ZEISS Axiocam Family

Your Guide to Microscope Camera Technology from ZEISS.

zeiss.com/axiocam

Seeing beyond

Cameras for Teaching or Routine Applications

High End Color Cameras

Polarization Camera

High End Fluorescence Cameras

Integrated Network Cameras

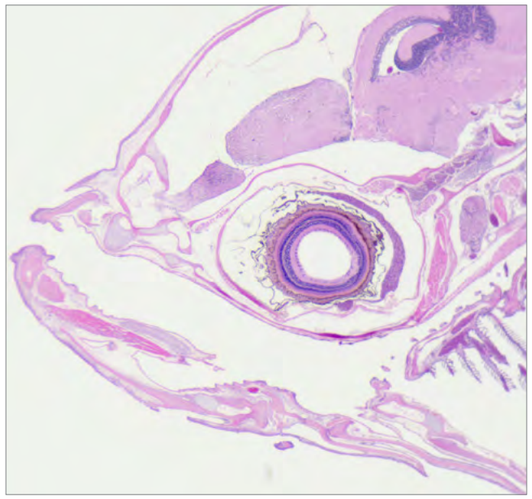
ZEISS Axiocam 105 color

Your 5 Megapixel Microscope Camera
for Documentation in Routine Labs

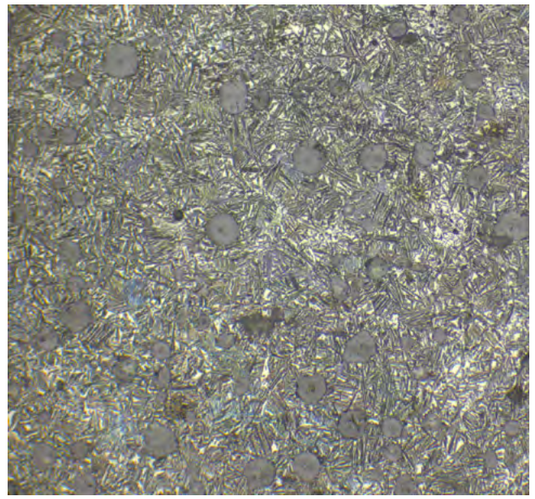
Axiocam 105 color is your small, no-frills microscope camera. With its compact design, it makes quick and efficient work of your daily documentation needs.
With its USB 3.0 connection, experience a high speed data transfer rate for handling your high resolution 5 megapixel color images. Offering an exposure time range of 30 µs to 1 s and a live frame rate of up to 30 images per second, the camera allows you to be well prepared to cover multiple tasks. Document your results quickly and conveniently.
With its attractive price-performance ratio, you can also expand the capability of your fluorescence imaging system with color imaging. Axiocam 105 color is ideal as a secondary camera on fluorescence microscopes that are traditionally equipped with monochrome cameras.
The camera's small form factor also lends itself well to environments with limited space.

Recommended for

- Applications with bright samples
- Documentation
- Education/Teaching
- Routine tasks
- Materials testing
- Quality assurance/Quality control



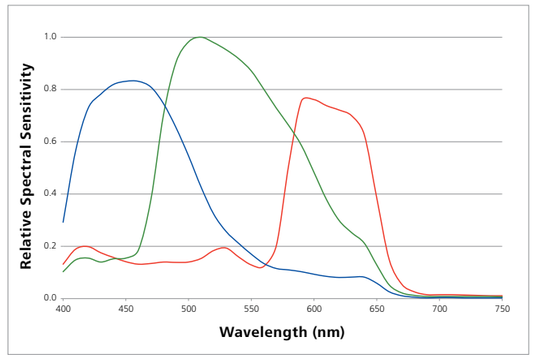
Fish, HE staining, brightfield, acquired with ZEISS Stemi 305



Graphite in brightfield, objective: EC Epiplan-NEOFLUAR 20×

Simpler. More Intelligent. More Integrated.

- 5 megapixel CMOS sensor
- 30 images per second at full 5 megapixel color resolution
- 8 bit digitization
- High resolution with 2.2 µm pixel
- Easy to use super-speed USB 3.0 connection
- Color and black & white imaging modes
- Fast and efficient operation with ZEN imaging software



Relative spectral sensitivity

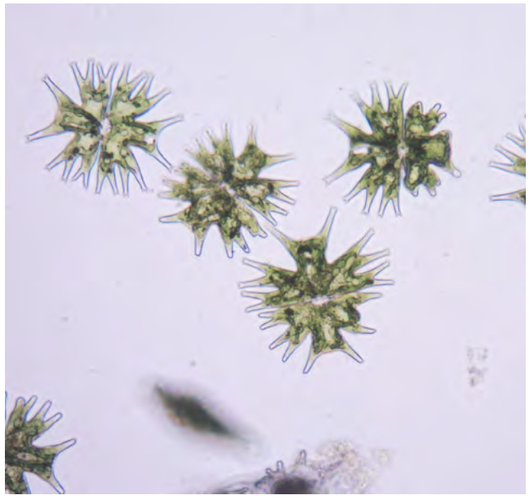
ZEISS Axiocam ERc 5s

Your 5 Megapixel Standalone Microscope Camera

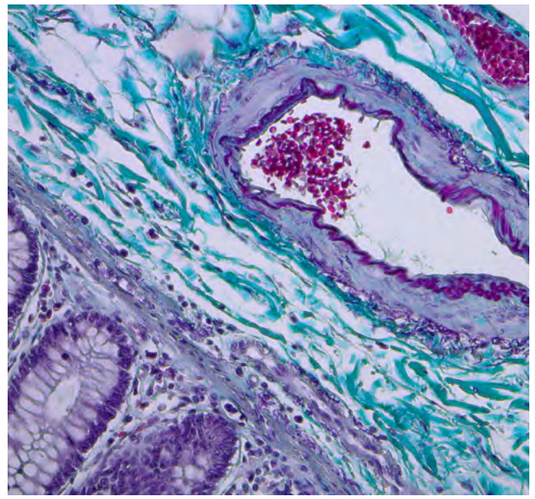
This 5 megapixel CMOS camera from ZEISS offers you flexible technology at an impressive price-performance ratio.
With Axiocam ERc 5s you capture the finest details of structures in your sample in high resolution. Connect your camera in a multitude of ways. Attach it to your PC to acquire crisp images with the easy-to-use imaging app Labscope or ZEN or use it as a digital video camera by connecting it directly to a monitor. Produce an exceptional live image for observing dynamic processes. Or exploit the full flexibility of Axiocam ERc 5s as a standalone camera in your lab. You can store your images directly onto an SD card and transfer them to a computer later, making your laboratory processes even more efficient.
The camera can also be connected to a network via Ethernet cable. Wirelessly connect your iPad on the same network and access the controls via Labscope. This means you can check in on your sample away from the system, freeing you to work on other tasks. Or share the live image by connecting multiple iPads to promote discussion amongst students or colleagues.

Recommended for

- Applications with bright samples
- Documentation
- Education / Teaching
- Routine tasks
- Industrial work
- Quality assurance/Quality control



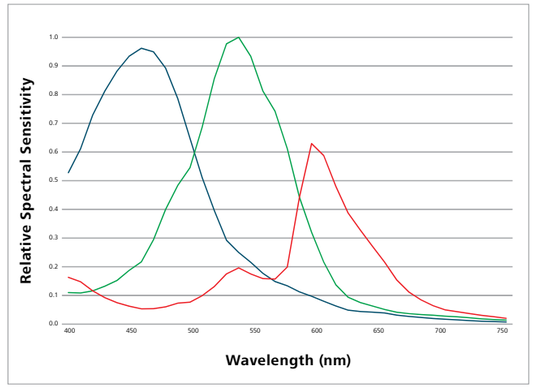
Micrasterias radiata *(algae), brightfield*



Pig gut, May-Grünwald-Giemsa staining

Simpler. More Intelligent. More Integrated.

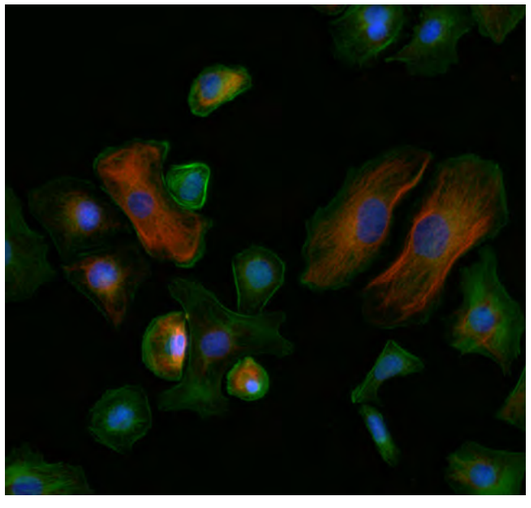
- 5 megapixel CMOS sensor
- 8 bit digitization
- High resolution with 2.2 µm pixel
- Color and black & white imaging modes
- Flexibility – use Axiocam ERc 5s as a stand-alone camera and acquire images / movies directly to an SD card.
  Or use it as digital video camera and stream HD (720p60 or 1080p30) via HDMI cable directly to a monitor or projector.
  You control the camera via remote control and define your acquisition settings and store for later use to carry out routine tasks independent of any computer. Alternatively use it via Labscope with a network connection and an iPad
- Efficient operation with Labscope or ZEN via an easy to install USB connection to a PC or via iPad / iPhone and Labscope App



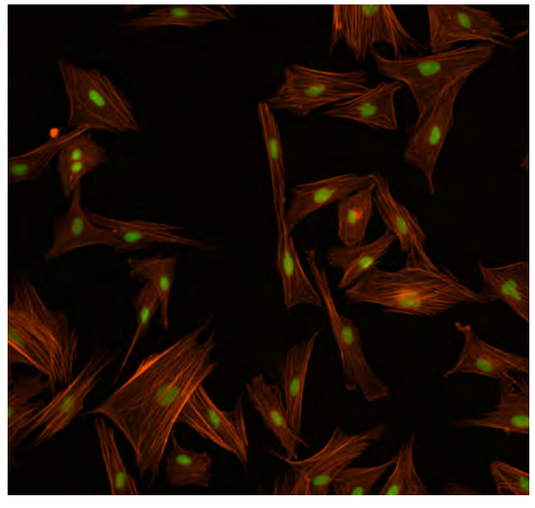
Relative spectral sensitivity

ZEISS Axiocam 202 mono

Your 2 Megapixel Stand-alone Microscope Camera for Routine Fluorescence Documentation



Mink endometrium cells, Vimentin (Ms) – Alexa Fluor 568, Phalloidin – Alexa Fluor 488, Hoechst 33342, acquired with ZEISS Axioscope 5, objective: Plan-APOCHROMAT 20×/0.8



Indian muntiac, deer epidermis fibroblasts, Tubulin (Ms) – Alexa Fluor 405, Phalloidin – Texas Red, SYTOX Green, acquired with ZEISS Axioscope 5, objective: Plan-NEOFLUAR 10×/0.3

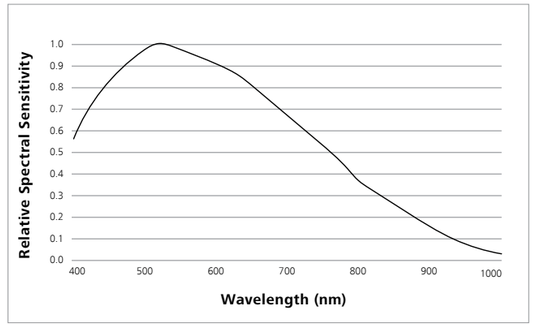
Axiocam 202 mono is your 2 megapixel monochrome microscope camera with automatic functions for routine fluorescence applications. With this CMOS sensor camera you can easily acquire monochrome images in stand-alone mode with no need of a PC. Since the camera automatically adjusts the exposure time you only need to press the snap button to capture and store your fluorescence images on a USB flash drive. If needed you can adjust parameters in the OSD (on screen display) menu before you acquire the image. In combination with the smart microscopes Axiolab 5 or Axioscope 5 you can even capture multichannel fluorescence images by simply pressing one button.

