AxioCam HR

Success Through Performance



The high-resolution camera for digital documentation

ZEISS

We make it visible.

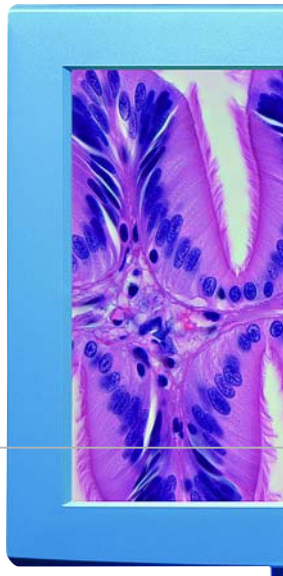
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Superior performance for research and routine work – brilliant quality documentation

Increasingly complex applications in pathology, developmental biology and material science demand microscope systems and camera technologies that reach the very limits of what is physically possible. A Carl Zeiss camera that meets even the highest demands of digital documentation has established itself in high-end microscopy. With needle-sharp images and brilliant color quality. Not to mention a good name: AxioCam HR – the Zeiss Blue.





High-resolution for lossless digital microscopy

Documenting with the AxioCam HR means seeing what the microscope sees – in full microscope resolution without interpolated image information. Different resolutions can be set depending on the application: from 1388 x 1040 up to 4164 x 3120, corresponding to 13 megapixels per color channel.

Outstanding image quality even with weak fluorescence

With a dynamic range of 2200 : 1 and a 14 bit gray level range, the monochrome version of the AxioCam HR produces high-contrast images even when it comes to demanding applications in fluorescence microscopy. The Peltier-cooled camera offers exposure times ranging from milliseconds up to several minutes. The advantage: high-quality images, even when signals are extremely weak.

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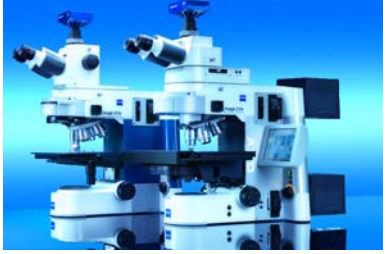
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Axiovert 200



SteREO Discovery



Axio Imager Material

Systems with Carl Zeiss quality: the complete solution with microscope, camera and software

Maximum convenience in a compact format

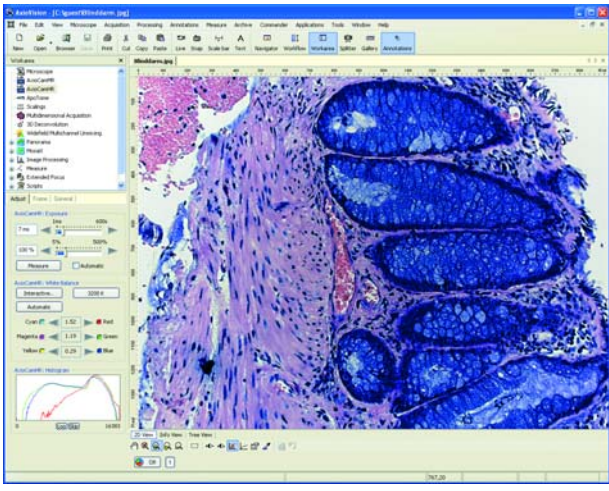
Very small dimensions and no external control box: the Zeiss Blue can be integrated as a compact solution into any laboratory or working environment and will not restrict your freedom of movement. As the AxioCam HR does not have rotating fans, it works without any vibrations and transfers the digital image data directly to your computer without interference.

