Revolutionary sensor blazes the way to a new era of high image quality

"Super CCD EXR"

A 'three-in-one' sensor for high resolution, high sensitivity and wide dynamic range
Made by photographic specialists for photographic specialists

PHOTOKINA 2008, COLOGNE, GERMANY, September 23, 2008 —FUJIFILM Corporation, on the anniversary of 10 years of FinePix cameras, has developed "Super CCD EXR," a revolutionary new sensor developed in the rigorous pursuit of high image quality.

There is strong demand in the digital camera market to increase the number of pixels on a sensor, which, all too often, is used as a convenient yardstick for image quality. While introducing excellent 12-megapixel cameras such as the FinePix F50fd and the FinePix F100fd, Fujifilm has had great success in increasing pixel density while at the same time controlling noise and optimizing sensitivity. Fujifilm's campaign to improve overall image quality, while at the same time increasing sensor resolution, has been coordinated under the program of 'Real Photo Technology.'

'Real Photo Technology' is underpinned by the belief that experienced photographers, many brought up using famous reversal films like FUJICHROME Velvia or PROVIA, understand that true image quality is about a combination of many factors like tone, hue, color fidelity, dynamic range, sharpness, and resolution. It is well known that increasing the pixel count on a sensor actually makes it more difficult to achieve high sensitivity and wide dynamic range. As the photodiode gets smaller, the problems of increased noise, blooming and clipping increase.

FUJIFILM
Expand the World of Imaging

It is widely believed that ‘high resolution’ and ‘high sensitivity’ are irreconcilable opposites, and impossible to optimize on the same sensor, particularly for compact cameras, where sensors are necessarily smaller.

High quality pictures are dependent on the subject. Excellent low light pictures need high sensitivity; high contrast pictures need wide dynamic range, while fine details, like the leaves of a tree or strands of a model’s hair, depend on high resolution.

Fujifilm engineers set about the task of building a Flexible sensor to match the demands of the photographer. The end-goal is to produce a sensor that works as close to that of the human eye as possible. Whatever nuance of color or sensitivity of tone that makes the scene so special to the photographer should be the continual challenge of the sensor engineer. The EXR sensor is essentially a switchable sensor; changing its complex electronic behavior to suit the subject, changing its characteristics as the photographer demands, and producing the very best picture without making compromises.

“Super CCD EXR” is the latest new generation of Super CCD to be produced by Fujifilm. Over the years, Fujifilm has excelled in high resolution sensors through ‘HR’ technology (F50fd, F100fd) and high sensitivity/wide dynamic range through ‘SR’ sensors (S3 Pro, S5 Pro). The direction in the future will be to combine HR and SR technology together to produce one universal sensor suitable for all high quality photography.

The Technology of Super CCD EXR

Super CCD EXR offers three main changes from previous Fujifilm sensors:

1. A new arrangement of the mosaic color filter
2. A new method of pixel binning
3. A complete revision of the electronic charge control

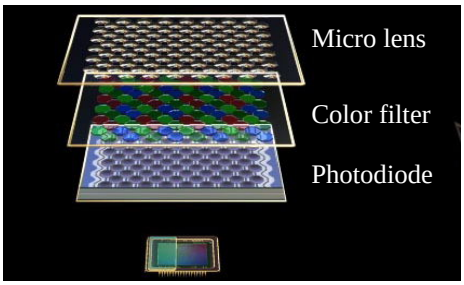
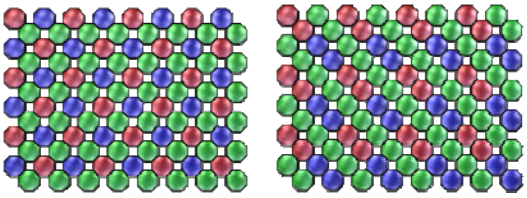


Fig 1) Diagram of Super CCD EXR



previous CCD EXR CCD

Fig 2) Comparison of previous and EXR color filter arrangements

1. EXR: 'Pixel Fusion Technology' for High Sensitivity and Low Noise

Boosting sensitivity by increasing gain causes the generation of random increased noise, and conventional efforts to control this noise have resulted in blurred images and loss of resolution. On the other hand, a low-noise signal can be obtained by pixel binning. However, the conventional approach to binning (along the horizontal and vertical axis) generates false colors because of the separation of pixels of the same color. Because it is necessary to suppress this phenomenon, the result is a significant drop in sharpness.

EXR changes the color filter arrangement. Two side-by-side, same-colored pixels are taken together as a single pixel. With this design, the area of imaging elements is doubled, the sensitivity is twice the normal level, and 'dark noise' is extremely small. Therefore it is possible to create a high sensitivity image with little noise, instead of increasing the gain from a single pixel and increasing the noise.

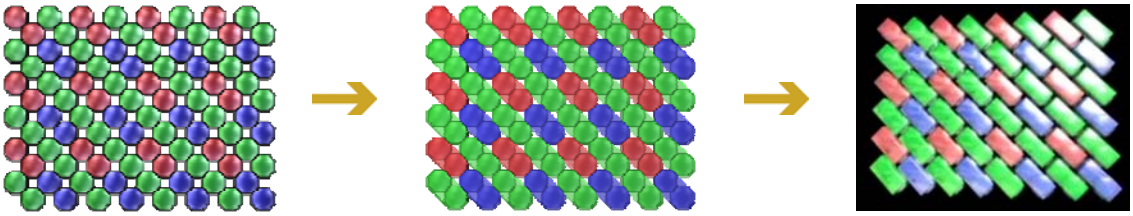


Fig 3) Conceptual Diagram of EXR's High Sensitivity/Low Noise Technology

Another problem with traditional pixel binning is the distance between same-colored pixels. Since the pixels are combined vertically or horizontally, the distance between combined same-color pixels is large, resulting in the generation of false colors. Boasting a new technology called **Close Incline Pixel Coupling**, the new Super CCD EXR can prevent the generation of false colors by mixing two adjoining pixels as one, and managing to achieve both low noise and excellent sharpness.

2. EXR: 'Dual Capture Technology' for Wide Dynamic Range

Super CCD EXR uses flexible and high-precision exposure control to simultaneously capture two images of the same scene: one taken at high sensitivity and the other at low sensitivity. It then merges the two images to generate a photo that has excellent depth and range.

Previously, Fujifilm used two different methods to improve dynamic range.

The first was Super CCD SR. Through the adoption of a "double pixel structure" based on silver halide film, which comprises an "S pixel" with a large area and high sensitivity and an "R pixel" with a small area, a dynamic range four times that of conventional sensors was achieved.

The second was based on Super CCD HR, where the gradation of shadows was gradually adjusted while raising the sensitivity of signal processing, and where

highlights were softened to delineate an optimal curve. Similar to Super CCD SR, the new EXR sensor uses **Dual Exposure Control** to impart two differing sensitivities by controlling the light exposure time (the time in which charge accumulates). Unlike SR, the imaging elements are the same (large) size, which means the potential for widened dynamic range is even greater, and facilitates a greater spectrum of graduated expression.

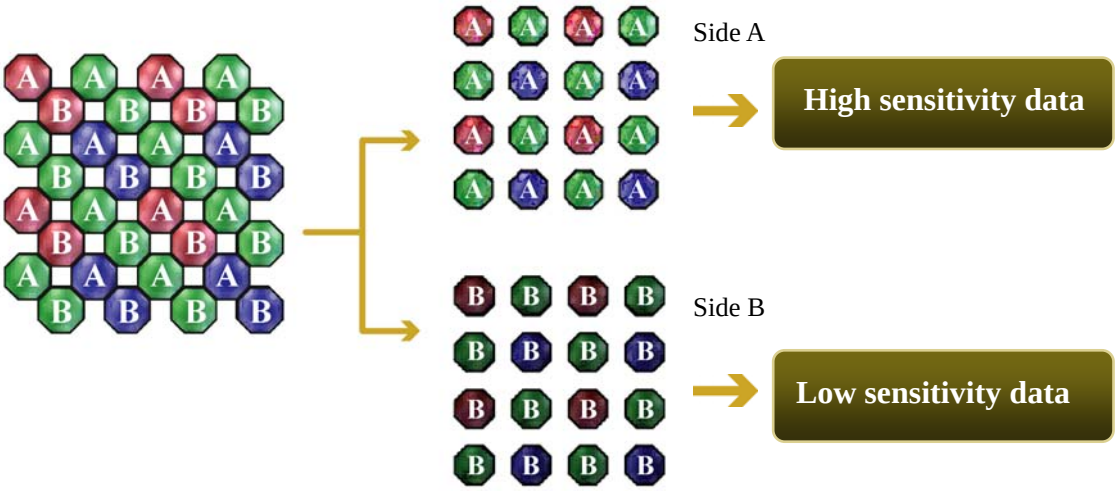


Fig 4) Conceptual Diagram of EXR's Wide Dynamic Range Technology

3. EXR: 'Fine Capture Technology' for High Resolution

The distinctive structure of the new Super CCD EXR fully exploits all the pixels in the layer beneath the new color filter matrix and takes advantage of the optimized signal processing of the new RP processor to create an image with the highest possible resolution quality. Even though the sensor has been designed for 'Dual Capture' for Wide Dynamic Range and 'Pixel Fusion' for Low Noise, it actually performs as well as previous 12-megapixel Super CCD sensors due to the new filter and photodiode design.

When light is full and even, and when fine detail is required, EXR can deliver exquisite detailed expression for landscape or architectural photography, and render the finest details of clothes, hair or jewelry in portrait photography.

EXR: The Future

Fujifilm is determined to use decades of imaging know-how gained through the development of film to push the boundaries of what is possible to achieve with an imaging sensor. The market for digital cameras is only around a decade old, and Fujifilm believes that it is possible to follow the holy grail of ‘absolute image quality’ in the domain of electronic imaging, just as it did with conventional imaging.

With EXR, Fujifilm can choose one engineering direction, rather than developing separate sensors for high sensitivity and high resolution. Fujifilm looks forward with excitement to introducing this sensor into its range of high quality cameras, and expects enthusiasts to see a quantum leap in image quality from anything they have seen before.