



Choke Coil
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Applications



Metal Powder Composite Choke Coils

Indispensable in business as well as in daily living, the personal computer has now become a standard household product. For that reason alone, marketing is greatly influenced by what can be used to entice customers. Of particular popularity recently are light-weight, compact laptops with sophisticated functions and AV PCs with large-screen LCDs.

Laptops perform almost all work at an ease comparable to a desktop computer, and are required to be light, thin and moreover, have a battery supply time that would not need recharging for a one- or two-day business trip.

The AV PC with its enhanced performance and multiple functions is gaining great popularity. This product is equipped with a large-screen, high-resolution LCD and enables digital terrestrial TV/DVD viewing, TV recording, image editing and more. As well, built-in wireless LAN allows Internet connectivity in any room. And even though the display is large, the trend is toward housing that enables compact storage so that the AV PC does not take up household space. Increasingly, these kinds of products have the same types of boards used in laptops.

The most significant issue facing these types of PCs is the power supply and related parts. A power supply is a device that supplies power from an outlet or battery and processes it into a useable form for main components such as the CPU. In all cases, a coil component called a "choke coil" (power inductor) is used.

Conventionally, the voltage of electronic components that handle main functions, such as the CPU, in enhanced-performance PCs has been lowered in order to reduce power consumption. Meanwhile, more and more electric power is being consumed to realize more functions on a PC in total. In other words, while progress is being made in energy conservation on the one hand, an increased amount of energy is being used on the other.

The result is that total PC power consumption itself has changed little from before. However, a significant change is in the current required.

As electric power equals voltage \times current, if the voltage decreases and the PC power consumption remains the same, the outcome is a constantly increasing current.

And though calls to reduce the dimensions of laptops have ceased, there is no change in the direction toward even thinner and lighter laptops, and therefore a strong demand continues for the necessary technology.

These kinds of demands of the times made on the choke coil are not only contradictory but actually extremely difficult to resolve.

Until recently, the majority of choke coils used were coil components with copper wire wound around magnetic cores made of ferrite.

When a current is applied to the copper wire, magnetic fluxes are produced in the core. The number of magnetic fluxes has an upper limit depending on the material and the core size. Therefore, original functions cannot be performed if a current that produces magnetic fluxes exceeding this limit is applied. The result is a loss in power and heat generation.

As long as the conventional ferrite is used, increasing the size of the core is the only way a larger current can be applied.

However, we are caught in a contradictory situation in which increasing the core size is not permitted because of demands for lighter and thinner laptops.

At the same time, choke coils assembled with bulk cores made of ferrite potentially produce a structural whining sound making them inappropriate for AV PC use.

To resolve these various issues, NEC TOKIN offers the Metal Powder Composite Choke Coil.

The Metal Powder Composite Choke Coil is a choke coil in which the conventional ferrite has been replaced with metal.

As metal materials have a higher saturation magnetic flux density (*1) than ferrite, many magnetic fluxes can be produced. Therefore, in comparing the two using the same size cores, metal is able to deliver the required performance even when a larger current is applied.

However, as the current flows out as it is with metal, an eddy current is created when an alternate voltage is applied, causing a large loss. This loss not only shortens the battery life, but at the same time converts into a large volume of heat. Moreover, if a fan is used to lower the temperature, the power consumed will further shorten the battery life, in addition to deteriorating AV performance due to the noise caused by the fan.

As the temperature of recent CPUs is particularly high when they are operating, the problem of how they can be cooled down has become a major issue. As using a device that produces an even larger amount of heat in such a place was inconceivable, it was decided that the practical long-term application of metal-core choke coils would be difficult.

However, through applying the manufacturing method for a traditional sendust core, and using a fine, highly efficient material powder while taking advantage of the high saturation magnetic flux density that is available only with metal, we at NEC TOKIN Corporation have successfully produced Metal Powder Composite Choke Coils. These coils exhibit excellent properties with low loss. In addition, by molding the metal powder materials into a single piece, this structure reduces the conventional whining sound.

Of the Metal Powder Composite Choke Coils, the MPC Series is most suited for the high operating frequencies around CPUs due to the especially large current applied.

