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Development of a 1MW pulsed air core electromagnetic toroidal coupler for wireless power transmission with reduced stray emission

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Wireless power transmission (WPT) has seen rapid growth during the last decades. It is a promising technology which has gained worldwide attentions in several applications (smart grid, defense systems···). WPT has proved its capability to be convenient, safe and autonomous. Nevertheless, this technology requires a high power and large area coupler which increases the human exposure to the electromagnetic field. In this context, an air core electromagnetic coupler with reduced stray emission was developed. It is a part of a system which ensures a proper DC / DC conversion between a low-voltage bus (three-phase rectified, fuel cell, battery) and a bus regulated to another voltage value while ensuring the galvanic insulation between both. The transfer of very high power and the galvanic insulation can only be achieved in sinusoidal mode via an air core electromagnetic coupler. So, the innovative proposed architecture confines the magnetic radiation in a torus in order to have an efficient coupling factor (k=0.72) without any use of shielding plate. Our toroidal coupler works mainly in pulsed regimes (1MW) and it is a light solution for several needs. The operating frequency of the compact coupler is 200kHz, the expected average power is 200kW resulting in a satisfactory efficiency of 98%. The effectiveness of the proposed novel system was first investigated by CST 3D numerical modeling then tested with an experimental step-up at low and high level of power. The simulation and the experimental results will also be discussed.

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