

A 0.18 μm CMOS Low-Power Radiation Sensor for UWB Wireless Transmission

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We describe the design of a floating gate-based MOS sensor embedded in a read-out CMOS sensing element used as a radiation sensor. A maximum sensitivity of 1mV/rad is estimated up to 10krad. The paper shows the design of a microelectronic circuit that includes a sensor, an oscillator and modulator, which is now under fabrication. Given the small estimated area of the complete chip prototype, i.e. less than 1mm², the IC can enable a large variety of applications for spot radiation monitoring systems (High-Energy Physics experiments might benefit of this concept).

Summary

We describe the design of a floating gate-based MOS sensor embedded in a read-out CMOS sensing element used as a radiation sensor. The read-out cell is designed to asynchronously trigger an all-digital Ultra-Wide Band (UWB) transmitter operating in a 0-5GHz band, with a repetition frequency dependent on the radiation level. The designed input sensor ranges between 0 and 2V. The floating gate MOS sensor has been recently characterized and here emulated with a commercial radiation-sensitive FETs based on a metal-oxide-silicon p-channel structure, for a 2V variation given an equivalent absorbed dose of 100rad within 1 and 100krad [1]. A maximum sensitivity of 1mV/rad is estimated up to 10krad. The paper shows the design of a preliminary microelectronic circuit that includes a sensor, an oscillator and modulator, which is now under fabrication. The prototype will be interfaced with an external power supply and to an antenna for pulse transmission, to provide a preliminary proof-of-concept validation before a complete integration. Given the small estimated area of the complete chip prototype, comprising the antenna, i.e. less than 1mm², the IC can enable a large variety of applications for spot radiation monitoring systems (High-Energy Physics experiments might benefit of this concept). The paper shows measurements on a mini test-board equipped with the full-custom components comprising an external transmitter IC that will be integrated in the ASIC prototype (TowerJazz). First measurements, obtained at the "Istituto Italiano di Tecnologia", Center for Space Human Robotics, demonstrate the feasibility of the proposed event-driven asynchronous Ultra-Low Power (ULP) UWB transmission [2]. The Science and Technology Facility Council of the Rutherford Appleton Laboratory (RAL), UK, supports the entire research. Figures below show the sensitive cell layout, a block diagram of the design under development plus a picture of the submitted test device.

[1] R. Edgecock, J. Matheson, M. Weber, E. Giulio Villani, R. Bose, A. Khan, D. R. Smith, I.A-Smith, A. Gabrielli, JINST 4 P02002, 2009, (doi:10.1088/1748-0221/4/02/P02002).

[2] M. Crepaldi, I. Aulika, D. Demarchi, Ultra-Wide Band Novel Trends. Intech, pp. 79-96. (2011), ISBN 9789533073248.

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