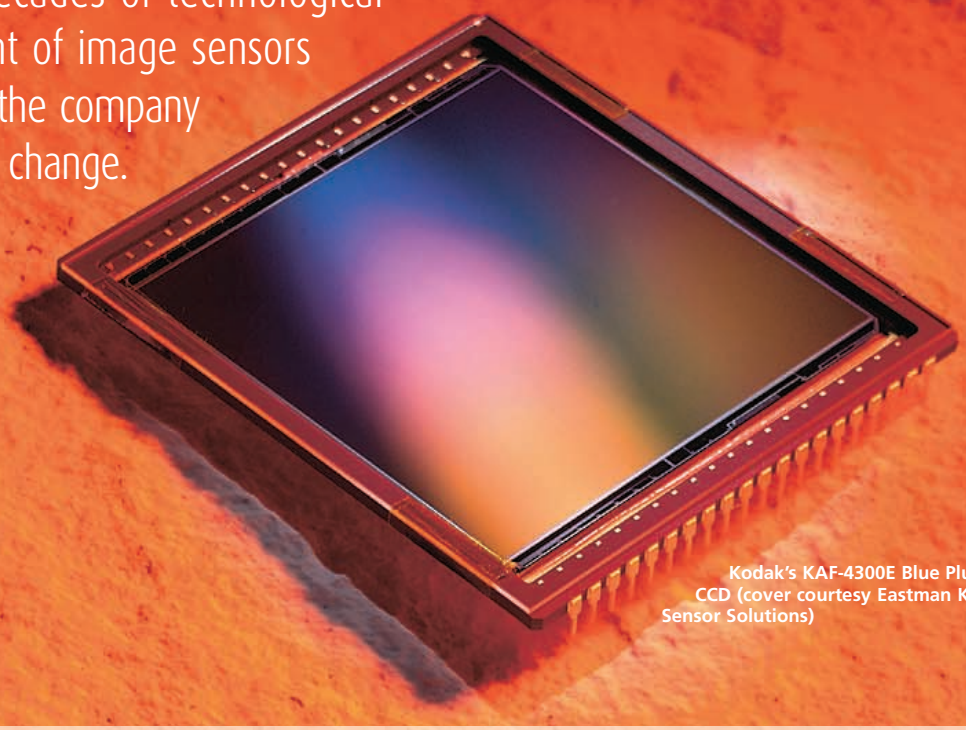
Kodak Sets Sights on World Imager Market

With two decades of technological development of image sensors to boast of, the company works a sea change.



Kodak's KAF-4300E Blue Plus full-frame CCD (cover courtesy Eastman Kodak Image Sensor Solutions)

According to Frost and Sullivan, an international marketing company, the worldwide market for image sensor integrated circuits in 1999 was approximately $1 billion and is estimated to grow to more than $1.7 billion by 2003. For the past twenty years and more, the division of Eastman Kodak then called the Microelectronics Technology Division (MTD) existed primarily to supply products and services to other Kodak divisions for use in professional digital cameras, film and paper scanners, and various government programs. But last year the company shifted its sights. Renaming the division Image Sensors Solutions (ISS), Kodak announced plans to market its line of image sensors worldwide.

Chris McNiffe, vice president of sales and marketing for ISS, says that the decision, and the new organizational structure it entailed, was dictated by the rate at which Kodak's core business was changing from film to digital technology. Now ISS is a full profit-and-loss center within the company, driven by commercial pressures and customers' needs. To signal the change, Kodak announced the availability of five new image sensors, including its first two embodying the complementary metal oxide semiconductor (CMOS) technology and a 16-million-pixel device that the company says has the highest resolution of any sensor on the market. The last is expected to find applications in astronomy, high-end studio cameras, and portrait cameras.

Though Kodak's product offerings range across full-frame, interline, and linear CCDs, along with their new line of CMOS imagers, it was the MTD's concentration on performance and features not found in other commercially available sensors, including higher-resolution, large-pixel devices with high dynamic range, that laid the groundwork for ISS's current position. By focusing initially on full-frame technology, ISS developed multi-megapixel imagers, and the digital replacement of film became a reality.

