Digital Cameras Part I

By Andrew Rodney

The New Wave of High-End Digital Cameras

The last quarter of 1998 will go down in digital imaging history. That's when instant-capture digital cameras came to match—often exceed—film-camera quality! In September 1998, several camera manufacturers announced new instantaneous capture digital cameras at the Seybold show in San Francisco. A few weeks later in Germany, several more cameras were introduced at Photokina—some instant capture, others that use multiple capture or scanning technology. I was lucky enough to have several camera vendors provide me samples of these cameras for review in *PEI*.

Many of the cameras I saw use new generation 3Kx2K (approximately 6,000,000 pixels), two-dimensional sensors that provide files of about 18MB in 24-bit color. Not all the cameras used the same make of CCD, and not all the companies would tell me which manufacturer made the CCDs in their cameras. However, it appears that between advancements in CCD chip manufacturing and recent software developments, these new cameras provide a new level of quality in instantaneous as well as multiple shot capture.

Improvements in Instant Capture

Light-sensitive CCDs are monochromatic devices, which, by nature, cannot record color images without filtration. Therefore, to create instantaneous color images, it is necessary to use three colored filters—one each for red, green, and blue—over the CCD (unless the camera has three separate CCD chips, one for each color). In most instant-capture, single-CCD cameras, the colored filters are "painted on" in a matrix that allows sharing of the color data. Each sensor sees only one-third of the colors (red, green, or blue), however, once the filtered CCDs are exposed, the camera's software interpolates the other two colors based on assumptions about a neighboring pixel and the color it records. This data sharing can create considerable problems with artifacting (multicolored noise known as the "Christmas tree effect") which shows up in highlights and high-contrast areas.

Pixel blooming, which likewise degrades image quality, can also be a problem with CCD sensors that are packed very close together. Blooming is the result of an over-exposed CCD element spilling light over into an adjacent pixel, which causes flare. Advancements in CCDs and digital camera software have virtually eliminated both the Christmas tree effect and blooming problems in most images. If pixel aliasing does appear, it is to a lesser degree. Moreover, these cameras produce such large files that color problems are far less noticeable in the output.

A significant advantage of digital capture has always been a wide dynamic range and a lack of graininess (See "Film vs. Digital," *PEI* April 1998). Now that the color of the captured images is so much cleaner, these 18MB files can be output at much larger sizes than with earlier models. The camera CCDs reviewed here are similar in size to a 35mm frame, yet interpolating these files up 200 percent or more produces output of impressive quality.

Since the pixel artifacts are minimal and the capture clean, these new cameras provide far more "horsepower" than you'd expect from a scanned 18MB file. Based on my tests, printing these files as large as 30 inches at 200 dpi results in image quality that easily exceeds 35mm enlargements printed on all but the finest grain film.

These new cameras also provide some innovative capabilities that make the shooting experience far more productive, and more like conventional film photography than ever before.

Kodak DCS-560

With the DCS-560, Kodak retains the superb design and features of the DCS-520, and improves it by incorporating a 3,072x2,048 CCD, measuring 27.5x18.4mm (actual image capture size of the DCS-520 is 3,040x2,008). The camera body is based on the Canon EOS 35mm SLR, so it is a completely portable system that mimics the 35mm shooting experience. Since the CCD is very similar to a 35mm frame, several significant advantages are presented to the photographer. First, placing a standard 35mm Canon lens on the camera produces a focal length close to that of a 35mm film camera.

Much like the DCS-520, the viewfinder on the DCS-560 is WYSIWYG. The newer model has a

beautifully large, clear LCD affixed to the back, with useful features to greatly improve the shooting experience. Naturally, the LCD displays the just-captured image, but it also allows the user to inspect previous images written to the internal PCMCIA card. Like the LCD on the 520, the newer camera provides image histograms along with highlight and shadow clipping, right on the display. The capability to evaluate the quality of an image immediately after capture makes conventional Polaroid test shots a thing of the past. Users can configure the LCD to display a single large preview, as well as a set of four- or nine-up thumbnails. Virtually all camera controls and functions can be set in the simple menu system displayed on the LCD, as can such manual controls as shutter speed, exposure compensation, ISO settings (80-200), and other controls unique to the digital components of the DCS-560.