Perfect interaction in the overall system

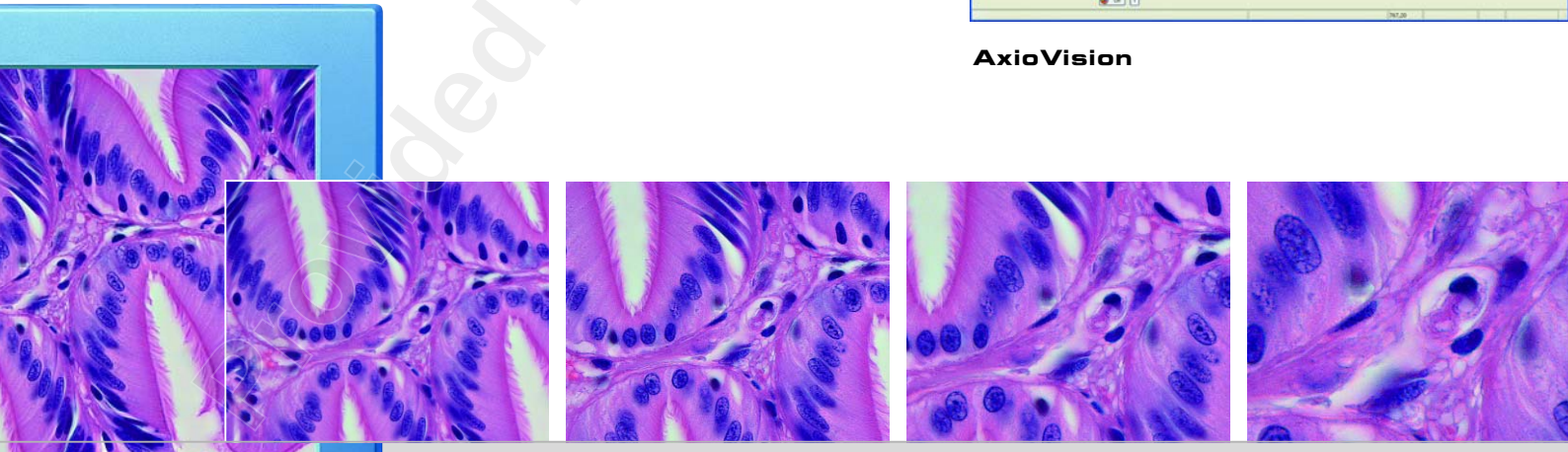
Carl Zeiss offers a wide range of components that complement each other perfectly and, when combined as an overall system, offer your applications optimum support. The AxioCam HR can be connected to any Carl Zeiss microscope that has a phototube or TV output. When combined with the Axio Imager or Axiovert 200 research microscopes and the AxioVision imaging software, you will have a high-performance system with a high degree of automation – for reliable, reproduceable results.

Intelligent control with AxioVision

AxioVision from Carl Zeiss is the software for all requirements in digital imaging. It allows you to control all the functions of both the camera and microscope. Acquisition and processing, analysis and archiving – all your work procedures combined in a single platform. AxioVision is practice-oriented, intuitive in terms of operation and easily adapted to your individual requirements.



AxioVision



Loligo Pealei (squid), liver,
Stain: hematoxylin eosin,
David Patterson, Marine Biological Laboratory,
Woods Hole, Massachusetts, USA

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Flexibility for every application: color and monochrome

Color or monochrome: always the right choice

Routine tasks or individual applications – the AxioCam HR from Carl Zeiss is the camera of choice for the complete range of applications. Whether you use it as a versatile color camera or in the monochrome variant with optional RGB filter modules – the AxioCam HR delivers color images in extremely high resolution, for every application.

Color co-site Sampling for excellent color brilliance

Accurate color images of even the finest structures without color moiré: the large CCD sensor of the AxioCam HRc ensures perfect color accuracy. By scanning all the red, green and blue components of the image, the patented Color co-site Sampling technique achieves a color brilliance that can otherwise only be achieved using 3 sensors. It guarantees you complete color information for every pixel – no "approximated" interpolated colors.

High performance at low light intensities

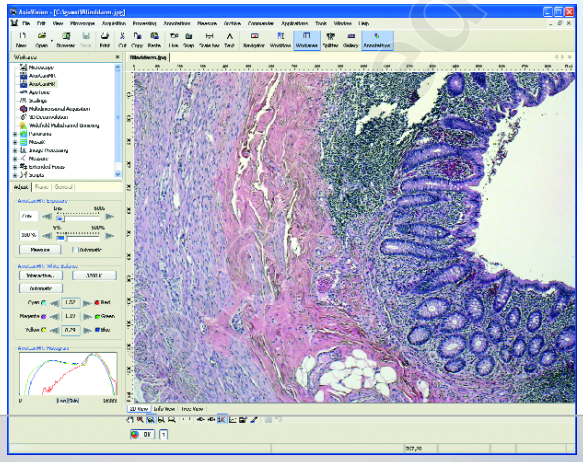
The extremely high sensitivity of the large 2/3" sensor, an outstanding signal to noise ratio and long exposure times – these are the qualities that allow the AxioCam HR to make high-quality imaging possible, even under the most challenging lighting conditions.

