chromasens
Imaging for Professionals

allPIXA evo camera | Manual

CD40195

R04 / 2022-05

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1 General information

1.1 About Chromasens

The name of our company, Chromasens, is a combination of 'Chroma' which means color, and 'Sens' which stands for sensor technology.

Chromasens designs, develops, and produces high-quality and user-friendly products:

- Line scan cameras
- Camera systems
- Camera illumination systems
- Image acquisition systems
- Image processing solutions

Today, Chromasens GmbH is experiencing steady growth and is continually penetrating new sales markets around the globe. The company's technologies are used, for example, in products and for applications such as book and document scanners, sorting systems and inspection systems for quality assurance monitoring.

Customers from all over the world of a wide range of industrial sectors have placed their trust in the experience of Chromasens in the field of industrial image processing.

1.1.1 Contact information

Chromasens GmbH
Max-Stromeyer-Str. 116
78467 Konstanz
Germany

Phone: +49 (0) 7531 / 876-0
Fax: +49 (0) 7531 / 876-303
Email: info@chromasens.de
HP: www.chromasens.de

1.1.2 Support

Should you ever have problems with the allPIXA evo camera that you cannot solve by yourself, please look into this manual for additional information, check the troubleshooting chapter 9, contact your local distributor, or send us an e-mail.

Chromasens GmbH
Max-Stromeyer-Str. 116
78467 Konstanz
Germany

Phone: +49 (0) 7531 / 876-500
Fax: +49 (0) 7531 / 876-303
Email: support@chromasens.de
HP: http://www.chromasens.de/en/support/support/support

Visit our website at http://www.chromasens.de which features detailed information on our company and products.

1.2 Firmware and software version in this manual

This document refers to the following version:

Camera: Packet 1.52.3

The recent version may have additional functions. Therefore, contact the Chromasens support.

1.3 List of abbreviations

Abbreviation	Meaning	Explanation
CCM	Color conversion matrix	The CCM supports the conversion from for example RGB to sRGB or any user-defined conversion
Corona II	LED illumination	Chromasens product
DSNU	Dark signal non-uniformity	Irregularity in the dark image
GenICam	Generic interface for cameras	Generic programming interface for industrial cameras administered by the European Machine Vision Association www.emva.org
LED	Light emitting diode	-
NIR	Near infrared	-
PRNU	Photo response non-uniformity	Difference in sensitivity of the individual pixels
ROI	Region of interest	-
RS485		ANSI standard defining the electrical characteristics of drivers and receivers for use in serial communication systems.
SFNC	Standard Feature Naming Convention	Document of the GenICam standard, which provides feature names for common camera features.
VSync	Vertical synchronization	Frame signal for an image (corresponds to FVAL: frame valid)

1.4 Definitions

Chromasens	Other used definitions	Explanation
Black-level correction	Background subtraction, Offset correction	Corrects the dark offset for each pixel (DSNU)
Trigger Delay Lines	Image start delay	Delay of the image’s beginning, as a number of lines, from the beginning of the trigger condition to the beginning of the image
Shading correction	brightness correction, White-level correction, PRNU correction	Corrects brightness inhomogeneities resulting from lens, light and non-uniformity of sensor pixels (PRNU)
Flat-field correction		Corrects dark offset and brightness inhomogeneities
RGB line distance	Line shift, Line distance, Spatial correction, ImageCalibrationLineDistance	The tri- or quad-linear sensor has individual pixel lines for (gray,) red, green and blue. Inside the camera, the spatial differences are corrected.
White balancing	Setting the operation point	White balancing ensures that a reference white is kept stable in an image with color temperature or brightness changes of the illumination. This can be done in a single setup process or in a continuous process.
White reference	White reference position	The white reference is a physical patch in the field of view of the camera that can be used for a camera-internal white balancing by adjusting the gain values.

1.5 Scope of supply of the allPIXA evo camera

Check your device upon delivery to ensure that it is undamaged and complete.

The following components are supplied with the allPIXA evo camera:

- allPIXA evo camera packaging

  Check the packaging for damage, which may have occurred during transport.

- allPIXA evo camera

  Check the camera for damage, which may have occurred during transport.

  The rating plate is located on the rear of the allPIXA evo camera. It shows the camera resolution and the serial number.

- Additionally ordered and supplied accessories

  Lens adapters, extension rings, lenses and other accessories are not included in the standard scope of delivery. These items must be ordered separately as accessories.

  Check additionally ordered accessories for completeness and for damage, which may have occurred during transport.

Read this manual carefully before using the camera, contacting your local partners or the Chromasens support.

Should there be any questions left, do not hesitate to contact your local partner or us.

We would be pleased to be of assistance to you.

1.6 Design of a line scan camera system

The following figure demonstrates the basic setup of a typical line scan camera system:

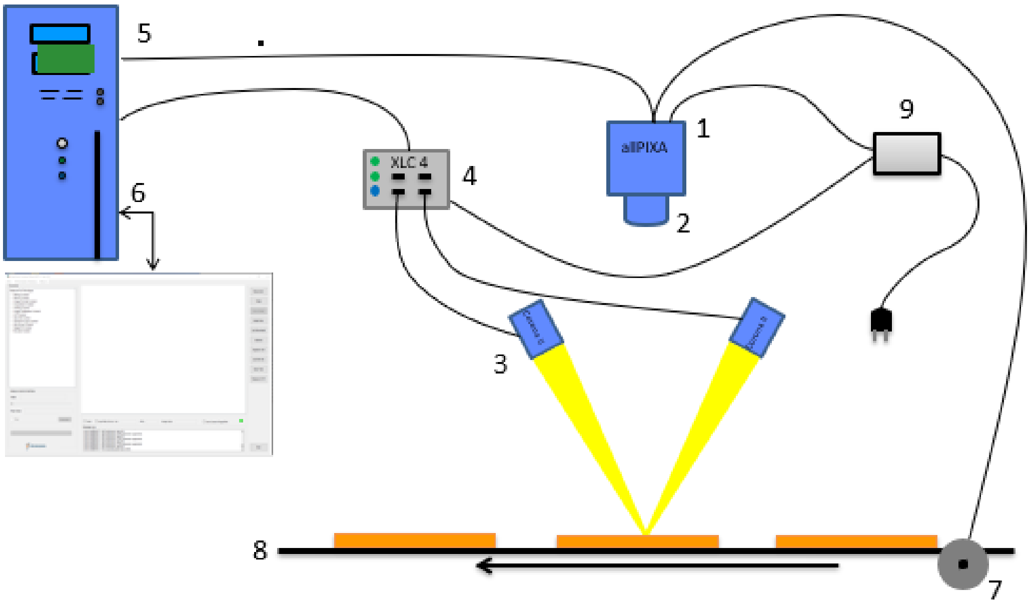


Figure 1: Design of a line scan camera application

The following components are necessary in a typical line scan camera application:

Component	No.
Line scan camera: An allPIXA evo camera, which scans the image line by line and communicates with the PC (5).	**1**
The optical system: Optical lenses with tubes and mounts with an adjusted focusing	**2**
Illumination: The illumination system lights up the information carrier/scan area on the passing object. The Chromasens Corona II illumination system is an ideal supplementary option for the allPIXA evo camera.	**3**
Illumination controller: Controls and monitors the illumination unit. The Chromasens Corona II illumination (3) has integrated temperature/voltage sensors which can be read out with the XLC4 controller. By use of the XLC4 controller, the illumination unit can be monitored and kept stable.	**4**
Cables and suitable network card or frame grabber in the PC: The image data is sent to a PC using one or two fiber optic cables or one to four CoaXPress cables depending on interface. (6).	**5**
PC: The PC system performs subsequent processing of the image data and can optionally control the illumination system (3 + 4).	**6**
Speed detection: The speed of the object / conveyor belt can be detected by an optional incremental encoder. The encoder can be connected to the allPIXA evo.	**7**
Conveying unit: The conveying unit moves the scanned object past the allPIXA evo camera.	**8**
Power supply: Both, the allPIXA evo camera and the illumination system, require a suitable power supply.	**9**

2 Specifications and definitions

The allPIXA evo camera family is available in the following maximum resolutions:

- 8,192 pixels
- 10,240 pixels
- 15,360 pixels

The allPIXA evo camera comprises all functions required for supplying images with the same color, brightness, and resolution of each operational area.

The allPIXA evo camera is especially suitable for inspection systems requiring a very high speed and a consistently high color quality.

The camera is compliant with the GigE Vision 2.0 specification which defines the communication interface protocol for any GigE Vision device. The device description of the camera is contained in an XML file. For more information for GigE Vision see: https://www.automate.org/a3-content/vision-standards-gige-vision.

The camera can be connected to the PC either with a single copper or fiber cable or with two cables using Link Aggregation.

Continuous white balancing is possible during image acquisition to ensure optimum color quality. In addition, offset and shading correction ensure the balance of different color pixel sensitivities (DSNU and PRNU) as well as the illumination process.

The design was fully revised during development of the housing, which is impressively tough but offers several screw-mounting options. Take notice that the wide range of adapter options makes the installation simple for users.

The standard mount connections M72x0.75 for the 10k camera, or M95x1.0 for the 15k camera, respectively, permit to use all commercially available standard lenses. In addition, special adapters are available that permit to connect Chromasens accessories.

2.1 Camera highlights

- 10k and 15k tri-linear CMOS color line scan with 5.6 µm pixel size
- 8k multiline CMOS color line scan sensor with 5.0 µm pixel size
- High accuracy sensor alignment
- GigE-Vision-compliant (GigE-Vision 2.0)
- 3 x 8 bits color information on the output side; RGB spatial compensation in the camera (also sub-pixel correction, patented)
- ROI mode (one ROI selectable)
- Continuous white balancing maintains a constant image brightness and color irrespective of the temperature and service life of the illumination system
- Incremental encoder port on the camera; this ensures simple handling and less programming work
- Flat field correction, fully automatic calculation internally in the camera
- Gamma correction, brightness, and contrast controller, separate for each channel
- Robust metal housing
- Standard mount connections M72x0.75 for the 10k camera, or M95x1.0 for the 15k camera, respectively
- Special adapters permit to use Chromasens accessories
- Internal test image generator
- Area scanning with variable image lengths based on trigger inputs (light barriers)

2.2 Available cameras

Cameras with 10GiGE interface:

allPIXA evo 8k DXGE

allPIXA evo 10k DXGE

allPIXA evo 15k DXGE

Cameras with CoaXPress interface:

allPIXA evo 8k CXP

allPIXA evo 10k CXP

allPIXA evo 15k CXP

All camera models are available as color or as mono camera.

2.3 Feature Reference

For detailed information on camera controls refer to the allPIXA evo Features Reference, which is available on the Chromasens website. It describes the standard and advanced camera controls for GigE Vision. Make sure that you always refer to the feature reference that matches the used firmware version.

2.4 Technical specification

	10K and 15K sensors	8K sensor
Sensor	Tri-linear CMOS color line sensor	CMOS line scan sensor with 16 lines (RGB, NIR-pass and mono)
Pixel size	5,6 µm x 5,6 µm (5,6 µm pitch)	5.0 µm x 5.0 µm
Line spacing	11,2 µm between R-G and G-B	10 µm between R-G and G-B
Spectral sensitivity	360 nm to 960 nm	360 nm to 960 nm
Resolution	10240 / 15360 px x 3 lines	8192 px x 16 lines
Video Output	Single/Dual 10 GigE OR 4 x CoaXPress 2.0 GigE Vision® 2.0 compliant	
Data format	3 x 8 bit color mode or 1 x 8 bit mono mode	3 x 8/10/12 Bit color or 1 x 8/10/12 Bit mono mode 4 x 8/10/12 Bit RGB + NIR-pass
Trigger mode	Off / On Frame Start / Frame Active / Line Start	Free run / External trigger Line trigger / Encoder and Frame trigger
Interface for 10 GigE camera	2 x SFP+	
Interface for CXP camera	4 x Micro-BNC	
Power	Power supply (6 pin Hirose, male)	
I/O	External I/O (15 pin HD D-Sub, fem.)	
Other Interfaces	USB 2.0 (Micro-USB)	
Camera mount	10K: M72x0.75 15K: M95x1.00	M72 x 0.75 mm F-Mount Adapter
Certifications	CE, RoHS	
Power supply	12 to 24 VDC +/- 10%; 1A@24V	12 – 24V DC ± 20%
Housing temperature	0°C to 60°C; 32°F to 140°F	0°C to 60°C; 32°F to 140°F
Housing dimensions	10k: 102 x 76 x 82 mm (W x H x D) 15k: 102 x 101 x 82 mm (W x H x D)	102 x 76 x 82 mm (W x H x D)
Weight	0.9 kg	0.9 kg

Line rates for 10 GigE variants

	10K and 15K sensors with 10 GigE	8K sensor with 10 GigE
Output	Single/Dual 10 GigE GigE Vision® 2.0 compliant	Single/Dual 10 GigE GigE Vision® 2.0 compliant
Maximum line rate - camera internal	mono: up to 68.4 kHz RGB: up to 3 x 68.4 kHz	Mono 8192 px x 1: up to 100 kHz RGB up to 3 x 100 kHz
Maximum line rate in ROI mode (1 ROI available)	*depends on ROI size* RGB and mono: up to 68.4 kHz	*depends on ROI size* RGB and mono: up to 100 kHz
Maximum line rate color: output	*Single 10 GigE:* 10240 px: up to 40 kHz (see note) 15360 px: up to 26 kHz (see note) *Dual 10 GigE (Link aggregation)* 10240 px: up to 68.4 kHz (see note) 15360 px: up to 49.5kHz (see note)	*Single 10 GigE:* RGB: 8192 px x 3: up to 50 kHz RGB+NIR: 8.192 x 4 Pixel up to 37 kHz *Dual 10 GigE (Link aggregation)* RGB: 8192 px x 3: up to 90 kHz RGB+NIR: 8.192 x 4 Pixel up to 68 kHZ
Maximum line rate mono: output	*Single and Dual 10 GigE* 10240 px: up to 68.4 kHz 15360 px: up to 68.4 kHz	*Single and Dual 10 GigE:* 8192 px x1: up to 100 kHz
Data format	3 x 8 bit color mode or 1 x 8 bit mono mode	3 x 8/10/12 Bit color or 1 x 8/10/12 Bit mono mode 4 x 8/10/12 Bit RGB + NIR-pass

NOTE	To use the full performance of the 10 GigE please make sure that your hardware on PC side is suitable (See also Getting started with 10 GigE). allPIXA evo 15K DXGE Color | Chromasens - Your specialist for machine vision and image capturing systems Maximum line frequencies over 10 GigE depend on PC performance, network hardware, and configuration. Take notice that Windows 10 does not support link aggregation without with the Kithara real time kernel solution anymore.
NOTE	Power consumption is1.3 ampere@24V. It is recommended to use a power supply with 24VDC/1.5 amp or higher.

Line rates for CXP variants

	10K and 15K sensors with CXP	8K sensor with CXP
Output	CoaXPress 2.0	
Maximum line rate -	mono: up to 68.4 kHz RGB: up to 3 x 68.4 kHz	Mono 8192 px x 1: up to 100 kHz RGB up to 3 x 100 kHz
Maximum line rate in ROI mode (1 ROI available)	RGB and mono: up to 68.4 kHz	RGB and mono: up to 100 kHz
Data format	3 x 8 bit color mode or 1 x 8 bit mono mode	3 x 8/10/12 Bit color or 1 x 8/10/12 Bit mono mode or 4 x 8/10/12 Bit RGB + NIR-pass

2.5 Sensor alignment and orientation

Sensor orientation and alignment in viewing from the front side of the camera. For a detailed mechanical drawing, see section 10.1.

