AxioCam HR

The Camera that Challenges your Microscope

Documentation at the edge of the visible

ZEISS

The Camera for Maximum Success: AxioCam HR

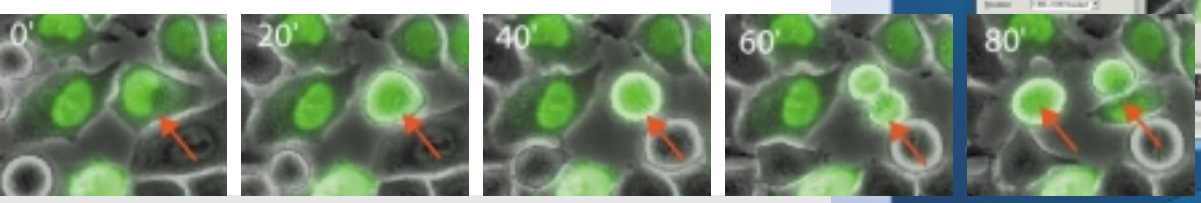
Low light fluorescence, live cell imaging, special applications in pathology and cytology: leading-edge applications in research and routine place extraordinary demands on microscope optics and camera technology. Until now researchers have been trying to meet these demands by selecting between digital cameras, analog cameras or various photographic procedures. A challenge still remained: To find a single camera that fulfills all of the documentation requirements of high-performance microscopy – in a single system. Consequently a camera was developed to meet the needs of the high-resolution sector faster and more flexibly than ever before. A camera available both in color and monochrome, one that is not only easy to use but also delivers brilliant images. Its name: AxioCam HR, the "Zeiss Blue".

Unique: Loss-free digital microscopy

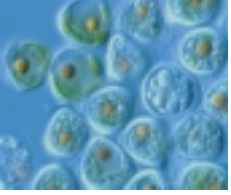
Seeing what the microscope can see: With AxioCam HR, whether color or monochrome, you can exploit the full power of your system. AxioCam HR always provides real microscope resolution without pixel interpolation. Freely selectable from 1300 x 1030, right up to single image resolutions of ultra-high 12 mega pixels – loss-free and in real color.

A new definition of speed: Digital real-time viewing

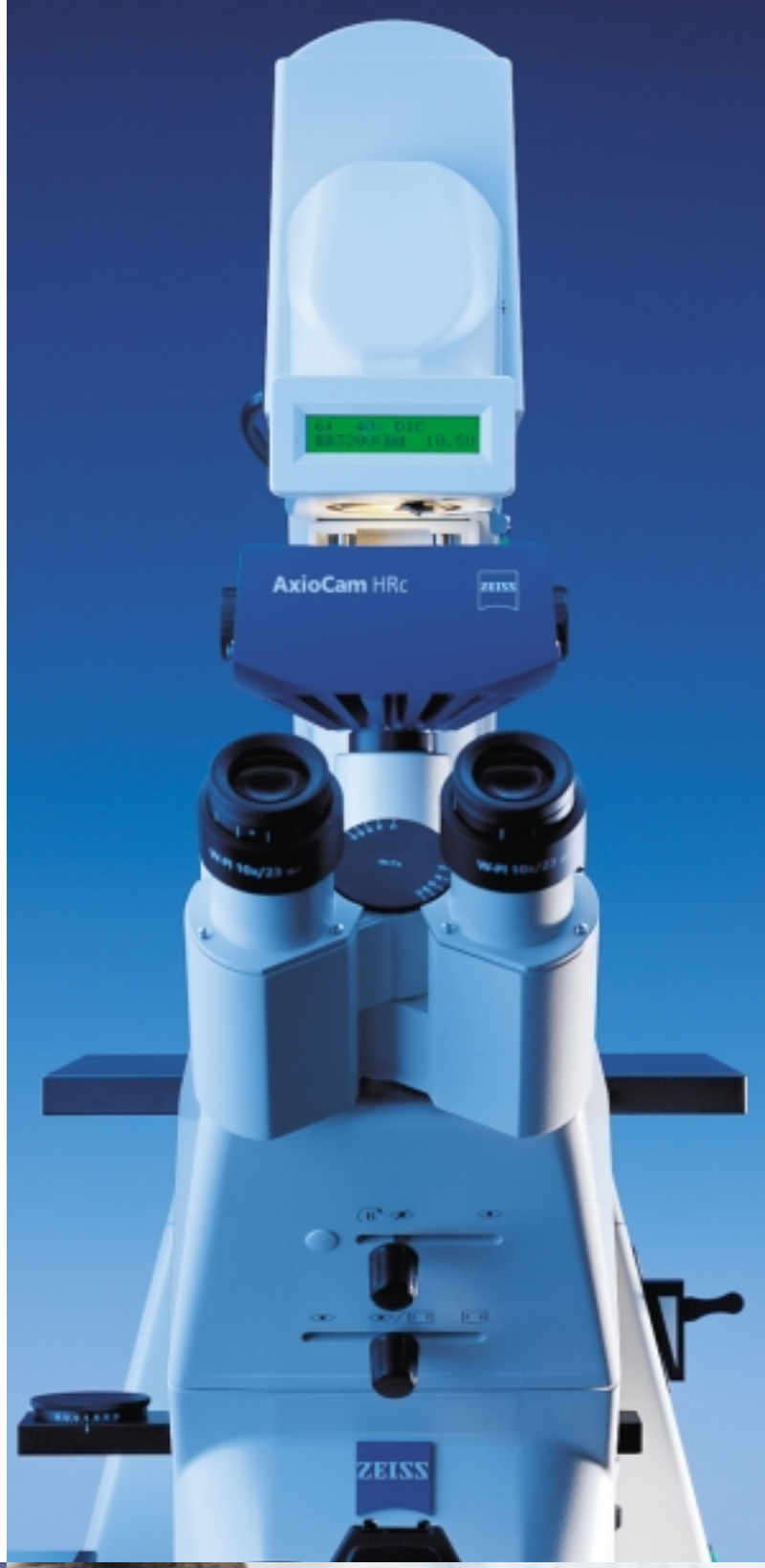
Up to now high image quality was a question of photographic methods and of time. With AxioCam HR you can achieve significantly faster results while maintaining the same quality. In real time on your monitor, online up to 20 images per second. All this means benefits: direct control in every color channel, easy focusing and the simple selection of the right segments of the image – faster than ever before.