Monochrome CCD for fluorescence imaging

Sensitive, weakly fluorescing specimens or contrast and acquisition procedures in several dimensions require maximum resolution with exposure times that are as short as possible. The monochrome version of the AxioCam HR has been specially developed with an enhanced sensitivity range to cope with these demanding tasks.



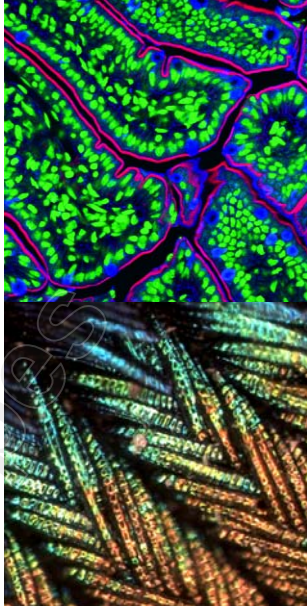
Medicine



Appendix, Prof. Dr. Joachim Diebold,
Institute of Pathology at the University of Munich,
Germany

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Applications



Peacock feather,
Martin Distel, Reinhard Köster,
GSF, Institute of Developmental Genetics,
Neuherberg, Germany

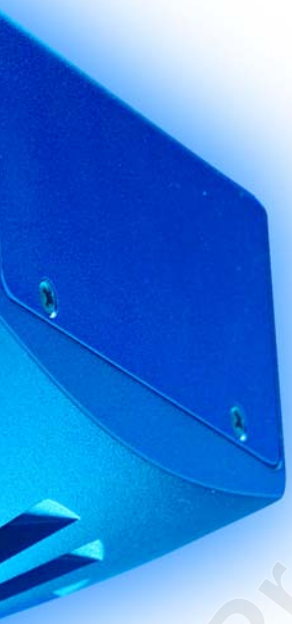
Superior performance without color filters

Crucial for your results when working at the limits of visibility: clear advantages in resolution and sensitivity thanks to a CCD sensor without light-reducing color filters.

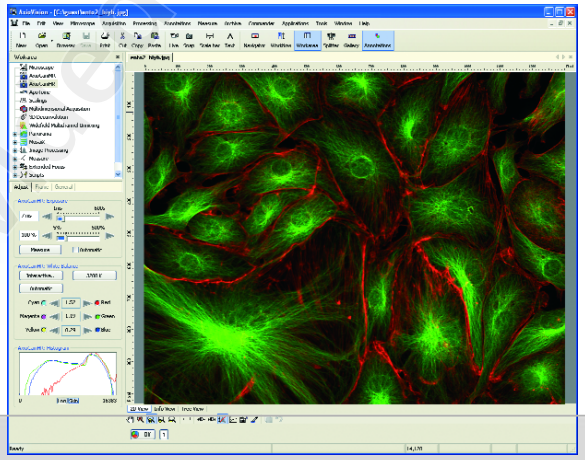
- The spectrum of detectable light is extended into the otherwise invisible near infrared.
- Even in the basic resolution of 1388 x 1040 pixels, images are acquired without the interpolation of a color sensor and the compromises associated with this.
- Images are scanned 4 x faster than with the color camera.
- The size of the file is reduced to a third compared with the AxioCam HRc color camera.