The removable and rechargeable NiCad batteries (not included) also give this camera an advantage over its predecessor. Kodak claims that one battery will produce up to 100 images per charge, depending on the use of the LCD. There's an automatic white balance sensor mounted on the body of the camera, along with four manual settings—for daylight, strobe, tungsten, and fluorescent conditions— and a "custom" white balance function. To download images, the DCS-560 uses FireWire (a.k.a. IEEE 1394), a wonderful way to move images to a host computer. The camera has a beefy RAM buffer, allowing a burst rate of one frame per second with a maximum three-frame buffer. When the buffer is filled, an image is written to the PC card every seven seconds. When shooting in the studio with quick recycling strobes, there were no delays while photographing our models, although your mileage may vary depending on your shooting style.

The Version 5.X beta of the Adobe Photoshop acquire module is similar to the software that presently ships with Kodak cameras, with an added feature for on-the-fly sharpening of DCS-560 files (highly recommended). The module allows the proprietary camera files to be imported to Photoshop at eight or 12 bits per color. Individual images can be rotated, cropped, and named, all prior to image acquisition. With this software, you can also output proof sheets of selected images in three different sizes. (The 35mm frames around the images waste a good deal of space, however, and serve no practical purpose.) Acquiring the full 3Kx2K file on a 266 MHz G3 Macintosh is fast—about 30 seconds.

Canon Auto Focus lenses are sharp and blazingly fast. We produced 12x18-inch prints of exceptional quality from our Fuji Pictrography 4000 printer, without Unsharp Mask filtration (but with sharpening in the Kodak Acquire Module). To find any sign of aliasing or blooming on screen, you'd have to zoom in far past 100% in Adobe Photoshop. The quality is a quantum leap over the older Kodak DCS-460 or any of the older generation instant capture digital cameras I've used.The software runs on both Macintosh and Windows 95/NT; suggested retail price of the Kodak DCS-560 is $29,995.

More info? Circle 125

Phase One LightPhase

Phase One has been producing some mighty impressive scanning cameras for several years. The new LightPhase marks the company's first non-scanning, instantaneous capture digital back. Like the other Phase One cameras, the LightPhase camera back is designed to fit on a conventional camera body, in this case, a Hasselblad medium format. It has a 2,000x3,000-pixel CCD (36x24 mm) that, like the Kodak DCS-560, produces an 18MB, 24-bit file. The back has an internal 48-bit data path that allows 14-bit analog-to-digital conversion and, for editing in such applications as Photoshop 5.0, the option of a 36MB, 48-bit file.

The LightPhase is intended for studio use, and must be tethered to a host computer via FireWire cable (up to 200 feet). Phase One promises a belt-type battery pack and storage unit in the near future, so the camera can be operated without a computer. Images are captured every

1.5 seconds, and the photographer can continue shooting as long as there is space on the hard drive; the ISO is 50.

Three seconds after the image is captured, the camera's excellent software interface presents a large preview on screen. Since the CCD is 36x24mm, it can be quickly rotated on the Hasselblad for portrait or landscape orientation. However, because the chip is smaller than the 2.25x2.25 Hasselblad format, you have to insert a mask into the viewfinder to see the exact capture area. In addition, a standard Hasselblad lens will produce a different field of view when used with the LightPhase digital back.

The LightPhase can be used with Hasselblad's entire line of mechanical and electronic bodies. For shooting with flash, a standard sync cord attaches to the back, along with the IEEE 1394 FireWire cable; a cable then runs from the LightPhase to the Hasselblad lens. The software that drives the camera is similar to the software that drives Phase One's scanning cameras, with a few added features. Worth noting is the feature that allows you to apply a standard tonal curve to the high-bit data, much as you would do when scanning conventional film. This curve is applied prior to the image data processing, so that a fully toned 48-bit file can be brought into Photoshop without additional corrections. You can also examine out-of-range clipping of highlights and shadows with this software, and load a custom ColorSync/ICC profile for the camera. A large preview window makes inspecting captured images an easy task.

I found the lighting set up to be easy and precise, because I could inspect all of the images on a calibrated 21-inch Mitsubishi SpectraView display. The ability to examine highlight and shadow clipping allows the photographer to set lighting and exposure for optimum results. As with the Kodak DCS-560 LCD display, there appears to be a significant advantage to shooting digitally: The camera's robust tools provide absolute control over lighting and exposure before the capture begins. The only minor disadvantages I found in using this system are working with a masked-off viewfinder, and not having a hot mirror filter affixed to the actual back, so the user must place a filter on the lens, which makes the image look somewhat dark and greenish through the viewfinder. I found neither the lack of a square format nor the need to rotate the back to be a disadvantage. It's rare that square film format doesn't get cropped to a rectangle, so doing it at the shooting stage didn't hamper my style.

