Resonators Insensitive to Alignment for Wireless Power Transmission

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An efficient method of wireless power transmission(WPT) was presented (A. Kurs, et al., "Wireless Power Transfer via Strongly Coupled Magnetic Resonances," Science Mag., Vol.317, No.5834, pp.83-86, 2007) and many papers have been reported since that time. This method is based on the magnetic resonance coupling and two identical resonators (or more) that have the same resonance frequency are used. As an advantage, this technology has a capability of transmitting power for distances that a few times longer than a diameter of transmitter or receiver and it is relatively safer than WPT using the electromagnetic radiation. However, to achieve its high efficiency, the alignment between two resonators should be required because the misalignment between resonators gives a weak coupling and poor transmitting efficiency. Especially, if the resonators are orthogonal to each other, transmission efficiency will be zero. Therefore, the resonators for free-alignment WPT are required for the practical applications.

In this paper, the WPT resonators insensitive to the alignment are studied. The resonator consists of three rectangular loops that occupy equal space in the azimuthal plane. Also, the three-loop resonator can generate four different modes with the different current directions of the loops. Each mode has an effective current direction that determines the direction of magnetic fields. Therefore, the direction of magnetic fields of the resonator can be controlled using the various modes. Utilizing this approach, the WPT resonators insensitive to the alignment can be designed. Also, applying the mode selecting algorithm, the more efficient WPT resonators can be achieved. The design procedure of the resonator including mode generation and mode selecting algorithm will be discussed. Additionally, the simulated data regarding to the WPT efficiency versus alignment of the resonator will be shown and compared with the measured data in the presentation.