A CMOS Image Sensor with 2.0-e^- Random Noise and 110-ke^- Full Well Capacity Using Column Source Follower Readout Circuits

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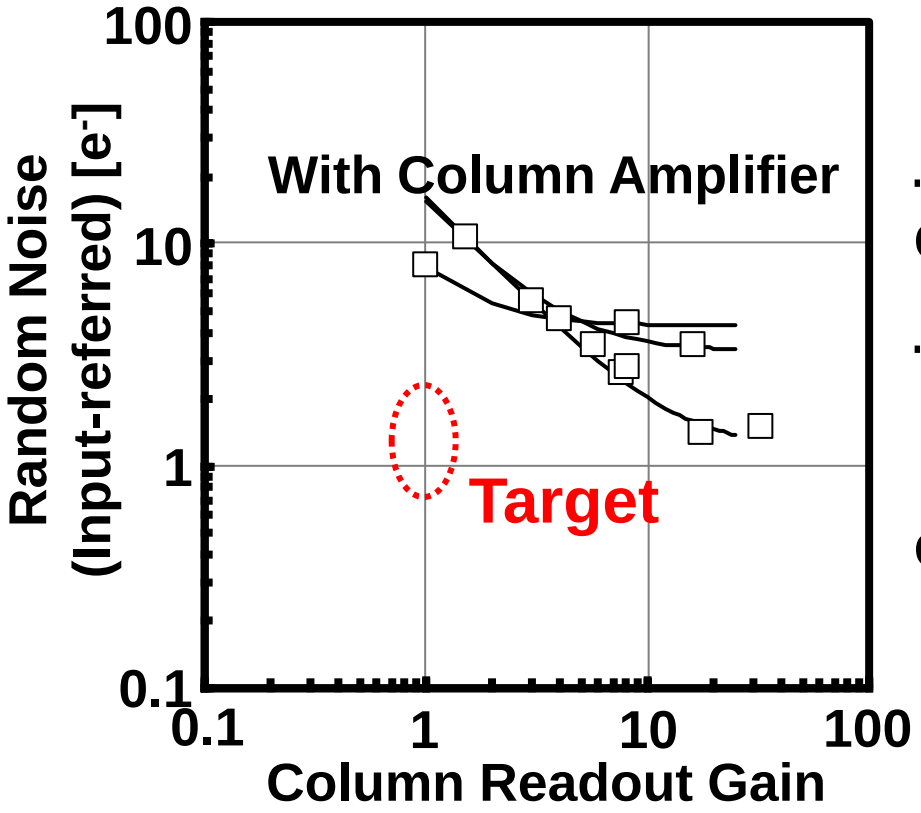
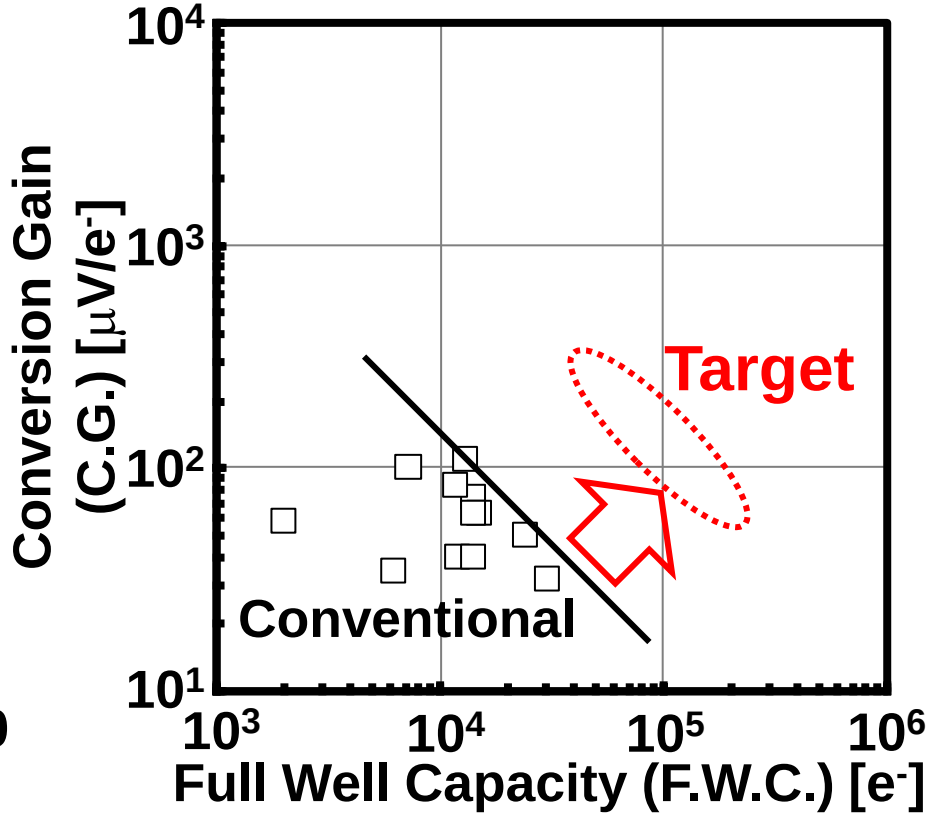
Background





