5.8 GHz RF Energy Harvester

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Specifications

A rectifying RF energy-harvesting device was required to convert microwave power into DC voltage to light an LED. It needed to be capable of operating in the 5.725- 5.850 GHz ISM band, as the input would be a 5.8 GHz, 10 dBm continuous wave. The device needed to interface with a 50Ω SMA line input and use only passive components.

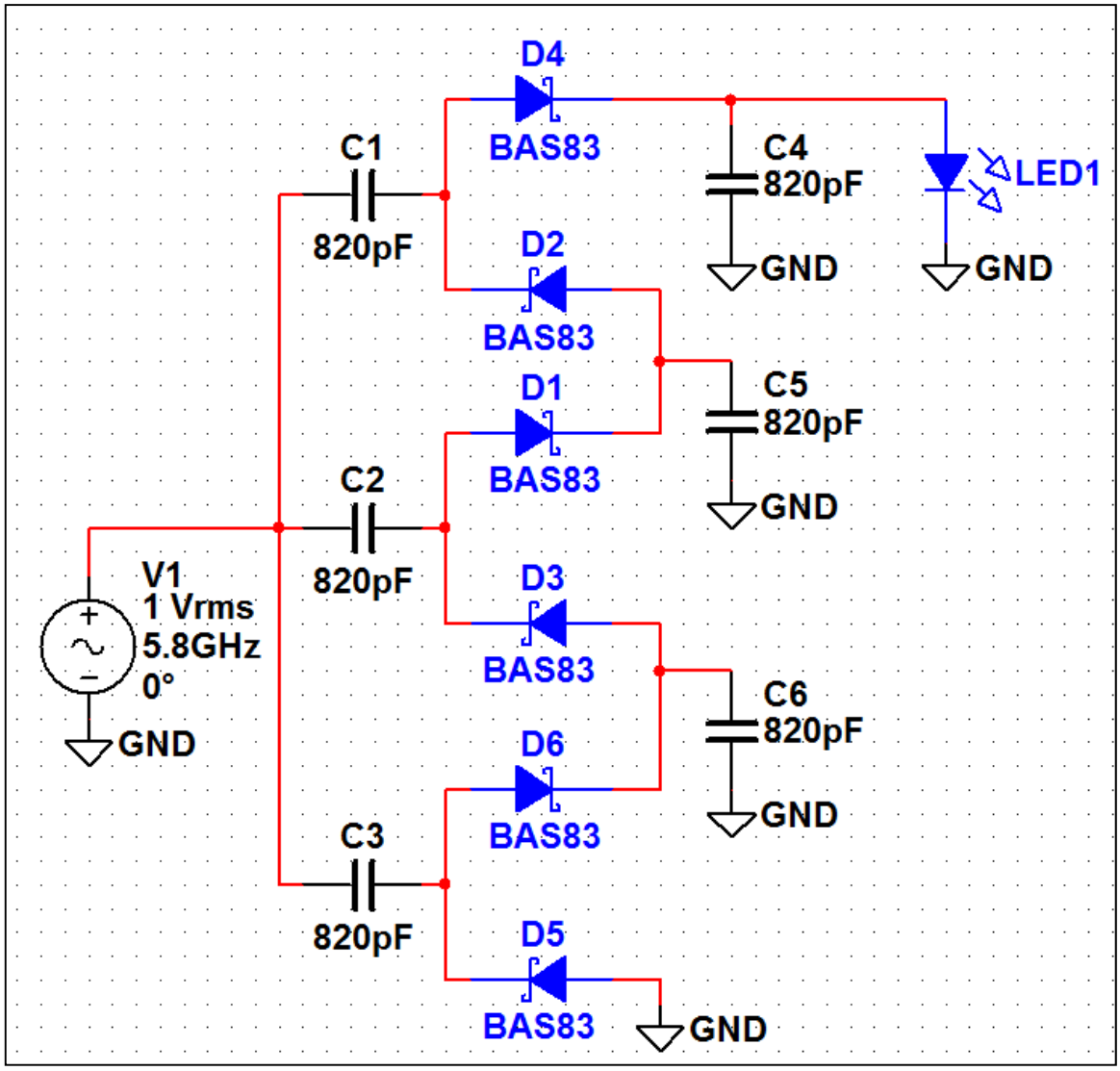

Figure 1. 3-stage Charge Pump

Design

For testing purposes, four different Dickson charge pumps were designed using DesignSpark. Two of the charge pumps used a two-stage design and two used a three-stage design, following the circuit diagram shown in Figure 1. All of the charge pumps used SOT-323 package RF Schottky Diodes, a single Digi-Key L62705CT-ND LED, and 820 pF capacitors. The final layouts of the fabricated circuit boards are shown in Figure 2. All four circuits were milled on a 32 mil FR-4 PCB and tested individually. An example of one of these charge pumps is shown in Figure 2.

