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Ultra-low power wireless transceiver systems for biomedical application

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The Impulse Ultra-Wideband (I-UWB) RFID technique has been leading short-range wireless communication technology for Body Area Networks (BAN) and biomedical application due to its abilities of high throughput, low power consumption and so on. However, the issue is that the conventional Ultra-Low Power RF (ULPRF) circuits tend to degrade Energy-Per-Bit (E/B) as the bit rate decreases, although BAN has multimodal application and therefore requires a variety of bit rates from kb/s to Mb/s. The main reason is that analog circuits consume large steady current which is not proportional to bit rate, and thus they mainly degrade E/B of transceivers at low bit rate. Especially, RF carrier-signal generation is the challenge. Although accurate RF frequency can be achieved by a Phase Locked Loop (PLL) technique, its power consumption can be as large as 1 mW. An Impulse Transmitter (I-TX) can generate RF signal without PLLs by exploiting delay-based impulse generation technique. The drawback of it is that the gate delay varies over ten times in 65 nm CMOS due to large PVT variation under low supply voltage such as 0.5 V. This paper presents design strategies of ULPRF transceiver systems. We also introduce the prototype I-TX in 65 nm CMOS technology to realize energy-per-bit of 1.5 pJ/bit, which is better than previous works showed in the semiconductor top conference. Our TX achieves superior energy-per-bit and ultra-low power operation from 1 kb/s to 10 Mb/s. The proposed Received Signal Strength Indicator (RSSI) consumes only 89.5 μ W with -85 dBm sensitivity. Our ULPRF technology develops unexplored near zero-power region in lower bit-rate wireless communication, which will contribute to realizing battery-less wireless communication for biomedical application.

Biography

Hiroyuki Ito received a PhD degree in the Department of Advanced Applied Electronics, Tokyo Institute of Technology, Yokohama, Japan, in 2006. From 2004 to 2007, he was a Research Fellow of the Japan Society for the Promotion of Science. He was a temporary Visiting Researcher and a Visiting Professor in the Communications Technology Laboratory, Intel Corporation, Hillsboro, OR, USA, in 2006 and 2007, respectively. He was an Assistant Professor at the Precision and Intelligence Laboratory, Tokyo Institute of Technology, Yokohama, Japan, from 2007 to 2013. From 2008 to 2010, he was with Fujitsu Laboratories Ltd., Yokohama, Japan, where he developed a RF CMOS transceiver and digital calibration techniques for mobile-WiMAX application. Since 2013, he has been an Associate Professor at the Precision and Intelligence Laboratory, Tokyo Institute of Technology, Yokohama, Japan. His research interests include analog, RF and mixed-signal circuit design for wireless and wire-line communications.

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