Time sequence images of cell division in human cells
(Hela, Ran-GFP transferred)
(Data from the laboratory of Dr. Ruth Brack-Werner, GSF Neuherberg)



Compact, powerful and easily attached via C-mount: The "Zeiss Blue" is a high performer in research and routine areas.

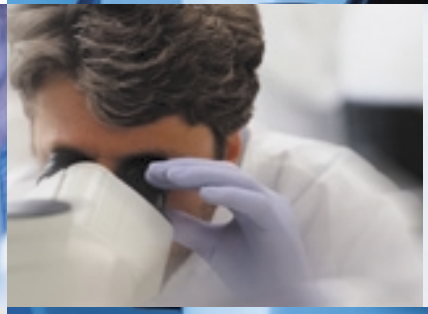


Weak fluorescence, strong dynamics

With its high dynamics of 14 bits, AxioCam HR easily masters the diverse challenges of fluorescence microscopy. This allows you to save and process image data with maximum color accuracy and image quality – also in 8 bits, should you prefer. The cooled camera integrates from 1/1000 of a second up to several minutes, generating needle-sharp pictures from the realm of the almost-invisible. Such high-quality fluorescent images are guaranteed even with extremely low light samples and long integration times.

Great convenience combined with compact size

Small dimensions, no external control box: Even the most complex set-ups won't hinder your work with AxioCam HR. With no mechanical shutters, filter wheels or cooling fans, the "Zeiss Blue" is absolutely vibration-free. Data are rapidly and securely transmitted via a long fiber optic cable.



The Peak of Progress:
In Color and Monochrome

The ultimate solution in color and monochrome

Whether your requirements are general or highly specialized: Carl Zeiss gives you the high-resolution microscope you need. The "Zeiss Blue" is available as a versatile color camera (AxioCam HRc) or as a monochrome version (AxioCam HRm). When it's a question of light sensitivity, resolution and speed – AxioCam HR provides the ultimate in digital images.

AxioCam HRc: Versatility in color

Unmatched in the scope of its applications, the high-resolution color camera AxioCam HRc meets the challenges of virtually all applications. From biology and medicine to materials analysis or quality control. From standard resolution right up to the physical limits of microscope optics.

