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ANALYSIS OF THE EFFECT OF TRANSISTOR AND MOSFET IN MAGNETIC COIL WIRELESS POWER TRANSFER

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Abstract

The current development of wireless power transfer for electronic equipment is so developed, but the ones on the market today only show a very short distance of 0 cm. The study of wireless power by using magnetik koil has much aspect in terms of transistor and mosfet. These factors are the norms and necessary aspect of wireless power transfer by using magnetik koil. From the transistor and mosfet test for wireless power transfer, it shows that the mosfet IRFP450 has the highest efficiency comparing to mosfet IRFZ44N, transistor BC639 and transistor BD139. Result shows efficiency for 0cm distance is obtained by mosfet IRFP450 which is 100% comparing to IRFZ44N which is 100%, BC639 which is 97.08% and BD139 which is 88.08%. Result shows that the highest efficiency for 50cm distance is obtained by mosfet IRFP450 which is 25.41% comparing to IRFZ44N which is 16.4%, BC639 which is 4.75% and BD139 which is 4.08%.

Keywords: Wireless Power Magnetic Coil Transistor Mosfet.

1. INTRODUCTION

Wireless power transfer (WPT) is a collective term that refers to a number of technologies for transmitting energy through magnetic coils without the use of wires (Pickelsimer et al., 2012), (Yoon & Ling, 2011), (Pickelsimer et al., 2012), (Pickelsimer et al., 2012), (Pickelsimer et al., 2012), (Pickelsimer et al (Olvitz et al., 2012). It has been demonstrated that, in wireless power transfer, the transmitting and receiving coils will be connected to each other if the frequency sizes of the coils are the same (Xue et al., 2013). (Zhang et al., 2012). Electric fields, magnetic fields (magnetic coils), radio waves, microwaves, or infrared light waves or visible light are some of the technologies that are used in wireless power transfer (Mizuno et al., 2012), (Dumitriu et al., 2012), (Mizuno et al., 2012), (Mizuno et al., 2012), (Mizuno et al., 2012), (Mi (Hui et al., 2014). There have been numerous scientific investigations into wireless power transfer since the classic work of Hertz, who demonstrated the propagation of electromagnetic waves in free space, and also the discoveries and experiments carried out by Tesla with his Wardenclyffe Tower, which demonstrated that electricity could be transmitted without the use of wires (Kim et al., 2013). (Lin, 2013). It is discussed in this study the components of wireless power transfer, namely the transistor and mosfet components, which are critical in the wireless power transfer process from the sender to the receiver and have an important role to play.

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2. METHOD

The transmitting part of this wireless power transfer is divided into two main elements, which are the transmitting oscillator circuit (Tx oscillator circuit) and the transmitting coil (Tx coil) (Matias et al., 2013). The transmitting oscillator circuit (Tx oscillator circuit) is a type of circuit that transmits an oscillating

signal (Raavi et al., 2013). The transmitter component will convert the DC waveform to an alternating current waveform (Jonah et al., 2013). The transmitter circuit is connected to a 12Vdc power source, which is drawn from a rechargeable battery. The transmitter circuit will convert this direct current (DC) signal into an alternating current (AC) power signal that will be transmitted through a magnetic transmitting coil (Beams & Nagoorkar, 2013).

