Pros and Cons of Various Types of Magnetic Cores

1 Abstract

High-frequency transformers are devices used to change alternating current (AC) voltage, current, and impedance. When an alternating current flows through the primary coil, it generates an alternating magnetic flux in the iron core (or magnetic core), inducing a voltage (or current) in the secondary coil. The transformer is composed of an iron core (or magnetic core) and coils, with two or more windings. The winding connected to the power source is called the primary coil, while the remaining windings are called the secondary coils. The magnetic core of the transformer comes in various types, including pot-type cores, RM cores, E cores, EC, ETD and EER cores, PQ cores, EP cores, and toroidal cores, among others. What impact do these cores have on the functioning of the transformer? The detailed analysis is presented below.

2、Pot-Type Magnetic Core

The bobbin and windings are almost entirely enclosed by the magnetic core, resulting in very effective shielding against EMI (Electromagnetic Interference); the dimensions of the pot-type magnetic cores conform to IEC standards, offering excellent interchangeability during manufacturing; they can accommodate simple-type bobbins (without pins) and PCB (Printed Circuit Board) mount bobbins (with pins). Owing to the pot-type design, the cost is higher compared to other cores of equivalent size; its shape is not conducive to heat dissipation, making it unsuitable for high-power transformer inductors.

3、RM-Type Magnetic Core

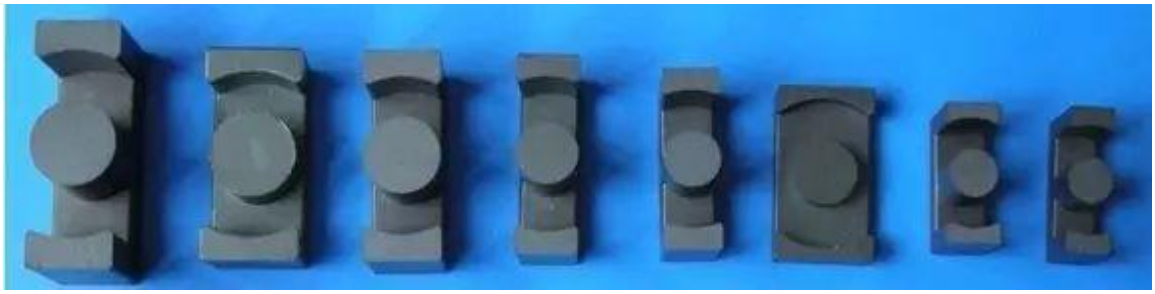
Compared to the pot-type, the RM-type has two symmetrical sides removed, a redesign that facilitates better heat dissipation and the extraction of large-diameter leads; it saves about 40% of installation space compared to the pot-type; the bobbin is available in both pinless and pinned versions; it can be mounted using a pair of clamps; RM-type cores can be made into a flat shape (suitable for current planar transformers or for direct assembly onto pre-designed printed circuit board windings); although the shielding effect is not as good as the pot-type, it is still quite satisfactory.

4、E-Type Magnetic Core

Compared to the pot-type magnetic core, the E-type magnetic core is much less expensive, and its winding and assembly are relatively simple, making this core shape the most widely used at present. However, a drawback is that it cannot provide self-shielding; E-type cores can be installed in different orientations, and several sets can be stacked to accommodate greater power; this core can be made into a flat shape (a currently popular core shape for planar transformers); it is also available in both pinless and pin type bobbin options; due to its excellent heat dissipation and the ability to be used in stacked configurations, it is generally used in high-power inductors and transformers.

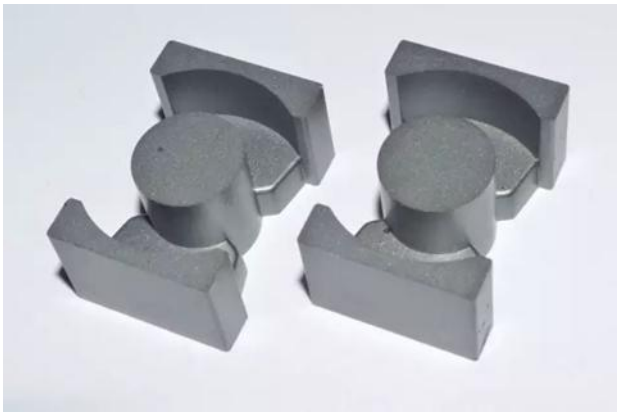
5、EC, ETD, and EER-Type Magnetic Cores

These types of magnetic core structures lie between the E-type and the pot-type. Like the E-type cores, they provide ample space for the extraction of large cross-section leads, catering to the current trend in switch power supplies towards low voltage and high current; these shapes of cores also facilitate very good heat dissipation; owing to the cylindrical central pillar, the single turn winding length is reduced by 11% compared to a rectangular cross-section of the same area, thus resulting in a 11% reduction in copper loss, and enabling the core to provide a higher output power; the cylindrical central pillar, compared to the rectangular one, also avoids the potential issue of damaging the winding wire insulation during the winding process due to the sharp edges of a rectangular pillar.



6、PQ-Type Magnetic Core

The PQ-type magnetic core is specially designed for inductors and transformers used in switching power supplies. The PQ shape design optimizes the ratio between the core volume, surface area, and the winding wire area; this design enables the use of the smallest core to provide the maximum inductance and maximize the winding area; it also allows for the maximization of output power while minimizing transformer volume and weight, and occupying the smallest PCB mounting space; it can be mounted and secured using a pair of clamps; this efficient design also makes the magnetic path cross-sectional area of the core more uniform, thus this core structure design has fewer working hot spots compared to other core structure designs.



7、EP-Type Magnetic Core

The EP-type magnetic core features a cylindrical central pillar with a three-dimensional structure that, except for the ends in contact with the PCB board, completely envelops the windings, offering excellent shielding. This unique shape minimizes the impact of air gaps formed at the contact surfaces during the assembly of the two core pieces, and it provides a larger volume and a greater overall space utilization ratio.

8.Toroidal Magnetic Core

From the manufacturer's perspective, the toroidal magnetic core is the most economical; it incurs the lowest cost among various comparable cores (although it is personally believed to entail a higher winding cost for transformer winding manufacturers); due to the use of abobbin, the additional and assembly costs are virtually nil; when suitable, a winding machine can be used for winding; it also offers very good shielding.

Conclusion

The above is a summary analysis we have prepared for you on how the shape of high-frequency transformer magnetic cores affects the functioning of transformers. We hope this can be helpful to everyone. If you wish to learn more about related transformer content, please subscribe to our channel in time. Thank you!