Motivation

Wireless Power Transfer (WPT) based on strongly coupled magnetic resonance has been under development for a long time. The ability of WPT is to transfer power safely and efficiently over distance without the use of cable by making them more convenient, reliable and environmentally friendly. All the power delivered needs a power switch and no batteries are required. However, this technology is still not that mature in terms of its power efficiency and the power transfer distance.

Objective

This project is to implement a Wireless Power Transfer (WPT) system based on strongly coupled magnetic resonance with the consistent efficiency around 30-50% even with the increase of distance.

System block diagram

![System block diagram](image)

Figure 1. System block diagram of wireless power transfer system based on strongly coupled magnetic resonance with relay

Methodology

STAGE 1: Implement the theoretical circuit in PSpice program to simulate the expected result.

STAGE 2: Implement the physical circuit and test for the power transfer efficiency based on the difference of the number of turns of the coil without the use of relay.

STAGE 3: Test the power transfer efficiency with the same circuit with the best combination of the coil but with a relay in between the transmitter coil and the receiver coil.

Waveform simulation result:

![Waveform simulation result](image)

Figure 2. The simulation waveform at transmitter coil from the OHiOPlator

Waveform physical result:

![Waveform physical result](image)

Figure 3. Signal waveform at transmitter coil detected by CKO. Blue line: Voltage  Pink line: current

Physical implementation:

![Physical implementation](image)

Testing result:

<table>
<thead>
<tr>
<th>Distance (cm)</th>
<th>Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5.0</td>
</tr>
<tr>
<td>5</td>
<td>13.6</td>
</tr>
<tr>
<td>10</td>
<td>16.6</td>
</tr>
<tr>
<td>20</td>
<td>19.4</td>
</tr>
<tr>
<td>30</td>
<td>22.2</td>
</tr>
</tbody>
</table>

Part 1: Without adding relay, both 10 turns with 2.75m radius transmitter and receiver coil. Efficiency-distance graph as Figure 4.

- Receiver current: 11.6 mA
- Receiver voltage: 3.4V
- Receiver power: 46.9mW
- Max. distance: 30cm

Part 2: Adding a 5 cm radius relay coil between the both 10 turns with 2.75m radius transmitter and receiver coil. Efficiency-distance graph as Figure 5.

- Receiver current: 12.4 mA
- Receiver voltage: 3.6V
- Receiver power: 45.3mW
- Max. distance: 28cm

Conclusion:

The power transfer distance and efficiency are significantly increased with the use of the relay.

![Conclusion](image)

- Reducing the magnetic field
- Regenerating the magnetic field

![Conclusion](image)

- Transfer distance range: around 20 cm
- Power transfer efficiency: 15%-30%

![Conclusion](image)

- Transfer distance range: around 3 cm
- Power transfer efficiency: 12%-29%