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A High-speed Adaptively-biased Current-to-current Front-end for SSPM Arrays

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Solid-state photomultiplier (SSPM) arrays are an interesting technology for use in PET detector modules due to their low cost, high compactness, insensitivity to magnetic fields, and sub-nanosecond timing resolution. However, the large intrinsic capacitance of SSPM arrays results in RC time constants that can severely degrade the response time, which leads to a trade-off between array size and speed. Instead, we propose a front-end that utilizes an adaptively biased current-to-current converter that minimizes the resistance seen by the SSPM array, thus preserving the timing resolution for both large and small arrays. This enables the use of large SSPM arrays with resistive networks, which creates position information and minimizes the number of outputs for compatibility with general PET multiplexing schemes. By tuning the bias of the feedback amplifier, the chip allows for precise control of the close-loop gain, ensuring stability and fast operation from loads as small as 50pF to loads as large as 1nF. The chip has 16 input channels, and 4 outputs capable of driving 100 Ω loads. The power consumption is 12mW per channel and 313mW for the entire chip. The chip has been designed and fabricated in an AMS 0.35um high-voltage technology, and demonstrates a fast rise-time response of 2 ns and 1.3% rms noise.

Author: ZHENG, Bob (Lawrence Berkeley National Lab)

Co-authors: VON DER LIPPE, Henrik (Lawrence Berkeley National Lab); WALDER, Jean-Pierre (Lawrence Berkeley National Lab); JANECEK, Martin (Lawrence Berkeley National Lab); MOSES, William (Lawrence Berkeley National Lab)

Presenter: ZHENG, Bob (Lawrence Berkeley National Lab)

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