Regime of Magnetically Coupled Wireless Power Transfer Systems under Resonance and Inherent Biasing

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The purpose of this research is to demonstrate design attributes of Wireless Power Transfer (WPT) System. The objective is to provide an operational domain map of WPT System (WPS) encompassing new findings. Scientific theories were reviewed in order to identify relevant parameters and variables. By accommodating required physical, natural, electrical, and magnetic parameters and variables such as reactance, impedance, transmitting power, coil turns, shields, range, orientation, and frequency, the basis of four distinct experimental set-ups were established that led to present results on inductive coupling, resonant coupling, effect of surroundings, and biasing. Through practical design with trade-offs, the results show that (i) Received power increases, saturates, and decreases non-linearly as the transmitter's rate of change of magnetic flux (frequency) increases, (ii) Power delivery capability is higher at resonance and impedance matching conditions, higher level of source power, and the presence of shield or core, and (iii) Since power transfer is omni-directional, 100% transfer efficiency is impractical. Effectiveness of the WPS design can be improved by taking into account inherent voltage biasing – a new finding in this research. A model to describe voltage biasing is developed for WPS. The operational domain map (ODM) includes an algorithm to deal with adaptability. The ODM provided in this research is comprehensive. The WPS designed for the demonstration of the ODM provides about 4.5 watts with received voltage of 2.06 volts at 15 cm, which is sufficient to power a realistic device. The future work will explore adaptability testing and biasing effect in micro-WPS.