CCD for brilliant color images

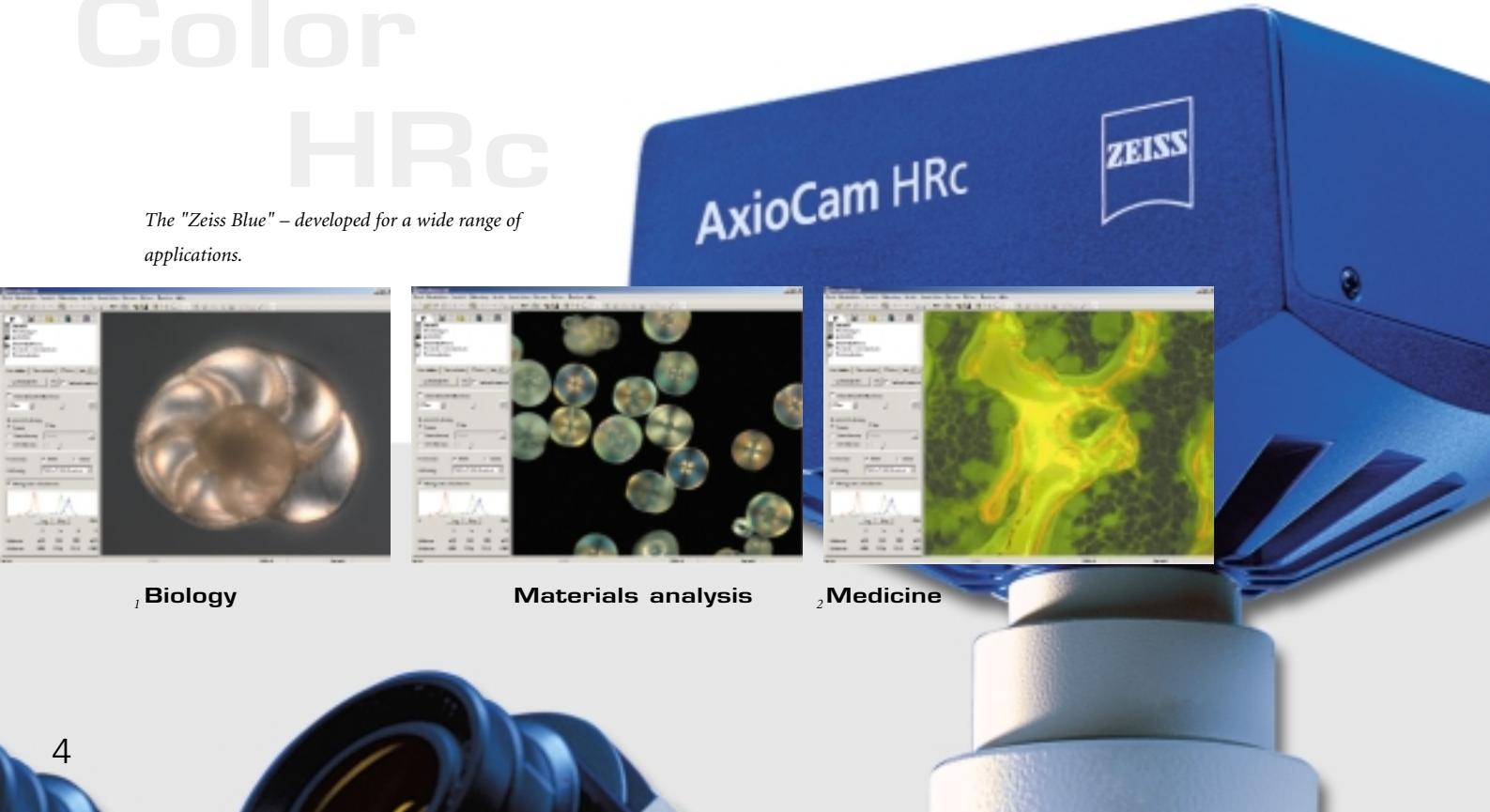
Absolutely color-fast images of even the finest structures without color moiré: The CCD color sensor of AxioCam HRc guarantees perfection in color images. With the special method of color co-site sampling, red, green and blue information is sampled at the same image location. This makes it possible to acquire real color information, whose quality is significantly better than "unreal" information generated by interpolation. As a result, a single CCD sensor is capable of matching the collective performance of 3 sensors.

High results with low light specimens

Superb light sensitivity of the sensor, an excellent signal-to-noise ratio and extremely long exposure times – powerful features which ensure that even the color version of AxioCam HR will fulfill the requirements of advanced fluorescence microscopy.

Color
HRc

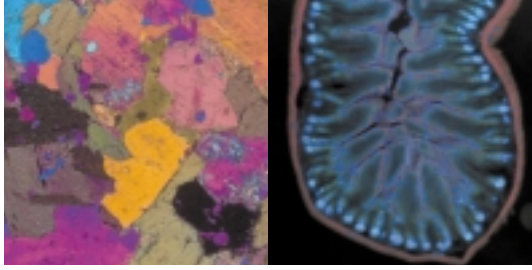
The "Zeiss Blue" – developed for a wide range of applications.