LightPhase image quality is truly amazing. Phase One has filed a patent on a new software technology that, according to the company, uses a process that replicates human vision. I'm not sure what that's supposed to mean, but the resulting files are significantly better than files of the same size from the DCS-560. Obviously, Phase One has some unique tricks for processing raw files. On the Macintosh G3, the beta version software I used took about 45 seconds to process each 48-bit, 36MB file. The company says the final version of the software will be significantly faster.

The 12x18-inch prints made from the LightPhase were of superb quality, tack-sharp, and required absolutely no image processing. I was able to interpolate the file to 107MB and output 30-inch prints to a Kodak LED printer with excellent results, far sharper than the same print made from the Kodak 560. The LightPhase operates on a Mac or Windows system (FireWire capabilities necessary) and lists for $22,990.

More info? Circle 126

MegaVision S3

The new MegaVision S3 camera back fits onto several medium-format cameras, including the Hasselblad 500 series (200 series custom fit); Mamiya 645, RB, and RZ; Bronica ETRSi and SQB; and Fuji GX680. It provides 2Kx3K instantaneous capture, and the 12-micron, 36x24mm CCD sensor produces a 3,072x2,048-pixel, 36-bit file. As with the LightPhase, a small mask must be placed on the ground glass to indicate the actual capture area, and standard medium-format lenses will exhibit a change in focal length when used with the CCD. No hot mirror filter over the lens is required. The S3 chip is rated at ISO 80. Instead of FireWire, MegaVision uses a proprietary 22-foot cable to connect the camera back to the computer, as well as it's own PCI card, which is inserted into the host computer.

A grayscale image appears on screen a mere 0.25 seconds after the image is captured, and you can shoot one frame every second. For a slight sacrifice of speed, you can opt for a color preview. The PhotoShoot

software is speedy because all the images captured are recorded into RAM. Images are downloaded to the hard drive after the shooting. However, the amount of RAM on the host computer directly influences how many photos can be captured. For example, with 192MB of RAM, only 12 images can be captured.

An AutoSave function is available, requiring an additional four seconds per image as the files are saved to disk and the RAM buffer freed up. Therefore, your options are to either have a lot of RAM and shoot quickly, or to delay the capture rate. My only concern with the former is that a system failure could wipe out all the images I had just saved to RAM!

The PhotoShoot software that drives MegaVision cameras offers significant control and many features, but it has a complex and laborious interface. I appreciate the powerful features the software provides, such as the number of different tonal clipping previews. The features you'd expect are all there, such as on-the-fly conversions to CMYK, but it is not ColorSync/ICC-savvy. A pop-up menu allows you to pick one of three processing algorithms to reduce pixel aliasing. While this greatly increases processing time, it does seem to clean up the files a great deal. One superb feature of PhotoShoot is the ability to select as many as 20 areas in the preview to set a neutral value for the file.

The quality of images captured with the S3 is very good, as you would expect from the new generation of chips, but the files aren't as sharp as those from the LightPhase, and the degree of color pixel aliasing was a more pronounced. With a dose of Unsharp Mask filtration (or better yet, the PhotoShoot sharpening controls), it would be easy to make the S3 capture almost as sharp as the LightPhase.

PhotoShoot software supports only Power Macintosh, but an NT version is expected any day now. MegaVision promises an S2 version of it's portable BatPack in the near future, which would provide complete mobile location shooting. Suggested price for the camera system is $22,500.

More info? Circle 127

Multiple Capture CCDs

Among the cameras I evaluated for this article is the three-exposure (one each for red, green, and blue) instant-capture digital system that produces true non-interpolated color with a new 2Kx3K chip. A filter wheel rotates between each exposure, providing red, green, and blue data instantly over the two-dimensional CCD. Since three exposures are necessary, this kind of camera can be used to photograph only non-moving subjects. However, this kind of capture suffers none of the interpolated color problems associated with the instant capture cameras discussed above.