First pixel of sensor lines:

Left side

Color lines orientation:

Blue: top
Green: center
Red: bottom

Sensor alignment:

Position:

X: < +/- 100 µm
Y: < +/- 100 µm
Z: < +/- 100 µm

Rotation about:

Y: < +/- 0.1 °
Z: < +/- 0.1 °

Planarity of sensor surface:

< +/- 0.50 µm

Sensor window:

	10k, 15k camera	8k camera
Thickness	1.1 mm	0.7 mm
Refraction index	1.5	1.5
Optical path extension	0.55 mm	0.35 mm

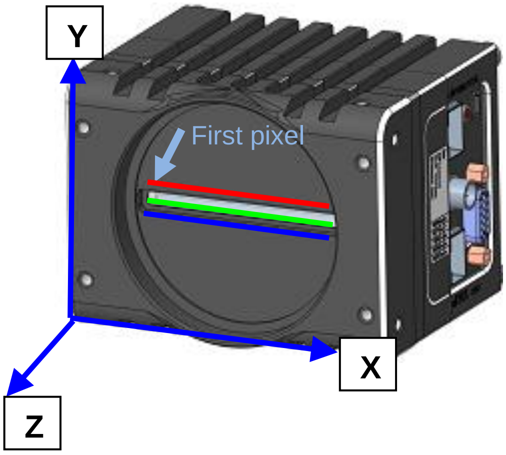


Figure 2: Sensor alignment

Sensor alignment is an important issue for:

- Adjusting multi-camera systems
- Replacing cameras
- Mechanical design of the mounting system for the camera

2.6 Environmental requirements

	Value
Temperature for camera operation	See 2.4 for the allowed housing temperature
Air humidity during camera operation	20% - 85% relative air humidity, non-condensing
Storage / transport temperature	-20 ºC - +85 ºC; -4 °F - +185 °F
Protection category	IP50
General ambient conditions	
Operation	IEC 721-3-3:IE33
Transport	IEC 721-3-2:IE21
Storage	IEC 721-3-1:IE11

NOTE: You should use thermal conductive mounting (for example direct attachment on metal frame) to decrease temperature and for improved camera performance. See also section 5.4.

3 Safety

3.1 Depiction of safety instructions

Safety-relevant information is indicated in this manual as follows:

WARNING

Indicates a potentially hazardous situation or task, which, if not avoided, could result in serious injury or death.

CAUTION

Indicates a potentially hazardous situation or task, which, if not avoided, may result in minor or moderate injury.

NOTICE Indicates a potentially hazardous situation or task, which, if not avoided, could result in damage to the product or the surrounding environment.

3.2 Basic safety regulations

The basic safety regulations always observe the following:

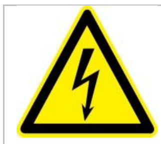
- Do not attempt to install the device or start operation before you have read all supplied documentation carefully and have understood its contents.
- Safe and correct operation of the device requires correct and appropriate transport, storage, mounting and installation as well as careful operation and maintenance.
- Operation of the allPIXA evo camera device is only permitted if it is in a faultless and safe condition. If a fault or defect occurs, the allPIXA evo camera, the machine, or the system in which the allPIXA evo camera is installed, must be stopped immediately, and the responsible person must be informed.
- Modifications and extensions to the allPIXA evo camera are only permitted if the prior written consent of Chromasens GmbH is obtained. This applies in particular to modifications and extensions which can negatively affect the safety of the allPIXA evo camera.
- Compliance with the ambient conditions described in this manual is essential.

3.3 Safety instructions on the allPIXA evo camera

Risks from hot surfaces

The body of the allPIXA evo camera heats up during operation.

Do not touch hot surfaces without suitable protective gloves. Always allow hot surfaces to cool down before carrying out any work on the unit.



Electric voltage hazard

The allPIXA evo camera runs with electric power. Before any work is carried out on the allPIXA evo camera, be aware to disconnect the mains cables. Make sure that the device is safely isolated from the power supply!

Risk of electrostatic discharge

The allPIXA evo camera contains components and units which are sensitive to electrostatic charge.

Observe all precautionary measures for handling electrostatically sensitive equipment.

Make sure that allPIXA evo camera, its corresponding tools, its equipment, and the knowledge of the person who is handling it have the same electrical potential.

3.4 Purpose / applications

- The allPIXA evo camera is designed for machines and systems which are used for commercial and industrial applications.
- The owner of the machine or system in which the allPIXA evo camera has been installed is responsible for compliance with relevant safety regulations, standards and directives. Commissioning of the allPIXA evo camera is only permitted if the machine or system, in which the camera is installed, complies with the safety regulations and standards of the country in which the allPIXA evo camera runs.
- The owner of the machine or system with the installed allPIXA evo camera must verify the suitability of the allPIXA evo camera for its intended use.
- Safety regulations of the country in which the device is used must be complied with it.
- The allPIXA evo camera may only be connected or used as described in this manual.
- The allPIXA evo camera must be set up and installed in compliance with the instructions contained in this manual.

3.5 Staff requirements

- The system owner must ensure that all persons working on the system are trained for the required work and have read and understood this manual. This applies particularly to the employees who only work occasionally with the allPIXA evo camera, for example, during commissioning and maintenance work.
- Work on the electrical installation of the system may only be carried out by a qualified electrician or persons who have undergone the necessary electrotechnical training under the supervision of a qualified electrician, in compliance with applicable electrotechnical regulations.
- Be aware that only suitably trained and qualified persons are permitted to work with the allPIXA evo camera. Such persons are qualified to work with the allPIXA evo camera device if they are familiar with its assembly, installation, care, and all necessary precautionary measures.
- Assignments and responsibilities of the staff charged with operation, commissioning, maintenance, and repair must be clearly defined and specified by the owner of the device in which the allPIXA evo camera is installed.

3.6 Organizational measurements

- The instruction manual must be stored safely in the vicinity of the camera in operation.
- Information contained in this manual must be integrated into the documentation of the device in which the allPIXA evo camera is installed.
- The allPIXA evo camera and all connected peripheries must be checked regularly for visible external damages.

3.7 Safety instructions for maintenance / cleaning

- Before any service or maintenance work is carried out, the responsible staff must be informed.
- Deadlines and intervals for regular inspections must be complied with.
- Before maintenance is started, the allPIXA evo camera must be isolated from the power supply.
- Due to the risk of fire, devices such as radiators, heaters, or lighting equipment must be allowed first to cool down.
- Only technicians of the Chromasens GmbH are permitted to open or slacken screws or housing sections of the allPIXA evo camera.
- Necessary repairs may only be carried out by Chromasens GmbH.
- Cleaning of the device is only allowed with a soft, lint-free cloth and Isopropanol (optional).
- To avoid damages, the camera should only be transported in its original packaging.

3.8 Maintenance and cleaning of the allPIXA evo camera

During operation of the device, particles such as dust etc. may be settled on the optical components (lens) of the camera. These deposits affect the optical image and the function of the camera negatively.

NOTICE	Chromasens recommends regular inspection and cleaning. The cleaning intervals depend on the actual operating and ambient conditions (for example dust-laden atmosphere).

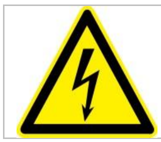
3.8.1 Cleaning intervals

Cleaning intervals depend on the environment. Regular inspection and cleaning intervals must be specified depending on the degree of soiling.

3.8.2 Cleaning process

The body of the allPIXA evo camera heats up during operation.

Before cleaning, you must switch off the device. Always allow hot surfaces to cool down before cleaning the device.



The device works with electric power. Before cleaning the device, make sure that the device is disconnected from the power supply.

All surfaces requiring cleaning can be wiped with a soft, lint-free cloth which can be moistened with Isopropanol.

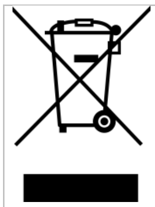
Never use any other liquid or cleaning agent than those stated in this manual.

Never use hard or sharp tools for cleaning the device.

Inspect the device to ensure that cleaning was effective and repeat, if necessary.

If it is not possible to clean a component due to irremovable contamination, it must be replaced.

3.9 Disposal



This symbol indicates that electrical and electronic equipment should not be disposed with normal garbage at the end of its working life. To prevent possible harm to the environment or human health from uncontrolled waste disposal, separate this from other types of wastes and recycle it responsibly to promote the sustainable reuse of material resources.

Please dispose this product in accordance with your local regulations and contact your local government office, for details of where and how they can take this item for environmentally safe recycling.

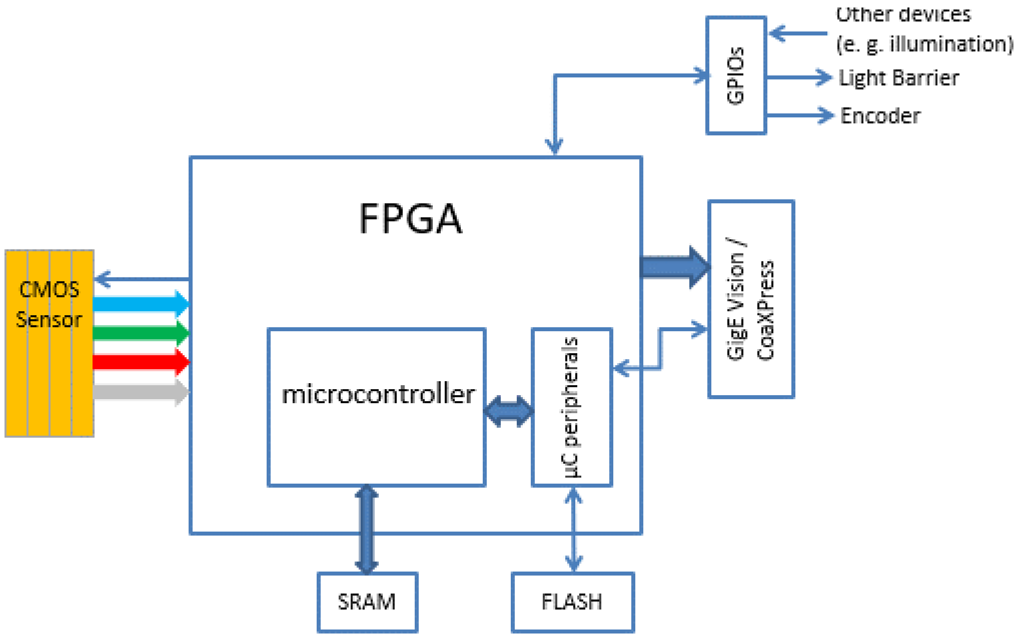
4 allPIXA evo – basic functionality

4.1 Basic design of the allPIXA evo camera

During operation, an object is scanned by the CMOS sensor. In the CMOS sensor, the analog signal of each pixel is transformed to a digital signal with its own AD converter. These parallel present pixel data are then converted via serializer into several parallel serial data streams. These serial data streams are read out with the logic of the FPGA. The FPGA includes also a softcore microprocessor with its peripherals. This softcore microprocessor with its external RAM and flash memory supports the FPGA logic during image data processing to output the images through the GigE Vision, or the CoaXPress interface.

The allPIXA evo camera can be configured with any software for configuration of GigE-Vision 2.0 compliant cameras. We recommend using the Chromasens program GCT, which provides dialog boxes and wizards for easy configuration of the allPIXA evo camera.

Signals from incremental encoders or light barriers can also be input by the Digital IO port (GPIOs), see 5.1.6 for more details.

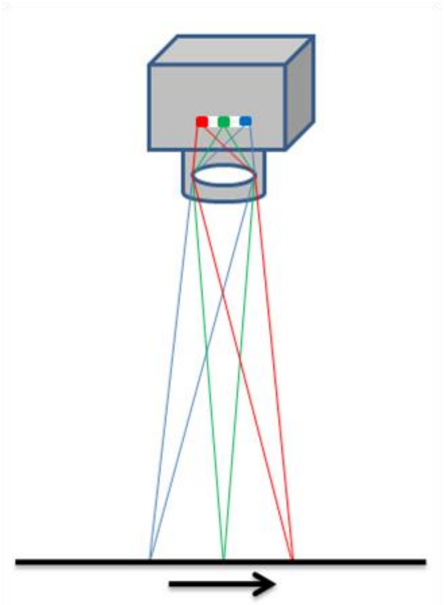


FPGA	integrated circuit for programmable logic circuits	GigE Vision / CoaXPress	camera connection
µC	microcontroller	GP IOs	multi-purpose inputs/outputs
SRAM	static random-access memory; information is lost if power is removed		
Flash	memory for the program and reference data		

Figure 3: Basic design of the allPIXA evo camera (block diagram)

4.2 Line scan sensors of the 10K and 15K allPIXA evo cameras

4.2.1 Design

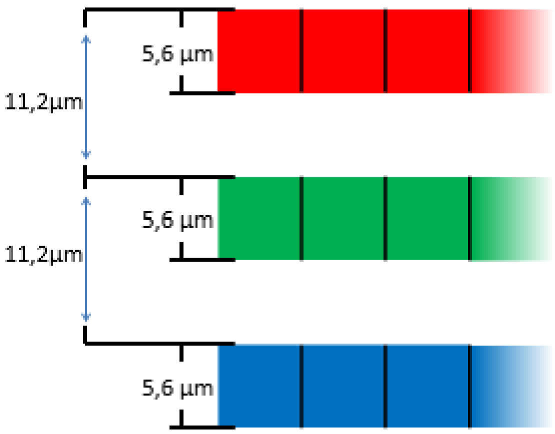


The 10K and 15K allPIXA evo camera color line scan cameras are equipped with a tri-linear CMOS line scan sensor with 3 spatially separated lines which are sensitive to brightness and the colors red, green and blue (RGB).

In this way, 3-color information is obtained from each image point (RGB). The spacing of sensor lines is compensated in the allPIXA evo camera.

Compared to camera systems with interpolating processes (for example single-line or bilinear color line scan cameras), the color information is acquired with 3 x 12 bits for each image point.

Take notice that high-quality color detection is only possible in that way.



Sensor pixels are 5.6 µm wide and 5.6 µm long. The distance between the color sensor lines is 11.2 µm.

Spatial correction is achieved by the corresponding delay of the individual items of color information. As a result of the object's movement, for example, an object point first reaches the blue sensor line, then the green sensor line and finally the red sensor line.

These 3 color channels are then combined into a complete image.

Continual scanning provides a color image which can theoretically be infinitely long.

