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Design and Simulation of Wireless Power Transfer System for Biomedical Implant

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Abstract

Analytical and simulation approach is explored for link design and performance evaluation for wireless power transfer system. Electrical parameters are extracted from geometrical parameters of a primary and secondary coil and two port network model has been considered for link design and performance evaluation. Magnetic resonant coupling using SP configuration has been selected for longer distance in MHz frequency range. The software tools are used for evaluation of complex analytical design equation and to facilitate the design process.FEM based simulation tool is being used to compare the analytical result.Square PCB type geometrical shape is selected for analysis and evaluation. The power transfer efficiency up to 78% at 4 MHz for the distance of 33mm using SP resonant topology is achieved. Maximum distance and frequency range are the shortcomings to design WPT for biomedical implant.

Keywords: *Wireless power transfer (WPT) system, primary and secondary coil, Resonant Inductive coupling, power transfer efficiency (PTE)*

1 Introduction:

Wirelesspowertransfersthetechnologythatenablesapowersourcetotransmitelectromagneticenergytoanelectricalloadacrossanairgap,withoutinterconnectingcords.This technique is rapidly growing and is applicable to the domains, including industrial applications consumer products and biomedical implant.Biomedical implanted devices are becoming popular in health and medical applications in a wide range of areas, such as, cardiac pacemakers, retinal prosthesis, cochlear implants, defibrillator, smart orthopaedic implants, and artificial hearts etc.The traditional approach of supplying power to these devices is implantable batteries, bio-fuel cell and percutaneous links. However, any battery has limited energy storage and life span, similarly bio-fuel cell has low output power and percutaneous links are susceptible to infection and reliability problems [1].

The current implantable devices available in the market consist of non rechargeable large sized batteries. Biomedical implants require high energy batteries to supply power for long duration, therefore bulky size of the battery is to be required to supply the power to biomedical implant for long duration.Moreover since the battery is non rechargeable, it has to be removed after its life span. This necessitates costly invasive surgery to replace the battery [2][4].

Presently most of the implantable devices, including pacemakers, cochlear implants, and neuro-stimulators, adopt a wide variety of WPT methods, including inductive, capacitive coupled power transfer and ultrasonic power transfer. The researcher reported that the inductively coupled power transfer system is efficient power transfer system for smaller distance than other system. The exact analysis of inductively coupled power transfer system for larger distance has not been cleared yet, there is still no firm consensus regarding methods of inductive link design and optimization [5][6][7]. Therefore, in this

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