Recommended for

- Applications with bright fluorescence samples
- Documentation
- Education/Teaching
- Fluorescence imaging applications with live and fixed cells
- Documentation of fluorescent cell cultures
- Routine tasks in cell laboratories

Simpler. More Intelligent. More Integrated.

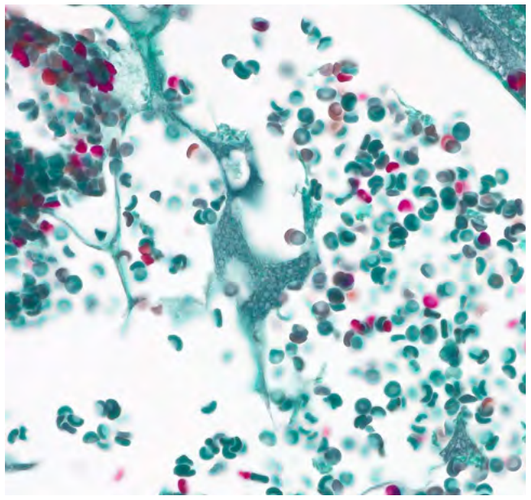
- 2 megapixel CMOS chip sensor with image diagonal of 13 mm and large pixel size for high sensitivity in fluorescence documentation
- Choose between 12 bit or 8 bit digitization
- Store images directly on USB flash drive in stand-alone mode
- Single button multichannel fluorescence acquisition when combined with Axiolab 5 or Axioscope 5 stands in stand-alone mode (with no PC)
- Automatic exposure and gain adjustment for easy fluorescence image capture
- Connect directly to a monitor by a HDMI cable for live image display for search and focussing and review of acquired images
- Perform secure image data transfer to TWAIN-compatible 3rd party software solutions with the TWAIN driver.



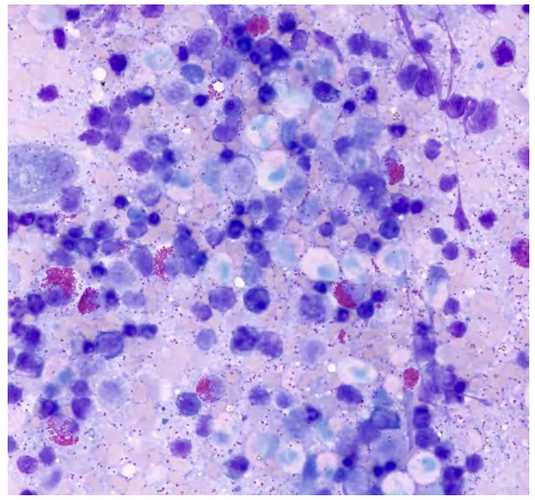
Relative spectral sensitivity

ZEISS Axiocam 208 color

Your Fast, 4K Microscope Camera for Smart Digital Documentation



Trichrome stained blood vessels in transmitted light brightfield, acquired with ZEISS Axiolab 5, objective: Plan-APOCHROMAT 40×/1.4



Red bone marrow in transmitted light brightfield, acquired with ZEISS Axiolab 5, objective: Plan-APOCHROMAT 40×/1.4

Axiocam 208 color is your smart versatile 8 megapixel color microscope camera suitable for education, documentation and routine applications. This CMOS camera delivers crisp, detail rich live images with high color fidelity at full 4k resolution in outstanding 30 fps. Choose between three modes of operation:

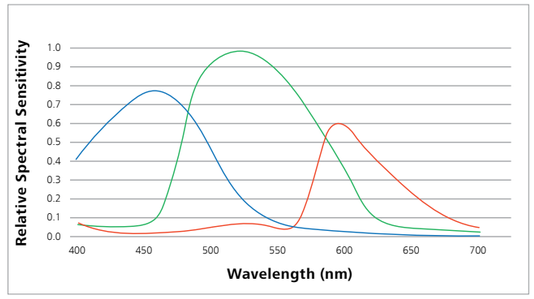
1. In stand-alone mode, you don't need a PC to acquire microscope images. The camera automatically adjusts brightness and white balance and offers live image enhancement functions like sharpening, denoising and HDR. Digital documentation of your specimen has never been easier.
2. Alternatively, connect the CMOS camera via USB or to a network and control it wirelessly with the easy-to-use imaging app Labscope. Since you can connect multiple cameras to the network, Axiocam 208 color is the ideal solution for digital classroom applications and for connected laboratories, too.
3. In addition, you can use the powerful imaging software ZEN with your Axiocam 208 color.

Recommended for

- Documentation
- Education/Teaching
- Routine tasks
- Materials research
- Quality assurance/Quality control
- Fast high resolution live image for co-observation

Simpler. More Intelligent. More Integrated.

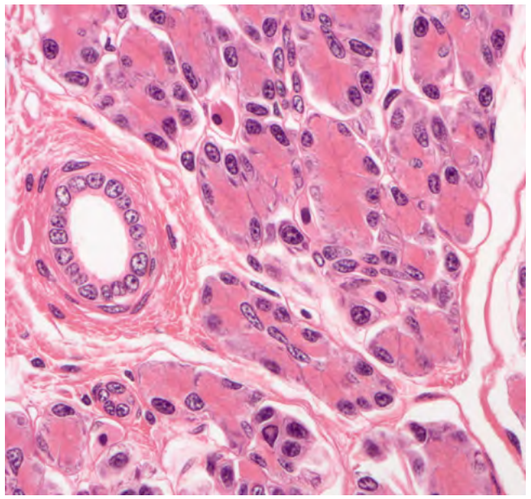
- Full 4K resolution in outstanding 30 fps
- Brilliant color rendering
- Live image enhancement functions like sharpening, denoising and HDR
- Use in stand-alone mode and save images on USB flash drive, use Labscope imaging app or ZEN imaging software
- Easy and effortless digital documentation – especially suitable for education, digital classroom and routine documentation
- Ethernet or USB 3.0 as digital data interface
- Use the optional WiFi stick and Labscope imaging app to control and transfer data wirelessly
- Document your samples as you see it in the eyepieces
- Stand-alone operation with camera control by intuitive On Screen Display via mouse and keyboard without a PC
- Connect directly to a monitor by a HDMI cable for live image display for search and focussing and review of acquired images
- Perform secure image data transfer to TWAIN-compatible 3rd party software solutions with the TWAIN driver.



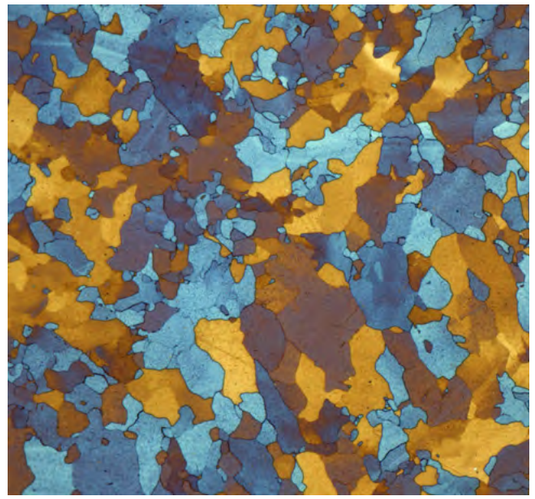
Relative spectral sensitivity

ZEISS Axiocam 305 color

Your Fast 5 Megapixel Microscope Camera for Routine and Research Labs



Liver of Amphiuma *in brightfield, HE-staining, acquired with ZEISS Axio Imager, objective: EC Plan-NEOFLUAR 20× / 0.50*



Pure iron in brightfield, reflected light, acquired with ZEISS Axio Observer, objective: EC Epiplan-APOCHROMAT 50× / 0.9

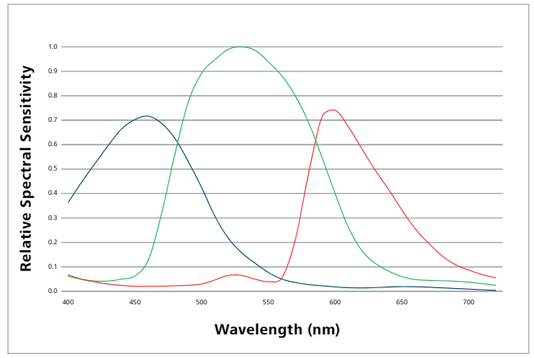
Axiocam 305 color is your 5 megapixel camera for high resolution imaging at fast speeds. With state-of-the-art CMOS global shutter technology, you can follow and capture samples distortion-free and with great accuracy. Thanks to this highly sensitive sensor technology and precise camera engineering, your Axiocam 305 color allows the capture of quality color images for a wide range of applications. Acquire great color images with crisp contrast or use the optional black & white mode to document basic fluorescence.
With this fast camera offering up to 36 frames per second at full resolution, achieve efficient searching, fast focusing and ergonomic handling at your digital microscope workplace.
Cover more of your area of interest with its ⅔" sensor format and produce great color images on your compound, stereo, or zoom microscope.
Though a simple and fast USB 3.0 connection, control the camera and experience robust performance with easy to use ZEN imaging software and its intuitive user interface.

Recommended for

- Applications with bright samples
- Documentation
- Routine tasks
- Materials research
- Quality assurance/Quality control
- Fast high resolution live image for co-observation
- Fast image acquisition and time-lapse recording

Simpler. More Intelligent. More Integrated.

