CS345

AMMCS 2022

应用数学，建模与计算机仿真国际学术会议

Applied Mathematics, Modeling and Computer Simulation

August 13-14, 2022

Wuhan, China

Analysis and optimization of coil loss in mobile phone wireless power transfer system

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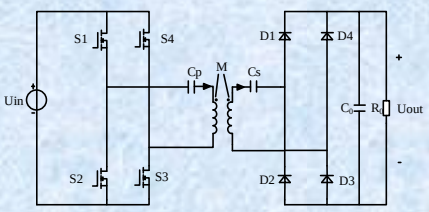
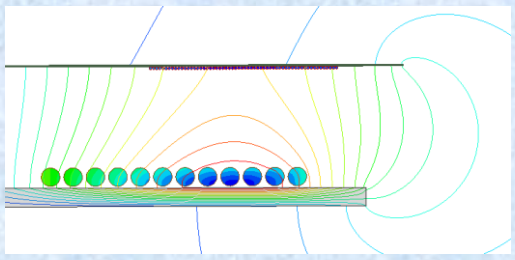
Introduction

In the mobile phone wireless power transfer (WPT) system with magnetic core, the loss caused by the magnetic core and winding is the central part of the system loss. Among them, the core loss is mainly related to magnetic materials, working frequency, magnetic flux density and other factors in the core; The winding loss is mainly related to the current flowing through the winding and the resistance of the winding. In this paper, it analyses the influence of the working frequency, the number of turns, the number of strands of Litz wire and different turn-width of the winding on the loss of the system. Finally, according to the analysis results, the coils within the allowable range of working frequency and current of transmitting and receiving coils are made to verify the feasibility of the optimization scheme. The simulation and experimental results show that the coil loss of the optimized scheme will be reduced.

Circuit schematic diagram and Distribution of flux lines



After the input DC voltage passes through the inverter circuit, the AC energy is transmitted and output to the T_X coil, and then the energy is transmitted to the R_X through the electromagnetic coupling. Finally, it is converted into DC energy available for the load through the rectifier circuit.

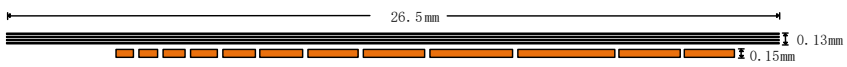


Due to T_X and R_X coil are in an open magnetic field space during electromagnetic induction, so only part of the energy can be transmitted from T_X to R_X. After adding the magnetic core, it can not only increase the permeability, but also prevent too much magnetic field from being absorbed by the surrounding materials.

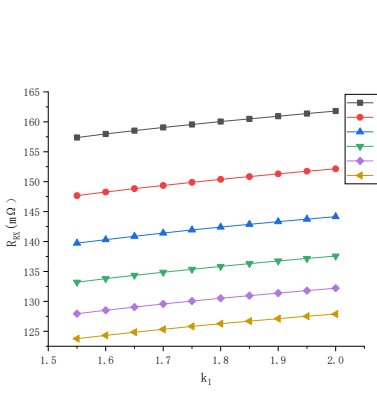
Influence of working frequency , turns and the number of strands of Litz wire

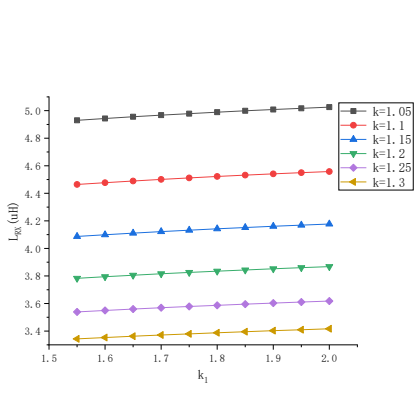
- **The minimum operating frequency can be selected within the allowable frequency range to reduce coil loss.**
- **The resistance and inductance of the coil will decrease with the decrease of the number of turns, and the influence of the outer diameter direction will be greater than that of the inner diameter direction.**
- **The number of strands of Litz wire has a great influence on the coil resistance, but has little influence on the inductance. Therefore, the winding loss can be reduced by increasing the number of strands to reduce the coil resistance.**

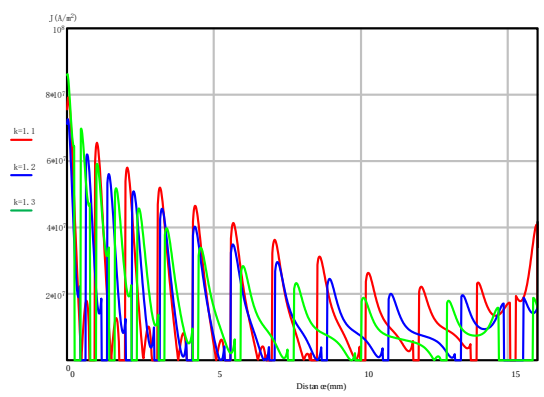
Influence of different turn-width

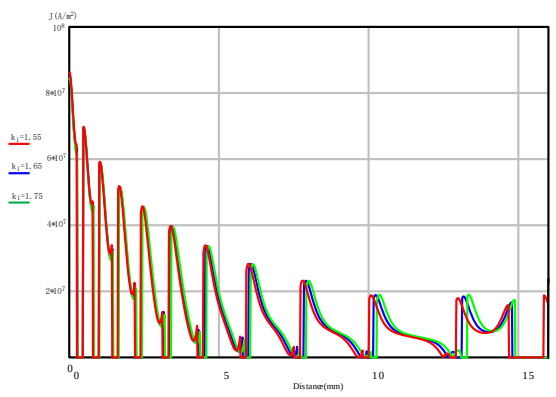


Taking 12 turns as an example, set the width of the 1st turn of the winding w_1, the width of the 2nd turn (w_2) is the k-fold of the first turn, the width of the third turn(w_3) is the k-fold of the second turn, and so on, but from the 11th turn, the width is $1/k_1$ times that of the previous turn. The optimal width of each turn will be obtained by changing the values of k and k_1.



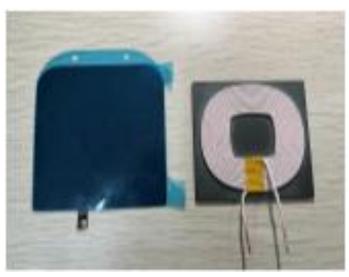






Actual measurement and analysis

The physical models of T_X and R_X.



The measured values of T_x.

The measured values of R_x.

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