:



$$E_1 = E_2 - V_F - V_{out}$$

$$= L \frac{di}{dt}$$

$$\therefore L = \frac{E_1 dt}{di} = \frac{E_1 \times T_{on}}{1}$$

In view of the ruffle and dummy load of I_{out} , general guidelines for the inductance of the output choke are derived using the following formula.

$$L = \frac{5E \cdot T_{on}}{I_{out(MAX)}} \text{ [H]}$$

✳ Gap

When a 0.1mm gap is placed in the core's middle leg, the total gap is 0.1mm, but when a 0.1mm gap material is inserted overall, the total gap amount becomes 0.2mm.

● For example, to make a 50μH choke coil with an output capacity of 5V-10A, the calculations become as follows.