CONCEPTUAL OF WIRELESS POWER TRANSFER (WPT)

K. A. Aznan, WSHW Muda, Affidie Sidek, N.M.Farid N. Hassan

Advanced Technology Training Center (ADTEC) Kemaman,
Kemasik, Kemaman,
Terengganu.

1.0 Introduction

Wireless power transfer (WPT) known for its transmission of electrical energy from power source to the electrical load without having conductors. Figure 1 shows the general block diagram of the WPT. It transmits field energy from transmitter end cross the air and reach the receiver where it will be converted to electric current to use for the load. The usage of WPT is useful when the conductor is not convenient, hazardous and not possible to interconnect from the power source.

There are two categories for the WPT and those are non-radiative and radiative. Non-radiative or near field techniques the power is transferred by magnetic fields using inductive coupling between coils of wire or by electric fields using capacitive coupling between metal electrodes. Generally inductive coupling is the most use like RFID tags, smartcards and inductive powering the electric vehicle (EV).

However, for the far field or radiative techniques the power is transferred by beaming the electromagnetic radiation such as microwave or laser beam. This technique can allow long distance for the energy transfer but will need to aimed at the receiver.

One to be note that, the limitation of the WPT is the exposure of humankind to potentially injured due to electromagnetic fields.

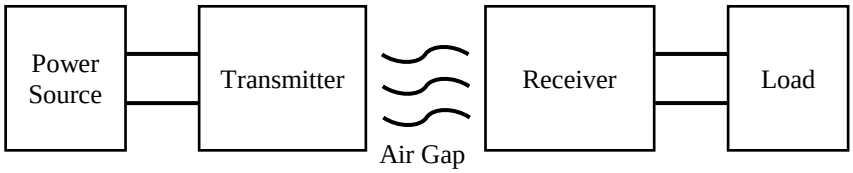

Figure 1 General Block Diagram WPT

1.1 Wireless Power Transfer

There are a few techniques of near filed can be discussed when talking about WPT. However, there are two techniques that are commonly used and they are Inductive Power Transfer (IPT) and Capacitive Power Transfer (CPT).

1.1.1 Inductive Power Transfer (IPT)

This is the oldest and common concept being used in Wireless Power Transfer (WPT). By using the magnetic coupling between the coils, the power is transferred from one terminal to another terminal. Generally this type of transfer is used for low to high power level applications spanning gap distances small to large (less 1mm) [1]. The biomedical implants usually use the range of low power less than 1W and adopt the IPT. The operating frequency higher, the efficiency is lower and the gap between the transmitter and receiver is shorter.

1.1.2 Capacitive Power Transfer (CPT)

Rapid development of this concept has been cover from Watt to Kilo Watt scale power level. The power transfer by using the electrostatic induction between the plates of a capacitor. For a better efficiency, the distance gap should be small. Compare to the IPT, the efficiency will decrease as the gap between the terminal is larger than 1mm [1].

1.2 Compensation Network Topologies

The need of the compensation network is to make unstable system become stable, increase the steady state and performance of the system (introduce the poles and zeros for the transfer function of the system).

There are four basic type of compensation topologies that can be describe as Series-Series (SS), Series-Parallel (SP), Parallel-Series (PS) and Parallel-Parallel (PP).

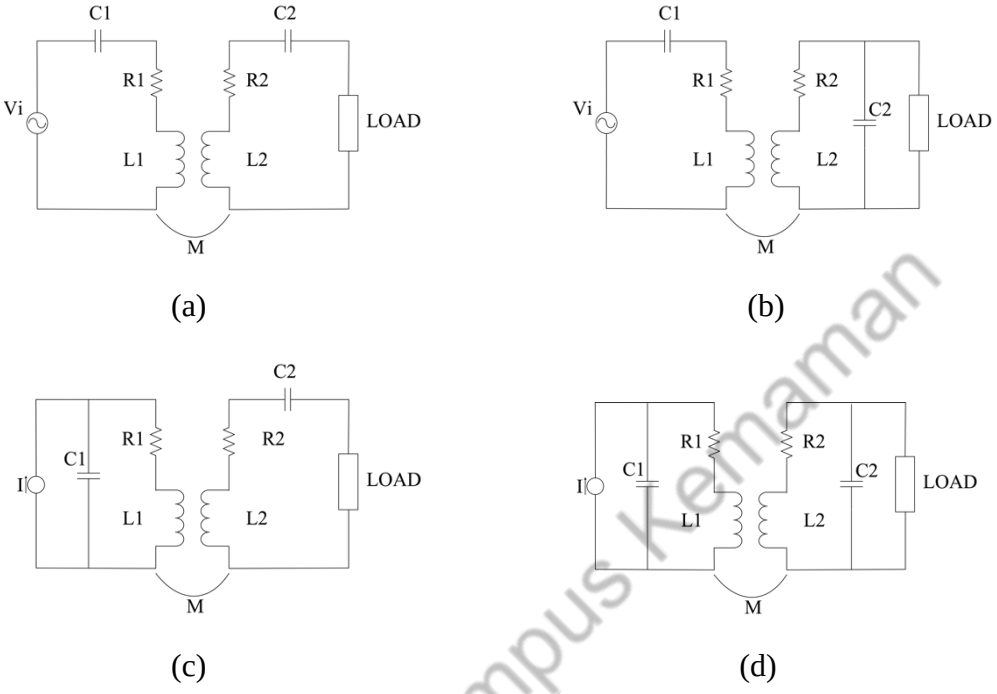

Figure 2 Four basic compensation topologies (a) SS, (b) SP, (c) PS and (d) PP

In order to reduce the VA rating on the coil and power supply, the compensation network is used [2].

By adding the capacitor at each side of the compensate network it will compensate the leakage inductance as shown in Figure 1.

While the primary side is, in series compensated, the voltage source could be connected directly to the coil. On the other hand, if the primary side is in parallel compensated, the use of inductor is needed to the converter to a current source.

2.0 Conclusion

This paper represent the conceptual of WPT and even though there are a few techniques of near filed have been discussed there are two commonly techniques used and they are Inductive Power Transfer (IPT) and Capacitive Power Transfer (CPT). This paper can be further discussed on the subject of IPT and CPT individually on how the topologies used for each technique.

Reference:

[1] A. Banerji, T. Datta, G. Bandyopadhyay, S. K. Biswas, A. Banerji, and A. Banerji, "Wireless transfer of power: Status and challenges," in *2016 International Conference on Intelligent Control Power and Instrumentation (ICICPI)*, 2016, pp. 251-257.

[2] S. Li and C. C. Mi, "Wireless Power Transfer for Electric Vehicle Applications," *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 3, pp. 4-17, 2015.