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STRESZCZENIE PRACY DOKTORSKIEJ

Rezonansowy układ przekształtnikowy z aktywną stabilizacją punktu pracy w systemach bezstykowego przekazywania energii

SUMMARY OF THE DISSERTATION

Resonance power supply with operational point active stabilization for contactless energy transfer systems

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Presented dissertation is focused on development of a technical solution for supplying electrical loads without a physical connection. Nowadays inductive systems are being broadly investigated. In this kind of systems, energy is transmitted to load like in a transformer, between at least two magnetically coupled coils. Such systems are more and more often applied, for instance in customer portable electronics or in the automotive industry. Author observed that such systems are sensitive to parameters change. First of all, it can be stated that value of the k factor (magnetic mutual coupling factor) could be freely changed during operation of the system. Secondly, system may work with a various levels of demanded power. Change of values of these parameters will affect the system, especially the main power inverter. This influence was investigated in simulation environment. Various simulations of proposed system (AC sweep and time resolved) were performed. Based on them it can be seen how resonant frequency and phase shift of primary voltage and current depend on k and load. Moreover, in selected parameters range, power delivered to load was estimated and presented. Based on time resolved simulations values of currents and voltages in main power circuit were estimated.

Main idea behind this work is that the system should be immune to parameter changes, moreover it should work with a fixed frequency. Author proposed an auxiliary power circuit (with control algorithm), which was placed in parallel to the primary side of the system. Introduced solution allows to keep zero phase shift for different than values of k and R_{bw} (it is a relative load resistance). It allows also to transfer demanded level of power for much wider range of mentioned parameter changes. An improved topology of the system was investigated in simulation environment.

To verify obtained simulation results a prototype was designed and built. It consists of a high frequency power inverter, the transformer, a compensation circuit and the load. All modules were designed and constructed by the author. Acquired experimental data corresponds well to results obtained in the simulations. Laboratory stand allows to measure efficiency of the system. Maximal achieved performance of the system was equal to 86%, and it was found that the usage of proposed compensator will not improve it. However, it also will not decrease the efficiency of power the inverter.