Full-strength signals

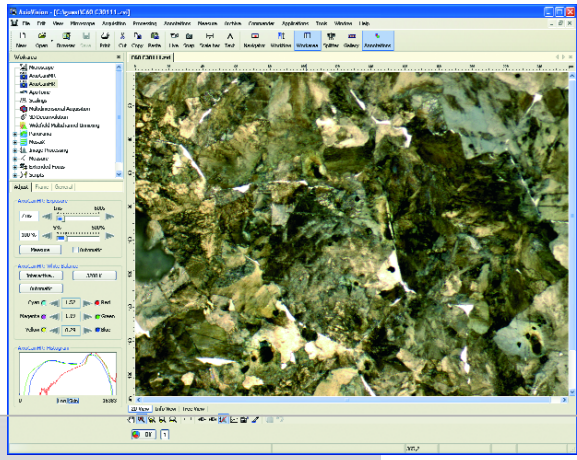
With the monochrome AxioCam HRm, no optical elements such as color or infrared filters stand in the way of the light. This means that even fluorochromes that emit in the near infrared are detected by the AxioCam HRm.



Biology



Materials Analysis



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Brilliantly sharp color images thanks to Color co-site Sampling

With ordinary 1-chip digital cameras, color images are acquired with a sensor. Each pixel of this sensor is sensitive to just one of the three basic colors. As only one image is acquired, each sensor pixel receives only the color information for red, green or blue at any one point in the image. However, as all three color channels are required simultaneously at a single point in the image in order to display a pixel in color, the missing color channels are determined by means of interpolation from the nearest neighboring pixels. This approximation results in the generation of imperfect images which display disruptive color fringes and distorted colors at fine image structures and edges.

With the Color co-site Sampling technique used by the AxioCam HR, several images of a specimen are produced and combined into a sharp resulting image. After the acquisition of each image a piezo mechanism moves the sensor by precisely the distance of one pixel, meaning that each point is seen by the sensor at least once in all colors. Interpolated color information is therefore not needed. In this way, the complete color information for each detail is obtained in four images and put together to form one image that is identically sharp in all three color channels.

Microscanning for all details

Using the same procedure you can achieve even more, however: by acquiring images at additional positions in the spaces between pixels, the accuracy of the images produced by the AxioCam HR is increased again. With up to three additional positions on the x and y axes, the resolution is increased from 1388 x 1040 by a factor of 9 up to 4164 x 3120 pixels. The Color co-site Sampling used at the same time ensures perfect, color-correct reproduction of the finest structures.

The resolving power of Carl Zeiss objectives in the intermediate image with 0.63x and 1.0x TV adapters in combination with the AxioCam HR's 2/3" CCD sensor (8.5 mm x 6.4 mm).

Objective	Magnification	NA	Lp/mm (TV-CpI 1.0x)	Necessary camera resolution	Lp/mm (TV-CpI 0.63x)	Necessary camera resolution
1. EC Plan-Neofluar	1.25	0.035	96	1632 x 1229	152	2584 x 1946
2. Fluar	2.5	0.12	144	2448 x 1843	229	3893 x 2931
3. EC Plan-Neofluar	5	0.15	90	1530 x 1152	143	2431 x 1830
4. Achroplan	10	0.25	75	1275 x 960	119	2023 x 1523
5. Fluar	10	0.5	150	2550 x 1920	238	4046 x 3046
6. EC Plan-Neofluar	20	0.5	75	1275 x 960	119	2023 x 1523
7. Plan-Apochromat	20	0.75	113	1921 x 1446	179	3040 x 2291
8. LCI Plan-Neofluar	25	0.80	96	1632 x 1229	152	2584 x 1946
9. EC Plan-Neofluar	40	0.75	56	952 x 717	89	1513 x 1139
10. EC Plan-Neofluar	40	1.3	98	1666 x 1254	155	2635 x 1984
11. Plan-Apochromat	63	1.4	67	1139 x 858	106	1802 x 1357
12. EC Epiplan-Neofluar	100	0.9	27	459 x 346	43	731 x 550
13. Plan-Apochromat	100	1.4	42	714 x 538	67	1139 x 858

