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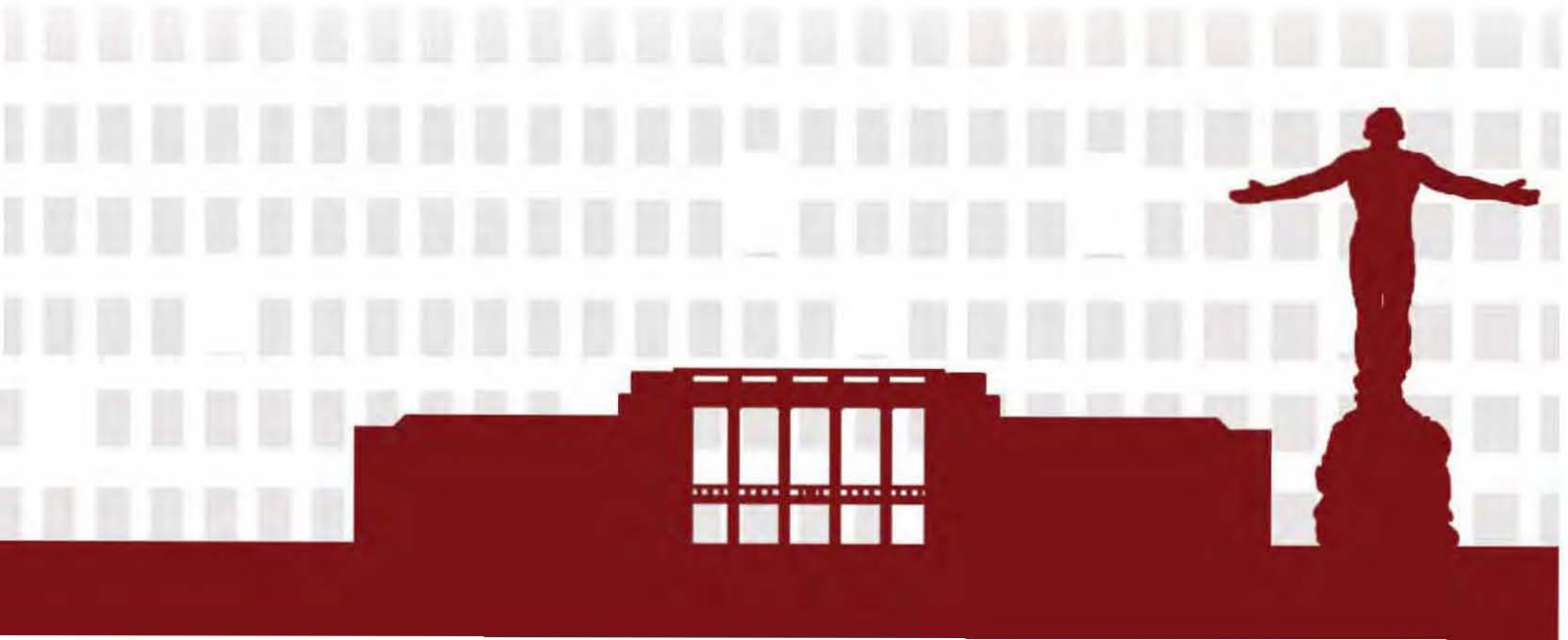
11th ERDT Conference
on Semiconductor and Electronics, Information and Communications Technology and Energy

16-17 November 2015
Metro Manila, Philippines



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INDOOR PHOTOVOLTAIC ENERGY HARVESTER FOR BATTERY RECHARGING AND WIRELESS SENSOR NETWORKS APPLICATION IMPLEMENTED IN 90NM CMOS TECHNOLOGY

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ABSTRACT

Wireless sensor networks (WSNs) have the potential to provide better quality data than single or small numbers of individual sensors in applications such as natural and built environmental monitoring, process monitoring, security and surveillance which is widely used in hospitals, factories and other industrial establishments. In order to be cost effective in many applications, the sensor nodes must be low cost and low maintenance. This presents challenges in terms of sensor calibration, packaging for survival in harsh environments and, particularly, the efficient supply and utilization of power.

While the performance of battery technology is gradually improving and the power requirements of electronics are generally dropping, these are not keeping pace with the increasing demands of many WSN applications. For this reason, there has been considerable interest in the development of systems capable of extracting useful electrical energy from existing environmental sources. Such sources include ambient light, thermal gradients, vibration and other forms of motion. Since most of the wireless sensors are found in building environments, the advantage of using an efficient indoor photovoltaic energy harvesting system in these applications has become increasingly apparent.

This paper presents an indoor photovoltaic energy harvesting system which utilizes a 500mV single unit solar cell operating under room lighting illumination. This voltage supplies the input stage of the whole system including the bootstrapped ring oscillator and self-Vth-cancellation differential rectifier, whose output frequency is 27MHz, which in turn generates the supply for the low-dropout regulator (LDO) and the charging circuit of the rechargeable NiMH battery of the output stage. The regulated output voltage from the LDO is equal to 1V with load current ranging from 50μA to 300μA which is suitable for wireless sensor networks application. The whole system is implemented using 90nm CMOS technology to minimize area and power consumption which results to a more efficient design architecture.

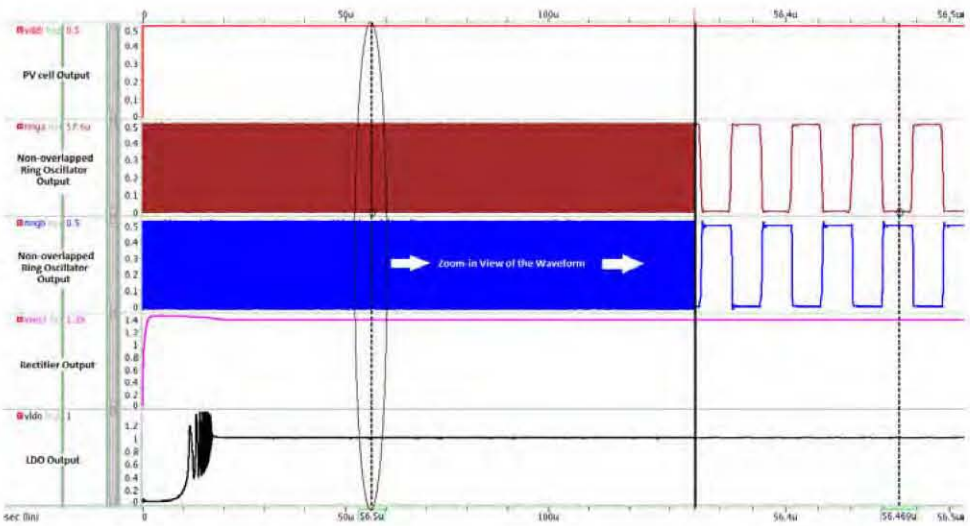

Figure 1. Output simulation results of indoor photovoltaic energy harvester.

Keywords: Energy harvesting, LDO, Photovoltaic cell, WSN

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