- 5 megapixel CMOS global shutter sensor
- 11.1 mm image diagonal
- Fast readout with 36 images per second in full color resolution
- 12 bit digitization for finer gradation in signal
- Small 3.45 micron pixels for better sampling at low magnifications
- Global shutter architecture for distortion-free images
- Active thermal stabilization of the sensor for extremely reproducible image quality
- Easy to use super-speed USB 3.0 connection
- Color and black & white imaging modes
- Fast and efficient operation with ZEN imaging software



Relative spectral sensitivity

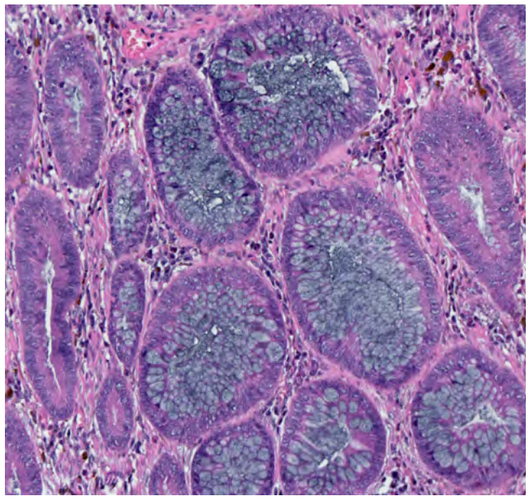
ZEISS Axiocam 506 color

Your 6 Megapixel Microscope Camera for Fast Imaging in True Color

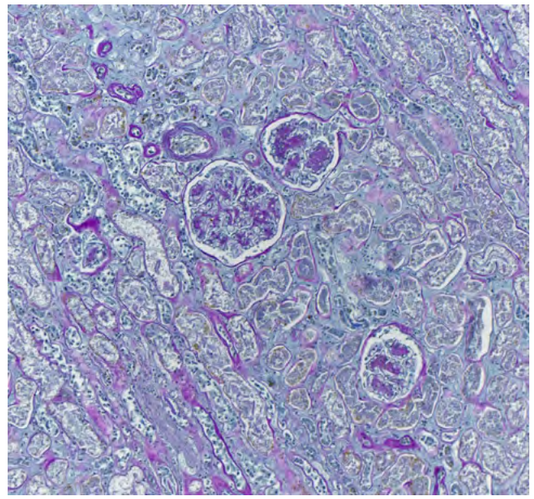
This high quality 6 megapixel color camera offers you an amazingly fast live image and acquisition speed despite its large pixel count and the very large 16 mm diagonal field of view.
This makes it the camera of choice whenever large sample areas have to be screened and recorded by taking many image tiles repeatedly in a minimum amount of time due to reduced number of tile positions.
This is extremely beneficial in acquiring large pathological tissue sections or large colored materials samples.

Recommended for

- Color imaging applications in life sciences and materials science
- Co-observation with fast high resolution live image in high quality color with a very large field of view
- Large pathology, cytology and materials samples
- Fast tile scanning applications
- Broadest range of intensities and exposure times



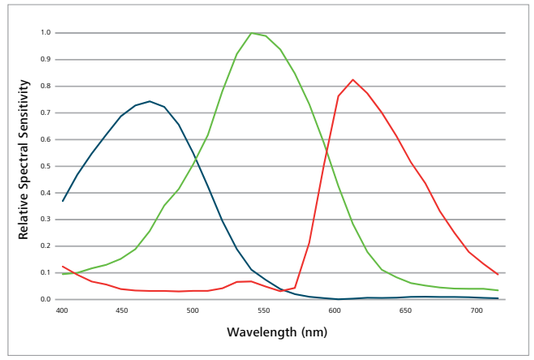
Human intestinal polyps, HE staining, acquired with ZEISS Axio Imager, objective: Plan-APOCHROMAT 20× / 0.8



Human kidney, Azan staining, acquired with ZEISS Axio Imager, objective: Plan-APOCHROMAT 10× / 0.45

Simpler. More Intelligent. More Integrated.

- 6 megapixel CCD sensor with 16 mm image diagonal
- 19 full resolution color images per second
- High image contrast with 14 bit signal conversion
- Small 4.54 micron pixels for optimal resolution
- Fast quad-port read-out with global shutter architecture for distortion-free images
- Black & white imaging mode
- Reproducible image quality due to active thermal stabilization of the sensor
- Easy to use super-speed USB 3.0 connection
- Thermo electrical cooled sensor



Relative spectral sensitivity

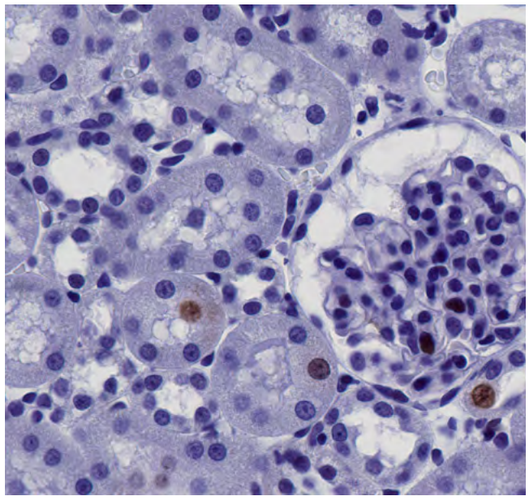
ZEISS Axiocam 705 color

Your Fast 5 Megapixel Microscope Camera
for True Color Image Acquisition in High Resolution

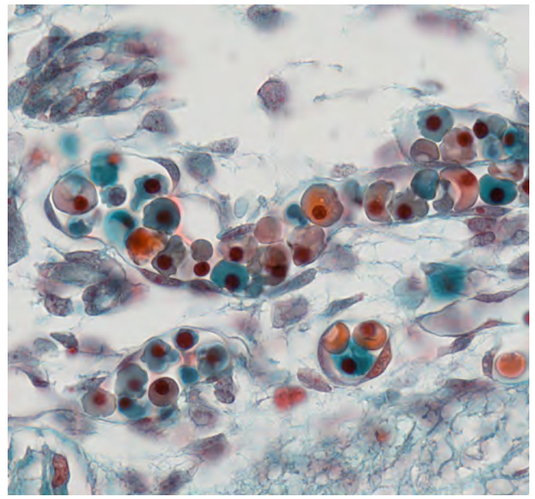
This flexible 5 megapixel scientific color camera strikes the perfect balance of speed and resolution. Delivering more than 60 frames per second at full 5 megapixel resolution, this camera captures even the most dynamic processes without compromising image resolution. Subsampling or sub-region readout accelerate your acquisition speed to hundreds of frames per second.

Recommended for

- High-resolution microscopy
- High-framerate imaging
- Research
- Documentation
- Industrial applications
- Materials research
- Quality control
- Medical microscopy
- Pathology
- Cytology



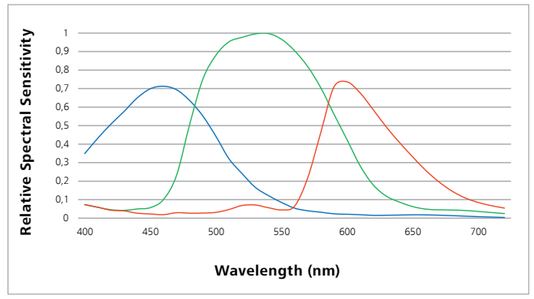
Rat kidney section, objective: Plan-APOCHROMAT 40×/1.4 oil



Rat embryonic tissue section, objective: Plan-APOCHROMAT 63×/1.4 oil

Simpler. More Intelligent. More Integrated.

- 5 megapixel cooled color CMOS sensor with 11 mm diagonal
- 62 frames per second in full 5 megapixel resolution
- Best-in-class color rendition
- Color and monochrome imaging modes
- Exclusive noise inhibition technology for low-light imaging
- Dynamic range of 1:25,000 in high-dynamic range (HDR) mode
- Combined analogue and digital pixel binning
- Small 3.45 µm pixels for high-resolution imaging
- Hardware triggering



Relative spectral sensitivity

ZEISS Axiocam 712 color

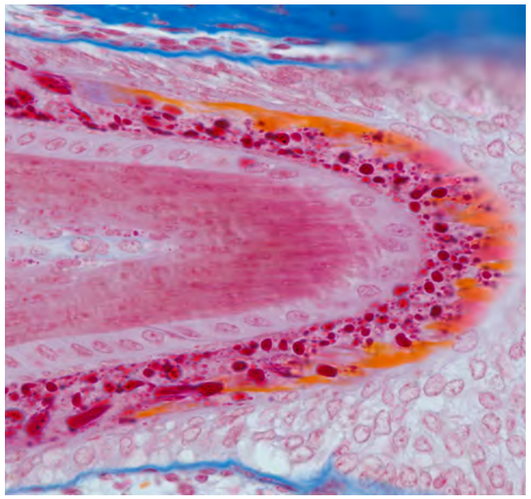
Your All-round 12 Megapixel Microscope Camera for True Color Acquisition of Large Specimen Areas in High Resolution

This 12 megapixel scientific grade camera combines a large image sensor, small pixel size, precise color rendition and fast imaging speed. The CMOS sensor delivers more than 20 frames per second with a 17.5 mm diagonal large field of view. You can now acquire large specimen regions quickly and with uncompromised image quality. The large field of view reduces the number of tiles required to image largest samples, and so drastically accelerates tiling experiments.

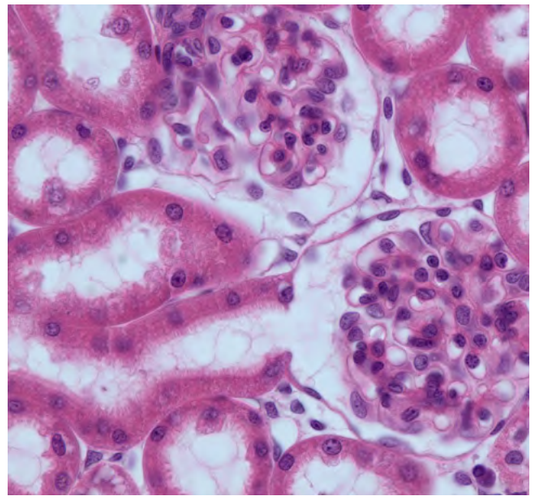
Axiocam 712 color is a highly evolved digital color camera addressing the needs of scientific microscopy, including documentation, reporting and analysis. Fast and artifact-free imaging with optimized color reproduction makes your work comfortable and efficient. In addition, exploring your sample on the screen, instead through the oculars, becomes a true and very convenient alternative.