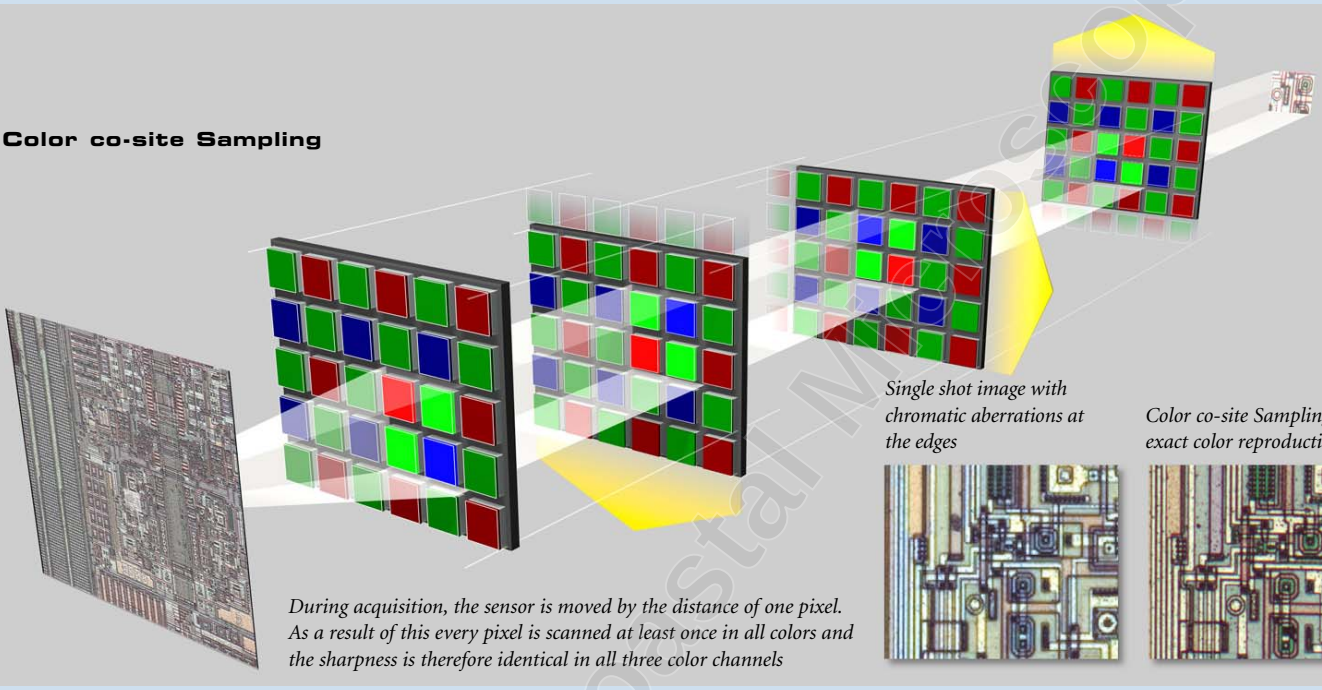
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View through the C-mount connection and the infrared barrier filter on the high-resolution CCD sensor

