

A 0.5Mpixel global-shutter image sensor with NIR QE enhancement, 20mW power consumption and smart event detection modes

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Abstract

Consumer applications such as AR/VR require GS image sensors due to image artifact reduction and due to their capability to sync with a pulsed illuminator. Other key requirements are low system power, (achieved through high QE at NIR and sensor low power operation) and miniaturized silicon size. Furthermore, HDR operation is especially required for world facing cameras.

To satisfy the needs of consumer apps, we designed a 0.5MP image sensor with 2.79um voltage domain GS pixels with a packaged sensor footprint of only 2.3mm x 2.8mm. All readout blocks are optimized for small size and low power consumption, with focus on the column ADC. The sensor includes features like in-pixel background-light cancellation and smart event detection modes. Advanced power down techniques allow ultra-low-power operation (e.g. <20mW at 10bit, 30fps).

The HDR technique validated in this sensor uses charge-overflow-on-FD technique, with critical improvements over SOA. Only 2 in-pixel capacitors are needed in the pixel for both global shutter operation and for HDR as compared to the 4 caps needed competition. Compared to alternative HDR techniques, no FPN calibration is needed and pipeline readout is possible, improving low light performance. Furthermore, DSNU due to FD leakage is minimized as overflow storage happens during a small fraction of total exposure time. The sensor can achieve ~90dB DR with ~27dB at dip point.

With a 2.3mm x 2.8mm packaged size the presented sensor is one of the smallest GS sensors ever reported. Despite its size, it packs 0.5MP, Mipi interface, ultra-low power operation, smart event detection modes and proves single shot HDR concept with pipeline operation. Combined with high QE (~92%@vis, ~38%@940nm) it well compares against great works from the past and it is an ideal candidate for consumer AR/VR devices.