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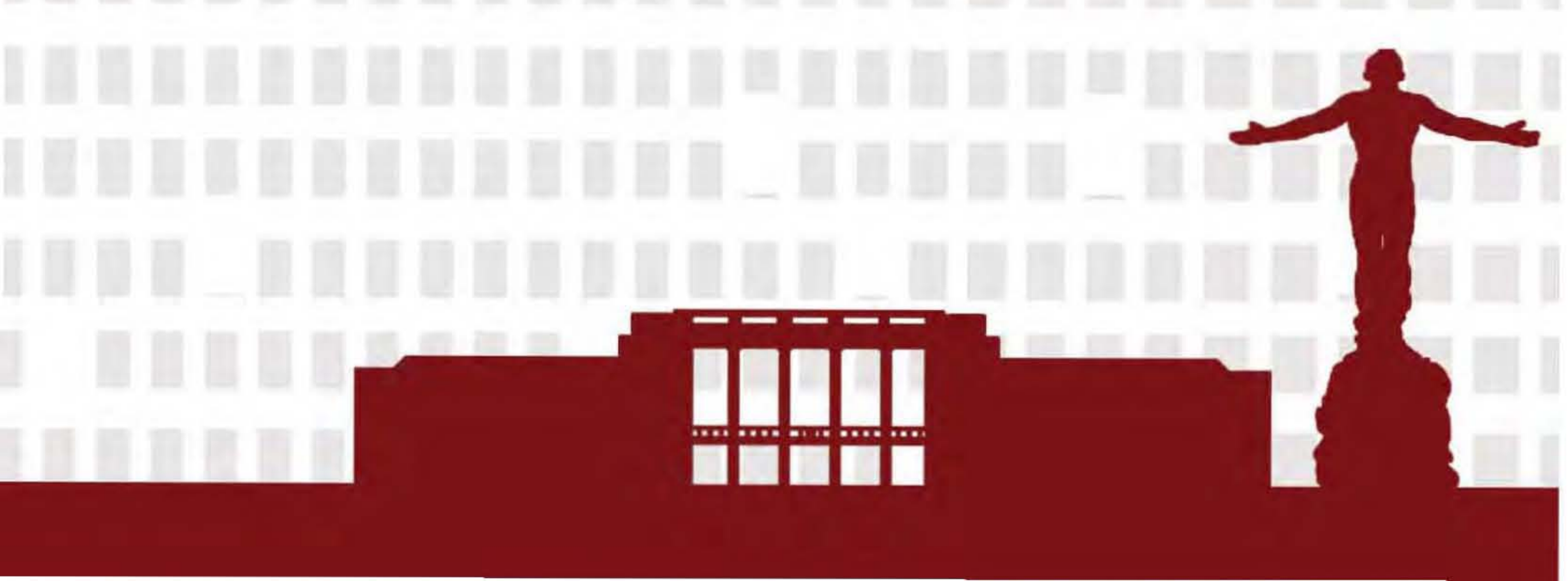

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A 5.8GHz DIFFERENTIAL-DRIVE RF ENERGY HARVESTER FOR WIRELESS SENSOR NODE APPLICATIONS

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ABSTRACT

Wireless sensor nodes are widely used as means of gathering information from the environment. These nodes are usually powered by batteries and deployed in remote areas or embedded within structures, making battery replacement impractical. But with the current trend of decreasing power consumption, harvesting energy from ambient sources becomes a feasible alternative to powering up these sensor nodes. Among the available sources, RF energy becomes a possible choice because of the unnecessary requirement for a high power density energy source. However, since there's a need for lower area and cost, the system needs to operate at a higher frequency, such as 5.8GHz, which will yield a low input power.

The goal of this work is to implement an RF energy harvesting system in a 65nm CMOS process. The losses in the rectifier, caused by on-resistances and leakage currents, must be minimized in order to provide enough power for the sensor node, given the low input power and input voltage. It must also be able to operate across fabrication process corner and temperature variations, since these sensor nodes will be exposed to harsh environmental conditions.

The harvesting system, shown in Figure 1, is composed of (1) an antenna, which converts the electromagnetic energy into electrical energy, (2) a rectifier, which converts the input AC signal into an output DC signal, (3) a matching network that matches the impedances of the antenna and the rectifier for maximum power transfer, and (4) an energy storage.

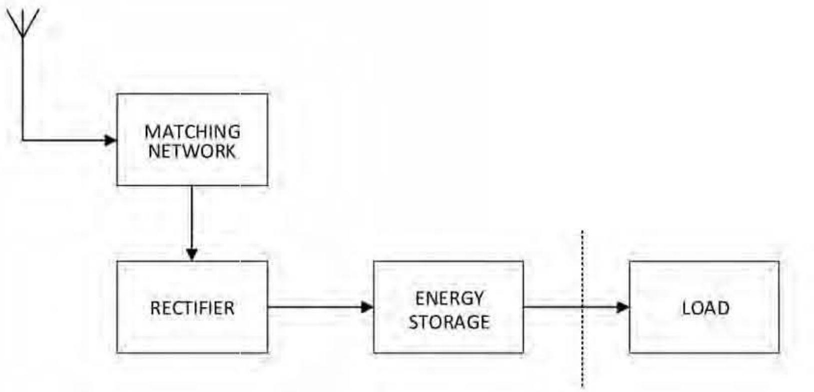

Figure 1. RF Energy Harvester Block Diagram

In this work, the matching network was used to boost the input voltage high enough to drive the rectifier. For the rectifier, a differential topology [1], was used since this simultaneously reduces the on-resistance and leakage current. Cascading a number of these increases the output voltage. However, the losses increases as the number of stages is increased. Thus, an optimal number of stages must be determined.

To further reduce the losses in the rectifier, an inter-stage gate control scheme [2] was used. In here, the gate transistors of each stage are connected to the source of the adjacent stage. It can also be connected to the stage after the adjacent stage, and so on, to increase the bias voltage.

A 4 stage differential-drive with inter-stage gate control was implemented. Compared with the normal topology, the inter-stage gate control lessened the variations in *Vout*. Table 1 shows the output voltage across process and temperature variations. Further design and layout improvement still needs to be done in order to achieve better results.

	FF100	TT27	SS0
V_{out}	**707mV**	**842mV**	**924mV**

Table 1. Output voltage across PT variations

Keywords: Differential-Drive Rectifier, Harvester, RF.

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