Column amplifier

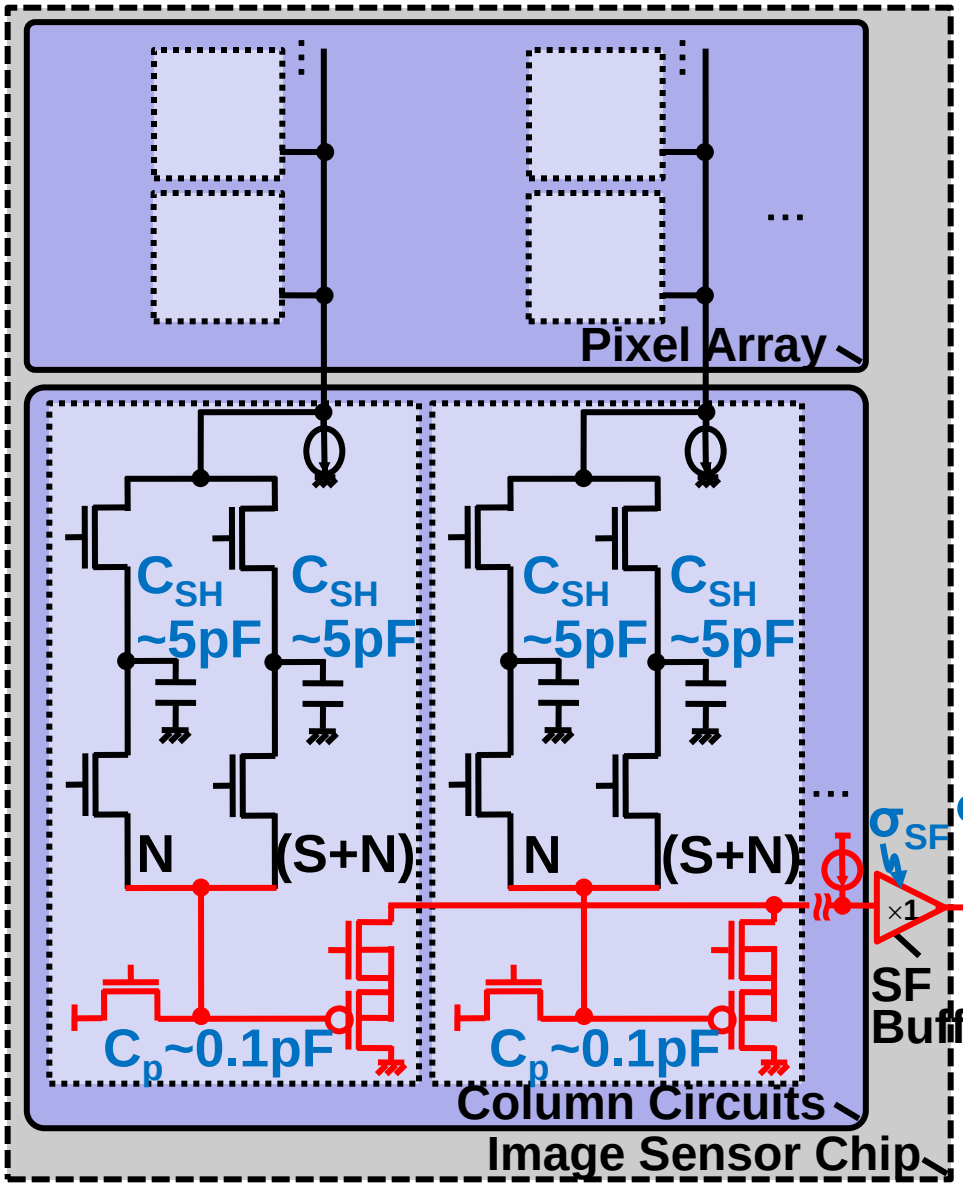
× Limitation by noises of pixels and amplifiers themselves.

