Optimization Design of 50W High Frequency switching Power supply

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Abstract

With the continuous change of national living standard, switching power supply is an indispensable part of people's daily life, and the quality of switching power supply directly affects people's quality of life. With the improvement of people's quality of life, electronic equipment is constantly updating and changing, and electronic equipment is developing towards miniaturization, which requires more and more demanding high-frequency switching power supply. At present, the main development direction of electronic products is "small, light and thin", which requires the power switch to develop towards high frequency, in order to fully increase its frequency and reduce the loss of the switch. This paper will mainly analyze the working principle of high frequency transformer and the performance factors of transformer, and then master the important parameters and performance of all kinds of high frequency magnetic core, and at the same time make the magnetic core with better performance for transformer making. Let the transformer achieve the best working efficiency.

Keywords

High frequency power supply; optimal control; power transformer; simulation; finite element; winding loss.

1. Introduction

With the rapid development of China's economy, China's electric power system is also constantly developing, the current development of electric power equipment has become an important problem in China's power industry. With the enhancement of national environmental protection consciousness, we have a longer and more energy-saving society, so that people's demand for high-efficiency, low-power stabilized power supply is increasing, and the safe and stable operation is an important demand for this kind of work.

2. The principle of high frequency switching power supply

2.1 Definition of high frequency switching power supply

In general, there are two main types of high frequency switching power supply, namely DC/DC and AC/DC.. Among them, the former has been modularized, its production process and design technology, now in China, abroad tend to be more standard, mature, but also won the majority of users good evaluation.

The DC/DC converter converts a fixed DC voltage to a variable DC voltage reasonably, usually used in switching power supplies, and in many cases requires an electrical isolation between input and output, which means that a transformer must be used for isolation. It is called isolation transformer. The transformer converts a DC current or voltage into a high-frequency current or voltage, which, after scientific rise and fall, is converted to a DC current or voltage by rectifying smooth filtering.

2.2 Working principle

The AC/DC transformation in high frequency switching power supply belongs to the process of converting AC to DC. The power flow can be two-way direction, and the power flow from load to power supply is called active inverter. Power flow from the power source to the load, is called rectifier. In the actual operation process, the AC/DC needs to be filtered and rectified, so the bulk filter container is needed. In addition, due to the limitation of the relevant safety standards, the AC power

used should strictly follow the relevant safety standards, which makes the miniaturization of the power supply volume of the AC/DC extremely difficult; at the same time, it is subject to the internal high-current switching operation and the high voltage. Because of high frequency and so on, the difficulty of EMC is increased, which requires the internal design of high density installation circuit to be of high standard. In view of the above situation, only when the power supply system is fully optimized, can the work efficiency be effectively promoted to the design standards and requirements.

3. The design of high frequency switching power supply

3.1 Composition and Core of High Frequency switching Power supply

In practice, there are two important components of AC/DC switching power supply, namely, control circuit and main circuit. Among them, the main control circuit is auxiliary power supply circuit, control circuit, protection action circuit and detection circuit, and the key part is DC/DC converter. The main circuit includes output rectifier filter circuit, input EMI filter circuit, DC-DC converter and input rectifier filter circuit.

The main core of switching power supply is transformer. Therefore, the quality of transformer will have a direct impact on the overall performance of switching power supply, especially for high frequency switching power supply, the transformer will be disturbed by many parameters. Therefore, in the process of designing high-frequency switching power supply, the key point is to design high-frequency transformer.

3.2 Ferrite and core

In general, the soft magnetic materials commonly used in switching power supply include silicon steel sheet, amorphous alloy, iron powder core, ferrite and constant conductive alloy, among which the most common is ferrite.

The main results are as follows: the most common Ferrite, belonging to black or dark gray ceramic material, has good chemical stability, brittle texture and hard. Among them, nickel-zinc and manganese-zinc are the two most commonly used combinations, and other metals are generally added to the above combinations in order to make the magnetic properties meet the standard. The staff can use the Ferrite as a magnetic core shaped to meet the needs and obtain different properties, such as remanence properties, electrical resistance, Curie temperature, temperature characteristics of magnetic induction intensity, and initial permeability, according to the different ratios of raw materials. The temperature characteristic of the loss and the saturation magnetic induction intensity, etc.

In general, the core of switching power supply transformer is mainly soft magnetic material with high permeability and resistance, low coercive force and low magnetic field. 1 the magnetic permeability is high, which can be used to determine the number of coil turns. The magnetic induction intensity of the coil can be higher by the passage of the smaller excitation current, so that the coil can bear the applied voltage higher, which can make the volume of the magnetic core smaller when the output power is fixed. 2 the resistance is higher. Eddy current and iron consumption are small. 3 lower coercive force can also reduce iron consumption.

4. Core hysteresis loss

4.1 Relevant definitions

When the external magnetic field acts on the magnetic material, there will be the phenomenon of "elastic rotation" of the magnetic domain which has a small difference with the direction of the external magnetic field. When the external magnetic field is removed, this part of the magnetic domain can be restored to the original direction. At the same time, after fully overcoming the friction of the magnetic domain wall, the other part of the magnetic domain will appear the phenomenon of "rigid rotation". When the external magnetic field is removed, this part of the magnetic domain will still maintain the direction of magnetization. This leads to the fact that in the process of magnetization, two kinds of energy will be sent to the magnetic field, in which the former will be converted into

potential energy, and the latter will be converted to overcome friction, resulting in the core gradually heating up until it is consumed, that is, hysteretic loss.

5. Residual loss

This kind of loss mainly refers to a kind of loss caused by the effect of magnetic posterity or magnetization relaxation, that is, the total loss minus eddy current loss and the remaining loss after hysteresis loss. In the process of magnetization, the state of magnetization is not changed by magnetization and then changes to the final state of itself immediately. It needs a proper change time, and this time difference will result in residual loss. Among them, the residual loss produced by ferrite is mainly dimensional resonance loss, spin resonance loss and Shunde wall resonance loss.

In high frequency cores up to hundreds of KHz, the residual loss and eddy current loss will be larger than the hysteresis loss, and almost all belong to hysteresis loss in low frequency.

6. Coil winding of transformer

When designing transformer, we should not only pay attention to designing its magnetic core, but also design its winding. The integrated characteristics of magnetic core and winding constitute the whole characteristic of magnetic device. In low frequency, the transformer is less affected by excitation inductance and leakage inductance of parasitic parameters. The basis of coil design is mainly according to the allowable loss caused by DC resistance of the coil.

For high-frequency switching power supplies, the main evidence for designing high-frequency magnetic components remains loss. In the process of increasing the frequency, the high frequency current will cause a strong "high frequency effect" in the coil. At the same time, the capacitance and parasitic inductance will also have a strong impact on the overall performance of the switching power supply circuit, resulting in electromagnetic interference. The generation of voltage spikes and parasitic oscillations greatly reduces the efficiency. Therefore, the staff concerned must scientifically determine the diameter and type of wire, the number and structure of winding turns, the way of winding and the way of installation.

7. Conclusion

This paper introduces the optimal design of high frequency switching power supply. The main circuit plays an important role in the high frequency switching power supply. The nervous system of the circuit control circuit determines whether its function can be brought into full play, and the performance of the whole system will depend on the overall design effect of the control circuit. Therefore, we should pay great attention to the design of the main circuit. Unlike ordinary high-frequency transformers, the high-frequency transformers used in high-frequency resonant power supplies have higher frequency, higher power and higher voltage levels, so higher requirements are put forward in the heating of high-frequency transformers and the design of insulators. These aspects are worth noting.

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