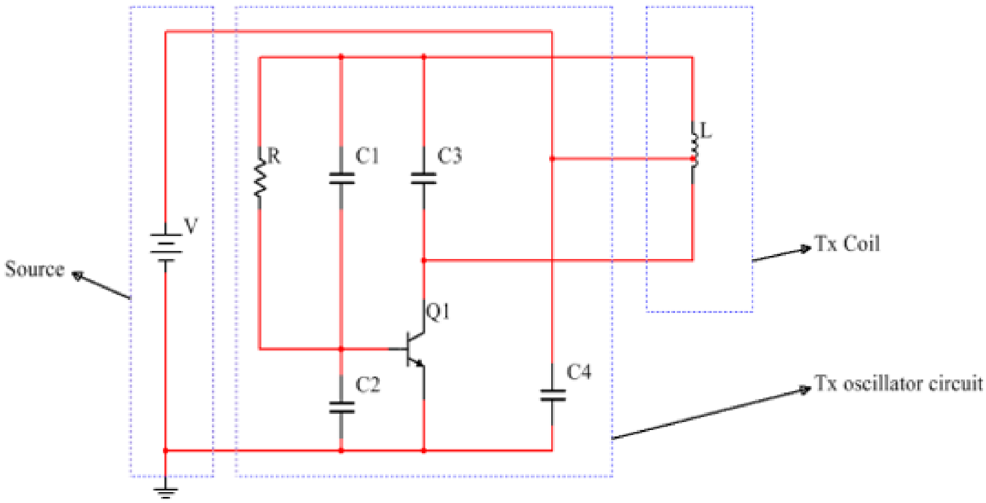

Figure 1: Design of transmitter circuit using one transistor

Figure 1 shows the design of the transmitter circuit using 1 transistor. The NPN small signal transistor is

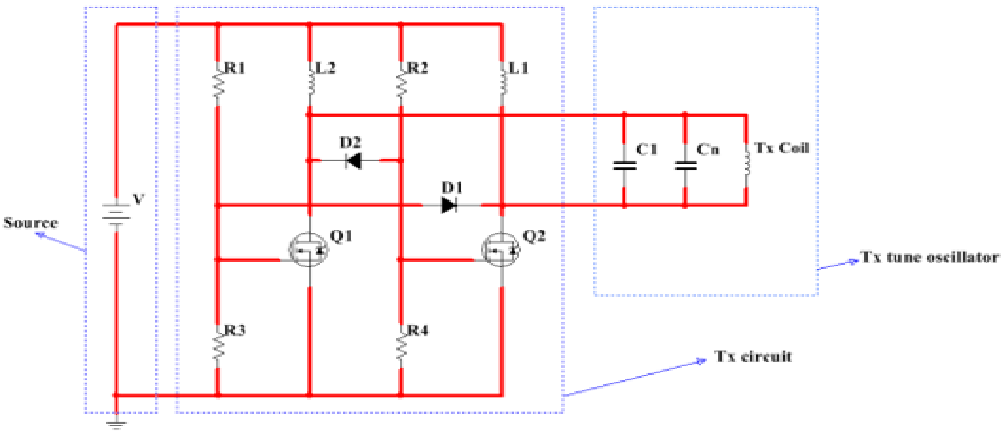

Figure 2: Design of transmitter circuit using parallel MOSFET

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Using a parallel MOSFET, the transmitter circuit is designed in Figure 2, starting with the source flow and progressing to the resistors (R1 and R2) and toroidal inductors (L1 and L2) (L1 and L2). R1 and R2 serve as voltage resistors, while R3 and R4 serve as ground resistors, allowing residual current to be discharged from the circuit. L1 and L2 function to induce voltage to be transmitted to the capacitor, while the diode serves as a rectifier current to the capacitor, and MOSFETs Q1 and Q2 serve as switches, increasing the power to the capacitor. R1 and R2 serve as voltage resistors, while R3 and R4 serve as ground resistor (Kesamaru, 2014).

Implementing this wireless power transfer receiver circuit is based on the circuit shown in figure 3 Rx coil, C1 and Cn are tune Rx oscillators, full bridge rectifier to get DC output, C2 is capacitor, LM7805 is as 5 Volt DC output regulator, and finally Load is used as the receiver load (Resonant et al., 2013). Figure 3. Receiver Circuit Design

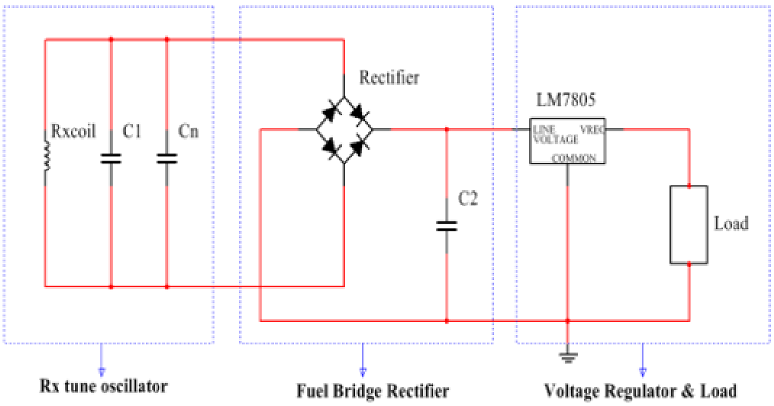

Figure 3: Receiver circuit design

3. RESULTS AND DISCUSSION

Using transistors and MOSFETs, researchers have achieved maximum distance and efficiency. Wireless power transfer utilising magnetic coils is tested and studied here for voltage, current, power and efficiency. As seen in table 1, the BD139 transistor impacts the power transfer efficiency