Recommended for

- High-resolution microscopy
- Large region imaging
- Medical imaging
- Material science research
- Macroscopic imaging
- Pathology



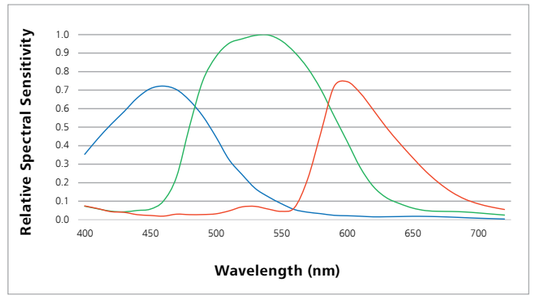
Mouth region of a mouse embryo section, objective: Plan-APOCHROMAT 63×/1.4 oil



Rat kidney section, objective: Plan-APOCHROMAT 63×/1.4 oil

Simpler. More Intelligent. More Integrated.

- 12 megapixel cooled color CMOS sensor
- Large sensor with 17.5 mm diagonal for extended field of view
- Best-in-class color rendition
- Color and monochrome imaging modes
- 20 frames per second in full 12 megapixel resolution
- 30 frames per second of the entire field of view in live image mode
- Exclusive noise inhibition technology for lowlight imaging
- Dynamic range of 1:25,000 in high-dynamic range (HDR) mode



Relative spectral sensitivity

ZEISS Axiocam 807 color

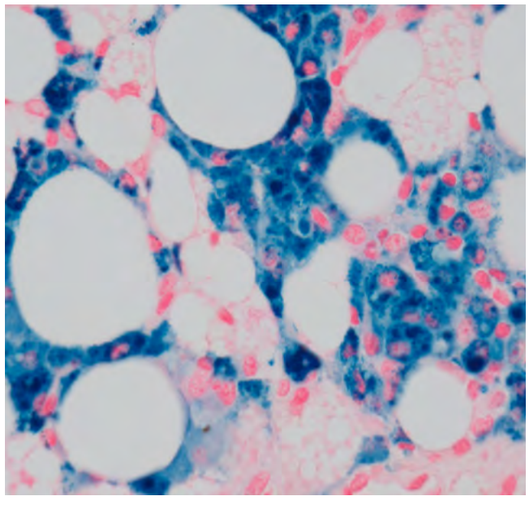
Your Fast, 7 Megapixel Microscope Camera for True Color Imaging of Large Fields of View

With its dual USB interface and state-of-the art CMOS sensor, this 7 megapixel color camera offers you amazingly fast live image and acquisition speeds. The large 17.6 mm diagonal sensor allows for efficient imaging of large fields of view.

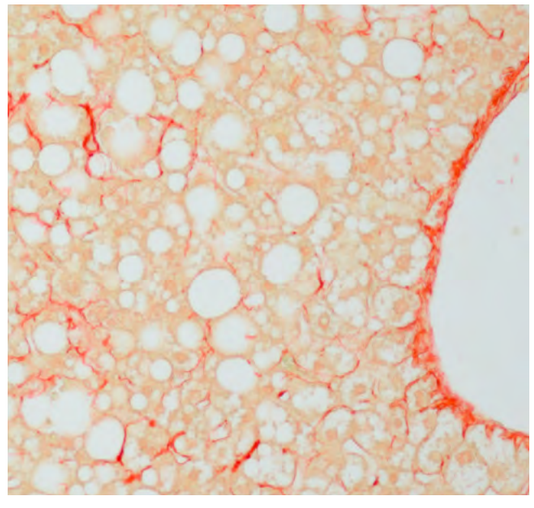
This makes it the camera of choice when screening large sample areas as it efficiently reduces the required number of tile images. This is extremely beneficial when working with large, pathology tissue sections or large, colored materials samples.

Recommended for

- Color imaging applications in a broad range of fields from life sciences to materials research and geoscience
- Co-observation with fast high resolution live image in high quality color with a very large field of view
- Imaging of large pathology, cytology and materials samples
- Fast tile scanning applications
- Samples with a broad range of intensities and exposure times



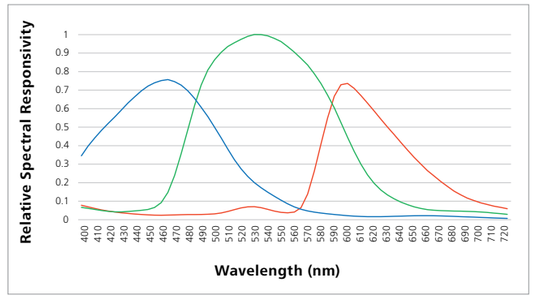
Prussian blue staining for hemosiderin (iron deposition) in brown adipose tissue of mice. Sample courtesy: A. Feuchtinger, Helmholtz Zentrum München, Germany



NASH mouse liver with connective collagenous tissue stained in red. Sample courtesy: A. Feuchtinger, Helmholtz Zentrum München, Germany

Simpler. More Intelligent. More Integrated.

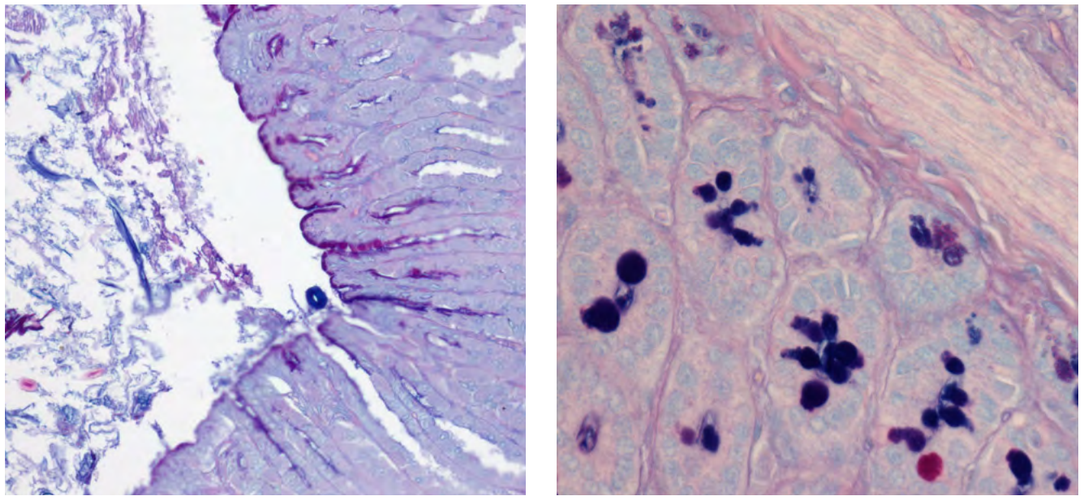
- 7 megapixel CMOS sensor with 17.6 mm image diagonal
- 73 full-resolution color images per second recording (faster with sensor sub-region readout)
- High image contrast with 14-bit signal conversion
- 4.5 micron pixels for optimal resolution and sensitivity
- Fast read-out with global shutter architecture for distortion-free images
- Monochrome imaging mode
- Reproducible image quality due to active thermal stabilization of the sensor
- Easy to use high-speed dual USB 3.0 connection



Relative spectral responsivity

ZEISS Axiocam 820 color

Your Sensitive 20 Megapixel Microscope Camera for Demanding, True Color Imaging of Large Fields of View



Mouse intestinal goblet cells with neutral (red) and acid (blue) mucine staining imaged with 20x/0.5 (left) and 63x/1.2W (right) objective. Sample courtesy: A. Feuchtinger, Helmholtz Zentrum München, Germany

Axiocam 820 color 20 megapixel camera combines high sensor resolution, color accuracy and a large sensor size for the most challenging samples. Its live image is 30 frames per second, providing navigation with the PC that is as smooth as looking through the eye pieces. The small pixels allow the use of low magnifications for high speeds and large fields of view without losing resolution.

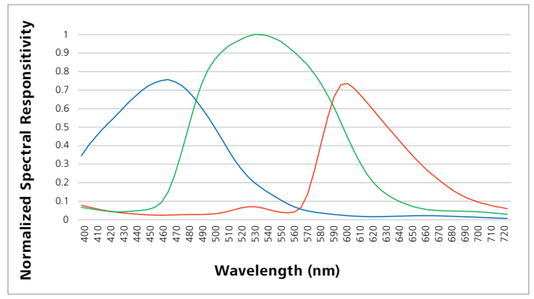
Scan large areas faster than ever before due to its large 17.5 mm square sensor. This makes Axiocam 820 color the ideal choice for demanding color imaging in cytology, pathology, materials research, and life science applications.

Recommended for

- The most demanding color applications in life sciences, materials research and geoscience
- Co-observation with a fast, high-resolution live image in high quality color with a very large field of view
- Large sample area imaging in pathology, cytology and materials samples
- Fast tile scanning applications
- The broadest range of intensities by high dynamic range

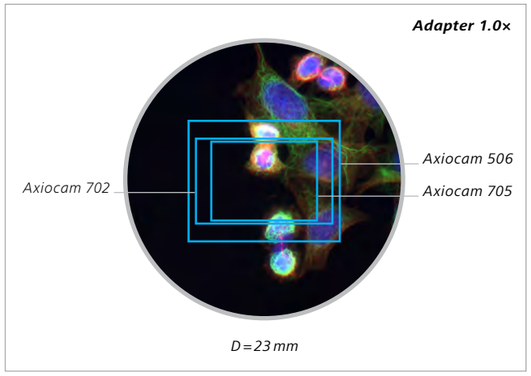
Simpler. More Intelligent. More Integrated.

- 20 megapixel square CMOS sensor with 17.5 mm image diagonal
- 28 full-resolution color images per second (faster with sensor sub-region readout)
- Small 2.74 micron pixels for resolving the finest details at all magnifications
- High-quality noise inhibition technology
- Fast read-out with global shutter architecture for distortion-free images
- Best-in-class color rendition
- Color and monochrome imaging modes
- Reproducible image quality due to active thermal stabilization of the sensor
- Dynamic range of 1:25,000 in high-dynamic range (HDR) mode



Normalized spectral responsitivity

Sensor Size vs Camera Adapter vs Field of View (FOV)
Use a c-mount camera adapter to mount your camera onto your microscope. Depending on the magnification factor of the adapter, the camera's sensor may cover more (lower magnification) or less (higher magnification) of the image coming out of your microscope (intermediate image). Typical intermediate image sizes are 25 mm for Axio Imager, 23 mm for Axio Observer or 23 mm for Axio Zoom.V16.



Different sensor sizes in relation to field of view.

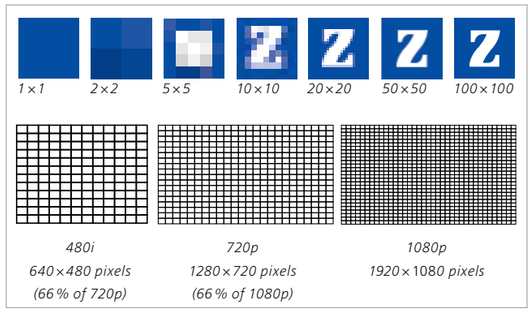
Typical image sensor diameters are 7.9 mm (½" format), 11 mm (⅔" format) or 16 mm (1" format).

