

An 8-channel Low Power ASIC for Helium-3 Tube Position Sensitive Neutron Detectors

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The majority of neutron spectrometers designated for use in the China Spallation Neutron Source (CSNS) rely on position-sensitive detectors that utilize Helium-3 tube technology. To minimize the impact of air on neutron scattering experiments, these detectors must be located inside a vacuum chamber. For these types of spectrometers, it is also advisable to house the readout electronics within the vacuum chamber to limit the number of feed-through cables required and enhance the signal-to-noise ratio. This paper proposes an application-specific integrated circuit (ASIC) dedicated to position-sensitive Helium-3 tubes, including front-end amplification, shaping module and readout driving buffer. The 8-channel chip, named HEROCV1 (Helium-3 ReadOut Circuits), achieves an input dynamic range from 10 fC to 1 pC, with a counting rate of up to 100 kHz. The equivalent noise charge (ENC) measurement result is $1297e^-@15pF$, and the power consumption is less than 9.9 mW per channel. The ASIC has replaced the traditional front-end circuit based on discrete components, fundamentally addressing the issue of front-end power consumption and enabling the entire detector system to operate in a vacuum environment.

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