



Design of RF Energy Harvesting Enabled Battery-less Autonomous ePaper Tag

Sangkil Kim^{*(1)}, Sion Park⁽¹⁾, and Nohgyeom Ha⁽¹⁾

(1) Pusan National University, Busan, Republic of Korea, 46241, e-mail: ksangkil3@pusan.ac.kr;
dovelets@pusan.ac.kr; nohgyeom@pusan.ac.kr

This talk presents a novel self-sustainable battery-less ePaper tag powered by ambient wireless RF power. Energy harvesting technology is attracting many researchers' attention because it is a sustainable green technology [1, 2]. Especially, battery-free systems for low-power sensor/display devices are a critical factor in implementing a stand-alone internet-of-things (IoT) networks. Nowadays, ePaper is widely adopted in many application areas, such as price tags in the grocery market, ebook readers, *etc.* ePaper module features low power and one-time-activation for display but requires batteries. The number of batteries that need to be replaced periodically in the grocery market is enormous, which resulting in huge amounts of chemical wastes and maintenance costs. The RF energy harvesting or wireless power transfer (WPT) technique is emerging to overcome those issues.

The proposed system features completely battery-less operation of ePaper tag. The proposed ePaper tag is powered by a charge pump-based RF-to-DC converter, and ambient RF power to deliver wireless power is managed by a solar-to-RF converter. The Solar-to-RF converter consists of an oscillator, a power amplifier (PA), and antenna arrays. The antennas are located on the four edges of the solar-to-RF converter module to radiate wireless power to omni-direction. The ePaper tag consists of an antenna, charge pump, super capacitor, and ePaper. An inverted-F antenna (IFA) is integrated to RF-to-DC converting charge pump. 16-stage Dickson charge pump is optimized to charge a 1-F super capacitor when the input RF power is higher than -15 dBm. The proposed autonomous display system including battery-less ePaper display tag and ambient RF energy supplier is a promising technology for green IoT sensor networks.

1. S. Kim, R. Vyas, J. Bito, K. Niotaki, A. Collado, A. Georgiadis, and M. M. Tentzeris, "Ambient RF Energy Harvesting Technologies for Self-Sustainable Stand-Alone Wireless Sensor Platforms," *Proc. IEEE*, vol.102, no.11, pp.1649-1666, Nov. 2014.
2. K. Niotaki, S. Kim, S. Jeong, A. Collado, A. Georgiadis, and M. M. Tentzeris, "A Compact Dual-Band Rectenna Using Slot-loaded Dual Band Folded Dipole Antenna," *IEEE Antennas Wireless Propag. Lett.*, vol.12, pp.1634-1637, Dec. 2013.