Figure 4: 10K and 15K line scan sensors

4.2.2 Spectral sensitivity

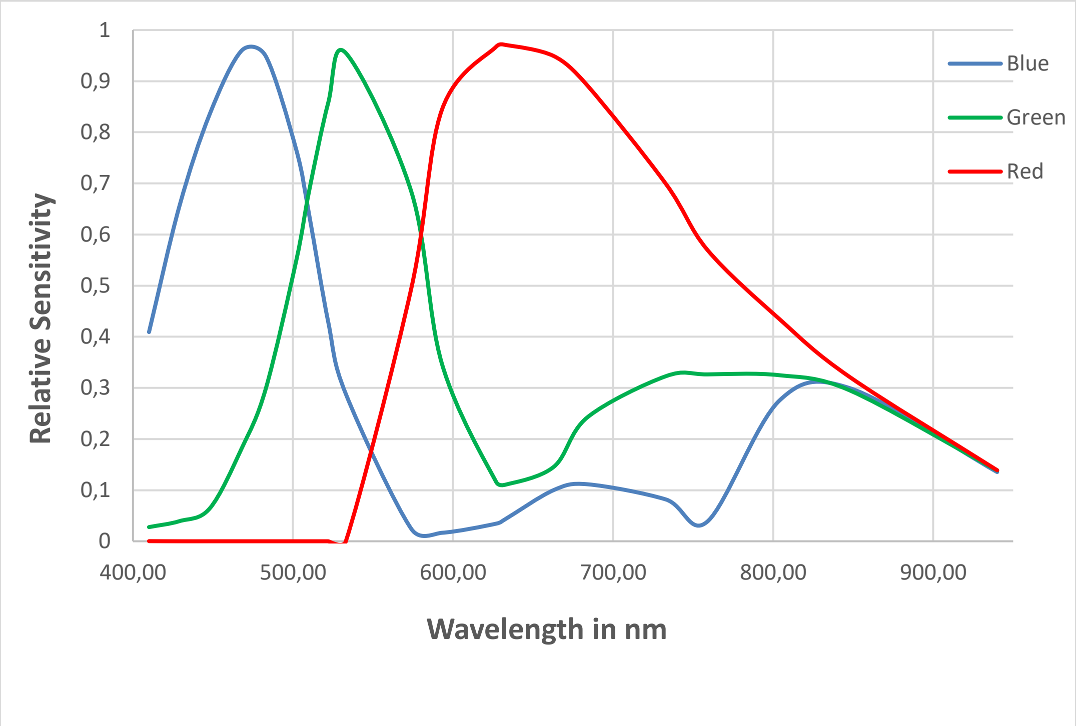


Figure 5: Spectral sensitivity of the color camera line scan sensor

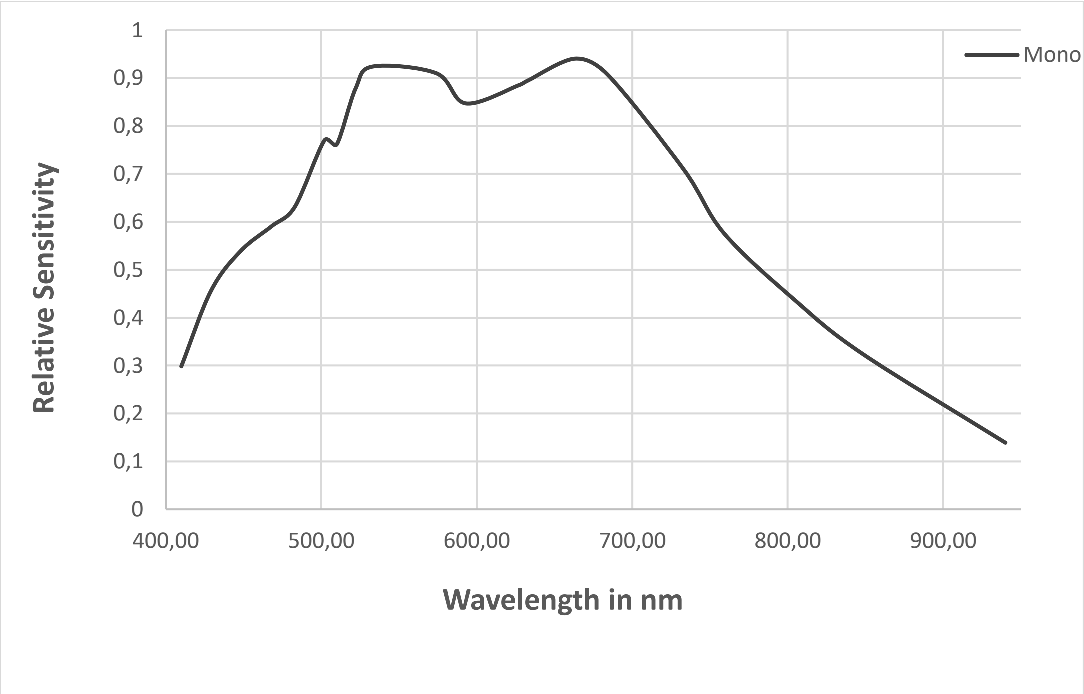
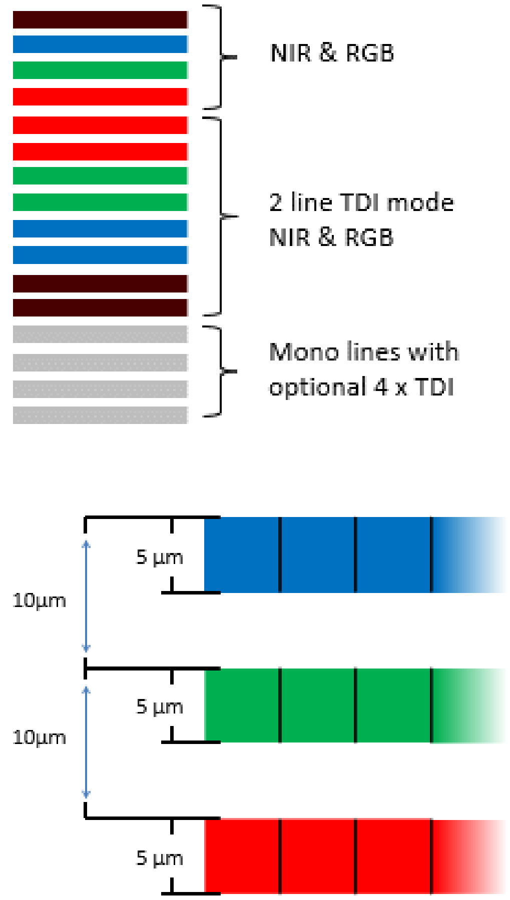


Figure 6: Spectral sensitivity of the mono camera line scan sensor

The sensors of the allPIXA evo family permit to adjust the sensitivity of the sensor to fit your application. For more information, see section 8.3

4.3 Line scan sensor of the 8K allPIXA evo camera

4.3.1 Design of the color sensor



The 8K allPIXA evo camera color line scan camera is equipped with a CMOS line scan sensor with 16 spatially separated lines which are sensitive to brightness and the colors.

Sensor pixels are 5 µm wide and 5 µm long. The distance between the color sensor lines is 10 µm.

Spatial correction is achieved by the corresponding delay of the individual items of color information. As a result of the object's movement, for example, an object point first reaches the blue sensor line, then the green sensor line and finally the red sensor line.

These 3 color channels are then combined into a complete image.

Continual scanning provides a color image which can theoretically be infinitely long.

Figure 7: 8K line scan sensor

4.3.2 Sensor pixel arrangement

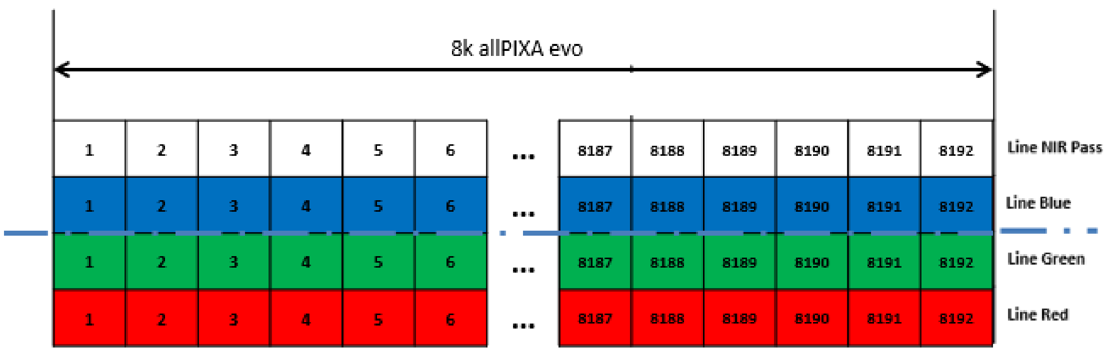


Figure 8 Pixel arrangement at the 8k allPIXA evo camera

4.3.3 Spectral sensitivity

Spectral sensitivity of the 8k camera:

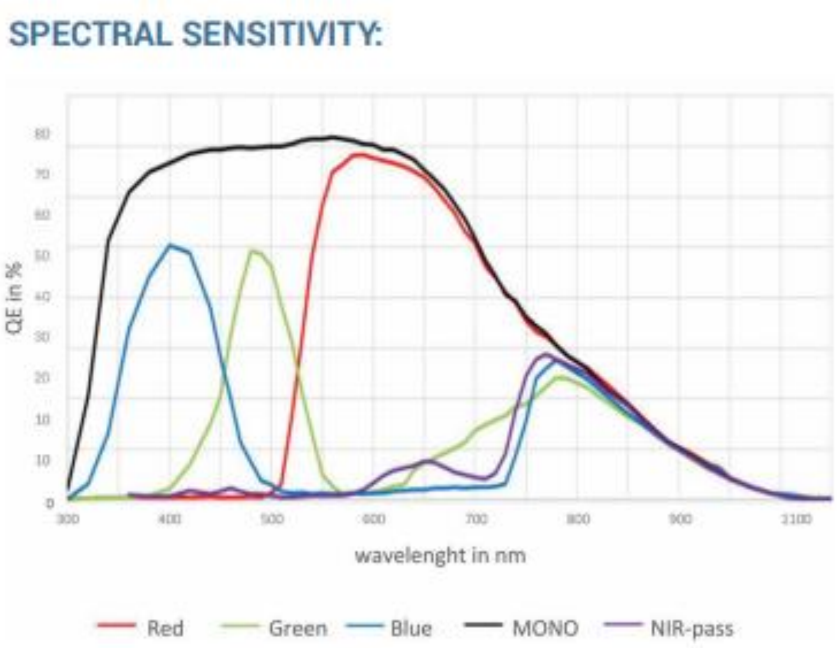


Figure 9: Spectral sensitivity of the 8k line scan sensor (color and mono camera)

The sensors of the allPIXA evo family permit to adjust the sensitivity of the sensor to fit your application. For more information, see section 8.3.

4.4 Image processing

Image processing in the allPIXA evo camera is digital. The following block diagram illustrates the internal processes.

4.4.1 Digital image processing

The data read out from the CMOS Sensor run through the image processing path as shown in ***Figure 10***:

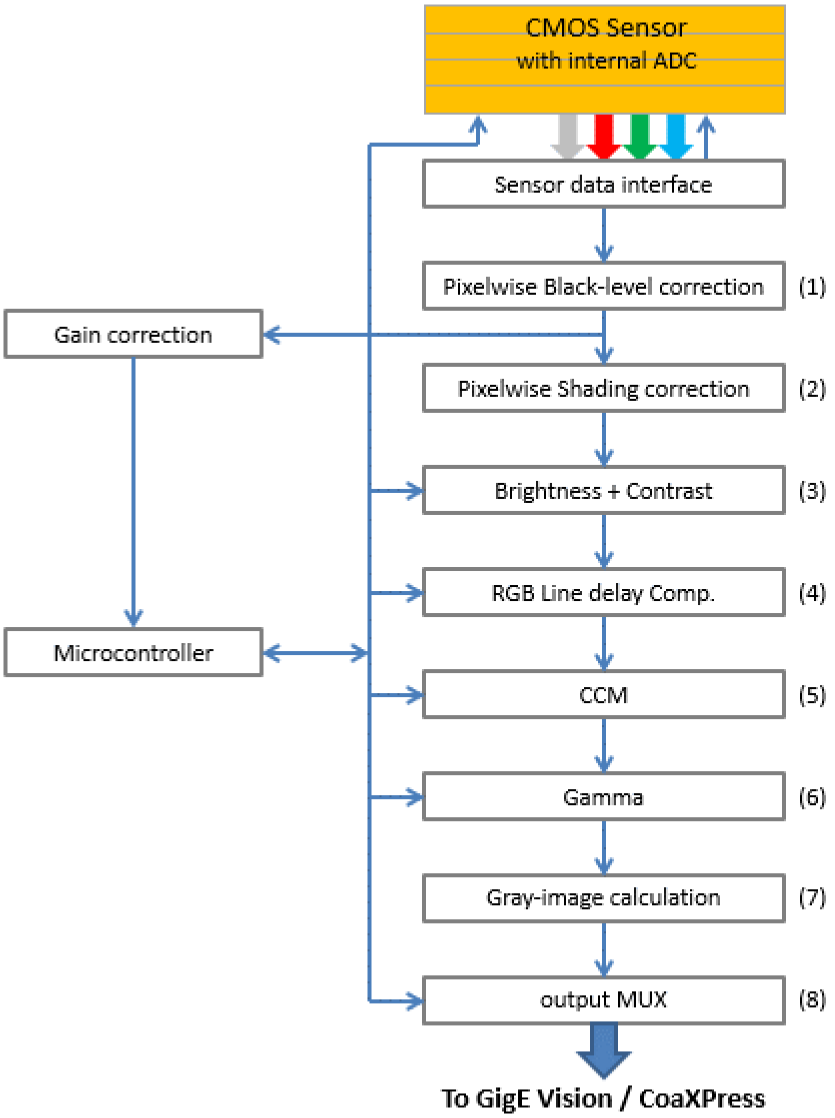


Figure 10: Digital processing of the allPIXA evo camera (block diagram)

First, pixel-by-pixel black-level correction (1) and shading correction (2) are carried out, then the image data are adjusted with the values programmed for brightness and contrast (3). Afterwards, the spatial correction (RGB) is carried out in the line buffer (RGB line delay compensation) (4), and the colors are adjusted with the color conversion matrix (5) and gamma correction (6). The color image can also be converted into a gray image by the FPGA (7). Auxiliary data can be added to each line before the image data are output via the GigE Vision or the CoaXPress interface (8).

4.5 Black-level correction and shading (flat-field) correction

The allPIXA evo camera supports black-level (offset) and shading correction.

The following points are important for understanding these kinds of operation:

- Both operations are based on pixel-by-pixel calculation, and the effects on behavior of single pixels such as PRNU (photo response non-uniformity) are eliminated.
- Both operations are carried out separately for every line ((clear), red, green, blue).
- The allPIXA evo camera offers two data sets for black-level correction and two data sets for shading correction Therefore, you are able to deal with, for example, two different lighting systems by selecting the necessary data sets without having to transfer or generate new shading data.
- Calculation of the correction data sets can be done offline on scanned images. Often, shading data have been calculated internally with a static white reference in front of the camera. In this case, spots of dust on the white reference lead to vertical lines in the image. This effect can be eliminated by slightly defocusing the lens during the generation of the references. The lighting distribution is then seen by the sensor and the lens. Another possibility to avoid this problem is to move the target slightly at the balancing process. In this way, distortions, for example by dust, may also be eliminated.
- The allPIXA evo camera permits offline calculation of the references. You can select a scanned image and define a region of the image, in which shading correction data shall be calculated. By averaging over a higher number of lines, distortions, for example caused by dust on the target, are eliminated. Therefore, it is possible to use an image with a moving white object.
- The allPIXA evo camera also permits to generate shading and offset data internally.
- Generated data sets may be stored to the hard disk of the PC. The stored data can be transferred to the camera later.
- For the calculation, the following formulas can be used:

Mode Recording of black reference line:

BRef(x) = VidRaw with black template or without illumination

Mode Recording of white reference line:

WRef(x) = VidRaw(x) – BRef(x) with white template

Mode / Correction (white- and black-correction is activated)

$$VidSHCOut(x,y) = \frac{(VidRaw(x,y) - BRef(x)) * VidMax}{WRef(x)}$$

This calculation is done separately for all color separations (CRGB).

- BRef — Black-Reference value for each pixel in the line (DSNU)
- WRef — White-Reference value for each pixel in the line (PRNU)
- VidRaw — Raw values for each pixel output by A/D Converter
- (x, y) — Number of pixels within the line or column
- VidMax — Maximum brightness value
- VidSHCOut(x,y) — Offset- and shading-corrected pixels of the image

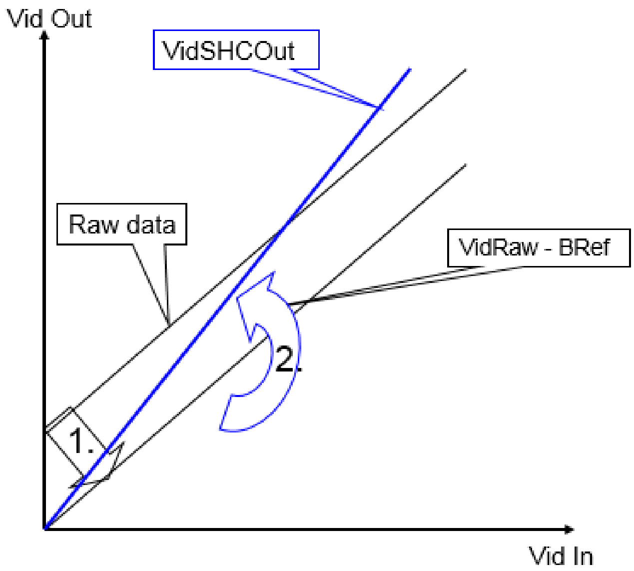


Figure 11: Offset and shading correction

1.: Black-level correction (DSNU)

2.: Shading correction (PRNU)

4.6 White balancing with a closed-loop control

To keep the video values stable on a white reference target, the allPIXA evo camera supports an automatic adjustment of the internal gain values. Therefore, a closed loop can be established, which enables an automatism of keeping the white-point stable, even if there are brightness or color temperature changes in the illumination. Usually, automatic camera functions use the brightest point for adjusting the best result to get the white color.

The allPIXA evo camera permits to arbitrarily define the area of an image chosen as reference and you can also set the reference values (target values) separately for each channel.

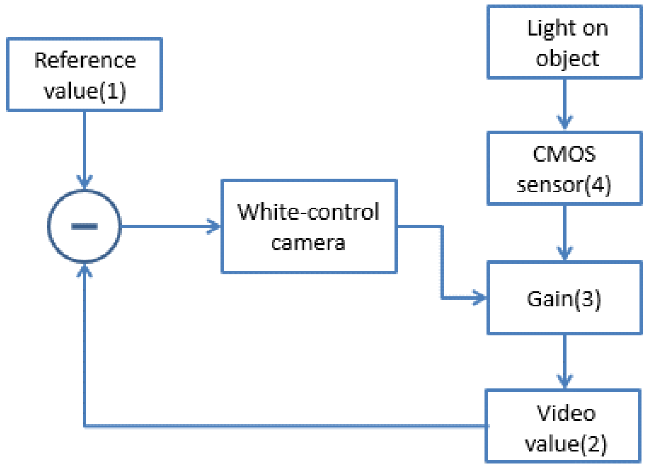


Figure 12: Closed-loop control for white balancing

This function can be used for:

- A single setup process with a static white reference in front of the camera during its installation.
- Adjusting the camera continuously during the scanning process. Therefore, it is possible to compensate warming up or aging of the light source.
- Instead of a white reference, you could use an area that has always the same color on every image.