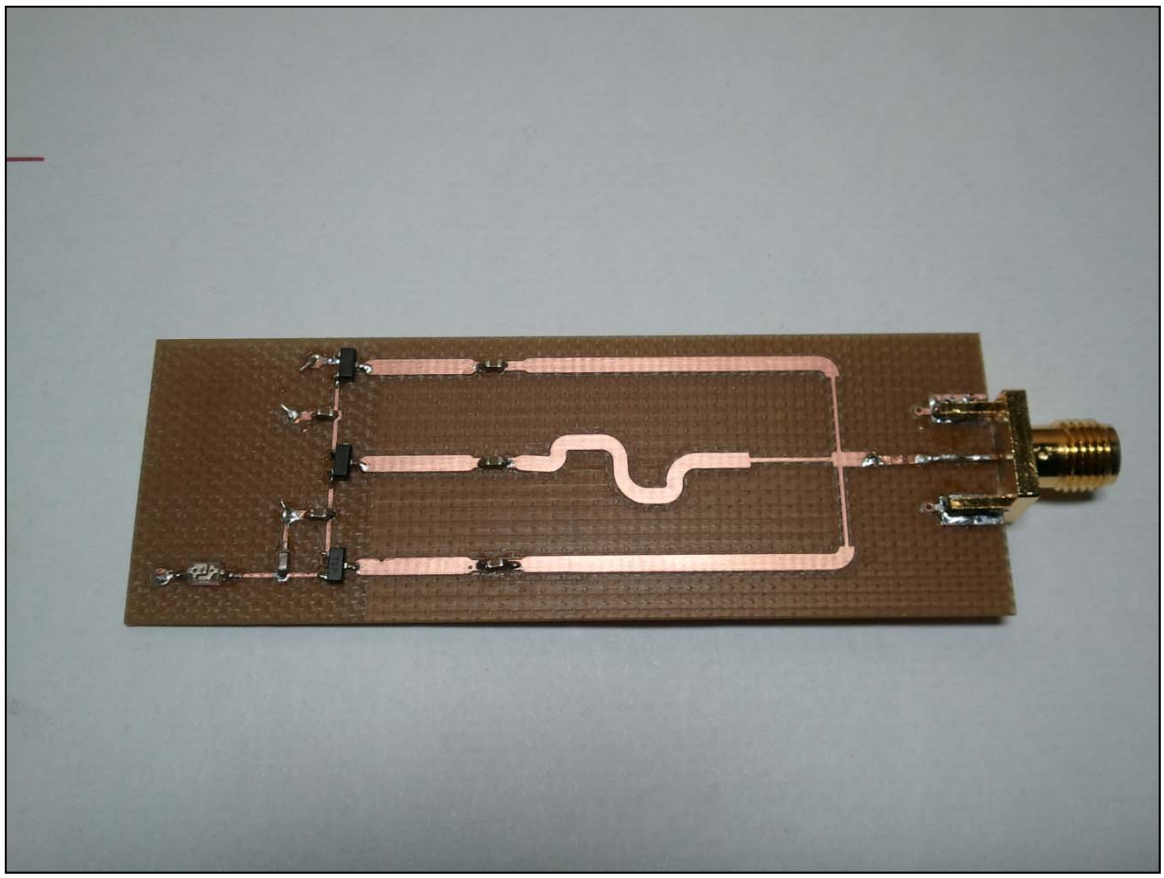

Figure 2. Three-stage charge pump.

Testing

In testing, it was determined that the three-stage charge pumps yielded a higher voltage output than the two-stage charge pumps. A return loss of -8.93 dB was measured for the two-stage charge pumps, and a return loss of -11.54 dB was measured for the three-stage charge pumps.

The three-stage charge pump was then also tested using a patch antenna with a measured return loss of -26.97 dB as its input. When a horn antenna was used to transmit 20 dBm of power, the LED was lit at up to 6 inches separation of the two antennas (Fig. 3).

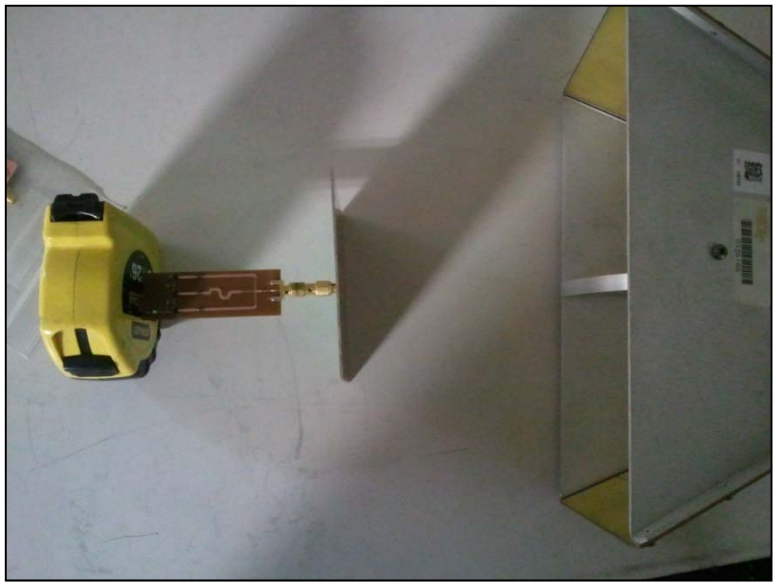

Figure 3. Testing a three-stage charge pump with a patch antenna.

References

1) Balanis, Constantine A. *Antenna Theory: Analysis and Design*, ed. 3. Hoboken, New Jersey: John Wiley & Sons, Inc., 2005.

2) Karthaus, U. and M. Fisher [ATMEL], IEEE J. Solid-State Circuits, 38 #10 p. 1602 (2003)