Through making structural adjustments such as in the material chosen and by forming the copper wire into flat wire, a low-loss performance that is uniquely high is achieved.

Also, when direct current (DC) is applied through a choke coil, inductance is lowered resulting in even more current passing through, thereby causing a phenomenon known as "DC superposition." When this phenomenon occurs more frequently, circuits become unstable thus increasing loss. In a worst-case scenario, DC superposition can result in destruction of IC circuits.

The superior nature of the MPC Series gives the ultimate level of control of this phenomenon.

Meanwhile, within choke coils for logic circuits where mid-level current are applied, ferrite continues to be popular mainly because of cost demands.

However, from the perspective of loss reduction on the overall PC, strategies specific to the CPU periphery are reaching their limits. There are now calls for highly efficient components in other areas.

NEC TOKIN offers the MPLC Series for these applications.

The difference between this series and the MPC Series is that by forming the copper wire into a round wire, this series responds to applications that require higher inductance. Of course, the high-efficiency, excellent DC superposition characteristics and non-existent whining sound are all due to the nature of the metal powder composite.

By using a highly efficient metal core, choke coil characteristics can be improved by almost twice compared to those of traditional ferrite cores. For this reason, a choke coil with the same performance as that of a traditional choke coil can be made in almost half the volume.

In addition, for a coil with the same-sized profile, the core can be thinned and instead, the diameter of the wire to be wound can be increased. As a result, electric resistance is reduced, loss is dramatically decreased and a choke coil that produces less heat can be realized.

*1 Saturation Magnetic Flux Density: The upper limit of magnetic flux density that limits the strength of magnetization of a material.

An Extensive Inductance Selection
 Low Core-loss and High Efficiency through
 Proprietary Material Technologies
 Compact with large Current Response due to Low DCR

MPC Series



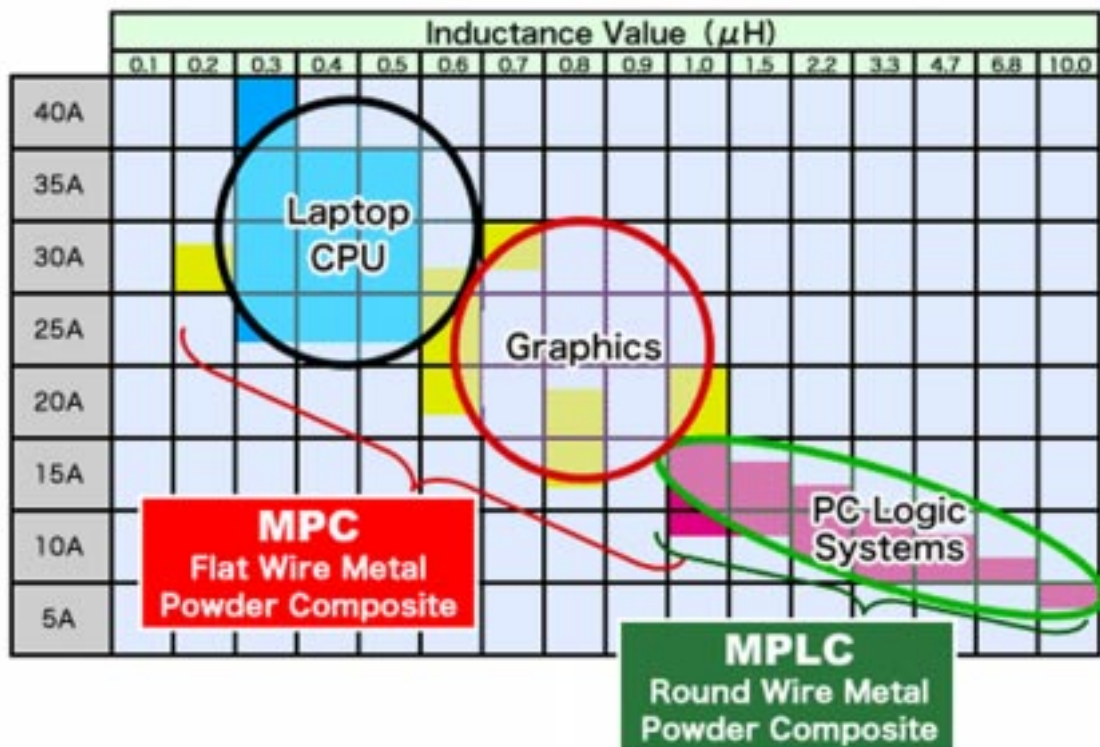
Inductance: 0.36 to 1.0mH
 Current: 17 to 40A
 Size: 12mm x 12mm, 10mm x 10mm

