Study of Near Field for WPT System

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***Abstract*—In this paper, the near field distributions was measured using the PCB scanner to analyze the noise source of magnetic resonance wireless power transmission system. The measured sample is transmitted by magnetic resonance using 6.78 MHz. The main noise sources are generated a lot of the harmonics of 6.78 MHz resonance frequency and internal clock signal of regulator for supplying a stabilized power. The harmonic signal is shown to be widely distributed in frequency band.**

Keywords—wireless power transmission; near field; harmonics;

I. INTRODUCTION

Recently the products using a wireless power transmission (WPT) are studied in various fields from small electronic device to electric vehicles[1-5]. The WPT technology provides power to the device without power cable. However, when the WPT system transfers power from the transmitting coil to receiving coil, it is caused electromagnetic field (EMF) exposure as well as electromagnetic compatibility (EMC) problems[6-8]. Using WPT systems, unintentional high power interference in a near-field region gradually has become an important issue in EMC problems[9]. Thus, in terms of EMC problem, the WPT systems because it is a very strong noise source, should minimize the influence on other devices.

In this paper, the near field distributions were measured using the near field measurement system to analyze the noise source of magnetic resonance WPT system. As results, the main noise sources are harmonics of resonance frequency which are maximum distribution in the power amplifier. Also the harmonics of internal clock are emitted by regulator.

II. MEASUREMENT OF THE NEAR FIELD

Fig. 1 shows the transmitting unit of WPT system that uses 6.78 MHz resonant frequency. The transmitting unit is divided into two parts, which are the pre-regulator region for supplying a stabilized power and the amplifier region for coil feeding. In amplifier region, the oscillator generates 6.78 MHz clock signal and the clock signal is input to the gate driver through the buffer. And then the signals go to transmitting coil through the amplifier, which is zero voltages switching (ZVS) class D amplifier. Output power is transmitted to the receiving coil through a transmitting coil connected to the SMA connector. In pre-regulator region, 1 MHz clock signal is generated by internal oscillator. The clock is input to the gate driver through the butter and it is amplified. The pre-regulator has been operating from input voltage and to limit the current up to 1.5 A to be supplied a stable voltage.

Fig. 2 shows a near field measurement system used for analysis of electromagnetic noise of the PCB level. The near field measurement system measures the electric field or magnetic field that shows the distribution of the PCB using the near field probe. The measurement system can be represented with respect to frequency or spatial distribution of the noise to the PCB.

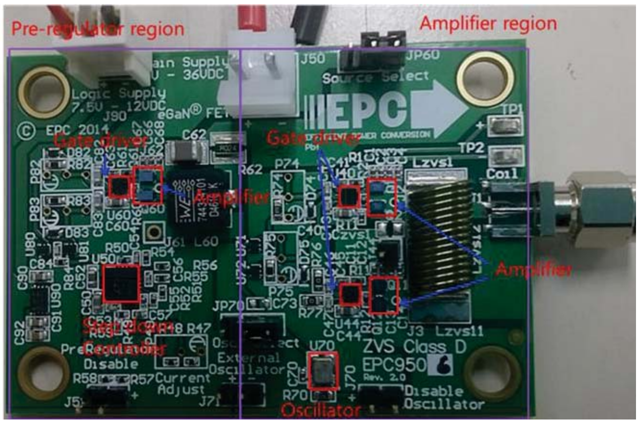


Fig. 1. Transmitting unit of wireless power transmission

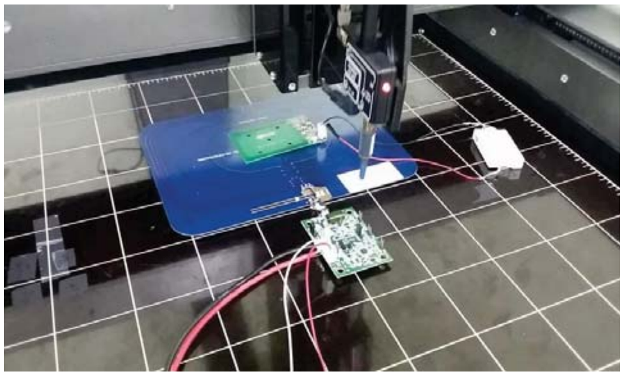
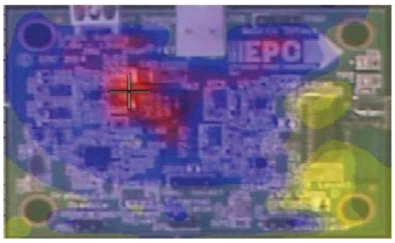


Fig. 2. Near field measurement system.