Different C-mount adapter magnifications are 1×, 0.63×, 0.5×. Using a lower adapter magnification such as 0.63× causes into a:

- Demagnification of the intermediate image, resulting in a larger field of view for the final image
- Enlargement of pixel size, thus increasing light intensity detected by the sensor
- Enlargement of pixel size, which reduces the effective camera resolution

Resolution
The spatial resolution of a digital camera is related to the pixel density, which is defined by the pixel count per sensor area. The smaller the pixel aperture, the finer is the sampling of the presented structure. The reproduction of fine structures (lines) requires at least two pixels per structure sequence (line pair). Depending on the spectral composition of the signal, the optical resolution of color cameras can be slightly lower compared to monochrome cameras because of the color filter array. However, elaborate interpolation algorithms allow color cameras to provide optimal image quality.

Pixel Size



The pixel size defines the resolution.

One pixel is the smallest effective area on the sensor which is to become one image picture element.

The unit cell size can be estimated by taking the geometrical length (height) of one sensor line (column) and dividing it by the number of all pixels in one line (column).

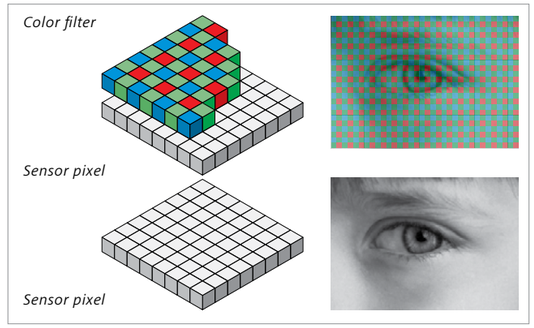
Effects of pixel size:
Smaller pixels are

- good for higher resolution
- lower in dynamic range
- less light sensitive
- noisier

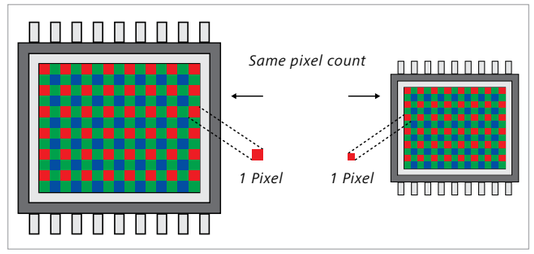
Larger pixels are:

- good for better light sensitivity
- less noisy
- higher in dynamic range
- reducing the spatial resolution

The best pixel size is a balance between sensitivity (larger pixel) and resolution (smaller pixel) to get the best possible compromise for the imaging requirements at a given optical setup.



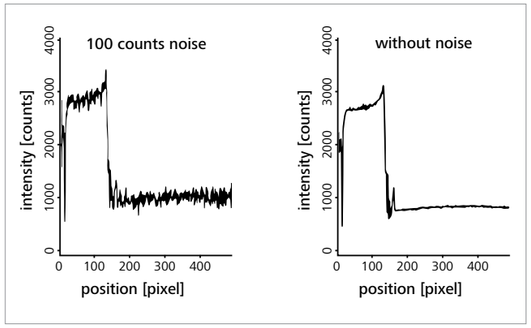
Monochrome and color sensors – a comparison.

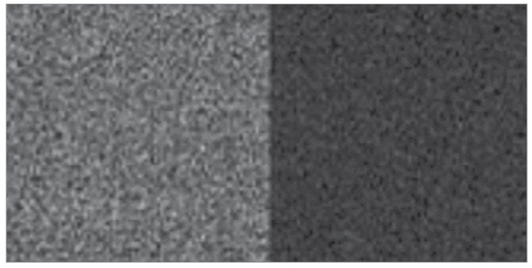


Even when the pixel count is the same, the image taken with the larger-sized pixels is less noisy because the CCD sensor is larger.

Name of Effect	Related Limitation	Counter Measure
Dark current Spurious signal by thermally generated electrons inside the sensor silicon material. This signal varies from pixel to pixel and causes an exposure time dependent signal offset for each individual pixel. In addition it contributes to the signal noise.	Maximum exposure time, Low light sensitivity, dynamic range, single pixel defects (hot pixels)	Given for a specific sensor-technology, active thermo-electrical cooling
Readout noise Noise added to the signal during read-out	Low light sensitivity, directly limiting the potential low light detection threshold, dynamic range	Sensor design and analog signal management dependent, signal amplification by EMCCD architecture
Photon shot noise Physical property of light, proportional to square root of produced electrons	Detection precision at high intensity levels, noisy, low light images	Theoretical and practical limit of detection is absolute, therefore no direct countermeasures
ADC effects Differential and integral linearity effects, quantitation errors of Analog to Digital Converters	Detection precision, intensity errors	Use of good ADCs, use more bits than needed, software calibration algorithms
Static sensor artefacts Defective pixels, non-uniformity effects of photo response, dark current, dark offset, electronic glow, hot pixels, column or row offsets, black offset non-uniformities	Visible cosmetic defects, fixed patterns in image overlaying image information	On the fly processing of the image data with correction algorithms, black reference, pixel wise dark current maps, use of selected sensors, Correction by calibration of static effects, dead pixel storage memory in camera
Dynamic sensor artefacts Blinking pixels, hot pixels, pixel and line offset flicker effects, electro-magnetic crosstalk of high frequency interference effects, etc.	Visible cosmetic defects, traveling overlaid patterns in image, subsequent artefacts in multi channels or Z-stack images causing errors in 3D renderings, errors in post processing algorithms like segmentation, counting, etc.	High quality electronic design, electronic shielding, high quality cables and connectors, on the fly dynamic correction algorithms, selection of high quality components, high quality sensors and dark current calibration.

Overview





Dark Noise *(Thermal Noise): origin by thermal electrons in the CCD cooling about 8 – 10° reduces dark rushing by factor two*

Noise

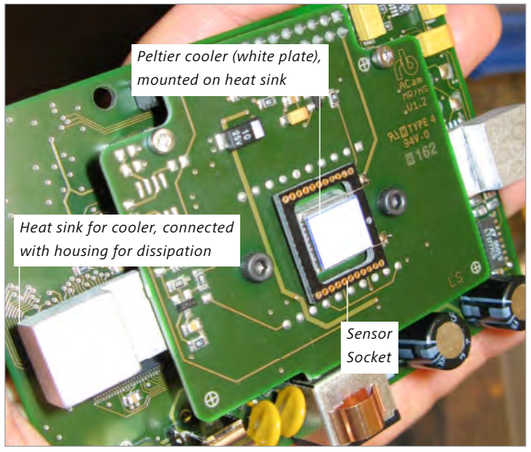
Noise in a digital camera is a random fluctuation of the image signal which causes a detection error. Noise can come from various physical sources and it limits the detection capability of a given camera. Post-processing algorithms can be used to minimize noise, but this sacrifices other image factors such as resolution.

Sensor Cooling

Cooling is used to minimize the thermal generation of electrons (dark current) in the sensor silicon material and the resulting dark current noise. You can reduce the dark current by approximately a factor of two by lowering the sensor temperature by 7 °C. Active thermo-electrical cooling prevents the sensor from being heated by the power dissipation inside the camera electronics.

Description	Explanation	Advantage	Disadvantage
Analog Gain	Amplification of the analog voltage signal at the output of an image sensor before the Analog-Digital-Converter (ADC)	■ Increases the brightness impression of the signal ■ Needed to optimally adapt the analog signal output from the camera sensor to the input range of the Analog-Digital Converter (ADC) within the camera electronics Special case: in the case of a bottleneck from the ADC input range → analog gain can be used as sensitivity improvement	■ Standard case: when the ADC can handle the full signal amplitude of the sensor no sensitivity improvement can be achieved by analog gain ■ Images look very noisy ■ Reduction of available intra-scene dynamic range
EM-Gain	Electron Multiplication-Gain. Dedicated on-chip high-voltage acceleration stage	■ Compensation for read noise limitation → real detection improvement of low light image signals ■ In combination with back thinning technology and large pixels → providing best possible low light sensitivity	■ Image affected by new noise source → random bright pixel events → minimization of EM-gain required ■ Gain efficiency affected by ageing → limited durability of EM gain ■ Reduction of available intra-scene dynamic range
Digital Gain	Multiplication of the digital pixel value by a numerical factor	■ Mathematical way to increase brightness ■ Commonly used for adapting different intensities to display different fluorescence channels in a multichannel image	■ No increase in detection sensitivity ■ Histogram representation affected → gaps in the histogram data ■ Reduction of available intra-scene dynamic range

Ways to amplify signals in cameras



Thermo electrical cooling helps to minimize dark current effects of CCD and CMOS image sensors.

Cooling requires a heat sink to dissipate power from the thermo-electrical cooler itself. Additional measures are needed to prevent condensation from humidity on the cold sensor surface. Modern sensors show a vastly reduced amount of dark current compared to devices from the past.

Extremely low temperatures – say, –20 °C – are not always required. Cooling is still unavoidable for EMCCD cameras, due to their specific working principle. All other camera technologies have a benefit by cooling only at long exposure times (after some 30s and more), when the low dark current sums up and gets disturbing again.

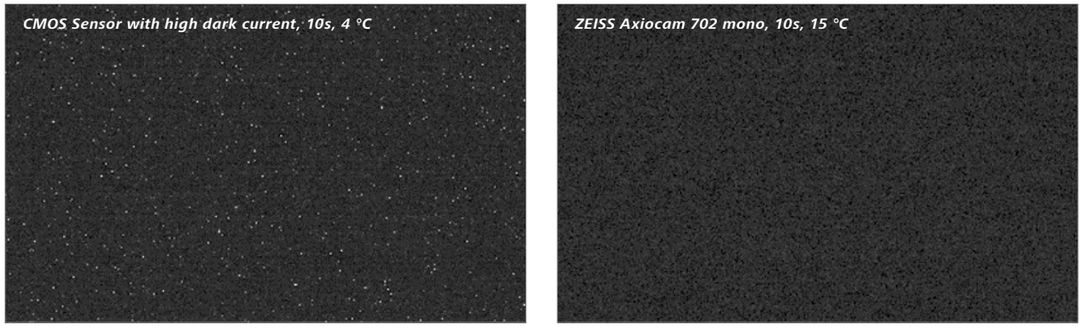
Binning

Camera sensitivity can be increased by combining photo generated signal charges from neighboring pixels during read-out. This also increases the camera frame rate. One side effect is the loss of image resolution. Binning factors can range from 1 × 1 (no binning) up to multiple pixels such as 5 × 5. Multiple charge binning is mainly available for CCD sensors. Binning in CMOS camera sensors is traditionally done in the digital domain by adding neighboring pixel values, which gives no extra sensitivity.