1 **Biology**

Materials analysis

2 **Medicine**



Top performance in monochrome: AxioCam HRm

Sensitive and low light samples, phase contrast, DIC and time sequence images as well as z-stack images and 3D deconvolution all require the highest image resolution possible at the shortest possible capture times. The monochrome version of AxioCam HR was especially designed for these extremely challenging areas in the life sciences.

1 x less for 3 x more

One thing is of crucial importance when your specimens border upon the invisible: eliminating the color filter mask on the sensor. This yields 3 times higher resolution and image quality because:

- the entire spectrum of light can be detected without differentiating the wavelengths on the chip
- you now have single images in the basic resolution of the sensor: 1300 x 1030 pixels
- AxioCam HRm scans 4 times faster.

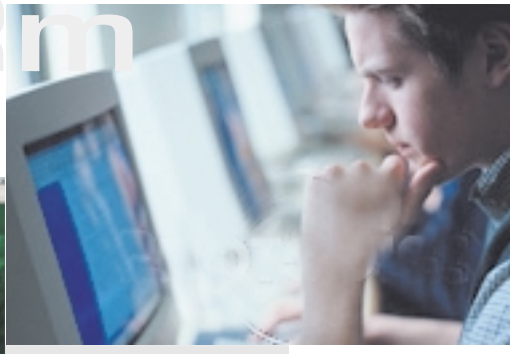
Full-strength signals

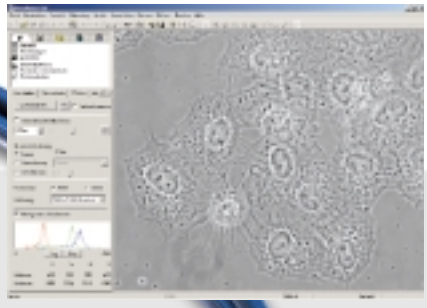
In contrast to the color sensor, the elimination of light-muting filters means a significant increase in detectable signal intensity. In the B/W area, infrared filters do not reduce the capacity of the spectrum. In concrete terms: With AxioCam HRm, you are expanding the sensitivity into the near infrared up to about 1000 nm.

Optimized for multidimensional images

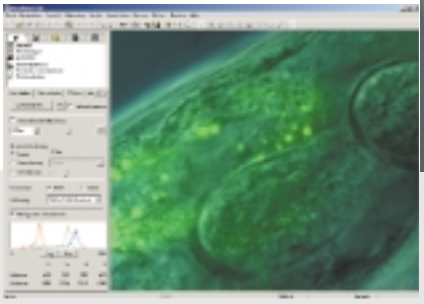
AxioCam HRm is the camera of choice wherever amounts of data would be too large for a color camera. For example, with such multidimensional imaging methods as time lapse, z-stack, and multichannel fluorescence. By omitting the color information, the volume of data is 3 times less than with the color version – while maintaining the same resolution and the same dynamics.

Monochrome HRm





3 **Phase contrast**

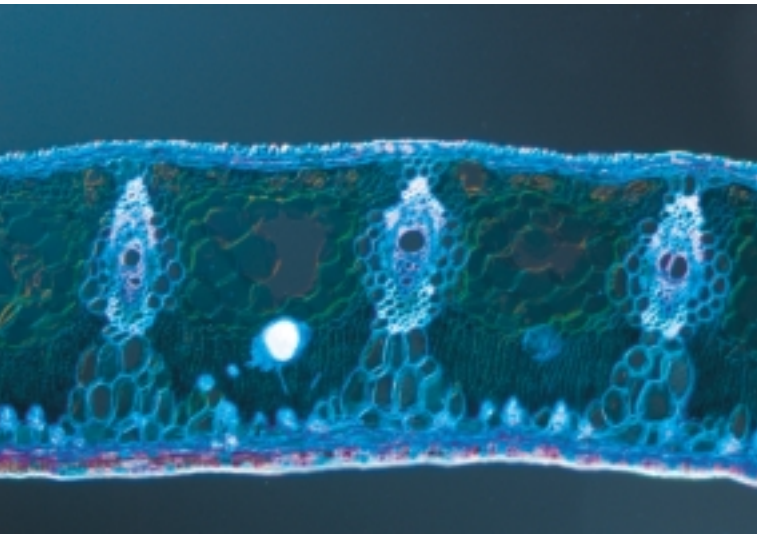


4 **DIC**

Sources:

1. *Biology microVscope from www.mbl.edu/microscope (Micro Biological Laboratory, Woods Hole, D. Patterson)*
2. *Medicine Guy's Hospital, London U.K.*
3. *Hela-cells in phase contrast*
4. *DIC and GFP fluorescence in C.Elegans*

The AxioCam HR System:
Will your Microscope Accept this Challenge?