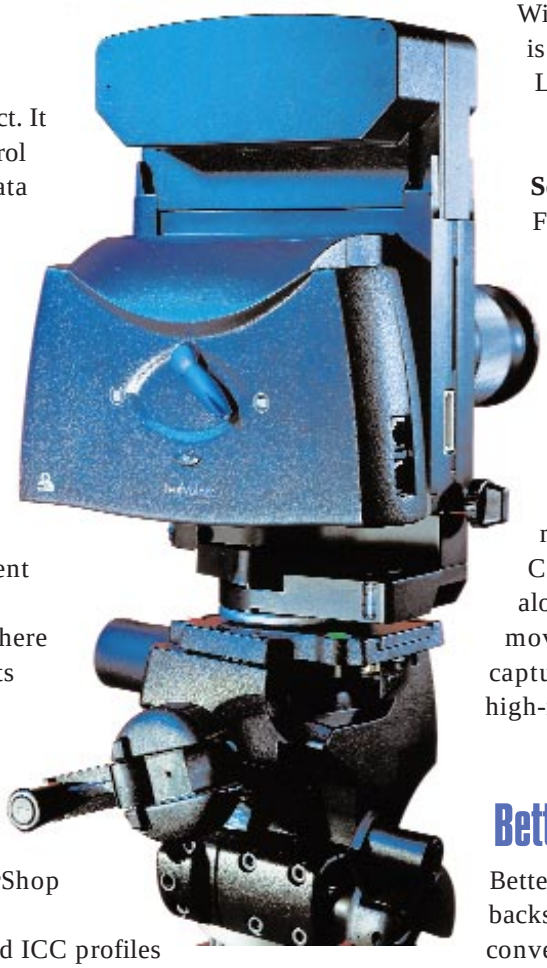
Leaf Volare

The 2,048x3,096 pixel Active Cooling CCD chip housed in the Leaf Volare camera back yielded stunning images. The Volare back mounts onto conventional camera bodies such as Hasselblad, Mamiya, and the Fuji 680. I used the back on the Leaf SinarCam, which has a built-in internal filter wheel.

The Volare has some unique features. For example, by simply twisting a small lever on the back of the camera, the rectangular CCD can be moved instantly to either horizontal or vertical format. Another unique feature—which I find insanely great—is the live video preview function that allows the photographer to focus, compose, and adjust lighting in real time while examining a black-and-white, high-resolution preview on the computer monitor. The supplied ColorShop software even allows you to focus the lens anywhere in the set with the graphical interface Leaf calls "LiveFocus." In addition, the software and LiveFocus support an overlay function that allows a saved, low-resolution image to be superimposed over a live preview while you compose the set. This would be a great aid for photographers who must shoot to an art director's layout specifications.

The Volare produces images of superb quality, thanks in large part to the active CCD cooling, which virtually ensures noise-free images, with exposures up

to 32 seconds. The camera captures 14 bits of data per color, and Leaf states it has a dynamic range of more than 11 f/stops. The ColorShop software is both powerful and user-friendly. Aside from a few shortcomings, it provides all the controls and features I would expect. It supports a sophisticated curve control for optimizing the total 42 bits of data the camera can capture. In addition, ColorShop has some of the most powerful sharpening controls I've ever used in camera driver software. Global and selective color controls are provided as well.



Leaf users rave about the quality of ColorShop's RGB to CMYK conversion controls, though I wish Leaf would implement an open workflow. The software doesn't support ICC profiles, and there is no means for saving out any of its proprietary CMYK conversion information; therefore, it's impossible to see an accurate preview when you bring a CMYK file from ColorShop into Adobe Photoshop. While the ColorShop conversions may be excellent, the noncompliance with Photoshop and ICC profiles left me less than satisfied. The Volare also requires a dongle (hardware protection) to operate, which I have always found to be an annoyance. Scitex promises that Version 4.1 will support ICC profiles.

Yet the quality of the Leaf Volare is no less than outstanding. I used it to photograph textured clothing, a subject that severely taxes many digital cameras and frequently produces moiré patterns, without any such artifacts. The anti-blooming technology is also impressive. When I photographed a shiny coin fully reflecting the light source, I could not produce visual pixel blooming in the capture. The 18MB, 24-bit RGB files (36MB in 42 bits) can be interpolated several hundred percent with no evident loss of quality in the output.

ColorShop's interpolation algorithm, when mated with the excellent sharpening tools, produces files of incredible quality, even when sized as large as 100MB. The instant capture cameras we've discussed are excellent, but not in the same league as a three-shot camera system using the same 2Kx3K chip. For the studio photographer who wishes to shoot with flash and whose subjects do not move, the Volare is a camera back to seriously consider. It currently operates only on the Macintosh system, but a Windows NT version of ColorSharp is in the works. The list price of the Leaf Volare is $25,000.

