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High Accuracy Injection Circuit for the Calibration of a Large Pixel Sensor Matrix

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Semiconductor pixel detectors, for particle tracking and vertexing in high energy physics experiments as well as for X-ray imaging, in particular for synchrotron light sources and XFELs, require a large area sensor matrix. This work will discuss the design and the characterization of a high-linearity, low dispersion injection circuit to be used for pixel-level calibration of detector readout electronics in a large pixel sensor matrix. The circuit provides a useful tool for the characterization of the readout electronics of the pixel cell unit for both monolithic active pixel sensors and hybrid pixel detectors. In the latter case, the circuit allows for precise analogue test of the readout channel already at the chip level, when no sensor is connected. Moreover, it provides a simple means for calibration of readout electronics once the detector has been connected to the chip. Two injection techniques can be provided by the circuit: one for a charge sensitive amplification and the other for a transresistance readout channel. The aim of the paper is to describe the architecture and the design guidelines of the calibration circuit, which has been implemented in a 130 nm CMOS technology. Moreover, experimental results of the proposed injection circuit will be presented in terms of linearity and dispersion. A complete analysis of noise performance will also be shown in the paper.

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