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Color co-site Sampling

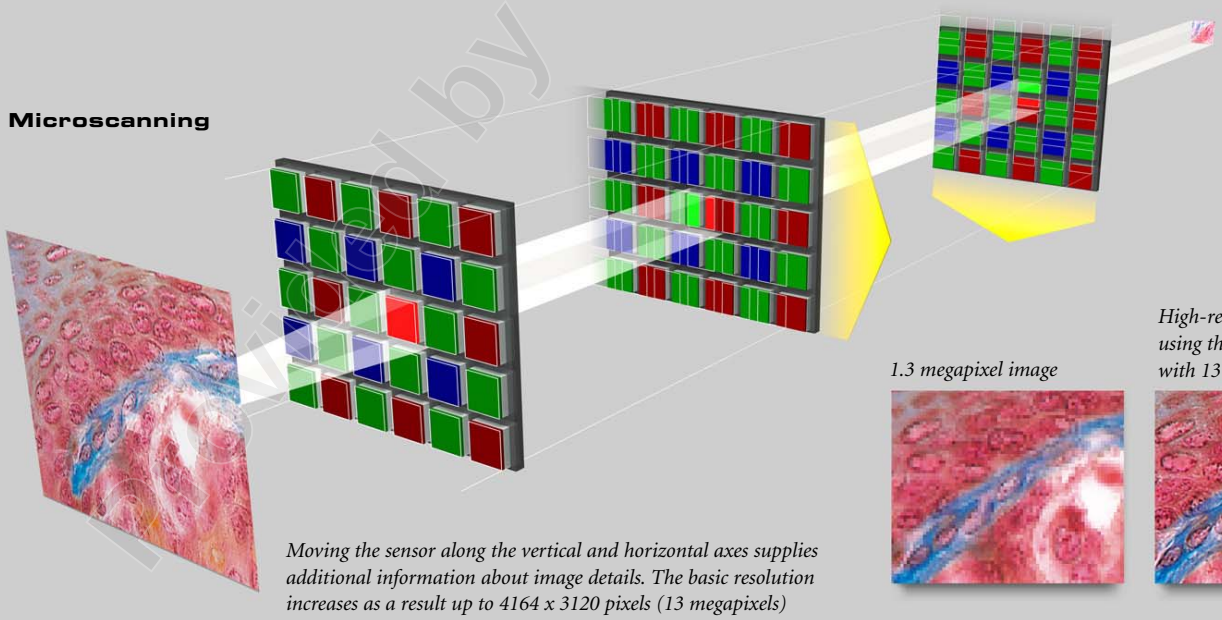


During acquisition, the sensor is moved by the distance of one pixel. As a result of this every pixel is scanned at least once in all colors and the sharpness is therefore identical in all three color channels

Single shot image with chromatic aberrations at the edges

Color co-site Sampling with exact color reproduction

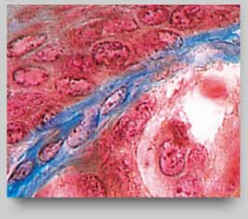
Microscanning



Moving the sensor along the vertical and horizontal axes supplies additional information about image details. The basic resolution increases as a result up to 4164 x 3120 pixels (13 megapixels)

1.3 megapixel image

High-resolution image using the AxioCam HR with 13 megapixels



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AxioCam HR: Data and Facts

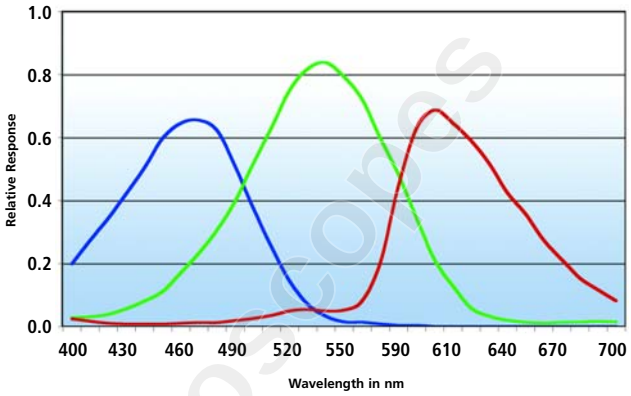
Max. camera resolution	4164 x 3120 = 13 megapixels		
CCD basic resolution	1388 x 1040 = 1.4 megapixels		
Pixel size	6.45 µm (H) x 6.45 µm (V)		
Sensor size	8.9 mm x 6.7 mm, equivalent to 2/3"		
Spectral sensitivity	HRc: approx. 400 up to 700 nm with BG 40 IR blocking filter, Bayer color filter mask HRm: approx. 300 up to 1000 nm with BK 7 protective cover glass (BG 40 can be inserted)		
NIR-Modus (AxioCam HRm)	Mode for higher sensitivity in near IR		
Dynamic range	Typical > 2200 : 1		
Full well capacity	Typical 17 Ke		
Readout noise	Typical 8 e		
Dark current	Typical 3.7 e/pixel/s		
Readout clock speed	10 MHz		
Resolutions (B/W and RGB)	Horizontal x Vertical		
	276 x 208	Binning 5 x 5, RGB	
	346 x 260	Binning 4 x 4, B/W	
	462 x 346	Binning 3 x 3, RGB	
	694 x 520	Binning 2 x 2, B/W	
	1388 x 1040	Single shot[1]	
	1388 x 1040	Color co-site Sampling[2]	
	2776 x 2080	Color co-site Sampling[2]	
	4164 x 3120	Color co-site Sampling[2]	
	4164 X 3120	Fast Scan (HRc)	
Frame rates	Frame rate	Binning factor	Horizontal x Vertical
AxioCam HRc	5 frames/s	1 / slow	1388 x 1040
	17 frames/s	3 / medium	462 x 346
	26 frames/s	5 / fast	276 x 208
AxioCam HRm	5 frames/s	1 / slow	1388 x 1040
	11 frames/s	2 / medium	694 x 520
	15 frames/s	3 / fast	462 x 346
Sensor subarea readout (ROI)	Free adjustable		
Raw data rate	Max. 20 MB/s (appropriate PC main memory capacity required)		
Exposure times	From 1 ms up to several minutes		
Optimum color reproduction	3200 K standard value at color version		
Digitization	14 bit / 10 MHz pixel clock		
Interface	PCI interface board for data and control lines		
Optical interface	C-Mount adapter		
Control signals	Trigger In/Out, TTL compatible, programmable polarity, adjustable trigger delay for shutter synchronization		
Housing	Aluminum, blue anodized, cooling fins, 11 cm x 8 cm x 6.5 cm, 500 g, 1/4" screw thread in housing		
Free back focal depth	Max. 5 mm		
Protective cover glass	BK 7 for HRm, annealed, IR-Filter BG 40 for HRc, annealed respectively		
CCD cooling	Single stage thermoelectrical cooling (Peltier) for decrease of dark current and thermal decoupling of the sensor, heat dissipation by means of the housing, no fan required		
Dark current compensation	Adaptive compensation algorithm in camera driver		
Max. file size per image	Ca. 78 MB at 4164 x 3120 at 3 x 14 bit (color)		
Operating system	Microsoft® Windows 2000 Professional Microsoft® Windows XP Professional		
Product types	Color and monochrome		
Certificates	CE, cUL		
Power supply	12 V DC, 1 A, 230 V / 110 V		
Environmental conditions	+5° up to +35° Celsius, max. 80% air humidity, non condensing , free air circulation required		