Unique through synergy

AxioCam HR can easily be attached to every Carl Zeiss microscope with a phototube or TV-output. And the camera opens up totally new horizons in combination with the image documentation software AxioVision and the motorized microscopes Axiovert 200 and Axioplan2 imaging. These perfectly matched top performers create a powerful homogeneous system with an equally powerful outcome: a high degree of auto-mation combined with a significant increase in quality and tangible benefits in the generation of complex multidimensional images in fluorescence microscopy.

Everything under control:
AxioVision software

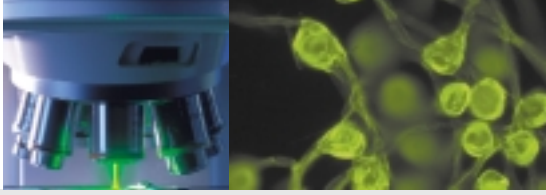
To really be a leader in its field, a high-performance camera must be integrated with high-performance software. With AxioVision, the innovative software package from Carl Zeiss, you not only precisely control all camera and microscope functions – you are also equipped with a highly sophisticated tool for the entire processing of images. Put an end to all those different programs for camera and microscope control and image processing! AxioVision gives you all these functions in a single system, together with a unique collection of tools for documentation, archiving, and specialized imaging functions.

Axiovert 200

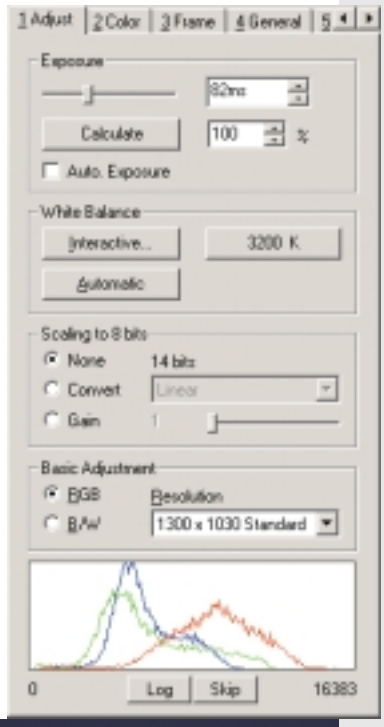
Axioskop 2 plus

Axioplan 2 imaging

Carl Zeiss quality in a single system: the powerful solution with microscope, camera and software.



Just like Carl Zeiss microscopes, AxioCam HR can be easily and quickly used via AxioVision software.



Capture
Camera control
Focus and image acquisition
Microscope control

Processing
Adjustment of contrast, brightness, color and sharpness

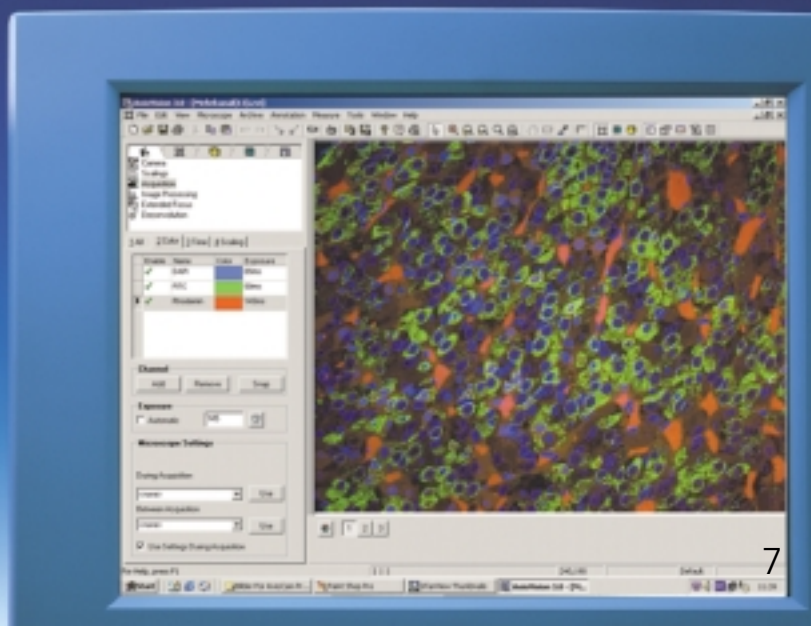
Annotation
Insertion of scale bars, markings, and text

