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Fast-Settling high input dynamic range Automatic Gain Control Front-end circuit for particle detect

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The calorimeter is the most important device in the field of particle detection. In recent years, the research of SiPM as the sensor of the calorimeter has attracted a lot of attention. There are two ways of traditional SiPM readout circuit, one is multi-channel readout, setting readout paths with different gains, the disadvantage is that the power consumption is high and the layout area is large. The other is to adjust the gain off-chip, which is inconvenient for practical application and slow in response. In this paper, a variable gain amplification chain is designed using GMSC 0.13um CMOS process to cover signal measurement with a large dynamic range. The post-simulation result shows that the gain dynamic range is $-6.6\text{dB} \sim 19.73\text{dB}$, covering 60dB the input dynamic range, from 160fC to 160pC. The -3dB bandwidth is about 20MHz, and the gain adjustment time is less than 5ns. And the linearity of the circuit is good. This method can cover a large input dynamic range and save power consumption by using only one analog-to-digital conversion and single measurement.

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