More info? Circle 127

Scanning Backs

For this review, I evaluated two new scanning cameras that operate just like the tri-linear CCDs in conventional desktop scanners. They produce true color, but they can take several minutes to capture an image. Because the CCD is not two-dimensional, manufacturers can produce a CCD that has a great many pixels along a single axis and then simply move that CCD over the image capture plane, which allows for very high-resolution images.

Better Light 6000

Better Light offers three scanning backs, each of which fits onto a conventional 4x5-inch view camera. I tested the Better Light 6000, which has a resolution of 6,000x8,000 pixels (137MB in 24 bits). The camera is beautifully designed and manufactured, with great attention to detail. The back ships with a proprietary cable that looks much like a standard SCSI cable (I used the optional 25-foot version). This cable runs from the camera back to the supplied external hard drive enclosure. The model I used contained a 2GB hard drive, where all the captured images are stored after shooting. I also used the Better Light optional battery kit, which allows the photographer to shoot on location when the external drive is mated to a laptop computer. There are few scanning backs with this option.

The Better Light is the fastest scanning camera on the market. I was impressed that while on location, at sunset, with the aperture set at f/22, I produced prescans in about 10 seconds. The camera back has a flicker-free technology so that any continuous lighting can be used, including standard tungsten. My only real criticism of the Better Light system is the antiquated software that drives it. The previews are small, and

there are few of the controls found on other scanning cameras.

The software allows you to create and save capture curves, which are applied to the 14 bits per color to produce a final 24-bit file. The interface is neither intuitive nor well designed, but it is surprising powerful. It ships with a number of pre-set Capture Curves, which worked quite well on location. In other shooting situations, the kind of curve selected or created can have a significant impact on the quality of the resulting file. You can save the raw 14-bit file and apply curves later in Photoshop.

The software has a nice focusing aid that allows the user to precisely focus using the prescan, as well as an interface with feedback so you know when the image is sharp. The captured images go directly to the supplied hard drive, and the user must use the File Manager to move the files onto another drive. I would have liked the option to bypass the drive and save files to any drive I desired. The quality of the images I captured from the Better Light was excellent, once I picked the best capture curve.

The really good news is that a newer version of the software is promised. The software runs on Macintosh systems, but a Windows version is planned for the end of this month. Retail price of the Better Light 6000 is $19,900.

More info? Circle 128

Leica S1 Pro

Leica's entrant in the digital camera arena is a scanning camera (not a back) called the S1. This beautiful camera produces a maximum file size of 5,140x5,140 pixels (76MB in 24-bit color), with capability of 14 bits per color and a stated dynamic range of 3.3 (which Leica says corresponds to 11 f/stops). The S1 can be used with several kinds of lenses, once the appropriate adapter is mounted. Photographers can choose Leica R and M lenses, Hasselblad, Pentax 6x7, Contax, Canon FD, Nikon, Minolta, and Rodenstock, or Schneider lenses with the optional Shift & Tilt Adapter. Since the CCD is a perfect 36mm square, when mated to a standard 35mm lens, the focal lengths undergo virtually no change.

A small viewfinder built into the camera body makes image composition easy. Like the Better Light scanning backs, the S1 incorporates a flicker-free technology, which can be used with tungsten, HMI, and fluorescent lighting. The software that drives the S1, is a superb scanning interface with robust controls, such as Unsharp Mask with high-resolution preview, curves, selective color, full ICC/ColorSync support, and the ability to scan into RGB, CMYK, or LAB. The densitometer allows the user to work in any of the supported color spaces.

LaserSoft supports a large, resizable interface, unlimited undos, and the ability to save the captured image in high-bit data (16 bits per color), so users can do further work in Adobe Photoshop in 48 bits. Another superb feature of SilverFast is the pre-made corrections that automatically analyze the file and apply some good auto corrections to the raw data. For exacting work, you can override SilverFast's editing functions and manually control exposure and color balance at the hardware level.

The quality of the S1 images I captured was

excellent. Scan time was also impressive: I captured a full-resolution image using a few Lowell tungsten lights in less than two minutes. I recommend the Leica S1 camera to studio photographers who don't need huge files, but want excellent software and plenty of lens options. The price of the S1 is $21,500, and it is compatible with Mac and Windows systems. (If your budget is tight, check out the S1 Alpha model, which can be upgraded later.)