4.7 Setting concept

4.7.1 Available user sets

You can store up to 8 different settings in the camera. All parameters, such as gaining or integration time, may be different from setting to setting and can be selected by short commands. Therefore, a fast change of the camera's behavior is possible for different products.

- For the user, 8 settings are available.
- The **Default** setting contains the default factory settings and is read-only.
- At power-on the camera always starts with setting 1.

User Sets can be controlled using the features of the **User Set Control** feature group. For more information, see allPIXA evo Feature Reference, that is available on the Chromasens website..

4.7.2 Data format

User set data are stored in a text file. Each item is specified in a separate line by a key-value pair. Key and value are separated by an equal sign. If an item is a sub-feature or depends on the value of a selector, underscores are used between the necessary names.

Example:

```
ImageHeight=1500
PixelFormat=RGB8Packed
TriggerSelector_FrameStart_TriggerMode=False
```

4.7.3 Restoring the factory default

The factory settings of the camera setting can be restored by loading the **Default** setting.

5 Installing the allPIXA evo camera

5.1 Interface and status LED

On the right side of the camera, you find the following interfaces:

- Two SFP+ (Enhanced Small Form-factor Pluggable) interface ports for 10 Gigabit Ethernet for image signaling and for communication between the allPIXA evo camera and the PC
- A digital port (IO interface 15 pin HD D-Sub female) for the incremental encoder signal, light barriers and other freely programmable inputs and outputs
- A USB port for service connection
- A power connection (Hirose HR10A-7R-6P, male) for power supply
- A multi-color LED, which indicates the allPIXA evo camera status
- Connector for cooling fan (8k camera only)

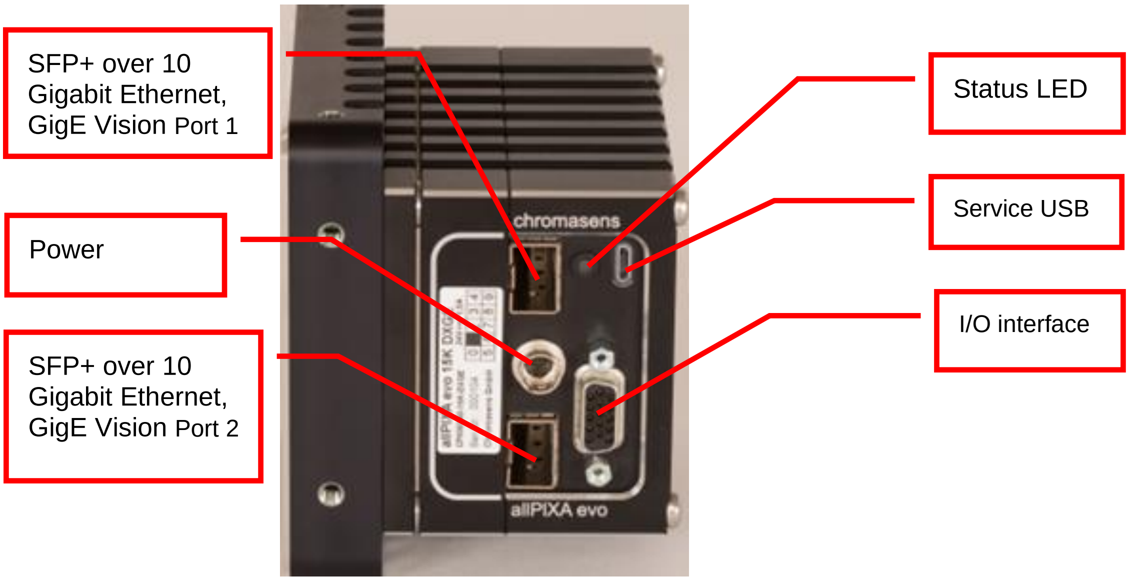


Figure 13: Camera connections and status LED (GigE interface,10k and 15 k cameras)

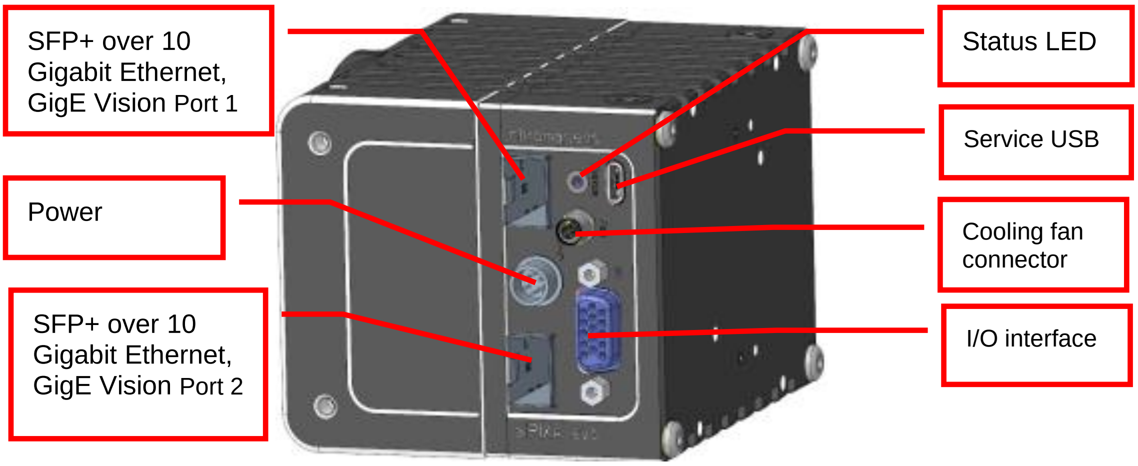


Figure 14: Camera connections and status LED (GigE interface, 8k camera)

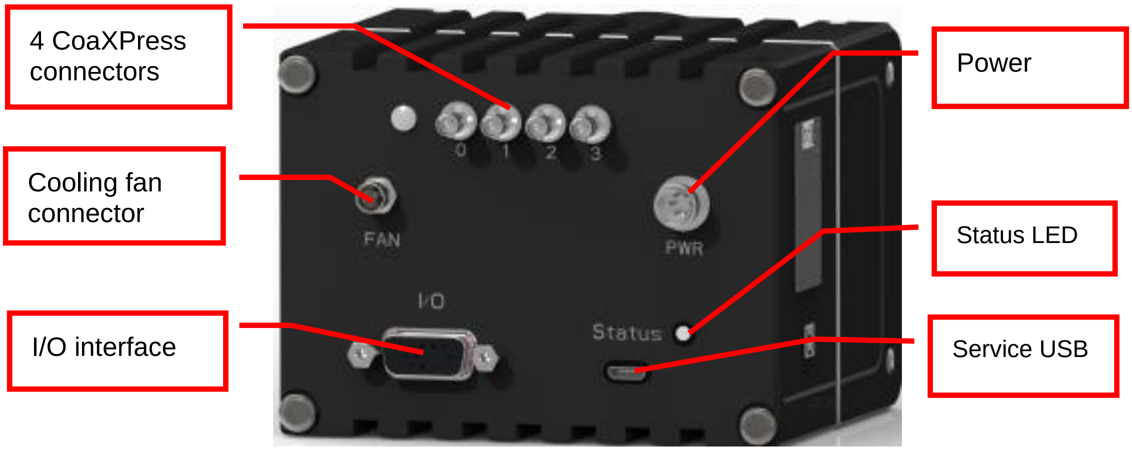


Figure 15: Camera connections and status LED (CoaXPress interface, Z variant)

Figure 16: Camera connections and status LED (CoaXPress interface, Y variant)

5.1.1 Power supply

Take notice that the following connector is required for the power supply cable:

Manufacturer: Hirose
Article no.: HR10A-7P-6S “female” (male connector is located on the camera)

Pin no.	Description
1	Power +24 V
2	Power +24 V
3	Not connected
4	Not connected
5	Ground
6	Ground

For more details about input voltage and currents, see section 2.4.

NOTE:	For a camera with CoaXPress interface, power can alternatively be supplied via the CoaXPress connection (Power over CoaXPress PoCXP).

5.1.2 Micro-USB

The Micro-USB connection is currently used for debugging information.

5.1.3 SFP+ connectors

The SFP+ 10 GigE connectors permit to use (direct attach) copper cables, or optical fiber cables with lengths of up to 400 m (10GBASE-SR). You can use only a single port for data rates up to 10 Gbit/s.
If higher data rates are needed, you can connect both ports using Link Aggregation.

5.1.4 CoaXPress connectors and cables

To connect the allPIXA evo CXP to a grabber, you need cables with Micro BNC (for CXP12) connectors on the camera side and suitable connectors for your Frame grabber on the Frame grabber side.

To adjust the correct number of links, which are connected to the camera, and the correct CXP interface type, adjust the number and type of CXP connections at the TransportLayerControl feature.

For more information, see GCT2 manual chapter 5.

5.1.5 Status LED (cameras with GigE interface)

During image output (FVAL active), the LED lights up in blue and then alternates in green or red.

Color	Description
Off	No power is present at the camera, or the input voltage is out of range. For more information see section 5.1.1, and chapter 9.
Blue	allPIXA evo camera is OK and provides image data
Green continuous	Camera is in power up status
Green blinking	Camera has power and is OK. Camera is ready
Green/Blue alternative	The camera is OK and provides image data frequently, based on a trigger signal
Yellow[1]	Warning-state: Camera is operational. (e.g. Temperature too high)
Red[1]	Error-state: Camera is not operational

[1] *Please check the device error code feature to get more detailed information*.

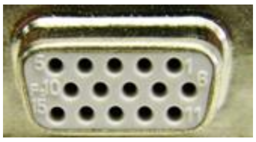
5.1.6 Status LED (cameras with CoaXPress interface)

Color	Description
Off	No power
Solid orange	System booting
Flash_1_red	Powered, but nothing connected (not applicable to a device reliant on PoCXP power)
AlternateFlash_12_5 green /orange; shown for a minimum of 1s even if connection detection is faster	Connection detection in progress, PoCXP active
Flash_12_5 orange; shown for a minimum of 1s even if connection detection is faster	Connection detection in progress, PoCXP not in use
AlternateFlash_0_5 red / green	Device / host incompatible, PoCXP active
AlternateFlash_0_5red / orange	Device / host incompatible, PoCXP not in use
Solid red	PoCXP over-current (host only)
Solid green	Device / host connected, but no data being transferred
Flash_1_orange	Device / host connected, waiting for event (e.g. trigger)
Flash_12_5 green	Device / host connected, data being transferred
500ms red pulse	Error during data transfer (e.g. CRC error, single bit error detected) In case of multiple errors there shall be at least two green Flash_12_5 pulses, before the next error is indicated.

AlternateFlash_0_5 green / orange	Connection test packet being sent
AlternateFlash_0_5 red / green / orange	Compliance test mode enabled (device only)
Flash_12_5 red	System error (e.g. internal error)

5.1.7 Digital IO port

You need a 15-pin HD D-Sub (male) to establish a connection to the digital I/O interface (X12) of the allPIXA evo camera:

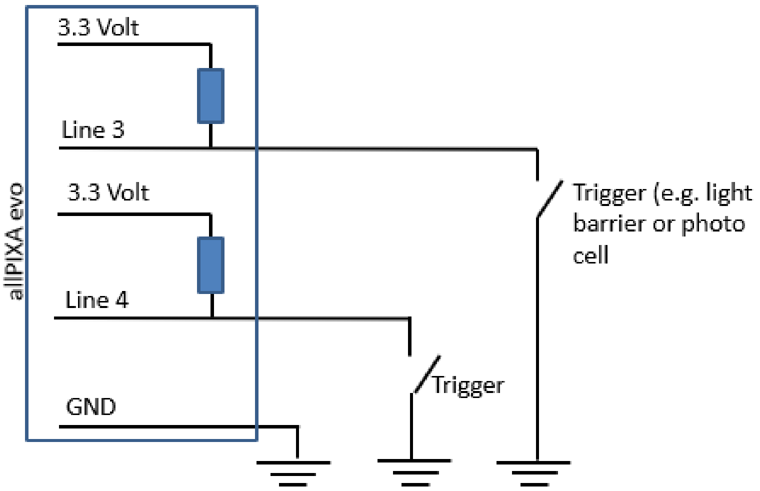


Pin	Gen<I>Cam	Signal	Level	In/Out	Example / Remark
1	Line 1	Enc0_InP (+)	RS 422	Differential input	Encoder0 or LineTrigger
2	Line 2	Enc1_InP (+)	RS 422	Differential input	Encoder1 ***or*** Frametrigger
3	Line 3	IO_0P	LVCMOS	Input single-ended	Trigger ***or*** AutoSelectMaster
4	-	RT	RS 485		
5	Line 5	IO_2P	LVCMOS	Out	LED-Out1
6	Line 1	Enc0_InN (-)	RS 422	Differential input	Encoder0
7	Line 2	Enc1_InN (-)	RS 422	Differential input	Encoder1
8	Line 4	IO_1N	LVCMOS	Input single-ended	Trigger ***or*** Master-Slave Cascaded
9	-	RTN	RS 485	Out	To LightController XLC4
10	Line 6	IO_3	LVCMOS	Out	LED-Out2
11	-	GND	GND		
12	Line 7	IO_4_SDA	LVCMOS	Out	LED-Out3
13	-	GND	GND	-	
14	Line 9	Master/Slave	LVCMOS	Bi-directional	Master/Slave
15	Line 8	IO_5_SCL	LVCMOS	Out	LED-Out4

NOTE	RS422: LVCMOS:	RS422 standard, (differential) input only With 10 Ohm series resistor, In/Out selectable.

For connection between master and slave camera, a suitable cable can be ordered from Chromasens. For more information, see section 8.2.3.

The single-ended inputs (Line 3 AND Line 4) have a pull-up resistor and must be switched to Ground:



Some requirements for using the RS422 interfaces:

a) Although RS422 is a differential signal, a proper ground connection is required additionally between the source (for example encoder) and the drain (for example camera).

b) The allPIXA evo contains an internal termination for the RS422 signal lines. The advantage of the internal termination is that you do not have to take care of termination if the RS422 is used as an interface between two devices.

5.1.8 LVCMOS and RS422 levels

I/O standard	V_{IL}		V_{IH}		V_{OL}	V_{OH}
	Vmin	Vmax	Vmin	Vmax	Vmax	Vmin
LVCMOS	-0.5	0.7	1.7	3.6	0.4	2.1
RS422	-6	0,8	2	6		

NOTICE	Maximum input level of the LVCMOS is 3.6 V! Use a level converter, if necessary (for example 74 LVC14). Non-compliance can result in irreparable damages to the allPIXA evo camera!

5.2 Trigger/IO and Encoder wiring

The allPIXA evo interface provides the following combinations for external triggering with or without use of an encoder.

You can connect either two differential signal pairs or two single-ended wires to control the camera.

You can either use RS422 or Single-Ended for FrameActive/FrameStart, LineStart, and Encoder. For information about the pin assignments at the digital I/O port, see section 5.1.7.

