High Dynamic Range Pixel Amplifier in Amorphous Silicon Technology for Diagnostic X-ray Imaging Applications

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Digital imagers using amorphous silicon (a-Si) technology are increasingly being used for large area medical imaging (Fig. 1) [1], because they offer the benefits of uniform deposition, low capital cost and are tolerant to X-ray radiation. In addition, for diagnostic X-ray imaging, a-Si digital imagers can provide tele-diagnosis, immediate viewing of the radiograph, convenient computer storage, and more compact imagers. Diagnostic X-ray imaging presents challenges to digital imaging electronics in the area of real-time digital fluoroscopy where a catheter is moved through an artery while the patient is continuously exposed to radiation which necessitates low doses and consequently, reduces the input signal to the digital imaging pixel electronics. Using industry standard, a-Si switch based pixels, the signal-to-noise ratio (SNR) at the low fluoroscopic exposure levels can result in blurred images.

In contrast, current-mediated a-Si pixel amplifiers (Fig. 2) have been reported [2] to give a good SNR for fluoroscopy even at low X-ray inputs. However, the pixel amplifier output becomes non-linear at higher input levels, thus reducing the pixel dynamic range and making it unfeasible to take a higher energy, higher contrast image at a region of interest.

In this research, we investigate a hybrid amplified pixel architecture (H-APS in Fig. 3) that exhibits both, large signal linearity and higher dynamic range [3]. Gain, linearity, noise, and metastability simulations along with area calculations will be presented for the H-APS circuit. The H-APS appears promising for dual-mode large area, active matrix flat panel imagers that can switch instantly between low exposure and higher exposure radiographic imaging modes. Lastly, the amplified pixel circuit is suitable for integration with on-panel multiplexers for both gate and data lines, which can further reduce off-panel circuit complexity.

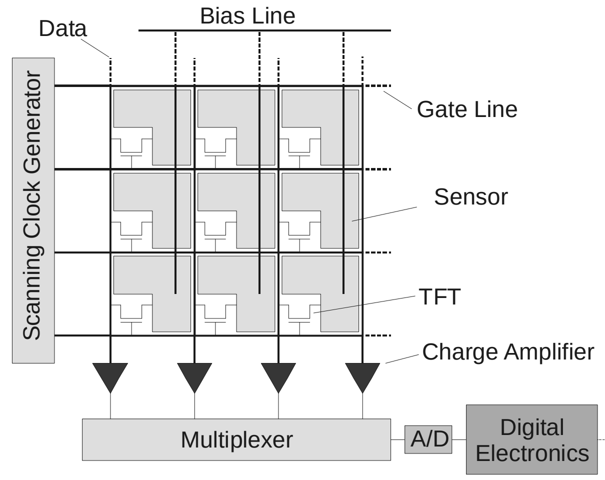

Figure 1. Passive Pixel Sensor (PPS) imaging array

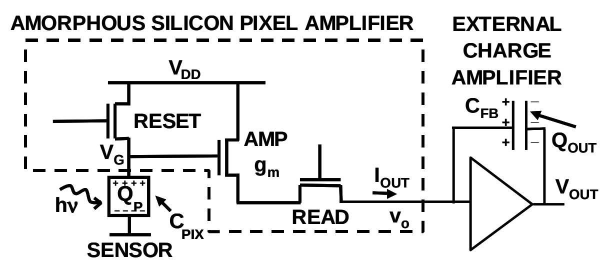

Figure 2. Current mediated APS architecture (C-APS)

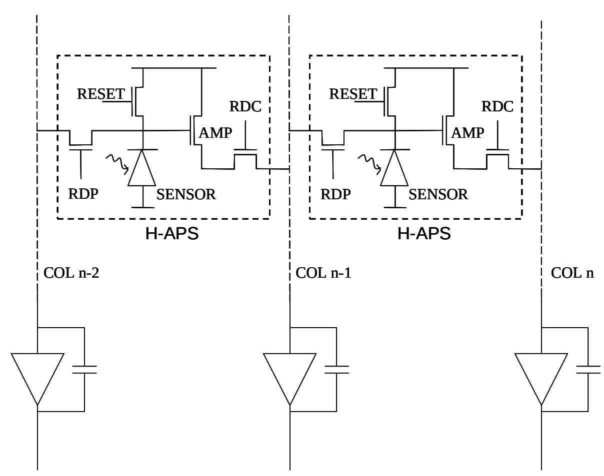

Figure 3. Hybrid APS (H-APS) pixel schematic

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