Frame Rate

The frame rate of a digital camera denotes the number of images which can be delivered per second (fps = frames per seconds). Unlike TV cameras, scientific cameras are not limited to standard video frame rates. Digital camera frame rates depend on various parameters:

Exposure time	shorter = faster: Exposure time limits the absolute frame rate independent from all other technical factors. If the time to collect photons lasts for 100 ms, the maximum achievable frame rate is 1 / 100 ms = 10 fps.
Sensor readout speed/clock speed	higher = faster: Total time to readout: accumulate photon signal+ conversion into a digital signal + transmission to a PC. Exposure and Readout correspond to a full cycle of an image acquisition.
Pixel count	less = faster: The more pixels, the longer the readout cycle, the slower the frame rate. The interface bandwidth can become the bottleneck if the pixel count cannot be transferred within the sensor readout time.
Sensor sub frame/region of interest	smaller = faster: Definition of sensor sub areas (ROI) help reduce the amount of transmitted image data → frame rates can be increased, Prerequisite: exposure time is shorter then readout time of ROI
Bandwidth of digital interface	higher = faster: Data transfer capacity of the interface. Effective USB 3.0 bandwidth is approximately 320 Mbytes/s.
Parallel readout architecture of CMOS sensors	more = faster: CMOS sensors exceed the frame rates of comparably sized CCD sensors due to significantly more parallel output structures on the sensor. The interface bandwidth is more likely to be the data transfer bottleneck.
Trigger signal synchronization	Synchronization of external trigger components with image acquisition → reduction of the maximum achievable frame rates with improvement of precision.
Overlapping readout and exposure	Special optimization for fast time series acquisition (fast time-lapse) without switching external components → overlap of exposure event while readout of the previous image. Only if exposure time is longer than readout → frame rate limited by exposure time.



ZEISS Axiocam 702 mono offers extended flexibility for long exposure times up to 60 s

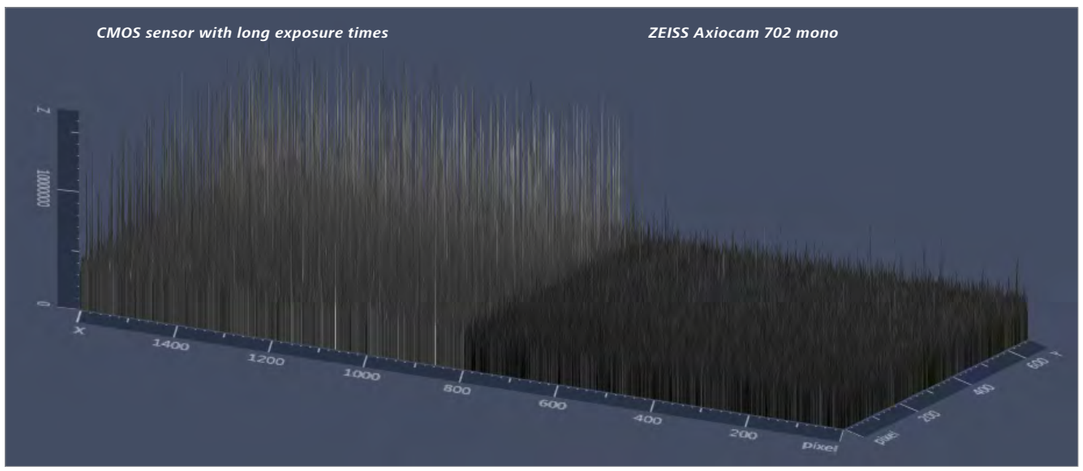
Hot Pixel

Cosmetic sensor defects are caused by a local emission of electrons in the sensor material. Hot pixels are visible as static single bright pixels against the black background. Their intensity varies widely and scales with exposure time and sensor temperature. The signal cannot be differentiated from photon generated electrons. If the sensor is temperature stabilized, the dark current can be compensated for by subtracting the spurious signal in correspondence with exposure time. Saturated pixels need to be interpolated because image information in these pixels is lost and cannot be reconstructed. Cosmic radiation can induce new hot pixel defects over time.

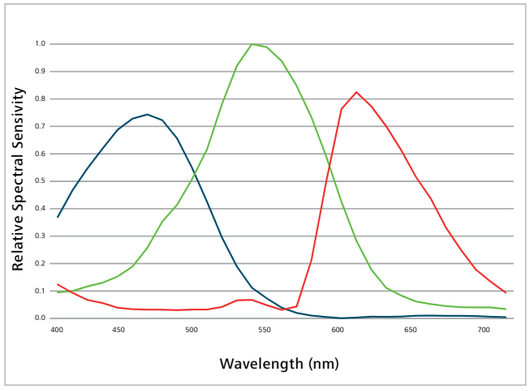
Spectral Sensitivity/Quantum efficiency

All kind of light detectors show a wavelength dependent light sensitivity. The conversion efficiency is the ratio of incoming photons to generated signal electrons stated as a percentage. Detection range of silicon based sensors like CCD or CMOS can stretch from approximately 350 nm up to 1000 nm, with a peak between 500 nm – 600 nm. For detection of radiation outside of this spectral range, other materials need to be used.

Modern front illuminated devices offer a typical QE in the range of 70 %. Monochrome peak QE can be improved with back thinned technology by up to 95 % in peak.



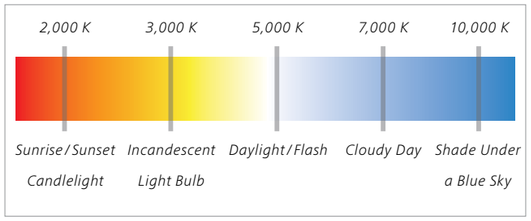
Left: Dark background, non uniformity from common CMOS sensor at 10s,
Right: ZEISS Axiocam 702 mono with modern CMOS sensor at 10s with very dark background, low non uniformity



Relative spectral sensitivity ZEISS Axiocam 506 color.

The spectral sensitivity of color cameras is lower than monochrome cameras. The color filter dyes on the pixels reduce the peak spectral QE by approximately 15 %. Color cameras also need an IR filter as color is only defined in the visible spectrum.

Color Temperature



Color temperature is a temperature value (in Kelvin) of a light source and is used to describe the spectral characteristic of the corresponding spectral emission. It indicates the color impression of a light source: lower temperatures are more red, higher temperatures are more blue.

The color temperature of the light influences how the human eye perceives color.

White Balance

The color of the illuminating light source influences the color of an object. The relative intensity of the color channels of a color camera needs to be adjusted to assure a neutral color reproduction. For this, you will need a manual or automatic selection of a neutral (grey) point in the image. Fine-tune the color reproduction by assigning slightly shifted target values for the neutral point. Adjust the color temperature of the monitor (i.e. 3,200 K) to reach the desired color reproduction.

Display Curve

The image display curve is a powerful tool in ZEN imaging software, used to define how image data is displayed on a computer screen without changing the raw image data. Use this tool to adjust dark areas of your image visually by selectively changing the curvature or the steepness of the curve. Shift the minimum or maximum points to allow for the limitation of the visualized intensity range. The color rendition can be influenced by a Gamma curvature. Image characteristics are applied to the image data, if the image gets exported into non .CZI image formats.

Gamma adjustment – linear display

Gamma Adjustment – Gamma 0.45

Technical Data

Color Cameras

	Axiocam ERc 5s	Axiocam 105 color	Axiocam 208 color
Sensor type	CMOS, Rolling Shutter	CMOS, Rolling Shutter	CMOS, Rolling Shutter
Sensor size	5.7 mm × 4.28 mm equivalent 1/2.5" diagonal 7.1 mm	5.70 mm × 4.28 mm equivalent to 1/2.24" diagonal 7.13 mm	7.1 mm × 4.0 mm equivalent to 1/2.1" diagonal 8.1 mm
Pixel Count	5.0 megapixel: 2560 (H) × 1920 (V)	5.0 megapixel: 2592 (H) × 1944 (V)	8.3 megapixel: 3840 (H) × 2160 (V)
Subsampling	–	–	–
Pixel size	2.2 µm × 2.2 µm	2.2 µm × 2.2 µm	1.85 µm × 1.85 µm
Full Well Capacity	–	–	–
Sensor Filter Mask	RGB Bayer Filter	RGB Bayer Filter	RGB Bayer Filter
Spectral Sensitivity	Approx. 400 nm – 700 nm, IR filter	Approx. 400 nm – 670 nm, IR filter	Approx. 400 nm – 700 nm, IR filter
Binning	Digital binning	No	No
ROI (Region of Interest)	Yes (adjustable)	Yes (adjustable)	Fixed frame 1080p mode
Readout Noise	–	–	–
Dark current	–	–	–
Dynamic range	–	–	–
Digitization Bit Depth	8 bit	8 bit	8 bit
Exposure Time Range	10 µs – 2 s	30 µs – 1 s	61 µs – 1 s
Analog Gain	No	Yes	1× – 22× adjustable
Frame rate live image/Time Lapse Recording	Live 20 fps at 800 × 600, Not recommended for time lapse imaging	Live 17 fps at 5 MP	Live Ethernet: 30 fps at 4K/1080p (H.264) USB 3.0: 30 fps at 4K/1080p (MJPEG) HDMI: 30 fps at 4K/1080p Not recommended for timelapse imaging in ZEN
Sensor cooling	No	No	No
External trigger	No	No	No
Interface	1× SD card slot, 1× mini USB 2.0, 1× RJ 45 (LAN), 1× HDMI (DVI-D)	USB 3.0 Micro-B (Camera) to USB 3.0 Standard A (PC/Board)	USB 3.0 Type C, Ethernet, HDMI, power
Power consumption and supply	5 W through 2× USB 2.0	max. 0.5 – 1 W through USB 3.0	9 W, external power supply
Software	ZEN blue, ZEN core, Labscope	ZEN blue, ZEN core	ZEN blue, ZEN core, Labscope