More info? Circle 129

Jenoptik eyelike

The Jenoptik eyelike is an interesting modular digital camera back that can be used as a 4x5 view camera back or as a stand-alone camera. The eyelike can actually be used in three different capture modes, all of which provide 12 bits per color. Jenoptik has produces a two-dimensional area array CCD of 2,048x2,048 pixels. The eyelike can capture images instantaneously in one-shot mode, or stationary subjects in the four-exposure mode, using filters that move in tandem with the CCD between exposures. The camera takes one red, two green, and one blue filtered exposure to provide superior non-interpolated color files. A cleverly designed third mode allows high resolution scanning capture.

In single or four-capture mode, the camera uses a 2K-square area array. However, the sensor can be moved into 36 different positions with the optional scan module controller. This allows the photographer to "scan" an image in 2Kx2K chunks, producing files as large as 6,144x6,144 pixels. With this two-dimensional area array, you can use continuous lighting, such as tungsten, daylight, HMI, or fluorescent. Because the 2K array moves, the available "scanning" resolutions are 2,048x2,048 (12MB), 4,096x4,096 (48MB), or 6,144x6,144 (108MB).

In stand-alone mode, various front lens adapters allow you to use standard lenses. When capturing images instantaneously, exposure times can range from $^{1}/_{1,000}$ to one second with an in-lens shutter. As an option, the camera itself has a shutter range of $^{1}/_{60}$ to one second. Jenoptik claims the eyelike can scan a full-resolution, 108MB file in as little as 40 seconds. The files are transferred from the camera to the computer with a fiber-optic connection to the supplied PCI card.

A unique feature of the camera package allows the photographer to compose subjects against a blue background, and then seamlessly superimpose various backgrounds. The eyelike can be set in a live mode, in which an on-screen preview can be updated every half second, allowing the photographer to compose the shot on the set. The eyelike runs on either Macintosh or Windows 95/NT systems. Price begins at $28,000, for the version that can capture the 2Kx2K files in one or four-shot mode, but not scanning mode; the optional scan module adds $9,990 to the price. ◀

More info? Circle 130

SinarBack

I wasn't able to test the new SinarBack, but I think it's worth a look. The 2Kx2K (2048x2048 pixels) unit fits many cameras, including Hasselblads, Sinar p2 or f2, SinarCam2, Mamiya RZ, Fuji GX680, and Rollei 6008. It shoots both single and four-shot exposure to produce non-interpolated color. This flexibility allows the instant capture of moving subjects, plus the high-quality capture of stationary subjects, under strobes or continuous lighting. The piezoelectronic element repositions the CCD array four ways for use in the multi-shot mode. The incorporation of two drives for the horizontal and vertical movements of the filter is meant to improve registration. According to the specifications, the cooled CCD is rated at ISO 100 with a dynamic range of 11 f/stops and 14-bit color. Three modes of live color video ease composing on set. I'm told the interface that drives the camera is "Photoshop-like," and allows such features as multiple exposures, ICC profiles, and the ability to export files to TIFF, Photoshop, and other formats. The software runs on a PowerMac, and a Windows NT version is due soon. List price is $26,868. ◀

(continued on page 25)

Andrew Rodney continues his review of the latest digital cameras next month in PEI *magazine.*

Camera	Mode of capture	Max resolution	Price
BetterLight 4000*	Scanning	3,750x5,000 pixels, 53MB, RGB	$11,990
BetterLight 6000	Scanning	6,000x8,000 pixels, 137MB, RGB	$19,900
Betterlight 8000*	Scanning	8,000x10,640 pixels, 244MB, RGB	$29,900
Jenoptik eyelike	Scanning, Single and Multi-shot	2048x2048, 12MB, RGB, 24 bit up to 6144x6144, 108MB, RGB, 24 bit	$28,000 to $37,000
Kodak DCS-520*	Instant	1736x1160, 5.7MB, RGB, 24 bit	$14,995
Kodak DCS-560	Instant	18MB RGB, 24 bit	$29,995
Leaf Volare	Three shot	18MB RGB, 24 bit	$25,500
Leica S1	Scanning	5140x5140, 76MB in 24 bits	$21,500
Phase One LightPhase	Instant	18MB RGB, 24 bit	$22,990
Phase One PowerPhase	Scanning	6000X8400, 144MB, RGB, 24 bit	
MegaVision S3	Instant	18MB RGB, 24 bit	$22,500

** not reviewed in this article*