Valid external trigger and IO/encoder combinations are:

→ Line1 and Line2 are differential signals

- FrameActive = Line2 (Low/High active) + LineStart = Line1
- FrameActive = Line2 (Low/High active) + LineStart = OFF (Camera.internal line control)
- FrameActive = Line2 (as Peakholder) + LineStart = Line1
- FrameActive = Line2 (as Peakholder) + LineStart = Encoder and Encoder0=Line1

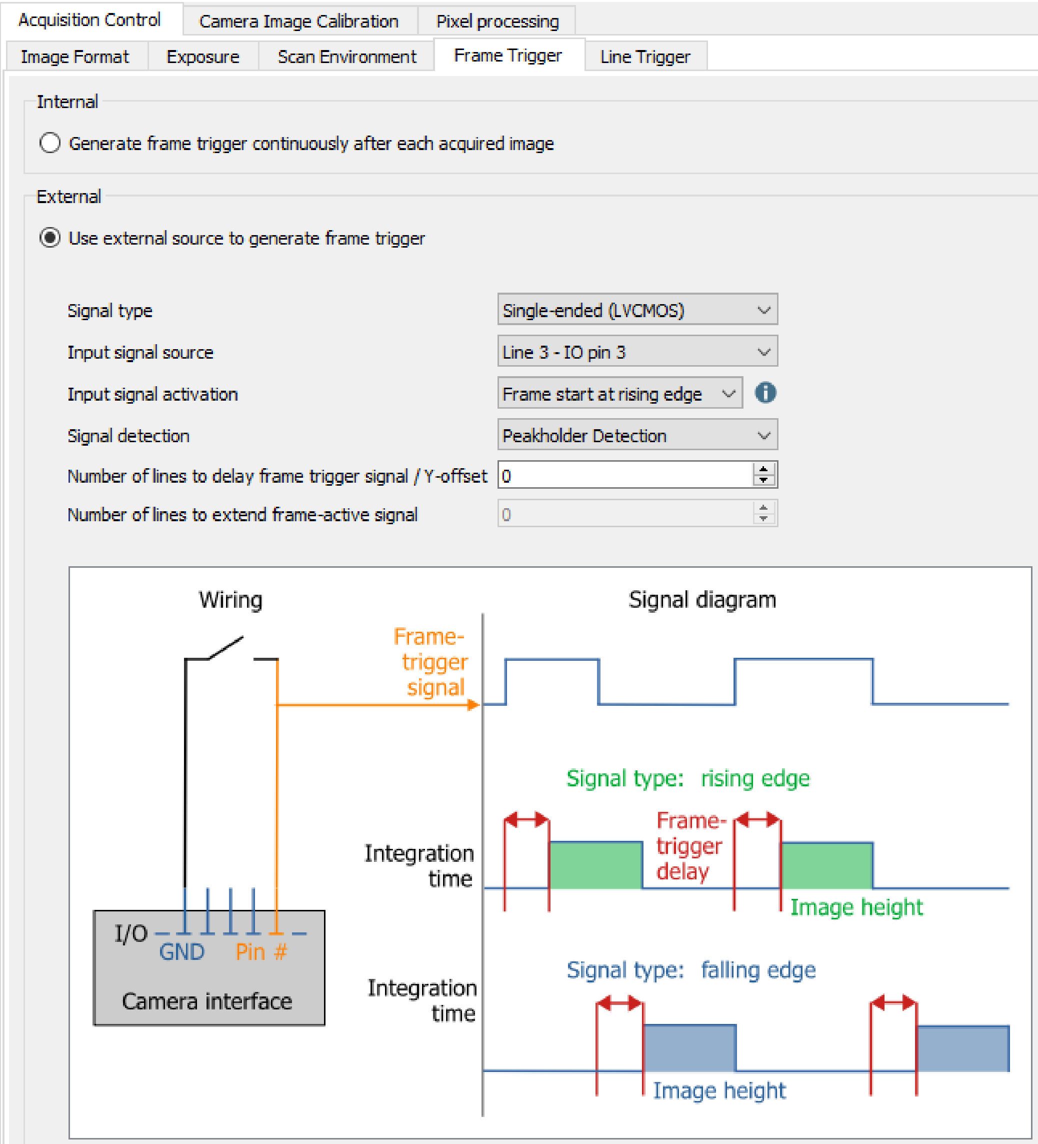
→ Line3 and Line4 are single-ended inputs

- FrameActive (Line3/4) + LineStart = OFF (camera-internal line control)
- FrameActive = Line3 + LineStart = Line4
- FrameActive = Line3 + LineStart = Encoder and EncoderA = Line4
- FrameActive = OFF + LineStart = Line4
- FrameActive = OFF + LineStart = Encoder and EncoderA= Line4

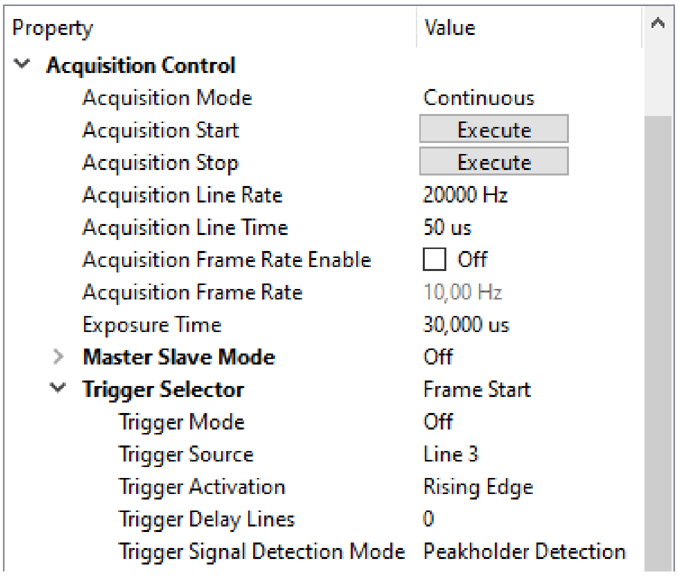
If **TriggerMode** is set to **Off** for trigger modes **FrameActive**, **FrameStart** and **LineStart**, the camera works in free-run mode with the configured parameters, e.g. image width and height.

The following sections describe several trigger modes. The features controlling the trigger modes can be found in the **Acquisition Control** feature group of the feature tree. Alternatively, on the **Configuration** view of GCT2, they can be found on the **Frame Trigger** subtab of the **Acquisition Control** tab.

Configuration view of GCT2:



Acquisition Control feature group in the feature tree:

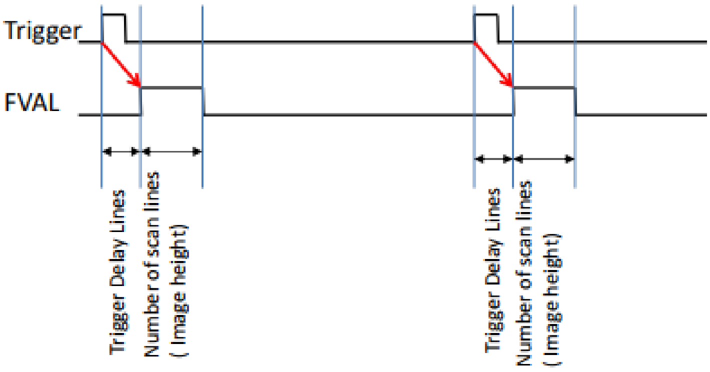


Property	Value
Acquisition Control	
Acquisition Mode	Continuous
Acquisition Start	Execute
Acquisition Stop	Execute
Acquisition Line Rate	20000 Hz
Acquisition Line Time	50 us
Acquisition Frame Rate Enable	Off
Acquisition Frame Rate	10,00 Hz
Exposure Time	30,000 us
Master Slave Mode	Off
Trigger Selector	Frame Start
Trigger Mode	Off
Trigger Source	Line 3
Trigger Activation	Rising Edge
Trigger Delay Lines	0
Trigger Signal Detection Mode	Peakholder Detection

5.2.1 Using a light barrier – Start condition only

Application: scanning objects of fixed length with a fixed distance from the light barrier.

Frame start is controlled by a light barrier. Image height is fixed.



Feature settings at the **Acquisition Control** feature group:

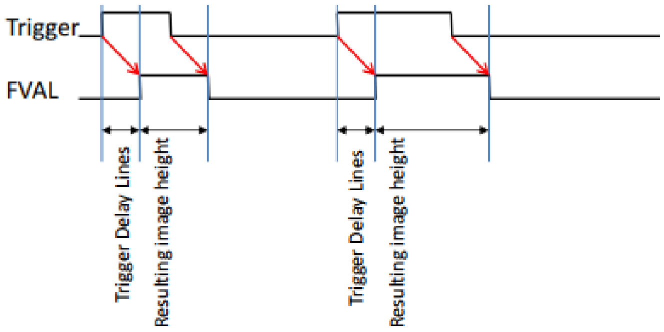
Trigger Selector = **Frame Start**:
- **Trigger Mode = On,**
- **Trigger Source** = e.g. **Line3** (single-ended input),
- **Trigger Activation** = **Rising Edge**,
- **Trigger Delay Lines** = <number of lines>,
- **Trigger Signal Detection Mode** = **Debouncing4Clocks**

Trigger Selector = **Frame Active:**
- **Trigger Mode** = **Off**

Trigger Selector = **Line Start:**
- **Trigger Mode** = **Off**

5.2.2 Using a light barrier – Start and stop condition

Application: scanning objects with varying lengths with a fixed distance from the light barrier. Trigger conditions control image start as well as image height.

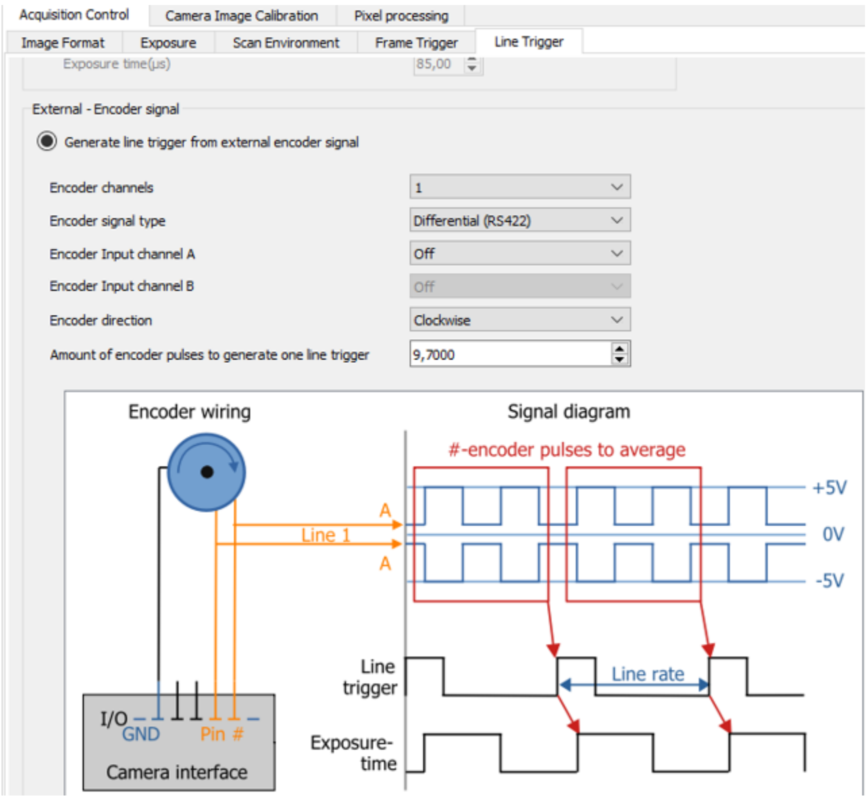


Feature settings:

Trigger Selector = **Frame Active**:
 Trigger Mode = On,
 Trigger Source = e.g. **Line3** (single-ended input),
 Trigger Activation = **Level Low**,
 Trigger Delay Lines = <number of lines>,
 Trigger Signal Detection Mode = **Debouncing4Clocks**
Trigger Selector = **Frame Start:**
 Trigger Mode = **Off**
Trigger Selector = **Line Start:**
 Trigger Mode = **Off**

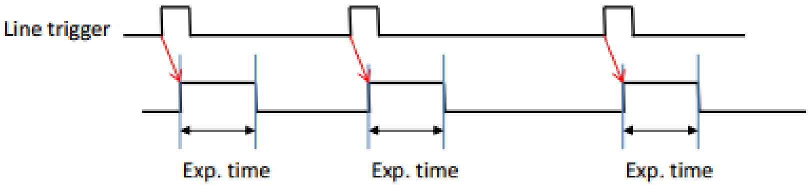
Depending on your light barrier, you may have to adjust the value of **Trigger Signal Detection Mode**.

Configuration view, **Line Trigger** subtab of the **Acquisition Control** tab:



5.2.3 Using line trigger input

A line trigger triggers a single line in the camera. **Exposure Time** is also used.

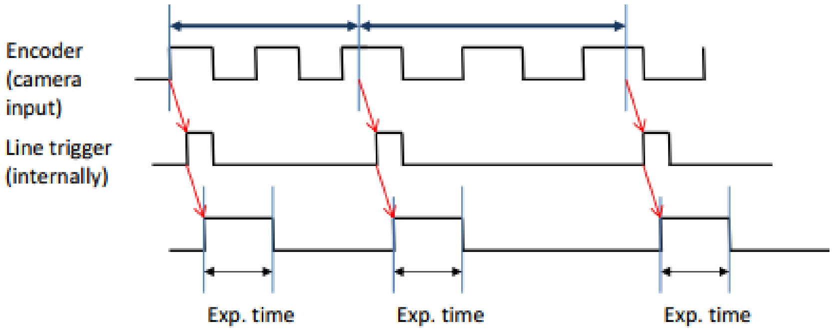


Feature settings:

Trigger Selector = **Line Start**:
  Trigger Mode = On,
  Trigger Source = e.g. **Line4** (single-ended input),
  Trigger Activation = **Rising Edge**,
  Trigger Divider = <number>
Trigger Selector = **Frame Start:**
  Trigger Mode = **Off**
Trigger Selector = **Frame Active:**
  Trigger Mode = **Off**

5.2.4 Using an encoder

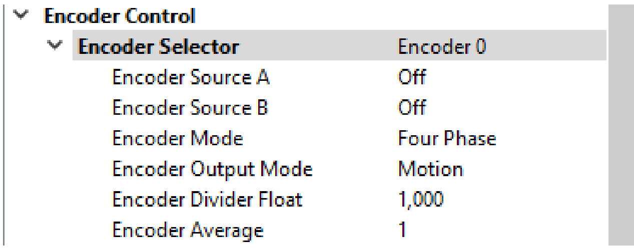
In contrast to the line trigger, an encoder typically does not have an integer ratio to the camera resolution. Thus, arbitrary ratios of encoder pulses per camera line are possible, for example 2.25. The value range is 0.05 up to 255 pulses per line.



To configure encoder usage:

1. At the **Acquisition Control** feature group, click **Trigger Selector**, and then click **Line Start** in the value list.
2. Click **Trigger Source** and click **Encoder0** in the value list.
3. Click **Trigger Mode** and select **On**.

   Note: For the values **Frame Start** and **Frame Active** of **Trigger Selector**, **Trigger Mode** must have the value **Off**!
4. At the **Encoder Control** feature group, click **Encoder Selector**, and click **Encoder 0** in the value list.



5. Click **Encoder Source A**, and then click **Line 1** for forward movement.

6. If your encoder has a B Line as well and backward is also possible, click **Encoder Source B** and click **Line 2** in the value list.

7. Click **Encoder Divider Float** and at the **Float Value** box enter a decimal number according to transport speed and the pulses per revolution of the encoder.

   The value specifies how many encoder pulses create a single image line (max. value is 255).

8. Click **Encode Mode** and then click **Four Phase** in the value list. This means that the camera can detect forward and backward movement to correct the color shift in the sensor.

9. If the number of pulses per line is greater than 255, the feature **Trigger Divider** at the **Trigger Selector** group of the **Acquisition Control** feature group can be used to reduce the value of **Encoder Divider Float** to a value below 255. For example, for 320 pulses per line, set **Trigger Divider** to 2 and **Encoder Divider Float** to 160.0.

For information about correct wiring, see section 5.1.7.

5.3 Mechanical installation

Various mounting options are provided by the allPIXA evo camera housing. Thanks to its numerous threaded holes for attachment, the installation of the allPIXA evo camera is very simple and versatile.

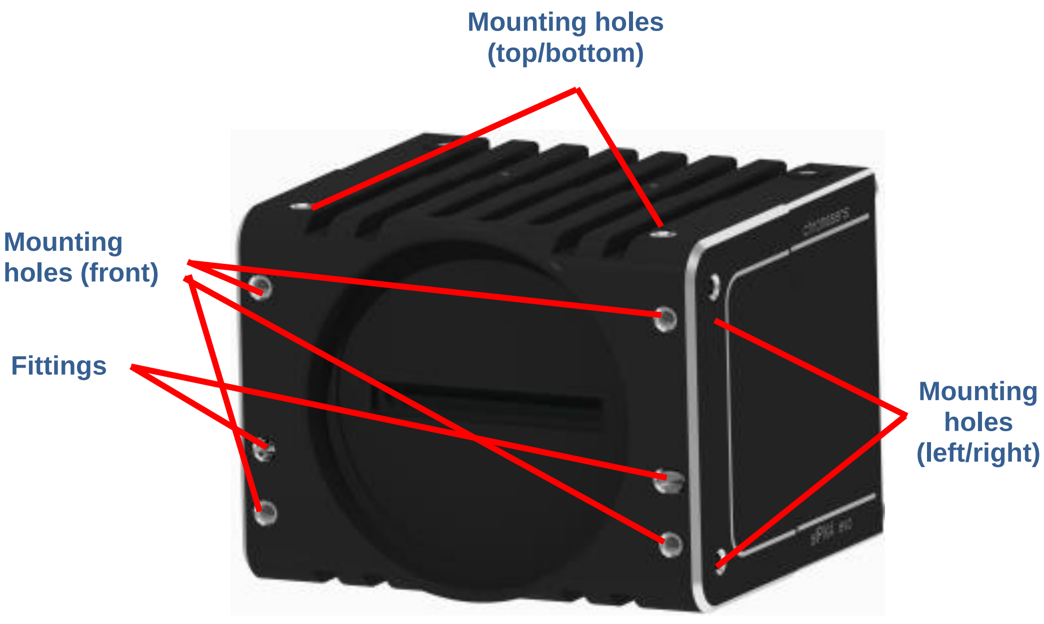


Figure 17: Mechanical connection points of the allPIXA evo 10k camera

The allPIXA evo camera is equipped with 4 fastening points on its front and 2 on each side with M4 threads (use maximum torque for full use of 6mm threat of 4 Nm).