Axiocam 305 color	Axiocam 506 color	Axiocam 705 color	Axiocam 712 color
CMOS, Global Shutter	CCD, Quad Port Progressive Scan	CMOS, Global Shutter	CMOS, Global Shutter
8.5 mm × 7.1 mm equivalent ⅔" diagonal 11.1 mm	12.2 mm × 9,8 mm equivalent to 1" diagonal 16 mm	8.5 mm × 7.1 mm equivalent to ⅔" diagonal 11.1 mm	14.1 mm × 10.4 mm equivalent to 1" diagonal 17.5 mm
5.07 megapixel: 2464 (H) × 2056 (V)	6 megapixel: 2752 (H) × 2208 (V)	5.07 megapixel: 2464 (H) × 2056 (V)	12 megapixel: 4096 (H) × 3008 (V)
1×1, 2×2	–	1×1, 2×2	1×1, 2×2
3.45 µm × 3.45 µm	4.54 µm × 4.54 µm	3.45 µm × 3.45 µm	3.45 µm × 3.45 µm
10,500 e^-	15,000 e^-	11,000 e^-	11,000 e^-
RGB Bayer Filter	RGB Bayer Filter	RGB Bayer Filter	RGB Bayer Filter
Approx. 380 nm – 720 nm, coated IR cut filter	Approx. 400 nm – 720 nm, coated IR cut filter	Approx. 400 nm – 720 nm, coated IR cut filter	Approx. 400 nm – 720 nm, coated IR cut filter
Digital binning 1×, 2×, 3×, 4×, 5×	Charge binning 1×1, 2×2, 3×3, 4×4, 5×5	Digital binning 1×, 2×, 3×, 4×, 5×	Digital binning 1×1, 2×2, 3×3, 4×4, 5×5
Yes (adjustable)	Yes (adjustable)	Yes (adjustable)	Yes (adjustable)
Typ. 2.2 e^- @ gain 1×	Typ. < 6.5 e^- (39 Mhz), Typ. 6 e^- (13 Mhz)	Typ. 2,2 e^- @ gain 1×, Typ. 1,15 e^- @ gain 16×	Typ. 2,2 e^- @ gain1×, Typ. 1,15 e^- @ gain 16×
Typ. < 1.0 e^-/p/s @ 25°C	Typ. < 0,06 e^-/p/s at 18 °C	Typ. < 0.5 e^-/p/s @ 18 °C	Typ. < 0.5 e^-/p/s @ 18 °C
Typ. 1:4800	Typ. 1:2500	Typ. 1:5000 at gain 1×, 1:25,000 at HDR mode	Typ. 1:5000 at gain 1×, 1:25,000 at HDR mode
12 bit / 8 bit	3× 14 bit / 12 bit / 8 bit	14 bit / 12 bit / 8 bit	3× 14 bit / 12 bit / 8 bit
100 µs – 4 s	250 µs – 60 s	100 µs to 60 s	100 µs to 60 s
1×, 2×, 4×, 8×, 16×	1×, 2×, 3×	1×, 2×, 4×, 8×, 16×	1×, 2×, 4×, 8×, 16×
Live 30 fps at 5 MP 67 fps at 1920 × 1080 (ROI in HD format) 136 fps at 512 × 512 (ROI)	Live at 19 fps at 6 MP 19 fps at 2752 × 2208; 32 (ROI in HD format) 33 fps at 917 × 733; 51 fps at 550 × 440	Live 30 fps 5 MP 60 fps at 2464 × 2056 (5MP) 115 fps at 1920 × 1080 (HDTV format) 436 fps at 1920 × 256	Live 30 fps at 2048 × 1504, Live 20 fps at full frame 23 fps full frame 63 fps at 1920 × 1080 (HDTV) up to 430 fps at 1020 × 120
stabilized at 25°C	stabilized at 18°C	stabilized at 18°C	stabilized at 18°C
No	Yes	Yes	Yes
USB 3.0 SuperSpeed (5 Gbit/s); Bandwidth max. 240 MB/s; USB 2.0 optional, with lower speed;	USB 3.0 SuperSpeed (5 Gbit/s); Bandwidth max. 240 MB/s; USB 2.0 optional, with lower speed;	USB 3.0 SuperSpeed (5 Gbit/s); Bandwidth max. 330 MB/s; USB 2.0 optional, with lower speed;	USB 3.0 SuperSpeed (5 Gbit/s); Bandwidth max. 330 MB/s; USB 2.0 optional, with lower speed;
4W, powered by USB 3.0-Bus from PC	7W, powered by USB 2.0 and USB 3.0-Bus from PC;	7W, powered by USB 2.0 and USB 3.0-Bus from PC;	7W, powered by USB 2.0 and USB 3.0-Bus from PC;
ZEN blue, ZEN core, Labscope	ZEN blue, ZEN core	ZEN blue, ZEN core	ZEN blue, ZEN core

Technical Data
Color Cameras

	Axiocam 705 pol	Axiocam 807 color	Axiocam 820 color
Sensor type	CMOS, Global Shutter	CMOS, Global Shutter Gen3	CMOS, Global Shutter, Back Iluminated
Sensor size	8.5 mm × 7.1 mm equivalent to ⅔" diagonal 11.1 mm	14.5 mm × 9.9 mm equivalent to 1.1" diagonal 17.6 mm	12.4 mm × 12.4 mm (square field of view), equivalent to 1.1" diagonal 17.5 mm
Pixel Count	5.07 megapixel: 2464 (H) × 2056 (V)	7.1 megapixel: 3216 (H) × 2208 (V)	20 megapixel: 4512 (H) × 4512(V)
Subsampling	1 × 1	1 × 1, 2 × 2	1 × 1, 2 × 2
Pixel size	3.45 µm × 3.45 µm, 6.9 µm effective pixel size based on polarization filter cell size	4.5 µm × 4.5 µm	2.74 µm × 2.74 µm
Full Well Capacity	11,000 e^-	25,000 e^-	10,000 e^-
Sensor Filter Mask	Polarization Filter (0°, 45°, 90°, 135°)	78% @ 520 nm	–
Spectral Sensitivity	Approx. 350 nm – 1,000 nm, coated protective glass	Approx. 400 nm – 720 nm, coated IR Cut filter	Approx. 400 nm – 720 nm, coated IR Cut filter
Binning	Digital binning 1×1	Hybrid binning 1×, 2×, 3×, 4×, 5×	Hybrid binning 1×, 2×, 3×, 4×, 5×
ROI (Region of Interest)	Yes (adjustable)	Yes (adjustable)	Yes (adjustable)
Readout Noise	Typ. 2.2 e^- @ gain 1× Typ. 1.15 e^- @ gain 16×	Typ. 5.7 e^- @ gain 1× down to 2.9 e^- @ gain 16×	Typ. 2.3 e^- @ gain 1× down to 1.3 e^- @ gain 16×
Dark current	Typ. < 0.5 e^-/p/s @ 18°C	Typ. 0.3 e^-/p/s @ 25°C	Typ. < 0.1 e^-/p/s @ 25°C
Dynamic range	Typ. 1:5,000 at gain 1×, 1:25,000 at HDR mode	Typ. >1:4,420 at gain 1×, Low Noise Mode 1:6,230	Typ. 1:4,400 at gain 1×, HDR 1:25,000
Digitization Bit Depth	14 bit / 12 bit / 8 Bit	3× 14 bit / 12 bit / 8 bit	3× 14 bit / 12 bit / 8 bit
Exposure Time Range	100 µs – 60 s	0.1 ms to 60 s	100 µs to 60 s
Analog Gain	1×, 2×, 4×, 8×, 16×	1×, 2×, 4×, 8×, 16×	1×, 2×, 4×, 8×, 16×
Frame rate live image/Time Lapse Recording	Live 25 fps 5 MP (values only for monochrome or fast color modes), Live 30 fps at 1920 × 1080 60 fps at 2464 × 2056 (5MP) 115 fps at 1920 × 1080 (HDTV format) 436 fps at 1920 × 256	Live at 30 fps at 7 MP 73 fps at 3216 × 2208 145 fps at 1920 × 1080 (HDTV) 260 fps at 1608 × 1104 487 fps up to 1920 × 256	Live 30 fps at 2256 × 2256 28 fps at 4512 × 4512 75 fps at 2256 × 2256 (subsampl.) 110 fps at 1920 × 1080 (HDTV) Up to 447 fps at 1920 × 128
Sensor cooling	stabilized at 18 °C	stabilized at 25 °C	stabilized at 25 °C
External trigger	Yes	Yes	Yes
Interface	USB 3.0 SuperSpeed (5 Gbit/s); Bandwidth max. 330 MB/s; USB 2.0 optional, with lower speed;	Dual USB 3.0 (2× 5 GBit/s); Bandwidth max. 620 MB/s; Single USB 3.0 operation at lower speed	Dual USB 3.0 (2× 5 GBit/s); Bandwidth max. 620 MB/s; Single USB 3.0 operation at lower speed
Power consumption and supply	7W, powered by USB 2.0 and USB 3.0-Bus from PC;	7W, powered by Dual USB 3.0-Bus from PC, 5V	7W, powered by Dual USB 3.0-Bus from PC, 5V
Software	ZEN blue, ZEN core	ZEN blue, ZEN core	ZEN blue, ZEN core