[1] Single exposure: color images with interpolated color quality, lower image resolution in all color channels.

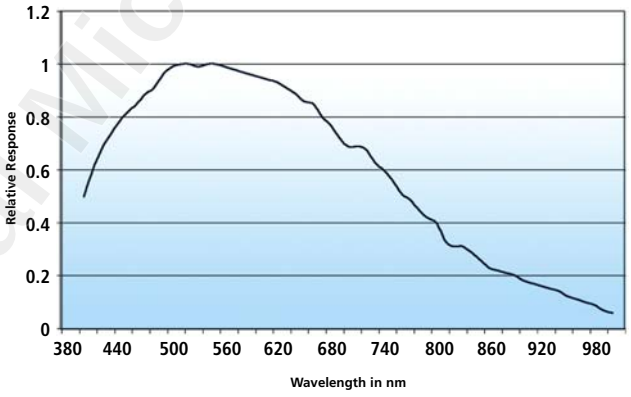
[2] Color co-site Sampling: color quality comparable to a 3-chip color camera, identical resolution for color channels; Color co-site Sampling is only available for HRc; scanning modes for resolution enhancement are available for HRc and HRm.

Comment: Technical data applies to the AxioCam HR Rev. 2. Above frame rates are supported by the camera electronics at 20 ms exposure time. Computer hardware, operating system and application software may decrease the frame rates.

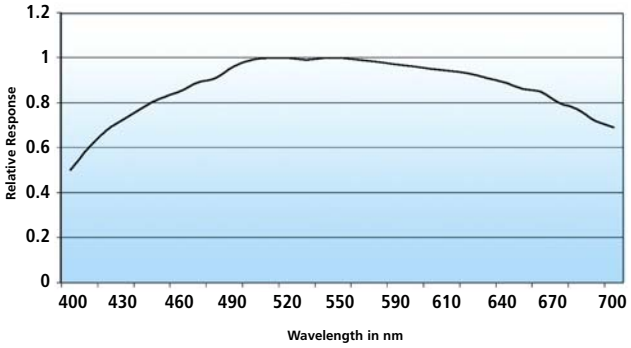
Relative Spectral Sensitivity AxioCam HRc with BG 40 IR-Filter



Relative Spectral Sensitivity AxioCam HRm maximum range



Relative Spectral Sensitivity AxioCam HRm visible range



Carl Zeiss
Light Microscopy

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