Table 1: Power transfer efficiency using BD139 transistor

V_{Tx} (Volt)	I_{Tx} (A)	P_{Tx} (W)	Jarak (cm)	V_{Rx} (V)	I_{Rx} (A)	P_{Rx} (W)	Eff %
12	1	12	0	11.75	0.90	10.57	88.08
12	1	12	5	3.78	0.13	0.49	4.08

Figure 4 shows a graph of wireless power transfer using a BD139 transistor with a transmission distance of 5cm with an efficiency of 4.08%.

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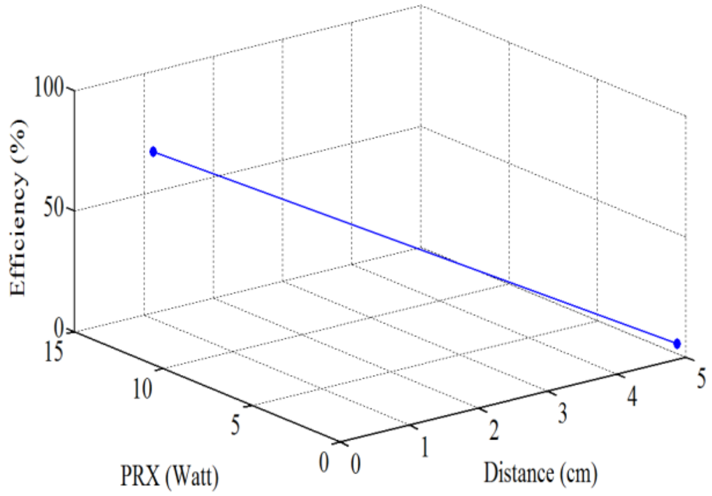

Figure 4: Wireless power transfer using BD139 Transistor

Table 2 shows wireless power transfer using a transistor BC639PH29 with a 12 watt power source, the efficiency is 97.08% with a distance of 0cm, efficiency of 24%, distance of 5cm and efficiency of 4.75% over a distance of 10 cm.

Table 2: Wireless power transfer using transistor BC639PH29

V_{Tx} (Volt)	I_{Tx} (A)	P_{Tx} (W)	Jarak (cm)	V_{Rx} (V)	I_{Rx} (A)	P_{Rx} (W)	Eff %
12	1	12	0	11.89	0.98	11.65	97.08
12	1	12	5	9.01	0.32	2.88	24
12	1	12	10	3.81	0.15	0.57	4.75

Using a BC639PH29 transistor and a voltage of 12Vdc, 1 A, and a distance of 10 cm, wireless power transfer may be achieved with an efficiency of 4.75 percent across a distance of 10 cm in Figure 5.

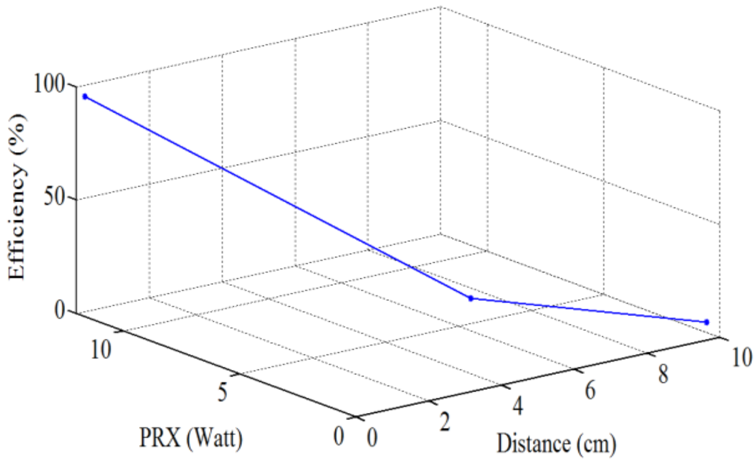

Figure 5: Wireless power transfer using BC639 transistor

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Using an IRFZ44N MOSFET and a 24 watt power source, wireless power transmission is demonstrated in Table 3.