MPLC Series

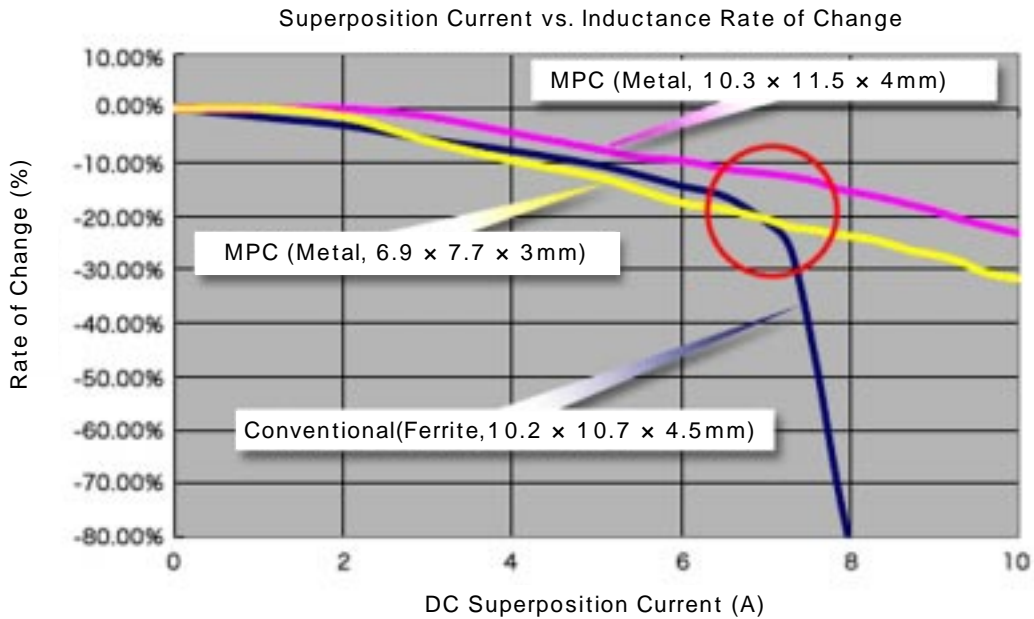


Inductance: 1.0 to 4.7mH
 Current: 5.0 to 15A
 Size: 10mm x 10mm, 7mm x 7mm

Areas Covered by MPC/MPLC

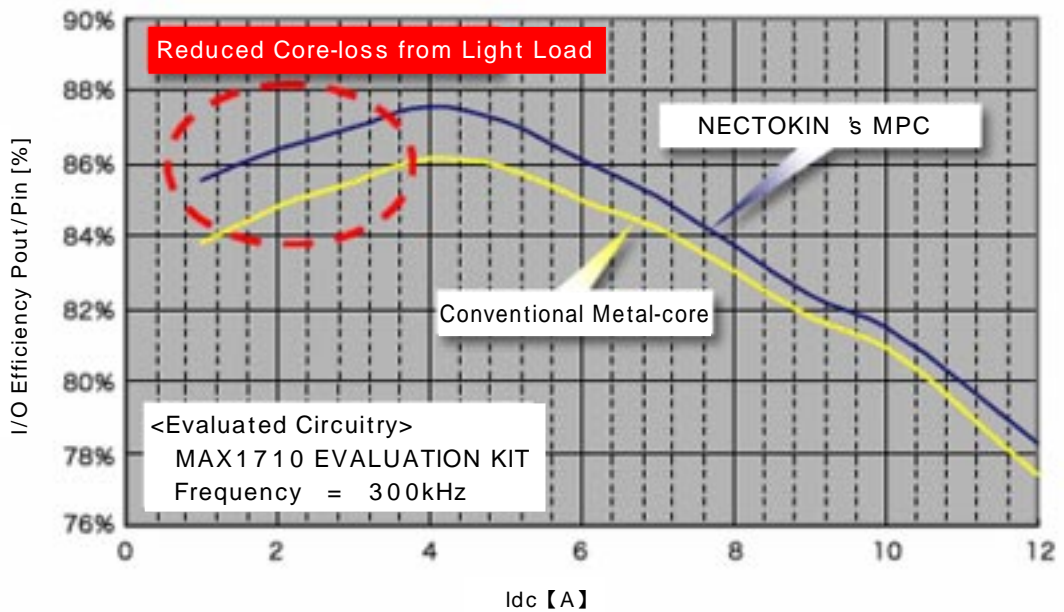


Superior Superposition Characteristic Realized through the High Saturation Magnetic Flux Density of Metal Materials



In comparison to the occurrence of magnetic saturation in the 7A range for conventional ferrite-core products, the MPC and MPLC series, using their saturation magnetic flux density characteristic with its high metallic magnetic materials, realizes a reduced inductance loss at a large current band and superior DC superposition characteristics.

Excellent Power Source Efficiency via Proprietary Metal Materials



Compared to the conventional metal products on the market, using MPC choke coils by NEC TOKIN reduced core-loss due to the light load, thereby contributing to an improved power source efficiency.

Magnet Bias

Even when it comes to traditional ferrite core choke coils, NEC TOKIN holds technology that can be found nowhere else.

This method is called “ magnet bias ” (MB · PI Series BIASCHOKE[®]). The upper limit of magnetic fluxes generated in a core when a current is applied to a coil can not be changed as long as ferrite is used.

Now, what would happen if magnetic fluxes in the opposite direction were made beforehand using a strong magnet? For example, supposing a certain core allows up to ten magnetic fluxes to be generated, and using a magnet, three magnetic fluxes in the minus direction of the fluxes are made. The result: a current that is only able to make up to thirteen magnetic fluxes can be applied to the core.

Although, this extremely interesting idea has actually existed for about 30 years, it was never realized because a strong magnet was required to make magnetic fluxes in the opposite direction.

A particular problem was the 230- to 240-degree heat that was added to a board as it was passed through the reflow oven during the mounting process. Due to this heat, an element that could function at normal temperatures became useless as the magnetic force became weakened during the device mounting process.

However, NEC TOKIN utilized their experience from handling magnetic materials over many years, and solved this issue by realizing the magnet-bias method choke coil.

With its superior nature, this fills the gap between the common ferrite core and metal.

Applications Covering a Wide Field, from AV PCs to Next-generation Digital Devices

The main application for Metal Powder Composite Choke Coils is as a power supply circuit to provide power to CPUs in PCs and other devices.

Metal Powder Composite Choke Coils are especially becoming a must for high-performance laptops and AV PCs, due to the large current applied to their circuits. These coils are becoming an indispensable component in designing PCs with more functions and a higher performance, as well as to realize devices with the same performance but with reduced loss and fewer problems with extended operation and cooling.

