High-voltage Broadband High-current Sensor and Its Anti-interference Design based on Giant Magnetoresistive Effect

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Abstract: With the continuous development and progress of modern smart grid, more and more technologies and equipment designed for smart grid have been applied to the development of actual smart grid. High-voltage broadband large-current sensor based on giant magnetoresistive effect is one of them. Therefore, it is necessary to study and analyze the design of high-voltage broadband high-current sensor and its anti-interference design based on giant magnetoresistive effect, so as to ensure that the high-voltage broadband high-current sensor can provide security for the development of national smart grid. This paper would analyse the design of high-voltage broadband high-current sensor based on giant magnetoresistive effect and its anti-interference design based on magnetoresistive effect, to provide meager help for those concerned.

Development and construction of modern intelligence makes smart grid become the most important part of modern grid construction. Compared with traditional power grid, smart power grid pays more attention to the efficiency and quality of grid operation. The main design principle of high-voltage broadband high-current sensor based on giant magnetoresistive effect is to measure the current frequency generated in the operation of smart grid. Therefore, it is necessary to analyse the design of high voltage broadband high current sensor based on giant magnetoresistive effect and the anti-interference design. In this way, it can provide corresponding security for the operation of smart grid and effectively improve the actual operation efficiency of smart grid, in order to guarantee the construction of national smart grid and the actual development of modern society.

1. Design of high voltage broadband high current sensor based on giant magnetoresistive effect

1.1 Design of signal processing circuit

The overall structure of high voltage broadband high current sensor based on giant magnetoresistive effect includes signal processing circuit, signal modulation circuit and filter circuit. signal processing circuit can detect the actual signal of the current to solve the problem about saturation phenomenon of high current and meet the requirements for high frequency measurement. module design of the signal processing circuit mainly includes energy supply, signal conditioning, filtering and demagnetization. magnetic field generated by excessive current would amplify by concentrating the magnetic loops. When the air gap in the magnetic ring is measured by the current sensor of the giant magnetoresistive effect measures, it will be converted into a voltage signal, which is tuned by signal modulation when being output by chip of giant magnetoresistance effect. Current signal simulated by the voltage will be output after filtering in a low pass filter.In the process of magnetic ring concentration, the magnetic field generated can not only be expanded, but also be interfered at a certain degree. Therefore, signal processing circuit would be installed at some place with higher voltage and signal in the practical measurement would be adjusted and filtered continuously, so that the magnetic field generated by the magnetic ring degrades [1].

1.2 Design of signal modulation circuit

In the design of signal modulation circuit, for high-precision resistance and broadband actual

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operational amplifier, we must build an instrument that amplifies the circuit using chips made up of four operational amplifiers whose actual width is hundreds of MHz. The circuit itself has the advantages of wider broadband, common-mode rejection and higher actual resistance to input. In the practical application of signal conditioning, The effect of the relatively stray current in the circuit board will cause the actual frequency intercepted by the amplifier to be much lower than the width and length of the operational amplifier theory. So resistance of relatively small feedback resistance is chosen in practical application, which will reduce the current impedance in the signal channel to suppress the stray current in the circuit board.

1.3 Circuit design for filtering and demagnetizing

In the design of high voltage broadband high current sensor with giant magnetoresistive effect, an infinite gain second-order low-pass filter processor is used in the design of the filter circuit. In the process of filtering the high-precision resistance and high-frequency resistance, most of them will be amplified to twice if the actual intercepted current frequency is 10MHz, and the parameter of actual quality is 0.707. If the actual intercepted current frequency is 100MHz, the amplification factor is also twice, and the quality parameter is the same as above. In the design of demagnetization circuit, when the chips in the magnetic ring is saturated, the remaining magnetism will cause a very large error in the final result of the actual measurement. So in the actual design, it is necessary to repeatedly magnetize the current to damp the oscillation in the demagnetization circuit, so as to ensure the complete degaussing [2].

2. Design of high voltage broadband high current sensor based on giant magnetoresistive effect

2.1 Design of PCB electromagnetic compatibility

The measurement system of the high voltage broadband high-current sensor adopts a ground-floating system with fiber isolation, which will not only make the anti-interference exterior unable to contact with the ground, but also lead to higher current frequency measured by PCB. Therefore, in the practical design, it needs to be improved in the following ways. First of all, in order to reduce the capacitance signal inconsistent with electromagnetic signal in the signal channels, we should choose PTFE-based material plate. Generally, four material plates need to be stacked and the thickness should be less than 2 mm. At the same time we need to choose 0603-type and ensure the diameter of the threaded hole below 0.3 mm in choosing resistance-capacitance packaging. Secondly, in order to ensure the anti-interference capability of the high voltage broadband high-current sensor based on the giant magnetoresistance effect, it is necessary to ensure the flatness of the ground plane in the high voltage processing circuit, so as to guarantee the following work.

Generally, the third layer of the mechanism of the four layer board need to be set as negative logic power separating layer and layer 4 doesn’t require wiring. This allows tight coupling of a ground plane on both ends of the signal line, which can improve the anti-interference ability of high voltage broadband high current sensor and guarantee the operation of the smart grid.

2.2 Design of electromagnetic anti-interference

The design of electromagnetic anti-interference is mainly to evaluate the surrounding magnetic field, electric field, electromagnetic field and current signal through the special metal external protector, while the anti-interference design of high-voltage broadband high-current sensor has become a necessary anti-interference measure for the construction of smart grid due to the security of smart grid in the actual operation process. First, according to the principle of anti-interference and the types of interference sources, interference sources hard to block will appear in the process of practical anti-interference. Professional material, frequency and thickness, waves length should be applied to calculate the interference sources of practical factors in order to solve this problem. The anti-interference equipment should be thickened so as to effectively prevent the damage caused

by the interference source to the operation of the smart grid. Secondly, it is necessary to analyze the nearby electric field, magnetic field and electromagnetic field through the anti-interference device, and select the anti-interference layer of different materials through the actual analysis results. SE occupies a relatively important position in the anti-interference design. The actual survey results show that the higher the SE is, the higher the anti-interference ability will be. Besides, the copper SE has better anti-interference performance than the aluminum SE, and that of permalloy SE is much higher than that of iron SE. Therefore, copper SE and permalloy SE should be applied in the actual design of electromagnetic interference. In addition, combined anti-interference materials are required in the selection of electromagnetic anti-interference materials. Generally, the performance of combined anti-interference materials is much higher than that of single anti-interference materials in the actual application. In this way, the performance of electromagnetic anti-interference can be greatly improved, thus providing guarantee for the smooth operation of smart grid [3].

3. Conclusion

The intelligent construction of national grid cannot leave the related technology and equipment development, and high voltage broadband high current sensor based on giant magnetoresistance effect can measure and analyse the current frequency produced in the operation of the smart grid, to provide security for the smart grid in the actual operation process and improve its actual operation efficiency. It can guarantee the normal operation of smart grid by analyzing the design of high-voltage broadband high current sensor based on giant magnetoresistive effect and the design of its anti-interference. Meanwhile the actual operation efficiency of smart grid can be improved so as to provide security for the intelligent development of modern society and effectively promote the intelligent development of China.

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