The 8k camera and all cameras with CoaXPress interface have two additional fittings on the front side:

For information about the exact mechanical dimensions, see “Mechanical specification” (section 10.1).

5.4 Thermal links / cooling

The camera works within the defined temperature range (see sections 2.4 and 2.6). To this purpose it may be screwed to thermally conductive parts on a wide and flat surface. A thermal connection to heat-conductive parts has a positive effect on operation of the allPIXA evo camera.

To dissipate the heat more effectively to the surrounding area, we also recommend using heat conduction pads between the allPIXA evo camera and heat-conductive parts. You can also cool the camera with a fan, which should be directed at a large surface area of the camera.

For more information about cooling kits and fans, see section 10.2.2.

If questions are left, or if you are not sure how to adapt the allPIXA evo camera most effectively to its ambient conditions, do not hesitate to contact our support team.

The maximum allowed internal camera temperature, which can be monitored by the camera, is:

Board temperature: 80°C
Sensor temperature: 80°C

5.5 Preventing installation errors

To ensure a high image and color quality, it is essential to align the camera correctly with the conveyor belt.

If the camera is misaligned, image artifacts may result.

5.5.1 Conveyor belt tracking

Make sure that the conveyor belt, on which the object is transported, runs completely straight.

In the left-hand section of *Figure 18* you can see the optimum tracking of the conveyor belt, that means the conveyor belt runs completely straight. The enlarged view shows that each of the 3 pixels highlighted in black acquires the same point on the object.

In the right-hand section of *Figure 18* you can see a situation in which the conveyor belt runs untrue and oscillates in a lateral direction to the transport position and then each line acquires a different area of the passing object. As a consequence, the image generated by the three color lines is not aligned, resulting in chromatic aberration which occurs laterally to the transport position.

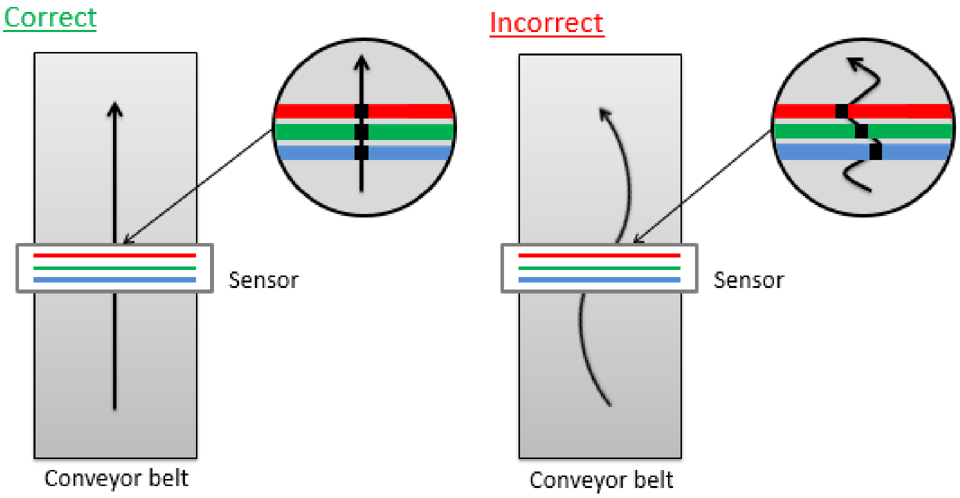


Figure 18: Optimum conveyor belt tracking

5.5.2 Perpendicularity of the sensor to the direction of transport

Make sure that the allPIXA evo camera is aligned at a right angle to the direction of transport.

In the left-hand section of *Figure 19* you can see the optimum alignment of the camera, that means, it is aligned perpendicularly to the direction of transport. The enlarged view shows that each of the three pixels highlighted in black acquires the same point on the object.

In the right-hand section of *Figure 19* the camera is not aligned perpendicularly to the transport position and therefore the same point on the object is imaged at different positions on the quad/trilinear sensor. Thus, the image generated by the three color lines is not aligned, resulting in chromatic aberration on the image:

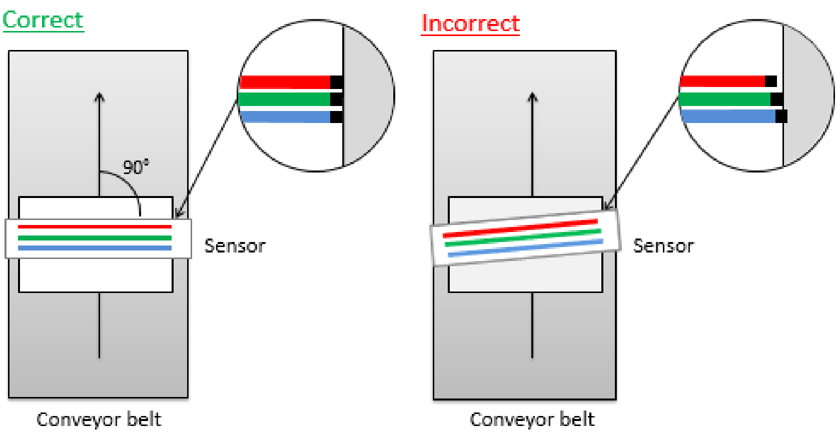


Figure 19: Rectangularity of the sensor to the object

5.5.3 Rotation around the longitudinal axis of the line scan sensor

Make sure that the longitudinal axis of the allPIXA evo camera runs parallel to the transport level.

The center section of *Figure 20* shows the optimum alignment of the camera, that means it is aligned parallel to the direction of transport.

If the allPIXA evo camera is installed in the rotated position around the longitudinal axis of the line scan sensor, chromatic aberration occurs in the image and the scale changes on the three (or four) color lines. Chromatic aberration increases symmetrically towards the outer edge.

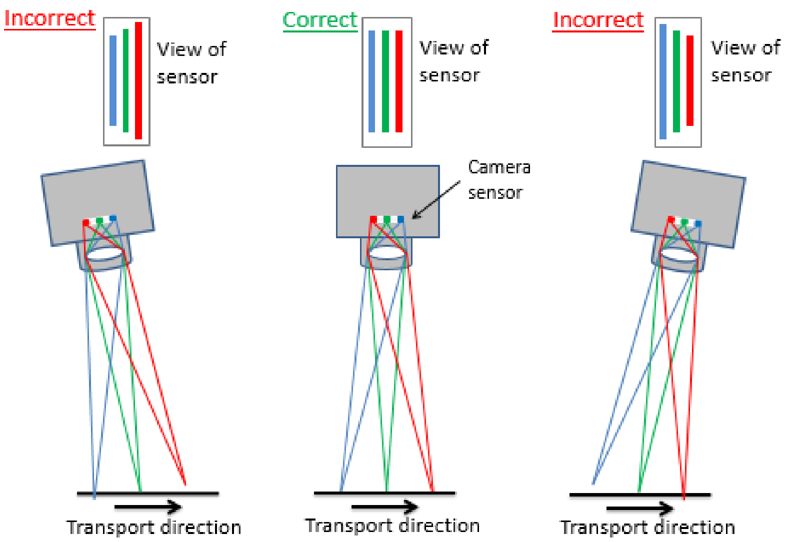


Figure 20: Rotation around the longitudinal axis of the line sensor

To obtain the best results, try to avoid the error shown in the above figure.

5.5.4 Rotation around the transverse axis of the line sensor

Make sure that the transverse axis of the allPIXA evo camera runs parallel to the transport level.

In the center section of *Figure 21* you can see the optimum alignment of the camera, that means it is aligned parallel to the direction of transport.

If the allPIXA evo camera is installed in a rotated position around the transverse axis of the line scan sensor, this results in a chromatic aberration laterally to the direction of transport, and the size and color changes in relation to the angle.

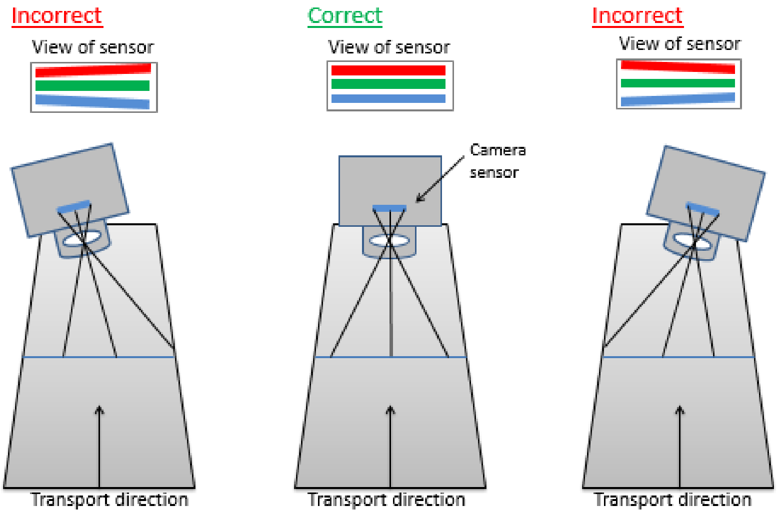


Figure 21: Rotation around the transverse axis of the line scan sensor

5.6 Electrical installation

WARNING

Only the authorized electro-technical trained staff is permitted to install and to start operation of the device.

NOTICE

Before connecting and switching on the power supply, make sure that all required plug connections have been established correctly.

This precaution prevents damage to the allPIXA evo camera and to its connected components.

NOTICE

When the allPIXA evo camera has been secured in its final working position and all cables are connected and screwed, check the cable configuration.

The weighting of the cables should not include the connectors one. No other mechanical strain should be exerted on the connectors.

NOTE	Grounding the housing and the outer cable shield: Due to an environment with electromagnetic contamination, it may be necessary to establish contact between the housing to the installation's electrical ground. The mounting threads for the housing are not isolated; therefore, you may use any of the mounting threads for connecting the housing to the electrical ground.

Connect a power cable from the camera to a 24V DC power supply.

For the pin allocation of the HIROSE see section 5.1.1.

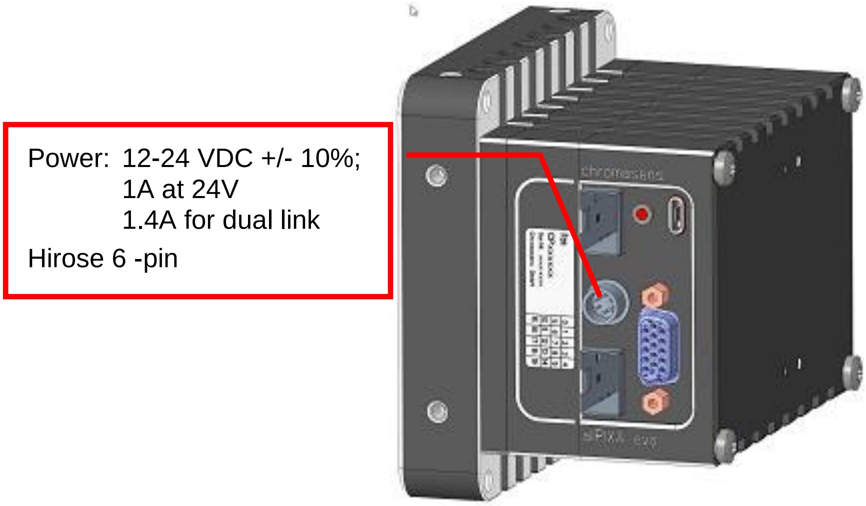


Figure 22: Connecting the allPIXA evo camera to the power supply

Power over CXP PoCXP

For the CXP version of the camera, power supply via CXP is also possible.

Take notice that at least two CXP cables (two links) are necessary for power over CXP.

If you want to use the power over CXP function, you don't need an additional power supply cable.

5.7 Connecting the camera to the PC with 10GigE

The camera is connected to the PC using the SFP+ connectors. You can attach (direct attach) copper cables for short lengths, or fiber optic connectors (transceivers) for long cable length up to 400 m with SFP+ (10GBASE-SR).

Connecting the fiber optic cable:

- With two fiber optic cables, the allPIXA evo camera (Port 1+2) supports full data rate. With a single cable, the data rate is limited by the bandwidth of single-line 10 GigE.
- A network adapter with one or two 10 GigE SFP+ inputs must be installed in the PC and the network adapter must be installed and configured.
- Follow the installation guide of GCT and Kithara. For more information refer to the GCT2 manual (PMA_CHR_CD40195_R02 (chromasens.de).

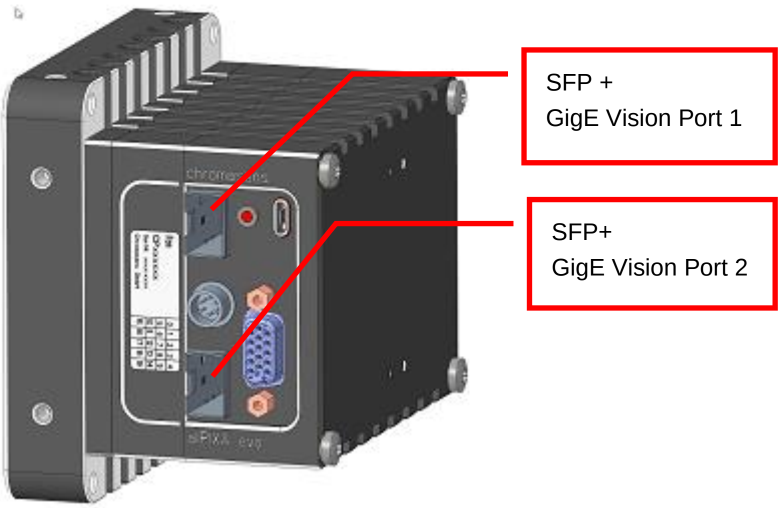


Figure 23: Connecting the allPIXA evo camera with 10GigE interface to the PC

Configuration of the PC interface for the different connection modes is described in detail in the GCT manual.

5.8 Connecting the camera to the PC with CXP

The camera is connected to the CXP frame grabber in the PC using CXP cables and connectors. Maximum cable length is 35m

If you want to use the power-over-CXP function for the power supply of the camera, you don`t need an additional power cable; but for power-over-CXP, at least two cables (two links) are needed.

Follow the installation instructions of the frame grabber manufacturer.

At the camera, always at least port 0 must be connected to establish a connection to the camera, since it is the master port.

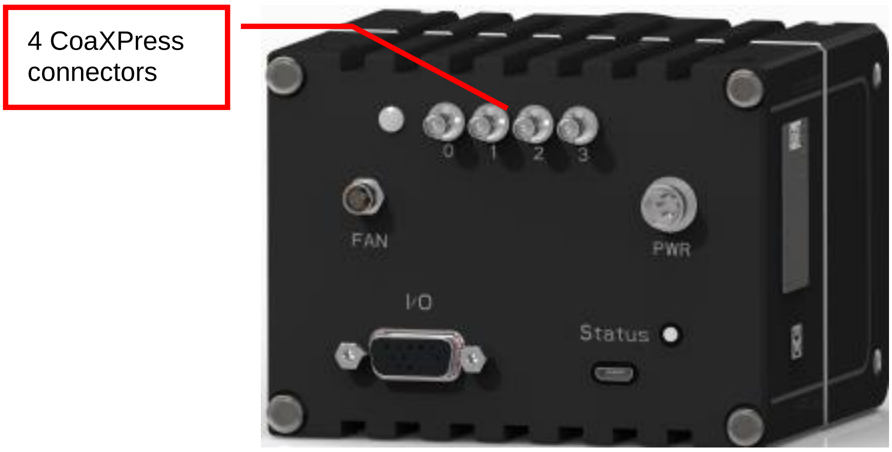


Figure 24: Connecting the allPIXA evo camera with CoaXPresss interface to the PC

6 Working with GCT

The camera can be configured with any software for GenICam-compliant cameras. We recommend using the Chromasens program GCT (GenICam Control Tool), which provides special dialog boxes and wizards that make configuring more comfortable.

