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The read-out integrated circuit for the high energy resolution X-ray strip detectors

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The X-ray imaging systems dedicated for X-ray spectroscopy, based on a semiconductor strip sensors have been recently an important research topic. The most important research objective is working towards improvement of the spectroscopic and position resolution features [1-3]. In spectroscopic applications the short strip silicon detectors are widely used due to their relatively small capacitance and leakage current. Using strip pitch below 100 μm enables achievement of high spatial resolution.

In this work, the analysis and design of the read-out electronics for the short silicon strip detectors are presented. The Charge Sensitive Amplifier (CSA) is optimized for the detector capacitance of about 1.5 pF, and the shaping amplifier default peaking time is about 1 μs (controlled by the sets of switches). To achieve the lowest possible noise level, the sources of noise in a radiation imaging system both internal (related to the front-end electronics itself), as well as external, were considered [4]. We target the noise level below 50 el. rms, considering low power consumption (a few mW) and limited channel area. To increase the speed of incoming hits processing, the continuous-time resistive CSA feedback together with a digital feedback reset are included. The prototype integrated circuit comprises of 8 charge processing channels, biasing circuitries, reset and base-line restoration logic, and a calibration circuit.

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