× Decrease in F.W.C. ($\sim\frac{1}{30}$)

Conventional Sensor

× Trade-off between C.G. and F.W.C.

New Low Noise Readout Circuits

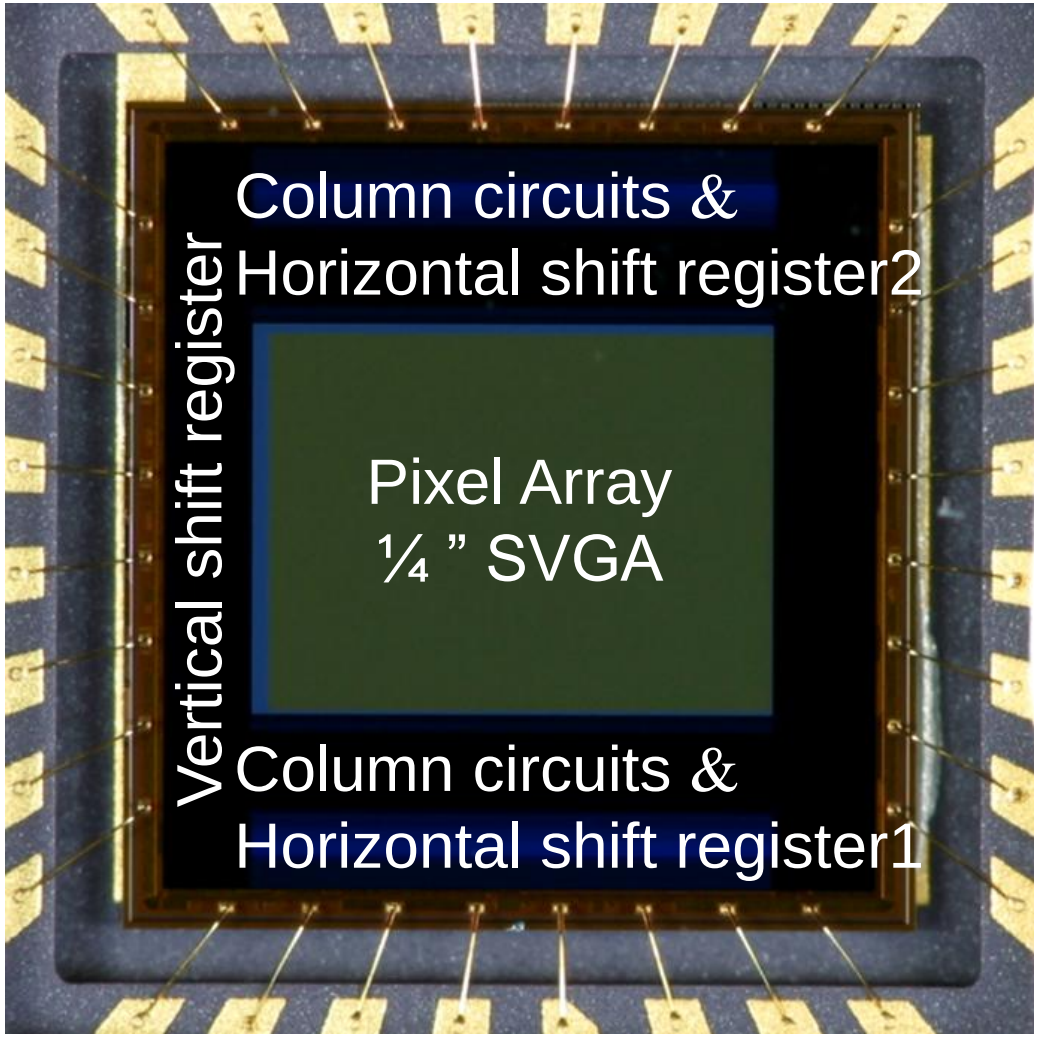


1. Column Readout
   Gain≅1
   - C_{SH}(~5pF)
   - C_p (~0.1pF)

$$\frac{C_{SH}}{C_{SH} + C_p} \cong 0.98$$

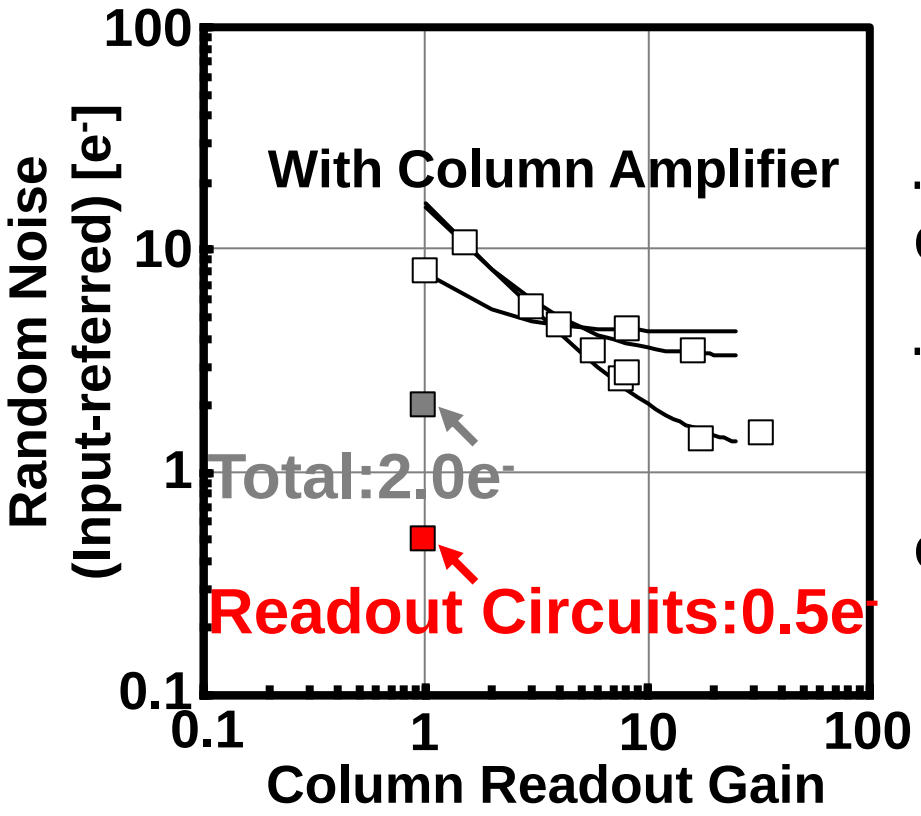
