Wireless Power Transfer and Harmonic Suppressed Antenna with Ferrites[+]

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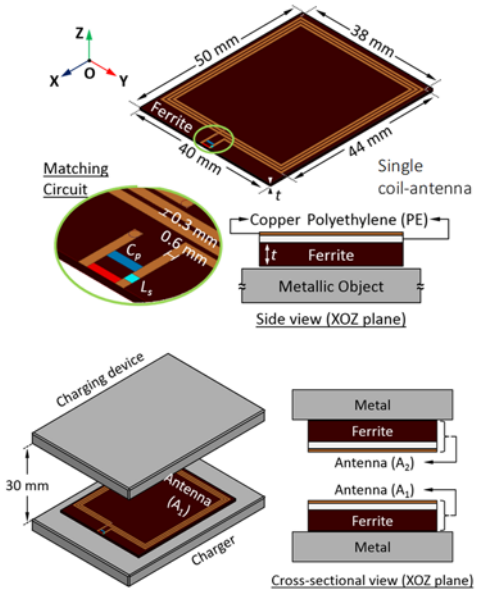
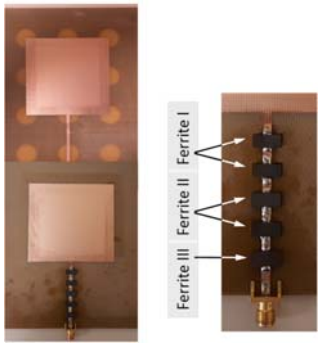
There are two parts to this talk. The first part is wireless power transfer, and the second is harmonic suppression.

Part I. We have developed a simple wireless power charging (WPC) antenna system (50 mm × 40 mm × 0.1 mm) for use in simulating power transfer efficiency (η) with and without ferrite and metallic object (battery case). As a result, suitable magnetic properties and ferrite sheet thickness were identified. The simulation results suggest that magnetic loss tangent (tan δ_μ) and permeability (μ) need to be less than 0.05 and higher than 125 at 13.56 MHz, respectively, to achieve at least 75% of the transfer efficiency (η_{max}) of the WPC antenna without ferrite and the metallic object. We have fabricated $Ni_xZn_{0.85-x}Cu_{0.15}Fe_2O_4$ (x = 0.32 − 0.38) spinel ferrites and obtained relatively high μ of 169 and low tan δ_μ of 0.1 with x = 0.38. This magnetic loss is still too high to achieve 75% of the η_{max}. To further reduce the magnetic loss, we have used the two-step sintering process and achieved μ of 132 and a tan δ_μ of 0.03 at 13.56 MHz. This ferrite meets criteria identified by the transfer efficiency simulation and is a good candidate for 13.56-MHz wireless power transfer charging antenna system.



Part I:Wireless Power Charging (WPC) System Simulation

Part II. We have designed and fabricated a multiple-ferrite-cored patch antenna (MFC-PA) to suppress harmonic radiation over the frequency range of 1 to 10 GHz and obtain wide suppressing bandwidth. Its suppression performance was compared to those of the conventional patch antenna (PA), photonic bandgap patch antenna (PBG-PA), and defected ground structure patch antenna (DGS-PA). Simulated and measured results show that MFC-PA effectively suppresses harmonic radiation up to 5.6f_0, where f_0 is 0.9 GHz, while the harmonic radiation of PBG-PA and DGS-PA is suppressed up to 3f_0. In principle, harmonic radiation of MFC-PA is suppressed by dissipating the unwanted signals in ferrite materials, whereas PBG-PA and DGS-PA suppress harmonic radiation by reflecting or redirecting unwanted signals, which is not desired. Ferrite loading is a unique approach to suppress any harmonic radiation.



PART II: Harmonic Suppressed Antenna with Ferrite Cores

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