5.8 GHz RF Energy Harvester

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Introduction

The purpose of this project was to build an RF energy harvesting device using charge pumps. The device must convert aa RF continuous wave signal at 5.8 GHz to a DC voltage. This DC signal is used to drive a low-powered light-emitting diode (LED). RF energy is gathered from the environment via an external antenna. The charge pump stores that gathered energy in a capacitor bank.

Design Specifications

Our design for the charge pump must be able to operate in the 5.725- 5.850 GHz ISM frequency band. The charge pump can only use passive components including microwave diodes, capacitors and printed circuit board elements to convert harvested microwave energy in to a DC voltage. The device must also interface with a 50 Ohm SMA line input and light the LED with a 10 dBm continuous wave 5.8 GHz input signal. The device will be milled on to a printed circuit board that is made from FR4 substrate and a copper layer that has the circuit etched into it.

Design Methodology

A charge pump is a circuit that when given an input in AC is able to output a DC voltage typically larger than a simple rectifier would generate**.** For our design, 5.8GHz energy is harvested via an external antenna connected via an SMA cable. Using the references given on the ECE 4730 web page[1, 2] we determined that a two(2) or three(3) stage charge pump would likely be the best. These resources along with the limited amount of time available to physically mill the board, two stages were decided upon. The schemetic for the design design that we used is shown in Figure 1.

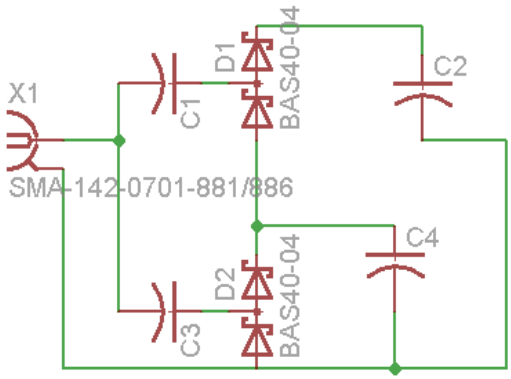

Figure 1. Charge pump schematic.

As shown, this design requires four RF Schotky diodes and four RF capacitors. We decided to use capacitors with values of 820 pF .

Verification and Results

Once the board is constructed, the board will first be tested with an RF function generator. The generator will be set to 5.8 GHz with 10 dBm output power, and the LED on the charge pump should light up.

After the design is verified with a function generator, the charge pump will be connected to a 5.8 GHz antenna. The antenna will be placed in the field of another antenna radiating 5.8 GHz, and the power coupled from the antenna should light up the LED.

Due to time constraints with the milling machine, the board has not yet been physically constructed, but it will be shortly

References

http://d-scholarship.pitt.edu/8478/1/Harrist_Thesis_072804.pdf

http://www.propagation.gatech.edu/ECE4370/notes/Charge_Pump_Intro.pdf