Last summer's introductions included two new CCDs for digital cameras: the aforementioned KAF-16801CE, a 16.8-million pixel device that is targeted at studio camera developers, and the KAF5100CE, a 5.1-million-pixel device designed for digital cameras used by professionals and advanced amateurs. All of Kodak's full-frame CCDs encompass the patented Blue Plus process, which, coupled with on-chip color filter arrays, provides significantly enhanced photoresponsivity, according to the company. This results in very high equivalent film speeds — up to 1600 and higher. Other features include a range of pixel sizes, from 6.8, 9, and 11 microns up to 13; ultralow dark current for improved dynamic range; antiblooming control for high light conditions; and enhanced blue sensitivity.

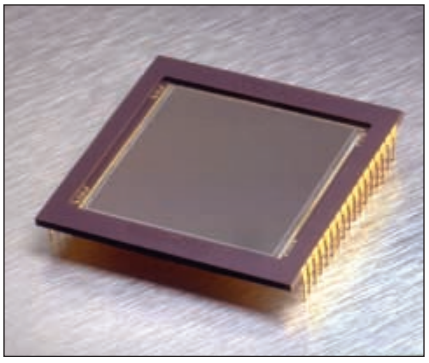
Launching CMOS

Along with these two devices, the summer introduction saw the most recent additions to the line of Kodak Digital

Science image sensors and the first to be based on CMOS technology. The CMOS devices are highly integrated image sensors that feature on-chip timing, programming control, analog signal processing and a 10-bit analog-to-digital converter — the "camera-on-a-chip" approach that results in smaller systems that consume less power. The KAC-0310 VGA sensor is a 640-×-480-pixel array in a 1/3-inch optical format using a 7.8-micron pinned photodiode active pixel structure. Developed for the CMOS line, and patented by Kodak, the pinned photodiode architecture separates the photodetector from the part of the pixel that transfers the charge, yielding, Kodak says, a better dynamic range and thus a higher ISO rating. (According to McNiffe, the average ISO for CMOS devices these days is ISO 60, where Kodak delivers ISO 200.) The sensor incorporates Kodak's patented "global shutter" technology that reduces image blur by simultaneously exposing the entire pixel array rather than sequencing the exposure line by line, as is typical.

The KAC-1310 VGA 1.3-megapixel CMOS sensor shares many features with the KAC-0310. It is a 1280-×-1024-pixel array in a half-inch optical format using a 6-micron pinned photodiode pixel structure. With a sensor output of 8 or 10 digital bits, it supports both progressive or interlace scan modes.

Kodak's CMOS imagers are the first commercial sensors to be produced through a joint development agreement by Kodak and Motorola. Both are fabricated in the ImageMOS process jointly developed and patented by the two companies. It sprang from well-established technology originally fashioned for dealing with the ever smaller linewidths on semiconductors; the companies introduced small improvements that enable the CMOS devices to combine Kodak's digital imaging experience with Motorola's semiconductor manufacturing and integration capabilities.



Kodak Digital Science™ KAF-16801CE image sensor, with 16.8-million pixels.

Kodak's KAF-1602E series Blue Plus full frame CCD.

CCD vs. CMOS

According to McNiffe, the differences between the CCD and the CMOS technologies result in a series of tradeoffs. CMOS devices use less power, and are therefore suitable for handheld devices with smaller batteries or whenever smaller means better. The level of integration in CMOS devices is greater, and they can approach the design goal of a "camera-on-a-chip." These factors, along with economies of scale in fabrication, mean that CMOS is the technology of choice where cost and high-volume production are issues.

CCDs, however, have two current advantages over their CMOS counterparts: they are capable of much higher resolution (resolution of CMOS devices is generally in the vicinity of 1.3 megapixels, whereas that of CCDs ranges from 3 to 16 megapixels and higher), and because they have much less noise and dark current than what the CMOS manufacturing process imposes on the latter devices, CCDs have much better dynamic range. Thus CCDs are suitable for any application where image quality is the most important factor: camcorders, spy satellites, radiographic and other biomedical products; CMOS technology finds its niches in such low-end devices as consumer cameras and machine vision, where high resolution is secondary to cost and ease of integration. In fact, McNiffe predicts, "within two to four years CMOS will own the consumer digital camera market."

In the new millennium ahead, Eastman Kodak is well armed to make the company felt in the imaging marketplace. The company has a contract with Motorola to produce the high-volume CMOS sensors, and its Rochester, NY, facility can expand for the production of CCDs. As McNiffe puts it, "Now Kodak is out there in the thick of things."

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