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Clock Induced Charge in EM-CCD Image Sensors

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Clock-Induced Charge (CIC) is a noise source commonly ignored in standard CCD technology since the net generation per frame is typically negligible compared to the noise introduced by the output circuit. For Electron Multiplication based technologies such as EM-CCDs, the sensitivity of the image section is reduced to the single electron level and so any spuriously generated signal can significantly degrade photon counting performance.

This paper describes an investigation into Clock Induced Charge generation within e2v EM-CCDs. Techniques are discussed that are able to provide sub-pixel resolution of CIC generation characteristics. The impact of operating mode, temperature, clocking frequency and radiation damage are also discussed. Advanced TCAD simulations of EM-CCD pixel structures are used to highlight the primary CIC generation sites within a pixel to further explain some of the trends observed in laboratory data. Additional mitigation techniques are discussed in terms of operating modes that may reduce CIC for applications where it remains a dominant noise source.

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