(a) 1 MHz

(b) 6.78 MHz

Fig. 3. Near field distribution in transmitting unit.

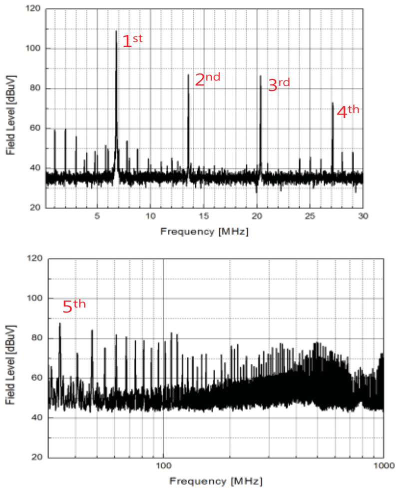


Fig. 4. 6.78 MHz oscillator in amplifier region.

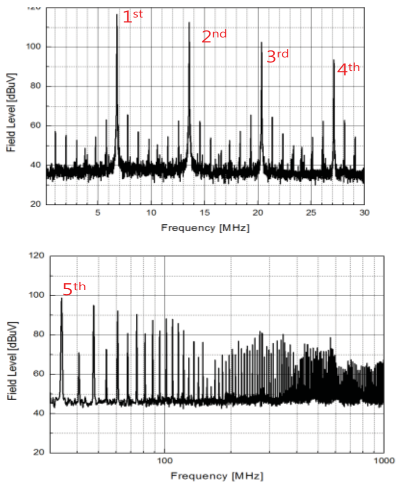


Fig. 5. Noise of class D amplifier in amplifier region.

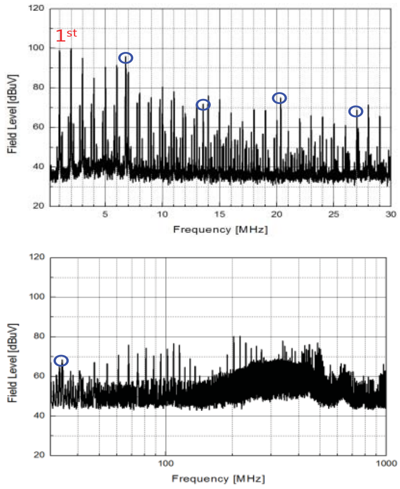


Fig. 6. Noise of amplifier in pre-regulator region.

Fig. 3 shows the results of using a PCB scanner measures the noise at the 1 MHz and 6.78 MHz that is distributed in the transmitter circuit. The noise of 1 MHz appears most significantly at the output of amplifier and 6.78 MHz noise shows highest at the class D amplifier location. Fig. 4 shows a near field distribution at the oscillator in amplifier region. The measurement was carried out frequency band 150 kHz ~ 1 GHz. The results show the harmonic signal of 6.78 MHz, it appears over the entire band up to 1 GHz. Fig. 5 is a measured result in class D amplifier, a lot of harmonic noise of 6.78 MHz is shown. The harmonic noise at the amplifier location is shown larger than the oscillator harmonic noise. Fig. 6 shows the results of the measurement at amplifier location in the pre-regulation region. According to the results, the harmonic signal of 1 MHz is a major noise source, which is clock signal used in pre-regulator. The noise also appears over the entire band up to 1 GHz. The circles show harmonic noise of 6.78 MHz in fig. 5. According to the results, the noises of transmitter circuit are the harmonic noises of the WPT system, which are 1 MHz in pre-regulator region and 6.78 MHz in amplifier region.

III. Conclusion

In this paper, the near field distributions were measured at transmitter circuits using PCB scanner to analyze the noise source of magnetic resonance WPT system. Based on the results, we have shown that the main noise sources are the harmonic noise of internal 1 MHz clock signal in pre-regulator region and 6.78 MHz resonance frequency in amplifier region. In addition, the harmonic components are shown in a wide frequency spectrum over the entire band. Therefore, it is necessary reduce harmonic noise at the WPT system in the future.

Acknowledgment

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