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Design of a 12-bit column-parallel ADC in the MAPS for real-time particle tracking

The Monolithic Active Pixel Sensor (MAPS) has been widely used in nuclear and particle physics. The real-time particle tracking applications at the Heavy Ion Research Facility in Lanzhou (HIRFL) and the High-Intensity heavy-ion Accelerator Facility (HIAF) require MAPS to measure the position, energy deposition, and arrival time of the particle hits. Thus, a MAPS with such capability is being designed in a 130nm process. As the critical part of this MAPS, a 12-bit column-parallel ADC has been designed to serve the pixels in every two adjacent columns.

This column-parallel ADC is designed in a novel structure to satisfy the restricted constraints on area, power, speed, and accuracy. The sub-ADC using a switched capacitor circuit is designed based on the input offset storage technology, effectively reducing the comparison offset. In addition, the SHA-less architecture reduces one clock cycle compared with the traditional structure. The well-optimized timing for the switches also decreases the charge injection effect and eliminates the influence of charge left from the last conversion, which benefits the resolution.

Each column-parallel ADC covers a small area of $380 \times 100 \mu\text{m}^2$ and consumes a power of 7.6mW at a 3.3V power supply. At 40MHz internal clock frequency, the ENOB of ADC reaches 11.61bit at the sampling rate of 3.63MHz, with the SNDR of 71.65dB.

Minioral

Yes

IEEE Member

Yes

Are you a student?

No

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