

In the case of an APS, the amplifier is an open loop, source follower type amplifier. In its simplest form, it is a single very large transistor, often consuming 30%-60% of the available pixel area. This amplifier converts the photon generated signal to a voltage, which is then output on a vertical column bus. All of the pixel amplifiers in a column are connected to this single bus.

NOISE: In an ideal world, each and every pixel amplifier in an array of pixels would have identical gain and identical offset. In reality, this is not the case. Each amplifier has varying gain and offset, resulting in signal distortion across the array of pixels. This is called Fixed Pattern Noise (FPN). This FPN is typically large. However most of this FPN can be removed with signal processing (adding expense, increasing power consumption) but the resultant signal is less and is not typically good enough for middle to high range consumer or professional imaging.

SPEED/RESOLUTION: Remember that vertical column bus each pixel is connected to? Well, it acts like a load or weight pulling the video signal down. When you increase the resolution, this load increases, and the amplifiers in each pixel must slow down to handle the load. This slows down the frame rate of the overall image sensor. In order to overcome this increased load, the APS designer could increase the size of the amplifier to give it more drive capability to push the load. This not only increases the power consumption, but reduces the Fill Factor! You can see the trade off between image quality, resolution, and speed of the APS architecture. Increase speed means lower image quality and higher power consumption. Increase resolution means lower speed and/or lower image quality with higher power consumption.

One very expensive way to increase the Fill Factor with an APS sensor is to use a CMOS fabrication process with smaller design rules. This means that they can design the pixel with smaller transistors to increase the fill factor. The problem with going to smaller design rules is two-fold: Cost and Dynamic range. Smaller design rule processes are much more expensive. The cost of the silicon can be 40%50% higher, increasing the overall sensor cost. Additionally, as the design rules get smaller, the operating voltage sometimes lowers, thus lowering the sensors dynamic range.

Q: What is ACS technology?

A: Simpler and better. Instead of cramming a poor performing, open loop amplifier in each pixel, the inventors of ACS realized that a true closed loop operational amplifier could be shared among all of the pixels in a column, leaving only the input stage of the amplifier inside of each pixel. This input stage is very small. The benefits of this architecture are many.

- Increased Fill Factor within the pixel, which means higher sensitivity and dynamic range.
- Pixel array operates in current mode, resulting in very high speed operation.
- No Gain varying Fixed Pattern Noise.

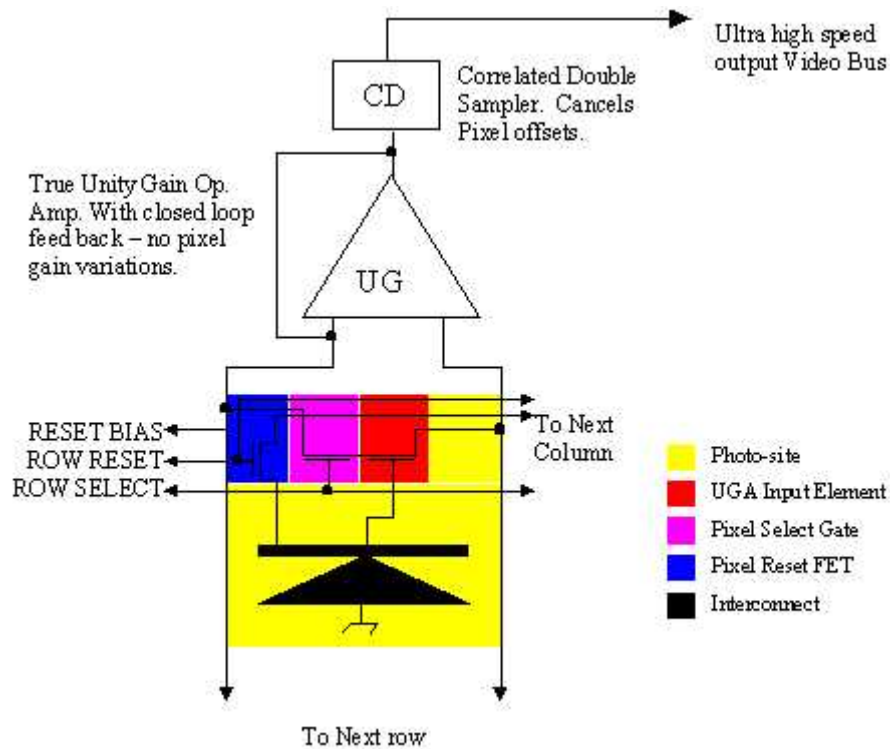


Fig. 2 - ACS implementation, note that the area to collect light is nearly twice as large as what is in the APS pixel shown in Figure 1.

Q: So how can APS image sensors meet the continued demand for higher resolution, higher speeds, higher image quality, and lower cost?

A: Unlike ACS technology, APS image sensors simply cannot enjoy having simultaneous benefits of excellent image quality, high frame rate, and high resolution, one or more must be sacrificed in favor of the others.

Q: After ACS, what is next?

A: Our next generation sensor technology is called XtremePIX™. As shown above, one of the key advantages of ACS technology is that it reduces the amount of in-pixel circuitry as compared to an APS which provides for more area to collect light, improve dynamic range, and sensitivity.

XtremePIX takes this concept even further, by reducing the in-pixel transistor count to as little as one-half (1/2)!!! That is 1/6 the circuitry of an APS type sensor. There are many other benefits as well.