Table 3: Wireless powe transfer using IRFZ44N MOSFET

V_{TX} (V)	I_{TX} (A)	P_{TX} (W)	Jarak (cm)	V_{RX} (V)	I_{RX} (A)	P_{RX} (W)	Eff (%)
12	2	24	0	12	2	24	100
12	2	24	5	11.8	1.91	22.5	93.9
12	2	24	10	11.1	1.82	20.2	84.2
12	2	24	15	10.18	1.74	17.7	73.8
12	2	24	20	9.03	1.65	14.9	62.1
12	2	24	25	8.87	1.52	13.5	56.2
12	2	24	30	7.77	1.47	11.4	47.6
12	2	24	35	6.71	1.35	9.1	37.7
12	2	24	40	5.51	1.28	7.1	29.4
12	2	24	45	4.52	1.16	5.2	21.8
12	2	24	50	3.89	1.01	3.9	16.4

Figure 6 illustrates wireless power transmission utilising an IRFZ44N MOSFET and a 24 watt power supply. At a distance of 0 cm, 100 percent efficiency is achieved, while at a distance of 50cm, an efficiency of 16.4 percent is achieved.

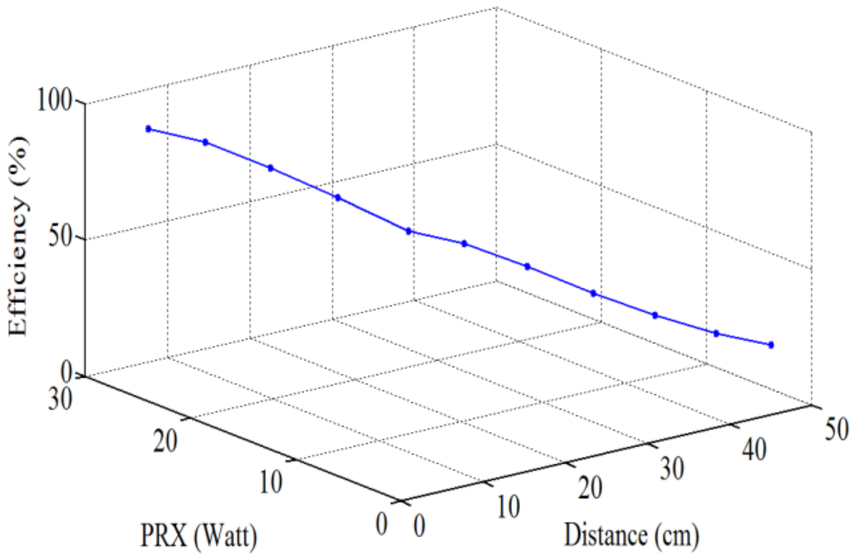

Figure 6. Wireless power transfer using IRFZ44N MOSFET

With a 24 watt power source, the wireless power transfer shown in Table 4 is achieved using an IRFP450 MOSFET.

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Table 4: Wireless power transfer using IRFP450 MOSFET

V_{TX} (V)	I_{TX} (A)	P_{TX} (W)	Jarak (cm)	V_{RX} (V)	I_{RX} (A)	P_{RX} (Wt)	Eff (%)
12	2	24	0	12	2	24	100
12	2	24	5	11.8	1.95	23.4	97.5
12	2	24	10	11.1	1.91	21.2	88.3
12	2	24	15	10.57	1.87	19.76	82.3
12	2	24	20	9.6	1.82	17.47	72.5
12	2	24	25	9.1	1.73	15.74	65.58
12	2	24	30	8.77	1.68	14.73	61.37
12	2	24	35	8.01	1.60	12.81	53.37
12	2	24	40	7.51	1.55	11.64	48.5
12	2	24	45	6.52	1.42	9.25	38.54
12	2	24	50	5	1.22	6.1	25.41

Figure 7 wireless power transfer using an IRP450 MOSFET with a 24 watt power source obtained 100% efficiency with a distance of 0cm, and an efficiency of 25.41% with a distance of 50 cm.