2. Minimize σ_{SF}
   - Optimum parameters
3. Eliminate $\sigma_{off\text{-}chip}$
   - With CDS function
   - Free from off-chip circuits

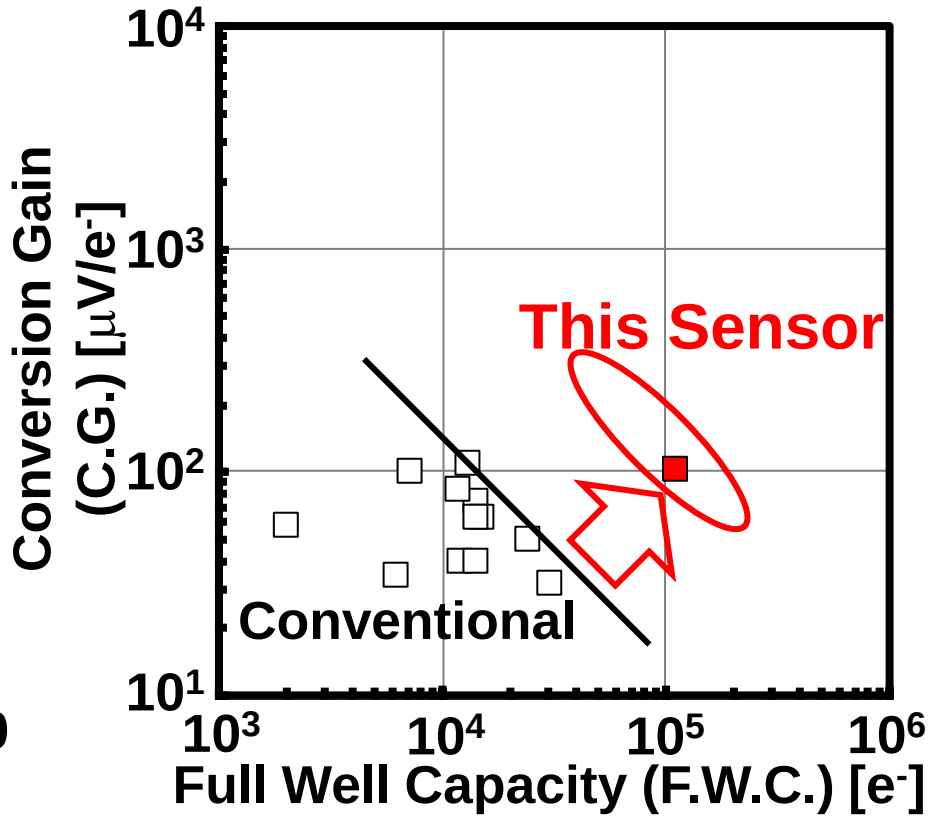
Chip Micrograph



- **Process Technology**
  - **0.18 μm 2P3M CMOS**
- **Die Size**
  - **5.6 mm^H × 5.8 mm^V**

