RF CMOS Wireless Receivers for 402MHz Medical Implantable Communication Systems

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Abstract:

With the increasing number of portable and implantable personal health care devices, there is a strong demand to control their communication in a single wireless network. The advances of wireless communication technologies have made these devices easier to use. One of the challenges in the deployment of these devices is the power consumption. Recently, wireless body-area-network (WBAN) is attracting much attention. WBAN is composed of numerous healthcare devices or physiological sensors and also provides wireless connectivity among them for continuous and ambulatory health care. WBAN technologies have been an active research area, and they are categorized into wearable BAN and implantable BAN. The wearable BAN is for communication among on-body devices such as electrocardiogram (ECG), electroencephalography (EEG), electromyography (EMG), and body temperature sensors. On the other hand, the implantable WBAN connects implanted devices such as a pacemaker with an on-body controller.

For data transmission in implanted medical devices, the 402-405 MHz, medical implant communication service (MICS) Transceivers, NB PHY, is adapted for the in-body devices. MICS standard is divided into 10 channels for listen-before-talk (LBT) protocol as mainly discussed by the Federal Communications Commission (FCC). This needs 10ms for scanning the channel before each MICS communication starts.

This tutorial considers the following three main topics:

1) A fully monolithic CMOS direct conversion and low-IF receiver architecture with integrated quadrature LO chain, which implemented in a closed-loop type-II PLL system for 402-405MHz band (MICS applications). This system is designed and implemented in a 0.13-µm CMOS process.
2) Design of a dual-band wireless communication system that can communicate in/on-sensors of the human body for BSN network. The transceiver system supports the 30-70MHz BCC and 402-405MHz MICS standards. The key future of the dual-system is that the BCC system is utilized during the scan period of the MICS channel, which results in reducing the system power consumption.
3) This tutorial is also focusing on designing and implementing an ultra-low power super-regenerative transceiver that employs improvement in amplitude-shift keying

or applying frequency-shift keying for flexible data rates without the need for expensive off-chip components.

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(c) Design and implementation of super-regenerative transceiver
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  4- Synchronization methods

Biography:

Sherif Mohamed was born in Cairo, Egypt, in 1976. He received his BSc in Electrical Engineering, with emphasis on Electronics and Communications in 1999, with honor degree from Al-Minia University, Egypt.

Sherif Mohamed received the MSc. in microelectronics engineering from in 2003 and the Dr.-Eng. degree from the Albert-Ludwigs-University, Freiburg, Germany, in 2012, both with highest honors. In 2000, he joined the Electronics Research Institute, ERI, Cairo, Egypt, where he was working as a research assistant in the field of low power analog circuit designs. In 2001, he awarded a scholarship from the Information Techology Institute, ITI, to study the VLSI diploma supported by the company of Mentor Graphics, Cairo, Egypt. From 2002-2003, he has been with the company of Mettler-Toledo, Zürich, Switzerland, where he has working in the field of VLSI. From 2003-2005, he was as a teaching assistant at the university of Modern science and Arts, MSA, October, Egypt, where he was working in the field of analog circuits for low-voltage, low-power applications. At the end of 2005, he moved to the center of electronics engineering research Institute, CEERI, Pilani, India, where he was working in the field of Microsensors. In 2006, he moved to the Institute of Microsystem Technology, IMTEK, Albert-Ludwigs-University, where he was working toward the Ph.D. degree in the field of RF wireless receivers for medical implantable communication systems until 2012. Since March 2012, Dr. Mohamed is a Posdoc at the chair

of microelectronics, IMTEK at the University of Freiburg. Dr. Mohamed' main research interests include analog-signal circuit design, RF wireless transceiver circuits for biomedical applications.

Yiannos Manoli holds the Fritz Huettinger Chair of Microelectronics at the Department of Microsystems Engineering (IMTEK), University of Freiburg, Germany. Since 2005 he additionally serves as director of the applied research "Institute of Micromachining and Information Technology" of the "Hahn-Schickard Gesellschaft" (HSG-IMIT). His research interests are the design of low-voltage and low-power mixed-signal systems with over 300 papers published in these areas. The emphasis lies in Analog-to-Digital converters as well as in energy harvesting and sensor read-out CMOS circuits. Additional research activities concentrate on motion and vibration energy transducers and on inertial sensors. Prof. Manoli received Best Paper Awards from ESSCIRC 2010 and 1988, MWSCAS 2007, MSE 2007, and PowerMEMS 2006. For his creative and effective contributions to the teaching of microelectronics and the design of a web-based animation and visualization of analog circuits (Spicy VOLTsim, www.imtek.de/svs) he received various awards including the Excellence in Teaching Award of the University of Freiburg and the Teaching Award of the State of Baden-Württemberg, both in 2010.

Professor Manoli is a Distinguished Lecturer of the IEEE. He is on the Senior Editorial Board of the IEEE "Journal on Emerging and Selected Topics in Circuits and Systems" and on the Editorial Board of the "Journal of Low Power Electronics". He served as guest editor of the "Transactions on VLSI" in 2002 and the "Journal of Solid-State Circuits" in 2011. Professor Manoli has served on the committees of a number of conferences such as ISSCC, ESSCIRC, IEDM and ICCD, and was Program Chair (2001) and General Chair (2002) of the IEEE International Conference on Computer Design (ICCD).

He holds a B.A. degree (summa cum laude) in Physics and Mathematics, a M.S. degree in Electrical Engineering and Computer Science from the University of California, Berkeley and the Dr.-Ing. Degree in Electrical Engineering from the Gerhard Mercator University in Duisburg, Germany.

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