Wireless Charging System Using FSK for Bidirectional Communication

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Abstract

This paper proposes a Wireless power transfer (WPT) is an emerging technology with an increasing number of potential applications to transfer power from a transmitter to a mobile receiver over a relatively large air gap. However, its widespread application is hampered due to the relatively low efficiency of current Wireless power transfer (WPT) systems. This paper presents a concept to maximize the efficiency as well as to increase the amount of extractable power of a WPT system operating in resonant operation. The proposed method is based on actively modifying the equivalent secondary-side load impedance by controlling the phase-shift of the active rectifier and its output voltage level. The presented hardware prototype represents a complete wireless charging system, including a dc–dc converter which is used to charge a battery at the output of the system. Experimental results are shown for the proposed concept and validated by simulations as well as by experiments with the help of a WPT prototyping system.

Index Terms: Inductive power transmission, rectifiers, reactive power control, wireless charging.

1. INTRODUCTION

Wireless power transfer is an old technology with new popularity. Its roots can be traced back to Nikola Tesla, who demonstrated in the late 1800s that light bulbs could be powered through wireless coupling of energy from giant high-voltage coils. At the time, wirelessly powered devices existed only in Tesla’s private labs and public lectures. Today, many products exist and much research is being undertaken relating to many implementations of wireless power transfer at a variety of power levels from micro-watts to kilowatts. [5]

Numerous portable electronic devices (such as laptops, cell phones, digital cameras, and electric shavers) rely on rechargeable batteries and must be routinely charged by the line power. A wireless charging technique capable of delivering electromagnetic energy to these portable devices would make them tether free and “truly portable.” Wireless charging is especially valuable for devices with which wired connections are intractable. [2]

1.1 PORTABLE WIRELESS CHARGING

This is used for wireless charging from a higher-power mobile device to a lower power portable device. The vision for future wireless power transfer is inspired by the structure of data transfer in place today. Currently, large amounts of data are transferred in a server-client structure in which servers with larger data storage capacity transfer data to clients with smaller capacity through a common cloud interface. This structure is convenient for users because a client can retrieve data from virtually any server with a simple connection to the cloud. The common infrastructure also reduces redundancy and waste. The benefits of the data transfer structure can be extended to power transfer if a similar structure is adopted in which devices with higher power storage capacity transfer power to devices with lower power storage capacity through a common wireless interface. We define this structure for power transfer as power sharing. [3] [4]
2. METHODOLOGY

To address the design challenges and meet the objectives, a resonant inductive wireless charging system is designed using the conventional circuit topology presented but with an added power amplifier control loop. The control loop senses the power amplifier switch drain voltage and adjusts the power amplifier shunt capacitance and resonant tank series inductance to compensate the changing conditions. [3]

The nominal components of the power amplifier are designed to meet the 200 mW delivered power objective. The control loop is low-power and the system components are carefully selected to achieve > 75% peak system efficiency. Dynamic compensation by the control loop allows the system to maintain high efficiency and balance delivered power as coupling and output load conditions change. This control loop approach is compared to previous work in the next section.

The primary-side and secondary-side inductors are implemented as transmitter and receiver respectively. Primary coil transmit the signal and secondary coil received the signal, So that there is communication between the primary and secondary is introduced and secondary will give feedback to the system and this feedback system improve overall efficiency.[1]

3. RESULTS AND DISCUSSION

Verification of the output with the help of the developed power MATLAB/Simulink set-up. In this work, the system is operated in discontinuous conduction mode which requires Sinusoidal Pulse Width Modulation (SPWM) for its operation. The advantage of this mode of conduction is it feeds optimization of the frequency and Rectified Voltage into the connected load. The capacity of system can be chosen judiciary with the constraints of,

- According to the parameters of the wireless charging system frequency is detected.
- Obtained Frequency is maintained to minimize the reactive losses.

It increases the output power and interect between primary and secondary circuit and send feedback to voltage controlled source and improve the voltage and improve efficiency of charging.[3]
First, method based on actively modifying the equivalent secondary-side load impedance by controlling the phase-shift of the active rectifier and its output voltage level is performed. The control loop senses the power amplifier switch drain voltage and adjusts the power amplifier shunt capacitance and resonant tank series inductance to compensate the changing conditions.

4. CONCLUSION

In this paper, a concept to maximize the efficiency as well as to increase the amount of extractable power of a WPT system operating in resonant operation is demonstrated. The theoretical background of the proposed concept has been presented and validated by simulations as well as by experiments with the help of a WPT prototyping system.

REFERENCES:


