See what you've been missing.

FOVEON®

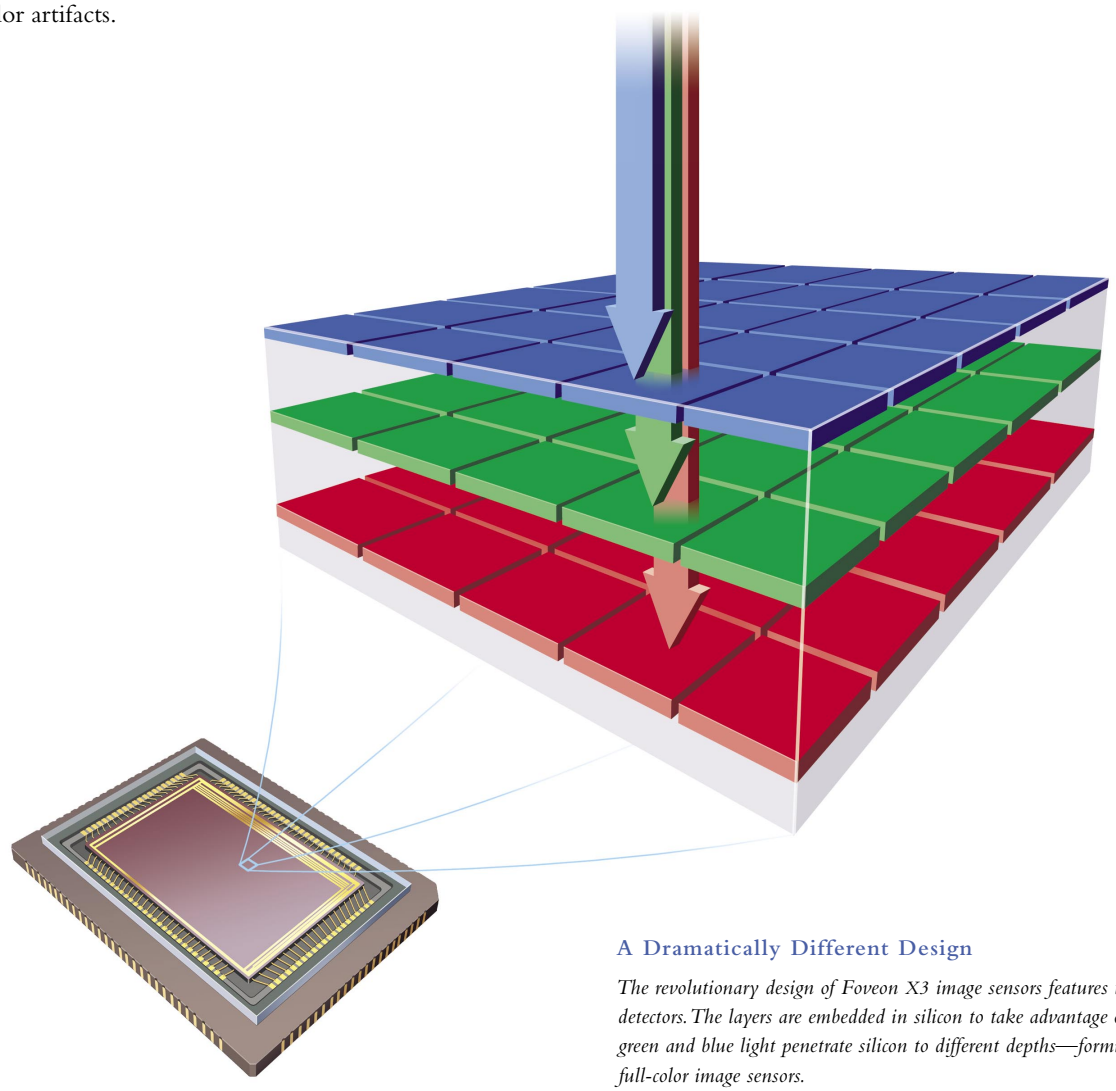
Introducing the world's

Foveon® X3™ technology delivers sharper images, better color detail and resistance to color artifacts.

Until now, you haven't been getting the picture. At least not the complete picture.

That's because revolutionary Foveon X3 technology features the first and only image sensors that capture red, green and blue light at each and every pixel. All other image sensors record just one color per pixel—that's why Foveon X3 technology delivers increased sharpness, better color detail and resistance to unpredictable color artifacts.

From point-and-shoot digital cameras to high-end professional equipment, Foveon X3 technology offers a wealth of benefits to consumers and manufacturers alike. At the same time, it paves the way for other innovations, such as new kinds of cameras that record both video and still images without compromising the image quality of either.



A Dramatically Different Design

The revolutionary design of Foveon X3 image sensors features three layers of photodetectors. The layers are embedded in silicon to take advantage of the fact that red, green and blue light penetrate silicon to different depths—forming the world's first full-color image sensors.

first full-color image sensors.

The secret's in the silicon.

To capture the color that other image sensors miss, Foveon X3 image sensors use three layers of photodetectors embedded in silicon. The layers are positioned to take advantage of the fact that silicon absorbs different wavelengths of light to different depths, so one layer records red, another layer records green and the other layer records blue. This means that for every pixel location on Foveon X3 image sensors, there's actually a stack of three photodetectors, forming the first and only full-color image sensors.

Until now, all other image sensors have featured just one layer of photodetectors, with just one photodetector per pixel location. To capture color, photodetectors are organized in a grid, or mosaic, resembling a three-color checkerboard. Each pixel is covered with a filter and records just one color—red, green or blue.

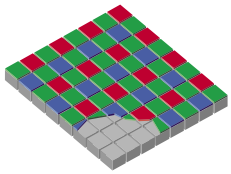
That approach has inherent drawbacks, no matter how many pixels a mosaic-based image sensor might contain. Since mosaic-based image sensors capture only one-third of the color, complex processing is required to interpolate the color they miss. Interpolation leads to color artifacts and a loss of image detail. Blur filters are used to reduce color artifacts, but at the expense of sharpness and resolution.

With its revolutionary process for capturing light, Foveon X3 technology never needs to compromise on quality, so you get sharper pictures, truer colors and fewer artifacts. And cameras equipped with Foveon X3 technology do not have to rely on processing power to fill in missing colors, reducing hardware requirements, simplifying designs and minimizing lag time between one shot and the next.

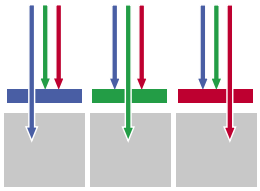
Dollar for dollar, pixel for pixel, nothing compares to Foveon X3 technology.

Mosaic Capture

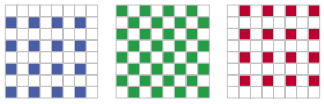
1. *In conventional digital camera systems, color filters are applied to a single layer of photodetectors in a tiled mosaic pattern.*
2. *The filters let only one color of light—red, green or blue—pass through to any given pixel, allowing it to record only one color.*
3. *As a result, typical mosaic sensors capture 50% of the green and only 25% of the red and blue light.*



1. *Typical Mosaic Image Sensor*



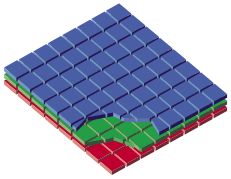
2. *Wasted Color*



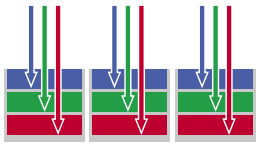
3. *An Incomplete Picture*

Foveon X3 Capture

1. *A Foveon X3 image sensor features three separate layers of photodetectors embedded in silicon.*
2. *Since silicon absorbs different wavelengths of light at different depths, each layer records a different color. Stacked together, they create full-color pixels.*
3. *As a result, only Foveon X3 image sensors capture red, green and blue light at every pixel location.*



1. *Foveon X3 Layered Image Sensor*



2. *Full-Measured Color*

3. *The Complete Picture*

A differe

Foveon X3 vs. mosaic systems: a side-by-side comparison.

Mosaic Capture

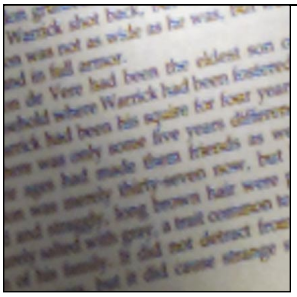
Foveon X3 Capture

Foveon X3 technology visibly improves image quality, as any comparison of equivalent pixel counts will demonstrate. In this case, a 2-megapixel file taken with a mosaic sensor is compared to a 2-megapixel file taken with Foveon X3 technology (more fully described as "2MP x 3" to reflect that each pixel measures three colors instead of one).

Mosaic Capture

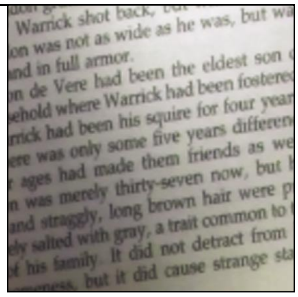
Foveon X3 Capture

A



Sharpness

As you can see, the camera equipped with Foveon X3 technology takes sharper pictures. That's because it captures twice as much green as mosaic image sensors, and the green wavelengths of light are critical in defining image detail.



A

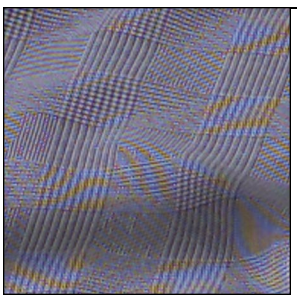
B

Color Detail

These pictures demonstrate how Foveon X3 technology improves color detail. The difference is that Foveon X3 image sensors measure full color at each and every pixel location, while mosaic sensors capture 50% of the green and just 25% of the red and blue.

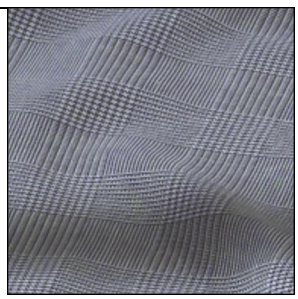
B

C



Artifacts

As shown here, Foveon X3 technology offers resistance to unpredictable artifacts. A mosaic image sensor is more vulnerable to artifacts, largely because it must rely on complex processing to interpolate the colors it missed. No amount of processing power can completely take the guesswork out of color interpolation.



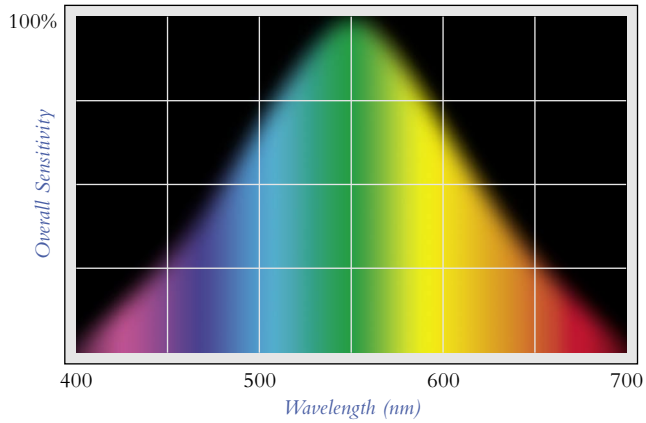
C

nce you can see.

Why Foveon X3 images are sharper.

The unique ability of Foveon X3 image sensors to capture all the light at every pixel location results in more than truer color—it also translates into images of unprecedented sharpness and clarity.

The Importance Of Luminance



While all colors contain the luminance information that defines sharpness and detail, the human eye is most sensitive to green.

All colors, especially green, carry luminance information that the human visual system uses to discern and define image detail. Recognizing the importance of green light, manufacturers of mosaic image sensors dedicate 50% of pixel locations to capturing green light, with the remaining 50% evenly divided between red and blue. Yet they still capture only half as much green as Foveon X3 image sensors, which capture 100% of every color for sharper, clearer images.

In many cases, the difference in sharpness and detail is compounded by the use of blur filters in mosaic-based digital cameras. The blur filters are intended to minimize luminance and color artifacts. The artifacts are unpredictable byproducts of the complex processing required to interpolate the information mosaic image sensors miss. However, blur filters reduce artifacts at the expense of resolution and sharpness.

These trade-offs are unnecessary with Foveon X3 image sensors. There's no need to rely on interpolation to reconstruct missing information, because all the information is captured by the revolutionary three-layer design of Foveon X3 technology.

The Effects Of Blur Filters On Sharpness

Cameras using mosaic image sensors are forced to compromise between image quality and sharpness. Images directly sampled with mosaic sensors have better resolution than those taken using blur filters, but suffer from interpolation artifacts. Blur filters will alleviate the artifacts, but cause a reduction in overall resolution and image detail.

Mosaic Without Blur Filter

Visible artifacts without blur filter.

Mosaic With Blur Filter

Overall image softening with blur filter.

Foveon X3

Foveon X3 image sensor, no blur filter required.

Supporti

Full-color pixels enable new capabilities—and a new kind of camera.

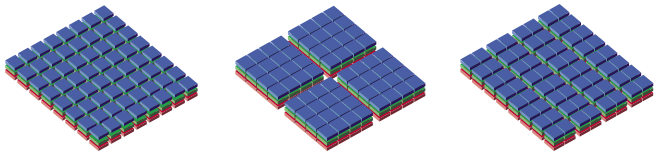
Foveon X3 image sensors not only lead to better pictures, but better cameras too, as a result of its powerful full-color VPS™ (Variable Pixel Size) capability. It opens the door to an entirely new breed of camera, one that can switch seamlessly between still photography and digital video, without sacrificing the quality of either.

The VPS capability allows signals from adjacent pixels to be combined into groups and read as one larger pixel. For example, a 2300 x 1500 image sensor contains more than 3.4 million pixels. But if the VPS capability is used to group those pixels into 4 x 4 blocks, the image sensor would appear to have 575 x 375 pixels, each of them 16 times larger than the originals. The size and configuration of a pixel group are variable—2 x 2, 4 x 4, 1 x 2, etc.—and are controlled through sophisticated circuitry integrated into Foveon X3 image sensors.

Because Foveon X3 image sensors capture full color at every pixel location, pixels that are grouped together form full-color "super pixels." No other image sensor can do this.

The grouping of smaller pixels into larger pixels increases the signal-to-noise ratio, allowing the camera to take full-color pictures in low-light conditions with reduced noise. Using the VPS capability to increase pixel size and reduce the resolution also allows the image sensor to run at higher frame rates, accelerating the speed at which images can be captured.

This makes it possible to shoot high-quality digital video, enabling the development of the first cameras with true dual-mode functionality. Without Foveon X3 technology, cameras attempting to accommodate both still and video functions must sacrifice performance in one mode to do the other well. And since the sizing of pixels can be done in an instant, a Foveon X3 image sensor can capture a high-resolution still photo in the midst of recording video—yet another first in digital photography.

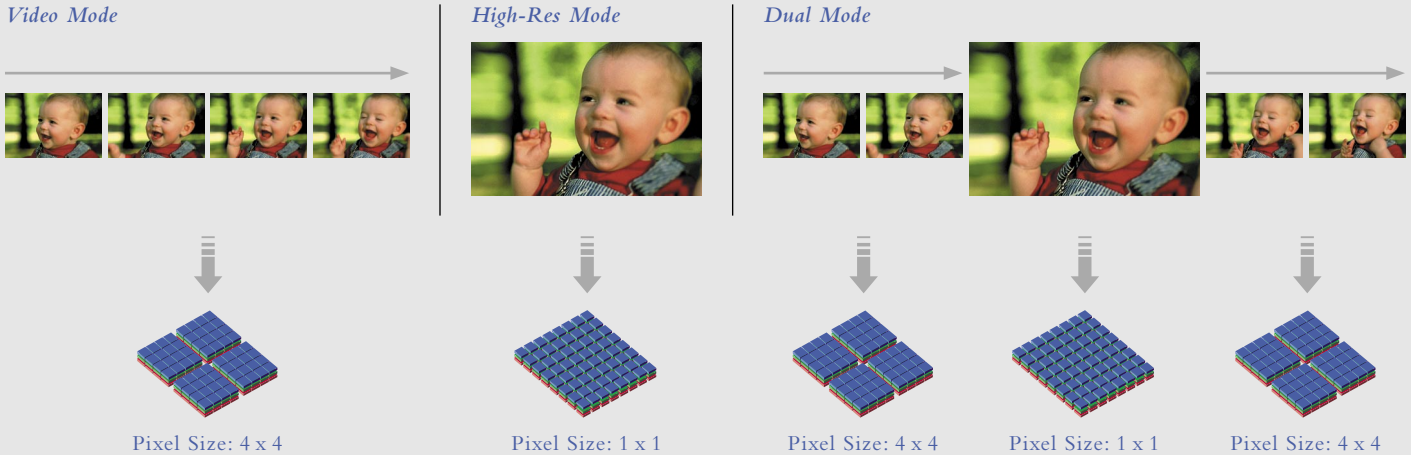


Pixel Size: 1 x 1 | Pixel Size: 4 x 4 *(using VPS)* | Pixel Size: 1 x 2 *(using VPS)*

VPS enables a Foveon X3 image sensor to be addressed in variable resolutions.

From Video To Still And Back

The unique design of Foveon X3 image sensors allows instant switching from high-quality video to high-quality photography—and makes it possible to capture a high-resolution still picture in the midst of recording video.



ng powerful new features.

A simpler, more flexible approach to windowing applications.

Foveon X3 image sensors support a highly flexible on-chip readout system, simplifying the implementation and enhancing the functionality of digital zoom, scene metering and other camera features.

The ability to selectively read out any rectangular region of the sensor array, known as windowing, stems from the fact that individual pixels can be accessed anywhere on a Foveon X3 image sensor. Windowing is controlled directly on the chip, allowing any size window at any location to be accessed and displayed with one-to-one pixel resolution.

Mosaic image sensors, by contrast, usually have no on-chip window readout capability. At best, they offer a fixed set of preset readout options. With Foveon X3 technology, digital camera manufacturers do not face these limitations, making it easier to implement windowing applications, and enabling them to offer more flexible features.

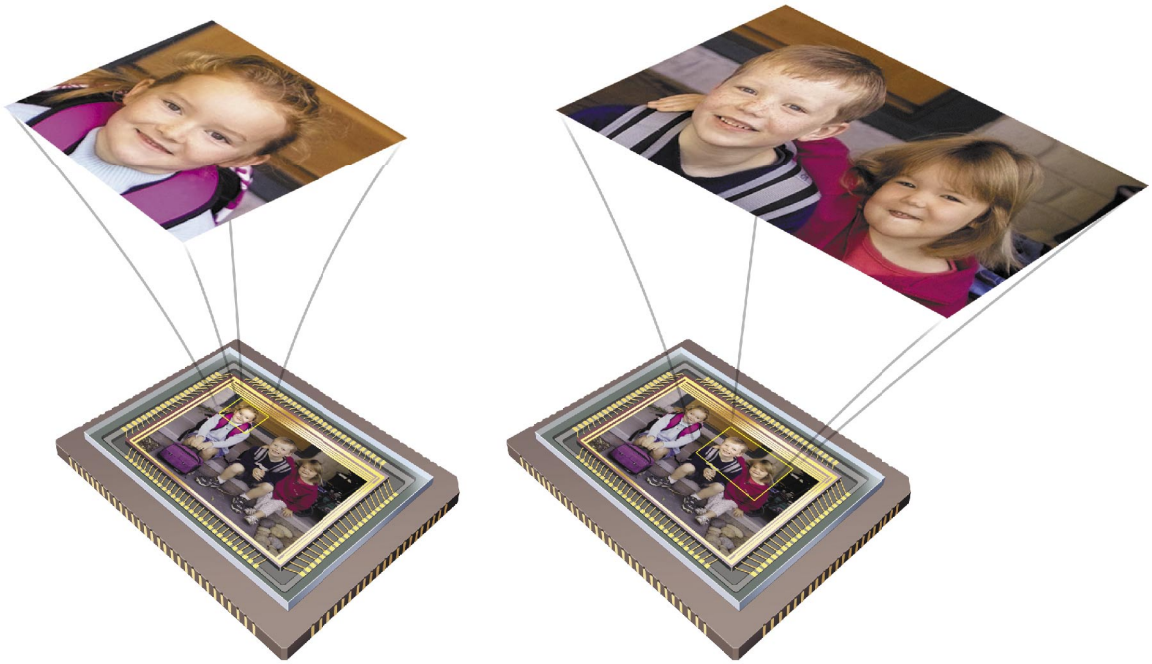
With Foveon X3 windowing, for example, it is possible to digital zoom into any region of an image—toward the top, bottom, right, left—depending on the area of interest. Because Foveon X3 image sensors take sharper pictures than any comparable mosaic-based systems, images captured through digital zoom will be sharper, pixel for pixel.

In addition to the enhanced digital zoom, Foveon X3 technology offers greater flexibility in scene metering. By specifying multiple window read areas, a wide variety of zone metering patterns can be easily implemented, accommodating a diverse range of lighting situations and end-user needs.

Windowing on a Foveon X3 image sensor can also be combined with the VPS capability and use larger pixels to enhance the performance of applications such as auto-focus, digital zoom and zone metering. Powered by the fundamental advantages of full-measured color, Foveon X3 image sensors deliver capabilities and image quality that today's mosaic-based products cannot match.

Foveon X3 Windowing

Windowing with a Foveon X3 image sensor allows any rectangular region on the senor to be selectively read out, enabling auto-focus, digital zoom and zone metering.



FOVEON®

2820 San Tomas Expressway
Santa Clara, California 95051

877.436.8366
www.foveon.com