Passive RF Energy Harvester at 5.8 GHz

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Abstract

RF to DC Converter (Rectifier) is the most important component in a wireless power transfer system. This rectifier will harvest Radio Frequency (RF) energy at 5.8 GHz and convert that power into a DC voltage. It utilizes two diodes, capacitors, an inductor, and a charge pump. This passive system will have a SMA connector to connect a receiving antenna.

Purpose

Today's society has a high demand for advancement in technology. Charging has become an inconvenience in certain situations to where wireless charging has taken lead in innovation. This project is to help fuel that innovation by absorbing a common 5.8GHz signal and creating a rectifier to filter an output of direct (DC) voltage.

Applications

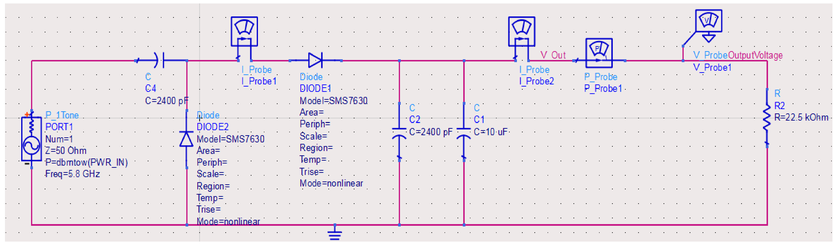
Wireless charging concepts have existed for a while in different aspects but none of these products have been fully implemented yet. The goal right now is for people to charge their devices from a distance, not just on a mat or stand. Apple Inc. is looking at the new Apple Watch being able to charge 3' away from the charging post. This project would look at the concept of charging smaller items such as sensors, biomedical devices, and more.

Objectives

There are 3 main objectives to this project:

- Create a system that can harvest a 5.8GHz signal that can rectify the signal into providing a DC output.
- Even though the power input is controlled, the system must still be efficient so that there is minimal loss.
- The charge pump the rectifier is feeding requires a minimum of .9V to power up, so the rectifier must provide at least a .9V output.

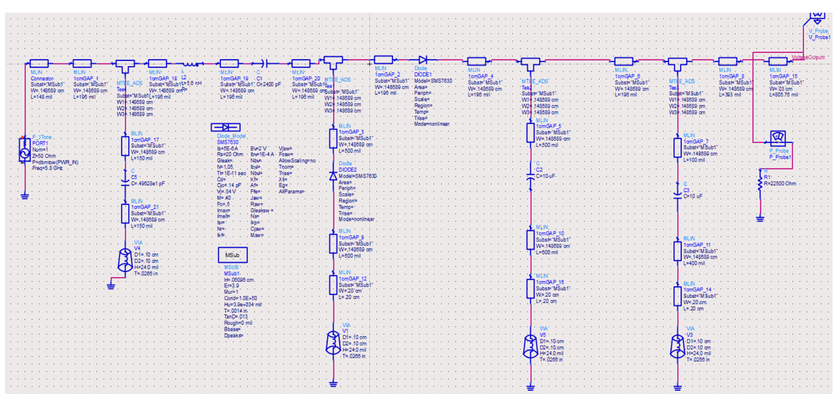
Design



The original design was supposed to be a half wave rectifier with one diode. After testing and simulations, it was discovered that adding a second diode in parallel with the first diode and an additional capacitor before the parallel diode nearly doubled the voltage. Prior to the additional diode, the system would not exceed 0.8V no matter how much power came in at the input. After the second diode, the input power had to be lowered to 8dBm so that the maximum input voltage for the charge pump of (1.8V) was not exceeded.

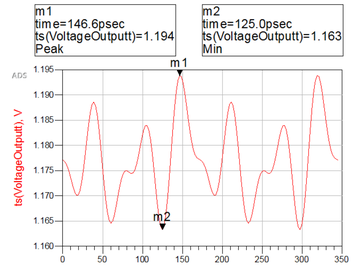
Final Design

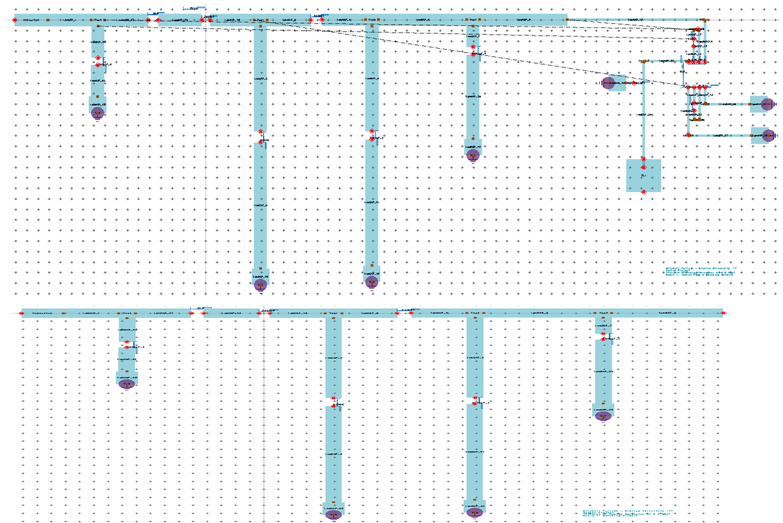
For the final design, the two diode system that acts almost as a half charge pump was used. The system will have 4 microstrips running through either a diode or capacitor to a VIA hole connected to ground. The end line will go through another series of microstrips to feed the charge pump and then have a pad to solder a wire to.



Testing & Simulations

The original generic design generated great results for the system output. Once the microstrips were added the simulations drastically changed from outputs of 1.4V to outputs of .05V. After boosting inputs and adjusting microstrip lengths, the voltage did boost back up to the required voltage but ripple of voltage was nearly .2V. Capacitor value changes and microstrip length adjustments on the breakout strips generated an output voltage of 1.2V with only .08V of ripple.





Conclusion

The board designs have been sent in to Micro Circuits Inc. to be fabricated. Up to this point it can be concluded that the simulations show positive results, but until the board and its components are physically assembled this cannot be concluded in a real life physical environment yet.