You can download the GCT installation program from the Chromasens website. On the product page of any allPIXA evo model, click the **Software** tab.

For information about installation and use of GCT, refer to the GCT user manual.

For information about configuration of the PC for the connections of a camera with CoaXPress or 10GigE interface, refer to the GCT2 manual (PMA_CHR_CD40195_R02 (chromasens.de))

allPIXA evo 8K DXGE Color X | Chromasens - Your specialist for machine vision and image capturing systems.

6.1 Setting image parameters

The following table shows some parameters that control image acquisition. Check and modify these parameters as needed:

Parameter	Position in parameter tree	Comment
Image Width	Image Format Control / Region Selector / Width	Ensure the **Region Selector** has the value **Region 1**.
Image Height	Image Format Control / Region Selector / Height	Ensure the **Region Selector** has the value **Region 1**.
Acquisition Line Time	Acquisition Control -> Acquisition Line Time	Specifies the time between current scan line and next scan line. Increasing line time reduces line frequency.
Exposure time	Acquisition Control -> Exposure Time	Specifies the integration time in micro-seconds.
Trigger Mode	Acquisition Control -> Trigger Selector -> Trigger Mode	If no explicit trigger is available, **Trigger Mode** must have the value **Off** for all three values of **Trigger Selector**
Test Pattern	Image Format Control / Test Pattern Generator Selector / Test Pattern, Image Format Control / Test Pattern Generator Selector / Test Pattern Value	Default value: **Off**. If you cannot produce a meaningful image, you can specify that the camera should send a specified test pattern by specifying a pattern and a pattern value.

Sometimes during grabbing the camera does not transmit an image and the message log shows GEV_TIMEOUT_ERROR. Possible reasons are the following:

- The **Use Filter Driver** check box is selected, but the filter driver is either not installed or it is not configured correctly. For more information, refer to the GCT2 manual.
- **Trigger Mode** is set to **On** for a value of **Trigger Selector**, but the respective external trigger is not available. See the respective line in the above table.

6.2 Updating the firmware

If a new firmware version is available, it can be downloaded on the Chromasens website as a `.zip` file. For more information about updating the firmware, refer to the GCT manual.

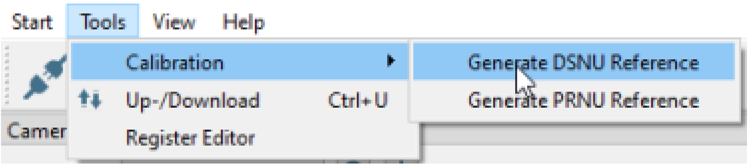
6.3 Flat field correction: Creating a black-reference (DSNU)

To create a black-reference:

1. Switch off illumination and cover the lens with a black or dark piece of cardboard or plastic so that there is no light on the sensor. Check that the piece covers the whole lens.

2. Prepare an image with GCT. Either click the **Acquire a single frame** on the toolbar, or click **Start grabbing**, wait until an image is shown and then click **Stop grabbing**.

3. On the **Tools** menu, select **Calibration**, and then click **Generate DSNU Reference**.

   The **Create DSNU Reference** wizard opens.

4. On the **Select image source** page, click **Use grab view image**, and then click **Next Step**.

5. On the next page, click at the first step (**1) Set ImageCalibrationMode…**), then at the second step, and at last at the third step.

6. If all three steps were reported as successful, click **Next Step**. The **DSNU Reference Generator** window opens and shows the grabbed image in expected image calibration mode.

7. In the **Settings for Average Value**, enter values for **Y-Position** and **Height** to specify the area to be used for reference generation, or click **Start 2-Click-Selection** and click start and end position on the image.

8. To create and save the reference data, click **Save DSNU File to Local PC**, specify folder and file name in the appearing file dialog box, and then click **Save** and close the wizard.

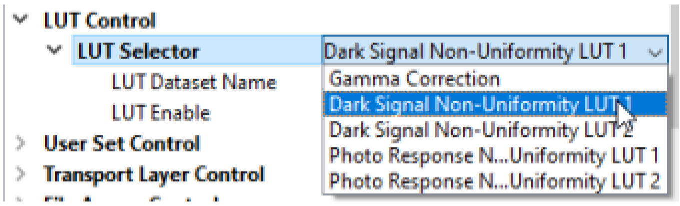
9. On the **Tools** menu click **Up-/Download,** and in the **Update/Download** dialog box click **Select Update File**. A file dialog box opens.

10. Select the DSNU file, and then click **Open**. GCT selects the appropriate file type in the **Update** list. If the file type is correct, confirm the appearing warning message.

11. Click **Start Update**, wait until the file has been uploaded completely, and then close the dialog box.

12. To activate DSNU, click the **LUT Control** feature group,

13. Click **LUT Selector** and click the respective DSNU LUT in the value list:



14. At the **LUT Enable** feature, select the check box.

To create a dark-reference from an existing image file:

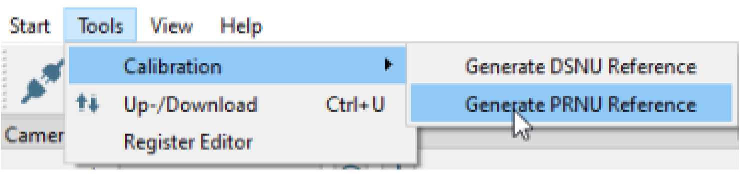
1. Perform steps 1 to 3 of the above procedure.
2. On the **Select image source** page, click **Load image from storage**, and then click **Next Step**.
3. Click **Choose BMP or TIFF File** on the following page and open the desired image file in the appearing file dialog box.
4. Specify a pixel offset, and then click **Next Step**.
5. Continue with step 7 of the above procedure.

NOTE:	While **Image Calibration Control** is active, the temporarily modified features are locked and cannot be modified until the feature is set to **Off**. Currently, the input image (regardless of whether acquired directly with the grabbing process or loaded from PC) will be converted to 8 bit and then used to calculate the DSNU reference.

6.4 Flat field correction: Creating a shading reference (PRNU)

To create a shading reference:

6. Check lighting and focusing.
7. Disable continuous white-control and save the parameters to the camera.
8. If possible, prepare a moving white target. If you use a stationary target, place the target a bit out of focus, to reduce the effect of dust or scratches on the calibration result.
9. Prepare an image with GCT. Either click the **Acquire a single frame**  on the toolbar, or click **Start grabbing**  ,wait until an image is shown, and then click **Stop grabbing** .
10. On the **Tools** menu, select **Calibration**, and then click **Generate PRNU Reference**.



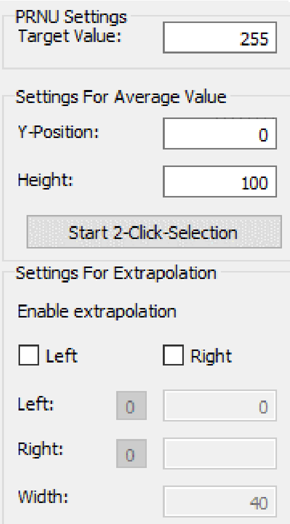
The **Create PRNU Reference** wizard opens.

11. On the **Select image source** page, click **Use grab view image**, and then click **Next Step**.

12. On the next page, click at the first step (**1) Set ImageClibrationMode…**), then at the second step, and at last at the third step.

13. If all three steps were reported as successful, click **Next Step**. The **DSNU Reference Generator** window opens and shows the grabbed image.

    On the right side, shading parameters must be specified in the **PRNU Settings** area:

14. Specify the target value for white, and the area that should be used to create the shading data:

    Target Value: Target value of white after the shading reference has been applied. The default target is 255, to receive the full range of the camera (8bit 255). The adjustment of brightness should be done by modifying **Brightness** and **Contrast** at the **Analog Control** feature group (see step 21). If necessary, **Target Value** can be set to s smaller value between 220 and 230.

15. **Y-Position**, **Height**: Start and height of the area used to generate shading data. If you specify 100 and 300 as values, 200 lines starting at line 101 are used. Enter values into the boxes, or click **Start 2-Click-Selection**, and then click on the start and end position of the desired area on the image. The specified area is then marked with blue bars at the beginning and at the end.

16. If the image has black borders on the left/right side, specify an area for extrapolation:

    For extrapolation on the left side, select the **Left** check box, for the right side, the **Right** check box. In the **Left** and **Right** boxes, enter the start positions of the areas used for extrapolation, and in the **Width** box the width of the areas.

    Start and end position of the areas are marked with red color on the image.

17. To show the result of the shading correction with the specified parameters, click **Test PRNU**.

18. To save the shading reference data, click **Save PRNU File to Local PC**, specify folder and file name in the appearing file dialog box, and then click **Save** and close the wizard.

19. At the **Image Calibration Control** feature group, click **Image Calibration Mode** and then click **Off** in the value list.

    This resets the previously modified features to their original values.

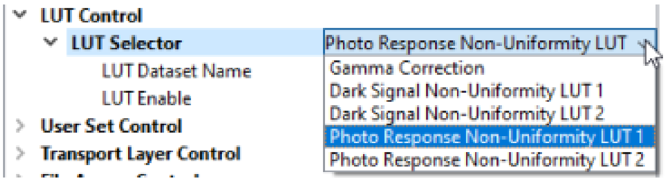
20. On the **Tools** menu click **Up-/Download,** and in the **Update/Download** dialog box click **Select Update File**. A file dialog box opens.

21. Select the PRNU file, and then click **Open**. GCT selects the appropriate file type in the **Update** list. If the file type is correct, confirm the appearing warning message.

22. Click **Start Update**, wait until the file has been uploaded completely, and then close the dialog box.

23. To activate PRNU, click the **LUT Control** feature group.

24. Click **LUT Selector** and click the respective PRNU LUT in the value list.



25. Click **LUT Enable** and select the check box.

26. At the **Analog Control** feature group, set **Brightness** and **Contrast** to a value about 0.9.

To create a shading reference from an existing image file:

- Perform the steps of the above procedure, but click **Load image from storage** in step 6, click **Next Step**, click **Choose BMP or TIFF File** on the following page, and open the desired image file in the appearing file dialog box.
- Be sure that the external image you use for creating a PRNU is made with the "image calibration mode on" to receive a satisfactory result. If for example "reverse X" was active when the external image was grabbed, the may be faulty later.

NOTE:	While **Image Calibration Control** is active, the temporarily modified features are locked and cannot be modified until the feature is set to **Off**. Currently, the input image (regardless of whether acquired directly with the grabbing process or loaded from PC) is converted to 8 bit and then used for calculating the PRNU reference.

7 Camera system set-up

7.1 Installing the camera

	Prepare the general setup:
1	**Prepare the camera and lens** • Select the correct lens and accessories to operate your camera in the desired environment. (For more information about lens and tube selection, see section 10.3.) • Install the lens and adapters correctly. For a detailed description of lens and mount installation, see section 10.2**Fehler! Verweisquelle konnte nicht gefunden werden.**.
2	**Prepare the right cabling for your application** • Connection to the PC: The allPIXA evo can be connected with one or two fiber-optic cables. • Power supply: Hirose 6-pin plug (HR10A-7P-6S). The allPIXA evo connecting interfaces are described in section 5.1. • Connect the camera to a power supply (24 VDC +/- 10 %; 1A; typical 20 W) (section 5.6).
3	**Install and configure the network adapter on your PC**
4	**Adjust the focusing point of your illumination unit and position it correctly** • Refer to the manual of the illumination manufacturer for proper installation of the illumination. • Make sure that the illumination is positioned correctly to illuminate the scanning area.
5	**Mechanically install the camera in your machine** • **Make sure, it is positioned correctly** The sensor line should be adjusted horizontally to the transport direction and the camera should look perpendicular to the inspection area. For a detailed description of a correct camera installation, refer to chapter 5. • **Make sure, you have the correct object-to-sensor distance** The sensor line is positioned 17 mm (optical photosensitive surface) behind the front surface of the allPIXA evo camera. You can find the detailed sensor position description in section 10.1.

7.2 Starting up the system

1 — Start up the camera:

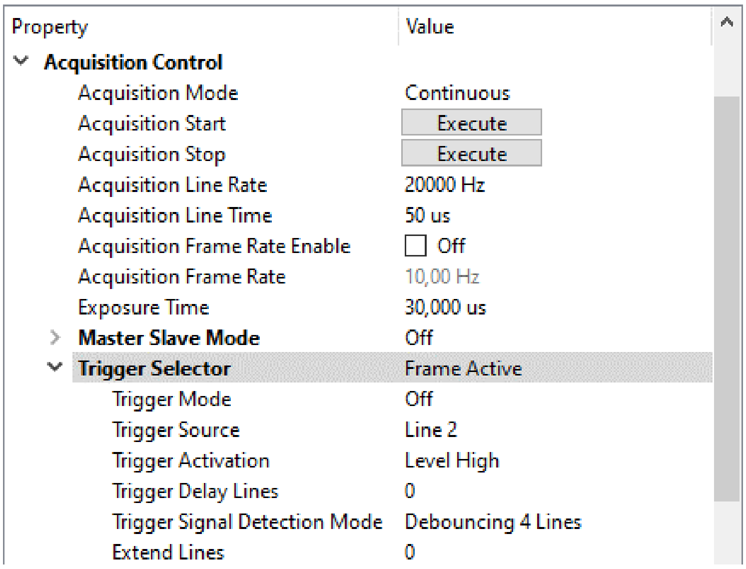
You can set camera parameters using the Chromasens program GCT. For information about installation and use of GCT, refer to the GCT manual.

- Turn on illumination and camera.
- Set up communication between PC and camera.

2 — Set the camera to free-run mode:

To control the connection to the camera, set it to free-run mode, that means, switch all trigger modes off:

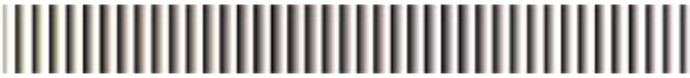
- At the **Acquisition Control** feature group, click **Trigger Selector**.



- Select **Frame Active** in the value list, and then click **Trigger Mode** and select **Off** in the value list.
- Repeat the previous step for the values **Frame Start** and **Line Start** of the **Trigger Selector** feature.

3 Produce a test image:

- At the **Image Format Control** feature group, click **Test Pattern Generator Selector**.
- Click **Test Pattern** and in the value list, click **Grey Horizontal Ramp Moving**.
- On the toolbar, click **Start grabbing** . The received images should look like this:



- On the toolbar click **Stop grabbing** .
- Click **Test Pattern** and click **Off** in the value list.

Proceed to section 7.3 to calibrate the camera and adjust the camera settings to your operating conditions.

7.3 Adjusting the camera to the environment (camera calibration)

Prepare the camera for calibration (see also section 7.1).
- Set the camera in free-run mode for lines and images
- Place a white reference target, covering the full scanning area

NOTE	The white reference target must be placed near the best focus plane of the camera. Therefore, any features on its surface (for example dust, scratches) end up in the calibration profile of the camera. To avoid this, use a professional (non-moving) white reference target, like a clean white ceramic or plastic material, not paper. Ideally, the white object should move during the calibration process because the movement results in an averaging process and the camera diminishes the effects on any small variation in the white reference.

To calibrate the camera setting to your operating conditions, follow the steps below.

1 — Check your line scan system application:

- **Illumination setting:**

  Switch on the lighting and ensure that the adjustment of the lighting provides best illumination on the target.

- **Camera adjustment:**

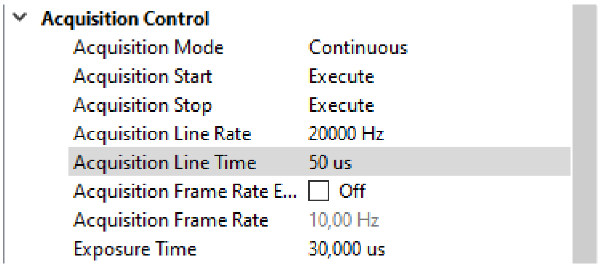
  Adjust the camera to the target for best orientation and for the best lighting.

- **Focusing and f-stop**:

  Set the camera to best focus and select the requested f-stop.

2 — Set integration time:

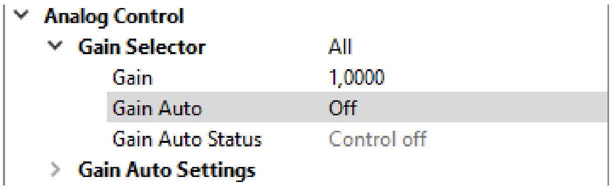
- In the **Acquisition Control** group, specify the **Acquisition Line Time**.