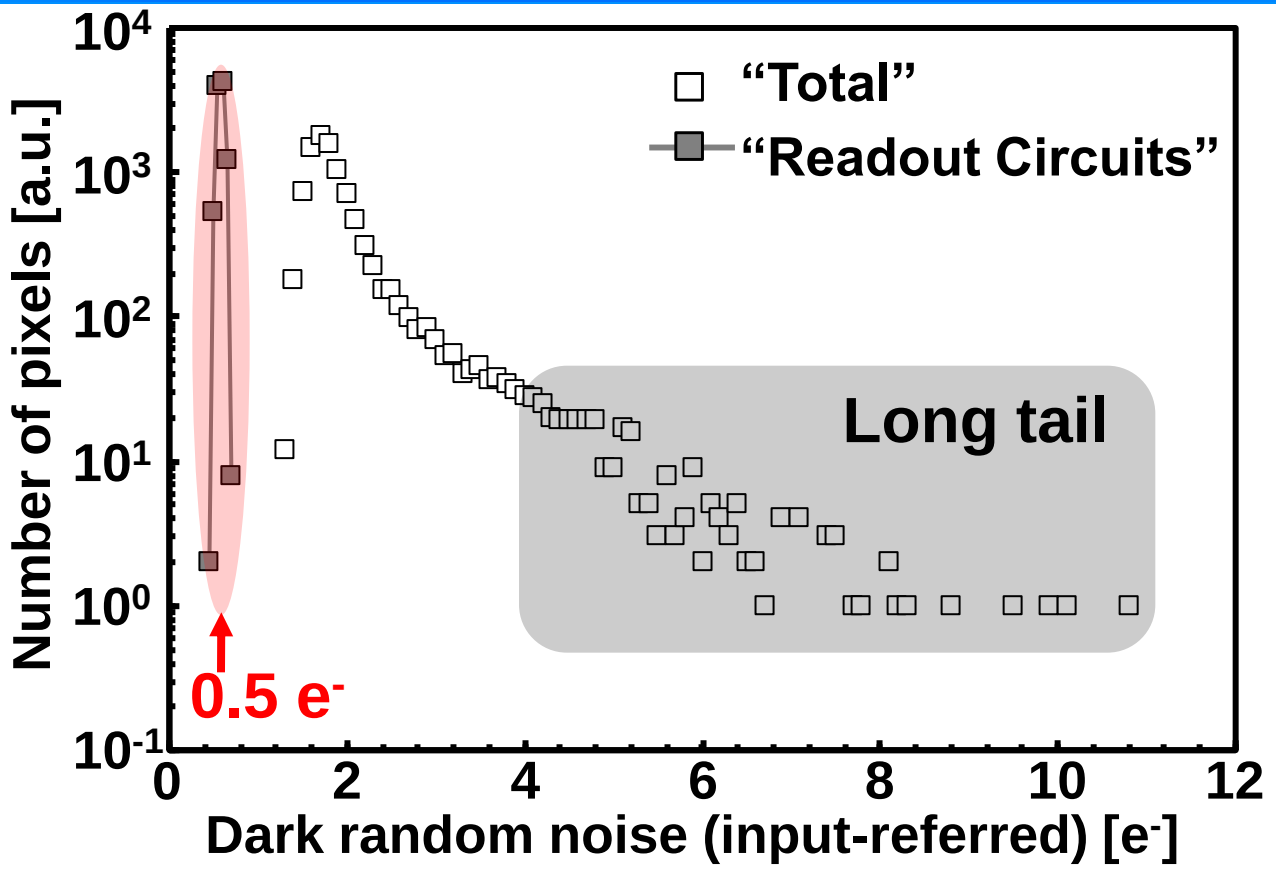
Measurements Summary





A low noise and high F.W.C. CMOS image sensor has been developed by using column source follower readout circuits.

Noise Measurements



- Random Noise of Readout Circuits : 0.5 e^-
- By using developed low noise readout circuits, the behaviors of pixel noises have been accurately measured.
  - ↳ *RTS, Flicker noise, Charge transfer noise*
- These fingings are useful to make pixel noises much lower.