Archiving
Image data, measurement data, microscope and recording settings

Report
Individual reports with images, texts, annotations, and microscope settings

Modules
Time Lapse Imaging
Multichannel Imaging
Z-Stack Imaging
3D Deconvolution
3D Visualization
and other modules

Software AxioVision



Technical Specifications AxioCam HR									
1.	**CCD Basic Resolution**	1300 x 1030 = 1.3 mega pixel							
2.	**Pixel Size**	6.7 µm x 6.7 µm							
3.	**Sensor Size**	8.7 mm x 6.9 mm, equivalent to 2/3"							
4.	**Spectral Range**	HRc ca. 400 - 720 nm (color) with BG 40 IR filter							
		HRm ca. 360 - 990 nm (monochrome) with BK 7 glass cover without IR filter							
5.	**Max. Charge / Pixel**	Full well 20.000 e							
6.	**Selectable Resolution**	Horizontally	x	Vertically					
	(B/W & Color)	260	x	206	(binning 5 x 5, RGB)				
		324	x	256	(binning 4 x 4, B/W)				
		432	x	342	(binning 3 x 3, RGB)				
		650	x	515	(binning 2 x 2, B/W)				
		1300	x	1030	(single exposure)	(1)			
		1300	x	1030	(co-site sampling)	(2)	1.3 mega pixel		
		2600	x	2060	(co-site sampling)	(2)	5.3 mega pixel		
		3900	x	3090	(co-site sampling)	(2)	12 mega pixel		
7.	**Live Image Frame Rates**	Max. frame (@ 20 ms)			Binning Factor	Horizontally	x	Vertically	
	(Binning in Color Mode)	5 frames/s			1	1300	x	1030	
		13 frames/s			3	432	x	342	
		20 frames/s			5	260	x	206	
8.	**Readout of Sub Frames**	Random definition of regions of interest on the sensor							
9.	**Digitization**	14 bit / 10 Mhz							
10.	**Dynamic Range**	Typical > 2000 : 1 at < 9 e readout noise							
11.	**Range of Integration Time**	1 ms up to several minutes							
12.	**Cooling**	Single stage Peltier cooling							
13.	**Product Types**	B/W (HRm) and color (HRc)							
14.	**Signal Output Connector**	TTL signal output prepared for control of external shutters							
15.	**Interface**	PCI interface card with thin fiber optic cable for data and control lines at 200 Mbit/s							
16.	**Optical Interface**	C-mount							
17.	**Max. File Size per Image**	Ca. 71 MB at 3900 x 3030 @ 3 x 14 bit (color)							
18.	**Operating Systems**	Win 98, Win ME, Win NT 4.0, Win 2000, MAC PhotoShop Plug-In							
19.	**Size / Weight**	Ca. 11 cm x 8 cm x 6.5 cm / 0.5 kg							
20.	**Housing**	Aluminium, with fins							
21.	**Registration**	GS, CE, cUL							
22.	**Power Supply**	Standard, 12 V DC, 1 A, 220 V / 110 V							

(1) Single exposure: Color images with interpolated color quality, lower image resolution in all color channels.

(2) Co-site sampling: Color quality comparable to a 3-chip CCD 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: 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.

The theoretical limit of the resolving capability of light microscopes is highly dependent on the objective. The following table shows the resolving power of Carl Zeiss objectives in the intermediate image for 0.63x and 1.0x TV coupling adapters in combination with a 2/3" CCD sensor (8.5 mm x 6.4 mm).

	Objective	Magnification	N.A.	Lp/mm (TV-Cpl 1.0x)	Necessary camera resolution	Lp/mm (TV-Cpl 0,63x)	Necessary camera resolution
1.	**Plan-Neofluar**	1.25	0.04	96	1632 x 1229	152	2584 x 1946
2.	**Fluar**	2.5	0.12	144	2448 x 1843	229	3893 x 2931
3.	**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.	**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.	**Plan-Neofluar Multi-Imm.**	25	0.80	96	1632 x 1229	152	2584 x 1946
9.	**Plan-Neofluar**	40	0.75	56	952 x 717	89	1513 x 1139
10.	**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.	**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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Light Microscopy

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