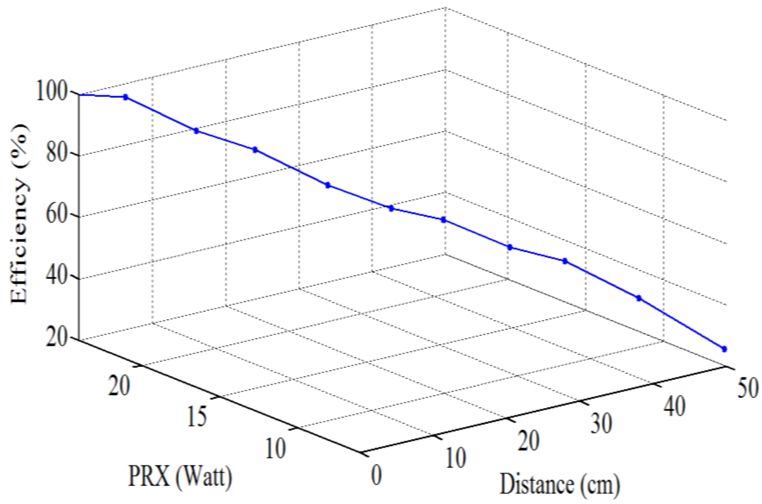

Figure 7: Wireless power transfer using IRP450 MOSFET

As a result of the comparative experiment, it was discovered that the BC639PH29 transistor type outperformed the BD139 transistor type and that the IRFP450 Mosfet type outperformed the IRFZ44N transistor type, as shown in table 5.

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Table 5: Summary of wireless power transfer of various types of various of transistor and mosfets

No	Type of Transistor & Mosfet	Jarak (cm)	Eff (%)	
1	BD139	0 – 5	88.08	4.08
2	BC639PH29	0 – 10	97.08	4.75
3	IRFZ44N	0 – 50	100	16.4
4	IRFP450	0 – 50	100	25.41

Figure 8 illustrates tThe comparison graph of wireless power transmission between transistor and MOSFET types demonstrates that the MOSFET type outperforms the transistor type in wireless power transfer applications. MOSFET type is better than the transistor type in wireless power transfer.

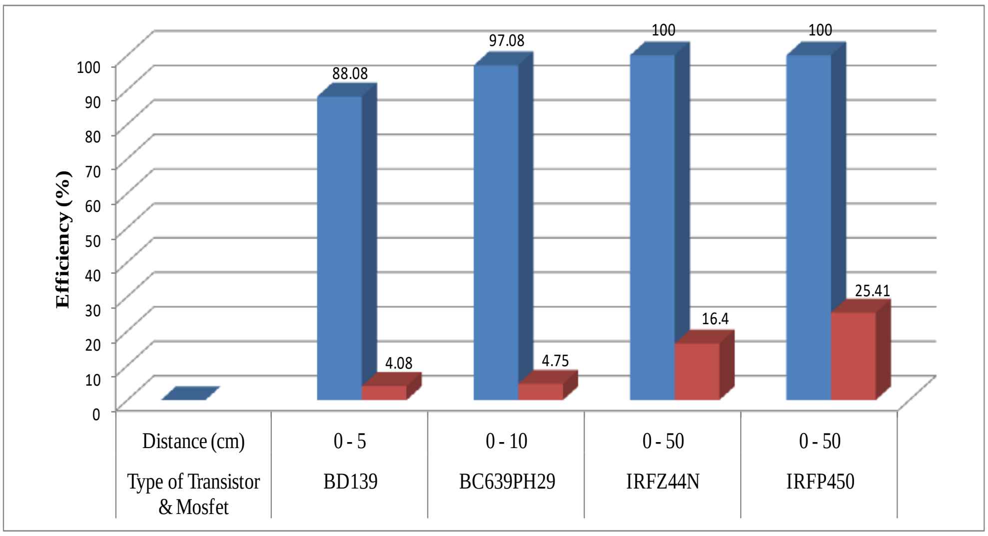

Figure 8: Comparison graph of wireless power transfer between transistor and MOSFET

4. CONCLUSION

According to the results of an experiment conducted to analyse the effect of transistors and MOSFETs in wireless power transfer using a magnetic coil, the IRFP450 mosfet with a distance of 0cm achieved 100 percent efficiency, compared to the IRFZ44N with 98 percent efficiency, the BC639 with 97.08 percent, and the BD139 with 88.08 percent. The results revealed that the IRFP450 MOSFET achieved the highest efficiency of 25.41 percent at a distance of 50cm, compared to the IRFZ44N which achieved 16.4 percent, the BC639 which achieved 4.75 percent, and the BD139 which achieved 4.08 percent. When compared to other transistors and MOSFETs, the results demonstrate that wireless power transmission utilising the IRFP450 MOSFET is superior, with a relatively high efficiency ranging from 25.14 percent to 100 percent in comparison.

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