

Optimization of Wireless Power Transfer (WPT) between Helical Antennas with Connected Ground Planes in the Near Field

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It has been experimentally demonstrated that two high-Q small helical antennas, with circular ground planes connected, can transfer power with efficiencies greater than 50% within the near field (at 18 MHz 57% for 2.5 meters; patent pending US 2016/0156230). Recent analysis and simulation has revealed that the efficiencies can be optimized by modifying the size and shape of the ground planes. This paper will examine results from three different configurations that have been optimized by the design of connected ground planes.

The first configuration is a single source single receiver system (Fig. 1). Three different shapes of ground planes structures have been used in this study, (i) circular ground planes connect by a single wire, (ii) a shared finite rectangular plane, and (iii) a perfect ground. From the findings, comments will be made as to why case (i) is the best choice in this configuration in regard to efficiency of transfer. The second configuration is a single source multi receiver system. Results from the studies on two different designs will be presented using optimized circular connected ground planes (from the earlier study) in two different arrangements (one source, three receivers). In the first arrangement, the source ground plane is connected directly to the receivers, while in the second each antenna connects with the adjacent one irrespective of whether it is a source or receiver. In the third configuration, the source and receiver are placed on opposite sides of the optimized circular ground plane (Fig. 2). Comments will be made as to the applicability of these configurations in charging mobile devices and electric vehicles.

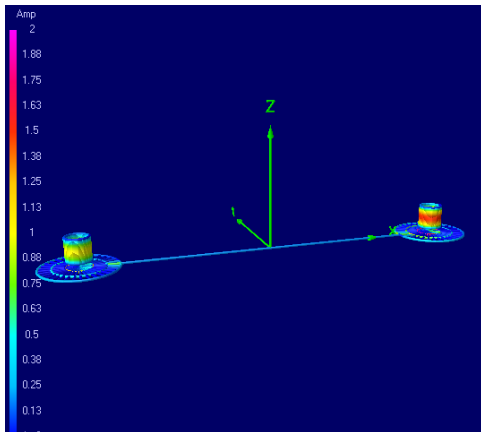


Figure 1. Single source single receiver configuration showing coupled current amplitude

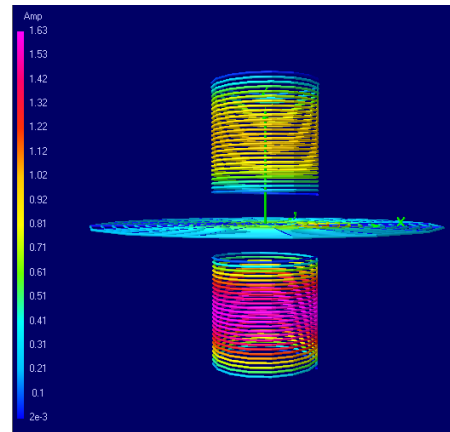


Figure 2. Source and receiver on opposite sides of ground plane showing coupled current amplitude.