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Analysis and Design of Inductive Power Transfer Systems for Automotive Battery Charging Applications

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Abstract : Transferring electrical power without any wiring has been a dream since late 19th century. There were some advances in this area as to know more about microwave systems. However, this subject has recently become very attractive due to their practiScal systems. There are low power applications such as charging the batteries of contactless tooth brushes or implanted devices, and higher power applications such as charging the batteries of electrical automobiles or buses. In the first group of applications operating frequencies are in microwave range while the frequency is lower in high power applications. In the latter, the concept is also called inductive power transfer. The aim of the paper is to have an overview of the inductive power transfer for electrical vehicles with a special concentration on coil design and power converter simulation for static charging. Coil design is very important for an efficient and safe power transfer. Coil design is one of the most critical tasks. Power converters are used in both side of the system. The converter on the primary side is used to generate a high frequency voltage to excite the primary coil. The purpose of the converter in the secondary is to rectify the voltage transferred from the primary to charge the battery. In this paper, an inductive power transfer system is studied. Inductive power transfer is a promising technology with several possible applications. Operation principles of these systems are explained, and components of the system are described. Finally, a single phase 2 kW system was simulated and results were presented. The work presented in this paper is just an introduction to the concept. A reformed compensation network based on traditional inductor-capacitor-inductor (LCL) topology is proposed to realize robust reaction to large coupling variation that is common in dynamic wireless charging application. In the future, this type compensation should be studied. Also, comparison of different compensation topologies should be done for the same power level.

Keywords : coil design, contactless charging, electrical automobiles, inductive power transfer, operating frequency
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