Ensuring Target Wireless Power Transfer (WPT) Efficiency Using Coupling Coefficient and Circuit Parameter Normalization

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This study aims to prove, using theoretical and experimental methods, that target wireless power transfer (WPT) efficiency can be ensured by utilizing the coupling coefficient among various factors affecting WPT efficiency (such as number of windings or radius of solenoid, frequency of AC signal, etc) and employing the method of circuit parameter normalization. First, for that purpose, the WPT circuit is modeled as an electrically equivalent circuit. Second, the characteristics of the equivalent circuit are simulated using a computer, and the effects of the coupling coefficient on WPT efficiency are analyzed quantitatively and qualitatively. Third, an experimental method for measuring mutual inductance is presented and verified. Fourth, it is shown that target WPT efficiency can be guaranteed by utilizing the coupling coefficient and the method of circuit parameter normalization. Lastly, a two-dimensional mutual inductance sensitivity map, which can visualize and analyze the inductance interrelationships of the primary and secondary circuits, and a WPT experimental apparatus are developed and various applications of them are presented.