RESONANT FREQUENCY SEARCH CIRCUIT FOR MAGNETIC RESONANCE TYPE WIRELESS POWERTRANSMISSION TO RECONFIGURE IN ENVIRONMENTAL CHANGES UNDER IMPLANTATION IN THE BODY

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ABSTRACT

In recent years, most implantable medical devices such as cardiac pacemakers use primary batteries, which require patients to undergo surgery every few years to replace the batteries. Since this is an extremely heavy burden for the user, research is being conducted to supply power wirelessly from outside the body. One of these studies is magnetic resonance wireless power transmission. In 2006, the Massachusetts Institute of Technology announced that it had succeeded in transmitting power with an efficiency of 40% over a distance of 2 meters. This method can transmit power over longer distances than the electromagnetic induction method, which is currently the most widely used method in practical use, and is resistant to coil misalignment, making it suitable for power transmission to medical devices implanted in the body.

On the other hand, it has the disadvantage that the transmission efficiency decreases if the resonance frequency shifts even slightly. Thin coils, which have been widely studied for implantation in the body, are easily affected by electrolytes in the body, and it has been pointed out that the resonance frequency of the receiver side may change after implantation.
In this study, we fabricated a circuit based on the method of estimating the resonance frequency shown in previous studies. The theory of the tuning method utilizes the anti-resonance due to the magnetic field phase coupling. A switch was attached to the receiver circuit, and the output voltage at on/off was compared from an external transmitter to experimentally tune the resonance frequency at 980 kHz. From the experimental results, it is considered possible to detect the resonance frequency at the receiver side by searching for the minimum value from the transmitter circuit and to resynchronize by changing the power supply frequency.

We also estimated the resonance frequency in saline solution. Based on the measurement results, it is considered possible to estimate the resonance frequency. However, it is considered that as time passes, the cellular tissue around the receiving coil implanted in the body adheres to the coil, weakening the coupling with the transmitting coil and decreasing the coupling coefficient k. Therefore, the minimum value of k that appears at resonance is considered to be the minimum value of k that appears at resonance. Therefore, the minimum value that appears at resonance is expected to become smaller, and depending on the output voltage, it may be difficult to estimate the resonance frequency of the power receiving side.