Technical Data

Monochrome Cameras

	Axiocam 202 mono	Axiocam 305 mono	Axiocam 506 mono	Axiocam 702 mono
Sensor type	CMOS, Global Shutter	CMOS, Global Shutter	CCD, Quad Port Progressive Scan	CMOS, Global Shutter
Sensor size	11.25 mm × 6.33 mm equivalent to 1/1.2" diagonal 13.4 mm	8.5 mm × 7.1 mm equivalent ⅔" diagonal 11.1 mm	12.2 mm × 9.8 mm equivalent to 1" diagonal 16 mm	11.3 mm × 7.1 mm equivalent to 1/1.2" diagonal 13.3 mm
Pixel Count	2 megapixel: 1920 (H) × 1080 (V)	5.07 megapixel: 2464 (H) × 2056 (V)	6 megapixel: 2752 (H) × 2208 (V)	2.4 megapixel: 1920 (H) × 1216 (V)
Subsampling	–	1 × 1, 2 × 2		
Pixel size	5.86 µm × 5.86 µm	3.45 µm × 3.45 µm	4.54 µm × 4.54 µm	5.86 µm × 5.86 µm
Full Well Capacity	–	10,500 e^-	15,000 e^-	32,000 e^-
Quantum Efficiency	–	69% @ 525 nm	74% @ 500nm	78% @ 525 nm
Spectral Sensitivity	Approx. 350 nm – 1,000 nm, coated protective glass	Approx. 380 nm – 1,000 nm, coated protective glass	Approx. 350 nm – 1,000 nm, coated protective glass	Approx. 350 nm – 1,000 nm, coated protective glass
Binning	No	Digital binning 1×, 2×, 3×, 4×, 5×	Charge binning 1 × 1, 2 × 2, 3 × 3, 4 × 4, 5 × 5	Digital binning 1 × 1, 2 × 2, 3 × 3, 4 × 4, 5 × 5
ROI (Region of Interest)	Fixed frame 1080p mode	Yes (adjustable)	Yes (adjustable)	Yes (adjustable)
Readout Noise	–	Typ. 2.2 e^- @ gain 1×	Typ. < 6.5 e^- (39 Mhz), Typ. 6 e^- (13 Mhz)	Typ. 6 e^- @ gain 1× Typ. 3.75 e^- @ gain 16×
Dark current	–	Typ. < 1.0 e/p/s @ 25°C	Typ. < 0.06 e^-/p/s at 18°C	1.1 e^-/p/s at 18 °C
Dynamic range	–	Typ. 1:4,800	Typ. 1:2,500	Typ.> 1:5,000 at gain 1× HDR Mode 25,000:1
Digitization Bit Depth	8 and 12 bit	12 bit / 8 bit	14 bit / 12 bit / 8 bit	14 bit / 12 bit / 8 bit
Exposure Time Range	61 µs – 2 s	100 µs – 4 s	250 µs – 60 s	100 µs – 60 s
Analog Gain	1× – 16× adjustable	1×, 2×, 4×, 8×, 16×	1×, 2×, 3×	1×, 2×, 4×, 8×, 16×
Frame rate live image/Time Lapse Recording	Live Ethernet: 30 fps at 1080p (H.264) USB 3.0: 30 fps at 1080p (MJPEG) HDMI: 30 fps at 1080p Not recommended for Timelapse imaging in ZEN	Live 30 fps at 5 MP 67 fps at 1920 × 1080 (ROI in HD format) 136 fps at 512 × 512 (ROI)	Live 19 fps at 6 MP 19 fps at 2752 × 2208; 32 (ROI in HD format) 33 fps at 917 × 733; 51 fps at 550 × 440	Live 30 fps at 2.4 MP time lapse: 128 fps at 1920 × 1216 210 fps at 1929 × 720 534 fps at 1920 × 128 1,000 fps at 1024 × 128
Sensor cooling	No	stabilized at 25 °C	stabilized at 18°C	stabilized at 18°C
External trigger	No	No	Yes	Yes
Interface	USB 3.0 Type C, Ethernet, HDMI, power	USB 3.0 SuperSpeed (5 Gbit/s); Bandwidth max. 240 MB/s; USB 2.0 optional, with lower speed;	USB 3.0 SuperSpeed (5 Gbit/s); Bandwidth max. 240 MB/s; USB 2.0 optional, with lower speed;	USB 3.0 SuperSpeed (5 Gbit/s); Bandwidth max. 240 MB/s; USB 2.0 optional, with lower speed
Power consumption and supply	9W, external power supply	4W, powered by USB 3.0-Bus from PC	7W, powered by USB 2.0 and USB 3.0-Bus from PC;	7W, powered by USB 2.0 and USB 3.0-Bus from PC;
Software	ZEN blue, ZEN core, Labscope	ZEN blue, ZEN core, Labscope	ZEN blue, ZEN core	ZEN blue, ZEN core

Axiocam 705 mono	Axiocam 712 mono	Axiocam 807 mono	Axiocam 820 mono
CMOS, Global Shutter	CMOS, Global Shutter	CMOS, Global Shutter	CMOS, Global Shutter, Back Iluminated
8.5 mm × 7.1 mm equivalent to ⅔" diagonal 11.1 mm	14.1 mm × 10.4 mm equivalent to 1" diagonal 17.5 mm	14.5 mm × 9.9 mm equivalent to 1.1" diagonal 17.6 mm	12.4 mm × 12.4 mm (square field of view), equivalent to 1.1" diagonal 17.5 mm
5.07 megapixel: 2464 (H) × 2056 (V)	12 megapixel: 4096 (H) × 3008 (V)	7.1 megapixel: 3216 (H) × 2208 (V)	20 megapixel: 4512 (H) × 4512(V)
1 × 1, 2 × 2	1 × 1, 2 × 2	1 × 1, 2 × 2	1 × 1, 2 × 2
3.45 µm × 3.45 µm	3.45 µm × 3.45 µm	4.5 µm × 4.5 µm	2.74 µm × 2.74 µm
11,000 e^-	11,000 e^-	25,000 e^-	10,000 e^-
72% @ 550 nm	74% @ 500 nm	78% @ 520 nm	–
Approx. 350 nm – 1,000 nm, coated protective glass	Approx. 350 nm – 1,000 nm, coated protective glass	Approx. 350 nm – 1,000 nm, coated protective glass	Approx. 350 nm – 1,000 nm, coated protective glass
Digital binning 1×, 2×, 3×, 4×, 5×	Digital binning 1 × 1, 2 × 2, 3 × 3, 4 × 4, 5 × 5	Hybrid binning 1×, 2×, 3×, 4×, 5×	Hybrid binning 1×, 2×, 3×, 4×, 5×
Yes (adjustable)	Yes (adjustable)	Yes (adjustable)	Yes (adjustable)
Typ. 2.2 e^- @ gain 1× Typ. 1.15 e^- @ gain 16×	Typ. 2.2 e^- @ gain 1× Typ. 1.15 e^- @ gain 16×	Typ. 5.7 e^- @ gain 1× down to 2.9 e^- @ gain 16×	Typ. 2.3 e^- @ gain 1× down to 1.3 e^- @ gain 16×
Typ. < 0.5 e^-/p/s @ 18°C	Typ. < 0.5 e^-/p/s @ 18°C	Typ. 0.3 e^-/p/s @ 25°C	Typ. < 0.1 e^-/p/s @ 25°C
Typ. 1:5,000 at gain 1×, 1:25,000 at HDR mode	Typ. 1:5,000 at gain 1×, 1:25,000 at HDR mode	Typ. >1:4,420 at gain 1×, Low Noise Mode 1:6,230	Typ. 1:4,400 at gain 1×, HDR 1:25,000
14 bit / 12 bit / 8 Bit	14 bit / 12 bit / 8 bit adjustable	14 bit / 12 bit / 8 bit	14 bit / 12 bit / 8 bit
100 µs – 60 s	100 µs to 60 s	0.1 ms to 60 s	100 µs to 60 s
1×, 2×, 4×, 8×, 16×	1×, 2×, 4×, 8×, 16×	1×, 2×, 4×, 8×, 16×	1×, 2×, 4×, 8×, 16×
Live 30 fps 5 MP 60 fps at 2464 × 2056 (5MP) 115 fps at 1920 × 1080 (HDTV format) 436 fps at 1920 × 256	Live 30 fps at 2048 × 1504, Live 20 fps at full frame 23 fps full frame 63 fps at 1920 × 1080 (HDTV) up to 430 fps at 1020 × 120	Live at 30 fps at 7 MP 73 fps at 3216 × 2208 145 fps at 1920 × 1080 (HDTV) 260 fps at 1608 × 1104 487 fps up to 1920 × 256	Live 30 fps at 2256 × 2256 28 fps at 4512 × 4512 75 fps at 2256 × 2256 (subsampl.) 110 fps at 1920 × 1080 (HDTV) Up to 447 fps at 1920 × 128
stabilized at 18 °C	stabilized at 18 °C	stabilized at 25 °C	stabilized at 25 °C
Yes	Yes	Yes	Yes
USB 3.0 SuperSpeed (5 Gbit/s); Bandwidth max. 330 MB/s; USB 2.0 optional, with lower speed	USB 3.0 SuperSpeed (5 Gbit/s); Bandwidth max. 330 MB/s; USB 2.0 optional, with lower speed	Dual USB 3.0 (2× 5 GBit/s); Bandwidth max. 620 MB/s; Single USB 3.0 operation at lower speed	Dual USB 3.0 (2× 5 GBit/s); Bandwidth max. 620 MB/s; Single USB 3.0 operation at lower speed
7W, powered by USB 2.0 and USB 3.0-Bus from PC;	7W, powered by USB 2.0 and USB 3.0-Bus from PC;	7W, powered by Dual USB 3.0-Bus from PC, 5V	7W, powered by Dual USB 3.0-Bus from PC, 5V
ZEN blue, ZEN core	ZEN blue, ZEN core	ZEN blue, ZEN core	ZEN blue, ZEN core

Applications

Color Cameras

	Axiocam ERc 5s	Axiocam 105 color	Axiocam 208 color	Axiocam 305 color	Axiocam 506 color	Axiocam 705 color	Axiocam 712 color	Axiocam 705 pol	Axiocam 807 color	Axiocam 820 color
Histology/Pathology	++	++	+++	+++	++++	++++	++++	+	++++	++++
Live Cell Imaging	+	+	+	++	+++	+++	+++	++++	+++	+++
Fluorescence Imaging	+	+	+	++	++	++	++	++++	++	++
Low Light Imaging for Dim Samples	+	+	+	++	+++	+++	+++	++++	+++	+++
Semiconductor Inspection	++	++	++	+++	++++	++++	++++	++++	++++	++++
Large Samples	+	+	+	+++	++++	+++	++++	+++	++++	++++
Materials Research	++	+++	+++	++++	++++	++++	++++	++	++++	++++
Quality Control	+++	+++	++++	+++	+++	+++	++++	+	++++	++++
Teaching	++++	+++	++++	+++	+	+++	+	++	+	+
Clinical Routine	+++	++++	++++	+++	+	+++	++	+	+	++
Dynamic Range	+	+	+++	++++	++++	++++	++++	++++	++++	++++
Color Rendition	++	+++	++++	++++	++++	++++	++++		++++	++++
Polarized Light Applications	+	+	++	+++	++++	++++	++++	++++	++++	++++

Monochrome Cameras

	Axiocam 202 mono	Axiocam 305 mono	Axiocam 506 mono	Axiocam 702 mono	Axiocam 705 mono	Axiocam 712 mono	Axiocam 807 mono	Axiocam 820 mono
Histology/Pathology	+	+++	+++	+	+	+	+++	+
Live Cell Imaging	+	++	++	++++	++++	++++	++++	++++
Fluorescence Imaging	+++	++	++	++++	++++	++++	++	++++
Low Light Imaging for Dim Samples	++	++	++	++++	++++	++++	++	++++
Semiconductor Inspection	++	+++	+++	++	++++	++++	+++	++++
Large Samples	+++	+++	+++	+++	+++	++++	+++	++++
Materials Research	++	++++	++++	++	++	+++	++++	+++
Quality Control	+	+++	+++	+	+	+	+++	+
Teaching	++++	+++	+++	+	++	+	+++	+
Clinical Routine	++++	+++	+++	+	+	+	+++	+
Dynamic Range	+++	++++	++++	++++	++++	++++	++++	++++

FOR MORE INFORMATION/QUOTATION CONTACT:

ALLIED HIGH TECH PRODUCTS - EXCLUSIVE DISTRIBUTOR
800-675-1118 (US/Canada)
info@alliedhightech.com
www.alliedhightech.com

Carl Zeiss Microscopy GmbH
Carl-Zeiss-Promenade 10
07745 Jena, Germany

Email: microscopy@zeiss.com
zeiss.com/axiocam