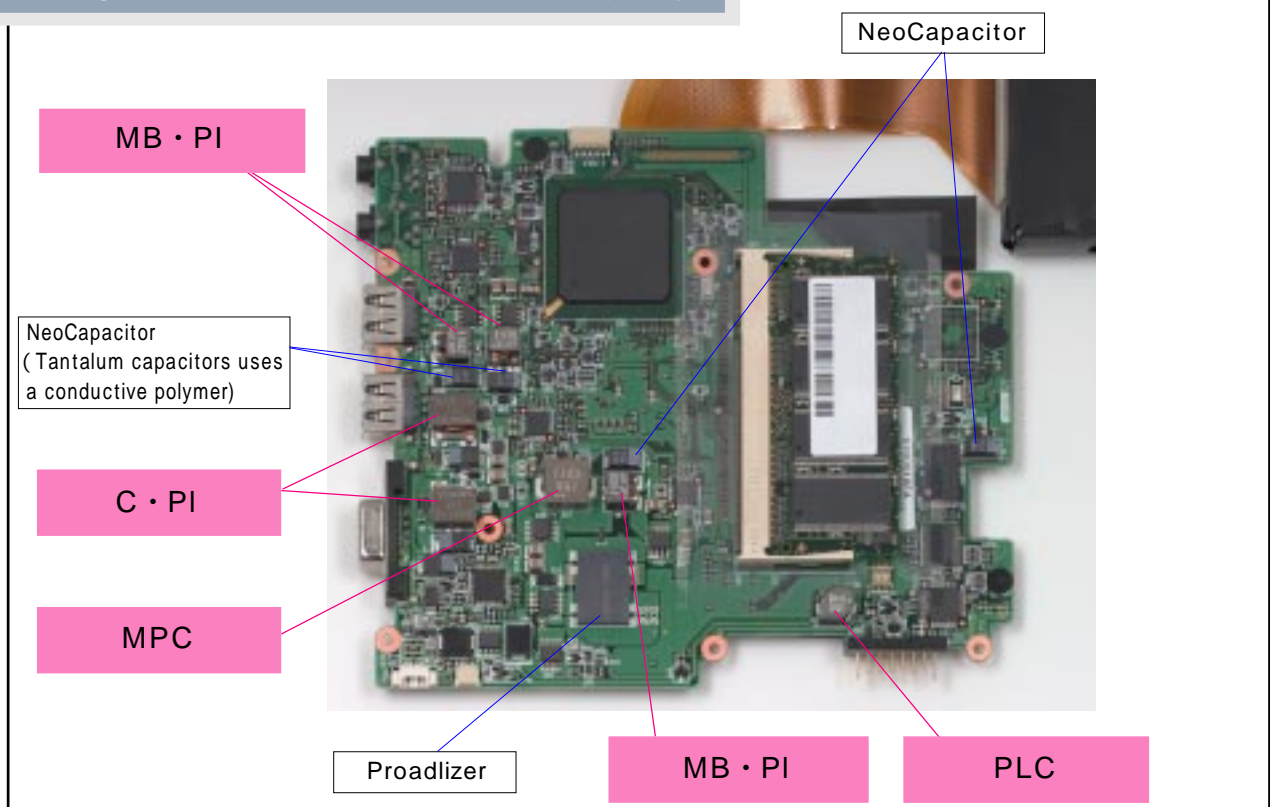
Metal Powder Composite Choke Coils by NEC TOKIN have received recognition for their high-performance and reliability, becoming a recommended component by CPU manufacturers and are integrated into power supply circuits of numerous PCs.

In recent years, there is an increase in products that are equipped with CPUs and image processing circuitry, with qualities virtually the same as PCs though their names are different.

For example, next-generation DVDs and consumer games, large-screen LCD televisions, plasma display televisions, and digital TVs/ all of these make use of Metal Powder Composite Choke Coils. Additionally, there is a rise in application in dispersed power supplies for servers, indispensable devices to the Internet society.

Moreover, with high-performance, multifunctional telephones having moving image shooting functions and a high-definition displays, as well as GPS and one-segment broadcasting functions, these types of third generation mobile phones are now bordering on being PCs. A more efficient power supply is required in this field too. And Metal Powder Composite Choke Coils are making a significant contribution to this application.

Mounting Example for Laptop & CPU Periphery



The technological needs of the times are bound to become even more severe. NEC TOKIN is working to develop materials with increased superiority. This includes the scheduled introduction of the newly developed material "Senntix™" (*2), realizing even lower loss. This will indeed further the evolution of Metal Powder Composite Choke Coil performance.

NEC TOKIN's Metal Powder Composite Choke Coils offer excellent characteristics that will bring about future electronics devices with more functions and heightened performance.

*2 "Senntix™"

This is a soft magnetic material of metal glass with iron as its main composition element. The uniqueness of metal glass is characterized by a stable and exceptional amorphous structure that has been unavailable. Though for this reason it was previously difficult to achieve, now both the high saturation magnetic flux density characteristics of an iron soft magnetic material and the superior low loss characteristics of an amorphous material have been successfully combined. In this way, the co-existence of large current responsiveness and high efficiency for inductors has been realized.