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Design and Characterization Challenges of an Attoampere-Sensitive ASIC-Based Ultra-Low Current System for Real-Time Radiation Monitoring

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The time budget for a radiation monitoring system to accurately determine the input dose rate could vary from microseconds to minutes, depending on the operational scenario. For personal protection, the typical requirement is often in the range of milliseconds. Consequently, such systems require a fast analog front end capable of transforming the continuous output of a radiation sensor into discrete quantities. A matching digital system is then needed to convert these quantities into interpretable metrics, such as dose rates. The output of radiation sensors typically manifests as a current, which could range from femtoamperes to microamperes or even milliamperes, depending on the type of sensor and environmental conditions. Hence, the most challenging subsystem in the design of such a radiation monitoring system is the analog front end. The radiation protection group at CERN has developed an Application-Specific Integrated Circuit (ASIC)-based front end to digitize the currents generated by an ionization chamber. The ASIC has demonstrated a sensitivity of 200 aA under controlled environments. Various aspects were considered during the design process, from tuning the correct simulator settings to selecting the optimum architecture and transistor variants, as well as effectively shielding the sensitive components. This paper summarizes the challenges faced and the methodologies adopted in successfully designing such a front end. The setup used for characterizing such a system is also described in detail.

Minioral

Yes

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No

Are you a student?

No

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