Analysis and optimization of coupled windings in magnetic resonant wireless power transfer systems with orthogonal experiment method

The coupled magnetic resonant unit (CMRU) has great effect on the transmitting power capability and efficiency of magnetic resonant wireless power transfer system. The key objective i.e. the efficiency coefficient $k_Q$ is introduced in the design of CMRU or the coupled windings based on the mutual inductance model. Then the design method with orthogonal experiments and finite element method simulation is proposed to maximize the $k_Q$ due to low precise analytical model of AC resistance and inductance for PCB windings at high-frequency. The method can reduce the design iterations and thereby can get more optimal design results. The experiments verified the design objective of $k_Q$ as well as the design method effectively. In the optimal PCB windings prototype at operating frequency of 4 MHz, the $k_Q$ and the maximum efficiency are increased by about 12% and 4% respectively.

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