You can find an instruction for calculation in the appendix (section 10.3.3).

3 | **Set the operating point (1):**

- Continuous white control must be disabled: In the **Analog Control** feature group, set **Gain Selector** to **All**, and then set **Gain Auto** to **Off**.



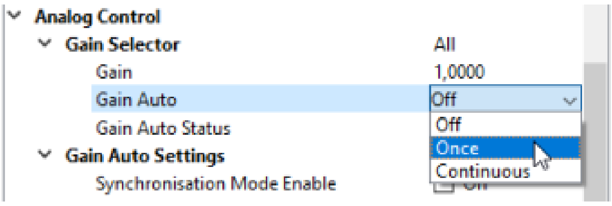
- Specify the reference mark position: In the **Analog Control** feature group, go to **Gain Auto Settings** -> **Gain Control Region** and specify position and size of the reference mark position using the features **Offset X**, **Width**, **Offset Y**, and **Height**. To control the position on images, you can temporarily select the **Visible** feature.

  For this operation, the reference mark position should be at the brightest region of the image. Typically, this will be at the center.

- Specify the target white reference values: Use the **Gain Control Region Channel Selector** to select the different colors, and for each color specify **Target value**.

  The target values should be in the range of 800 to 880 (10-bit value) so that values are between 200 and 220 in the output image.

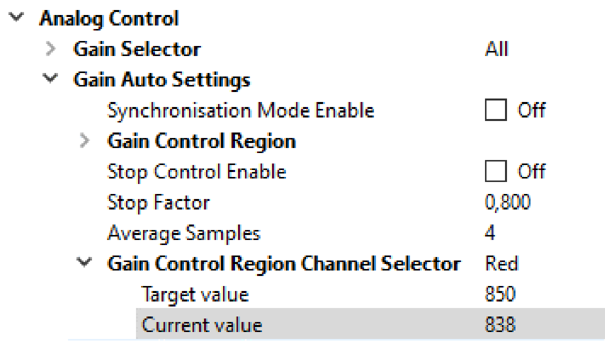
- At **Gain Selector**, set **Gain Auto** to **Once**. The camera then performs white balancing with the current settings.



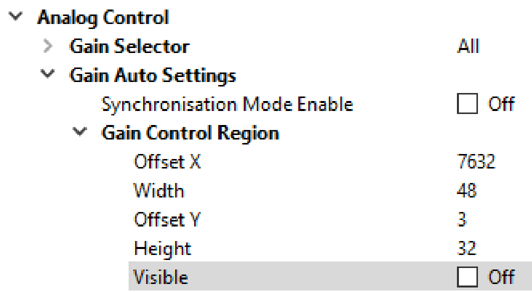
- If white balancing was successful, **Gain Auto Status** should return **Control Successful**.

4 Set the operating point (2):

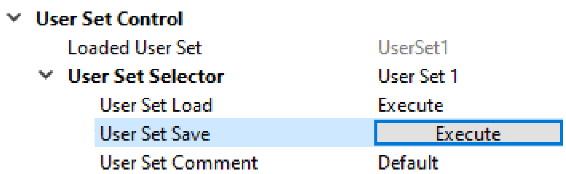
- At **Gain Auto Settings**, set the **Gain Control Region Channel Selector** to the different colors, and for each color check that **Current value** is near the specified target value.



- Optionally, you can grab an image and check image quality and the position of the white reference mark. If you work with GCT, you can click **Acquire a single frame** on the toolbar and control the image in detail.
- If you have selected the **Visible** check box at **Gain Control Region**, clear the check box now.



- Save the settings to User Set 1, so that the settings become active when the camera is switched on: In the **User Set Control** feature group, set **User Set Selector** to **User Set 1**, and then execute the **User Set Save** command.



Steps 3 and 4 must be repeated, for example, if you have changed the light or the f-stop.

5 Generate black-level reference (DSNU):

Generate a black-level reference. For more information, see section 6.3.

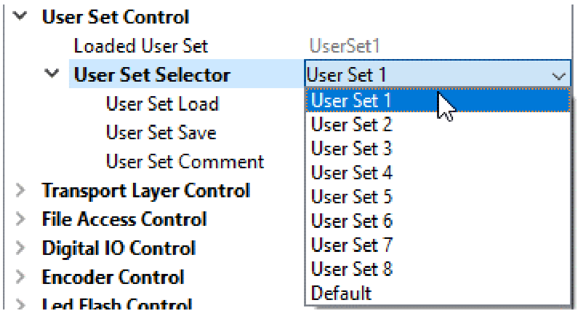
6 Generate the shading reference / flat-field correction (PRNU):

- If you use a static white reference target, place it a bit out of the camera focus to reduce the effect of features on its surface (dust, scratches) on the calibration result.
- Generate a shading reference. For more information, see section 6.4.

7 **Save the settings:**

Save the settings to a User Set:

- At the **User Set Control** feature group click **User Set Selector** and then click a user set item in the value list.



- Click **User Set Save** and then click **Execute**.

For more information about User Sets, see section 4.7.1.

.

8 **Configuring encoder or light barrier:**

- For information about encoder or light barrier, see section 5.2.

8 Additional features

8.1 Configuring multi-channel flash control

The allPIXA evo camera can be used to trigger up to four different flash controller channels synchronized to its line acquisition. This can be used to acquire several images with different illumination colors simultaneously in a single scan using line-multiplexing. When LED flash is active, the camera starts a complete LED pattern sequence after each Line Trigger, or after Sequence time in free-running mode, respectively.

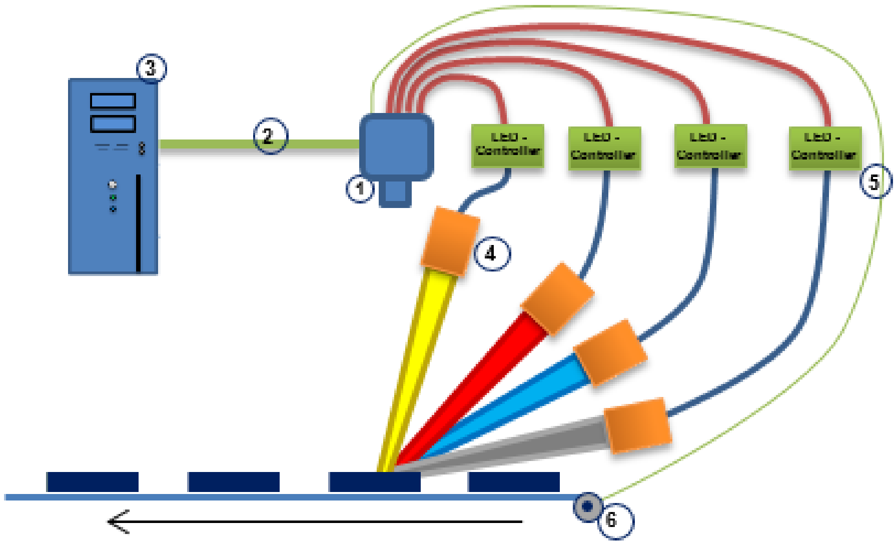


Figure 25: Connecting flash controllers and illumination modules

1. allPIXA evo camera
2. PC connection
3. Host PC
4. Illumination modules
5. LED controller
6. Encoder / Trigger

8.1.1 Operation principle

The camera provides up to four different outputs which can be operated individually to control illumination controllers.

Several outputs can be individually combined to be triggered at the same time. Each flashing scenario can be defined individually as line pattern.

The camera provides up to four different line patterns which are executed in a sequence. This sequence is repeated as long as scanning or triggering is active.

The following diagram demonstrates a sequence cycle with three different line patterns. In this example, the duration for each line pattern is set individually. All four available output channels are used:

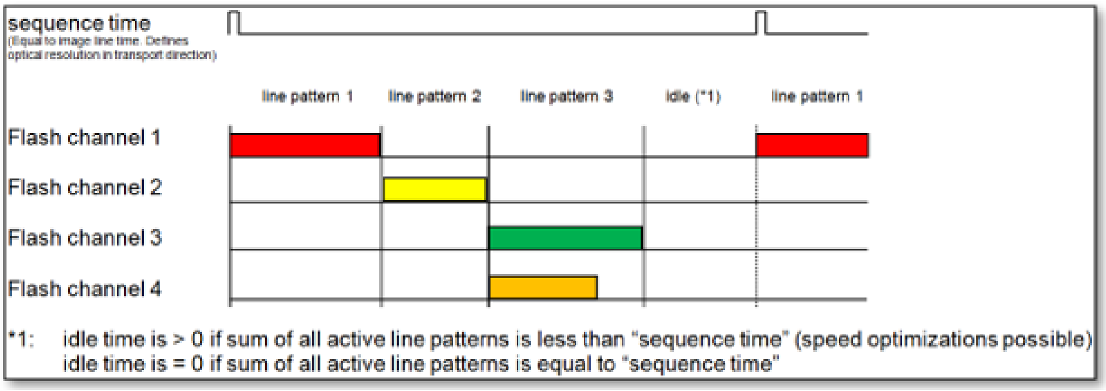


Figure 26: Pattern sequence (example)

8.1.2 Configuring Led Flash

Flash control is configured with the features of the **Led Flash Control** group. In GCT the features are shown as follows:

Led Flash Control	
Led Flash Enable	☐ Off
Led Flash Number of Pattern	1
Led Flash Pattern Selector	Led Flash Pattern 1
Out1 OnTime	0,000 us
Out2 OnTime	0,000 us
Out3 OnTime	0,000 us
Out4 OnTime	0,000 us
Pattern Off Delay	0,000 us
Pattern Duration	21,053 us
Led Flash Frame Control	Continuous
Led Flash Sequence Time	50,000 us

Which outputs are active and the exposure time of each flash output is defined by the features **Led Flash Number of Pattern** and **Pattern Duration**. Up to four patterns can be specified which are executed one after the other.

To configure Led Flash:

1. At the **Led Flash Control** feature group, click **Led Flash Enable** and then select the check box.
2. Click **Led Flash Number of Patterns** and enter the desired number of patterns.
3. Click **Led Flash Pattern Selector** and click **Led Flash Pattern 1** in the value list.
4. Click **OutX On Time** (X=1..4) and enter the time in microseconds for those channels that should be activated for the current pattern.
5. If all channels should be inactive at pattern end, specify a time in microseconds at **Pattern Off Delay**. In this case pattern duration is at least Max(**OutX On Time**) + **Pattern Off Delay**.
6. Repeat steps 3 to 5 the remaining patterns.

In GCT the minimum value for **OutX On Time** is 5.6 µs. If you enter a smaller value >0, GCT will adopt it to 5.6.

8.1.3 Example

With the patterns of the diagram shown in section 8.1.1, the features must be set as follows for free-running mode:

Trigger Selector = **FrameStart**,
Trigger Mode = **Off,**

Trigger Selector = **FrameActive,**
Trigger Mode = **Off,**

Trigger Selector = **LineStart**,
Led Flash Number of Pattern = 3,

Led Flash Sequence Time = **xxx,**

Led Flash Frame Control = **Continuous,**

Led Flash Enable = **On.**

	Pattern1	Pattern2	Pattern3	Pattern4
Out1 On Time (µs)	80	0	0	0
Out2 On Time (µs)	0	60	0	0
Out3 On Time (µs)	0	0	100	0
Out4 On Time (µs)	0	0	70	0
Pattern Off Delay (µs)	10	10	10	0
Pattern Duration (µs)	90	70	110	0

For Line Trigger mode:

Trigger Selector = **LineStart**,
Trigger Mode = **On**,
Trigger Source = **Line4**,
Ext. Line Time = 300**.**

With these settings, each sequence consists of three patterns. The image consists of groups of three lines. The three lines correspond to the three specified patterns.

8.2 Synchronizing cameras: Master and Slave operation

The master slave mode of the allPIXA evo camera ensures that two cameras are synchronized in such a way that each line is captured at exactly the same time by both cameras.

8.2.1 Principle

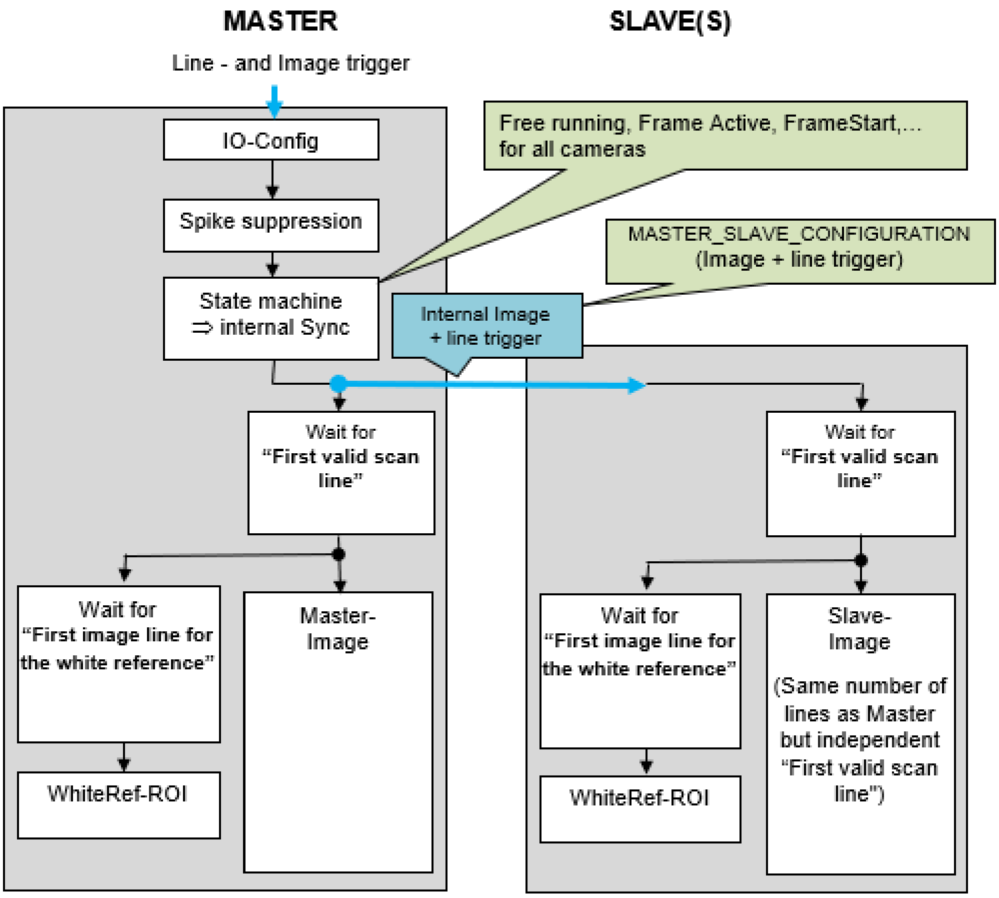
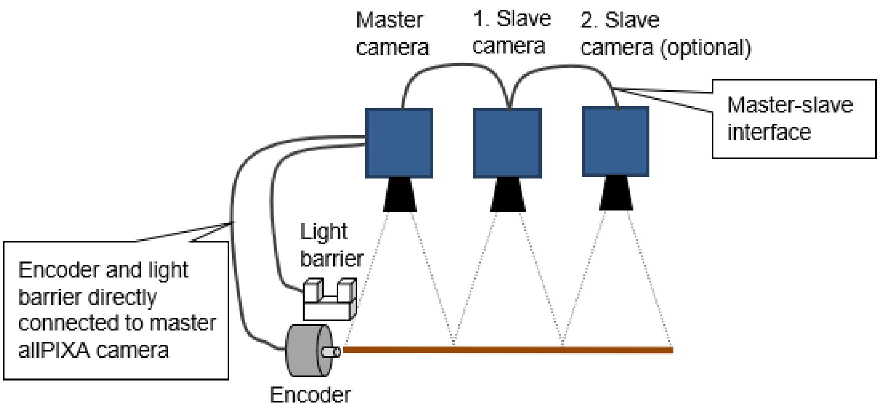


Figure 27: Principle of master/slave mode

To synchronize two or more cameras, use the **Master-Slave…** features of the **Acquisition Control** feature group. With these features you can:

- select the camera to be master or slave,
- configure the trigger input for master and slave,
- cascade cameras using one master and several slaves

The trigger signals from light barrier (frame trigger) and/or encoder (line trigger) are only connected to the master camera. The trigger information and additional timing signals, such as LED-Flash etc., are transferred to the slave camera(s) via the master-slave interface. Due to this synchronization interface all cameras run with exactly the same timing for lines and optional frames.



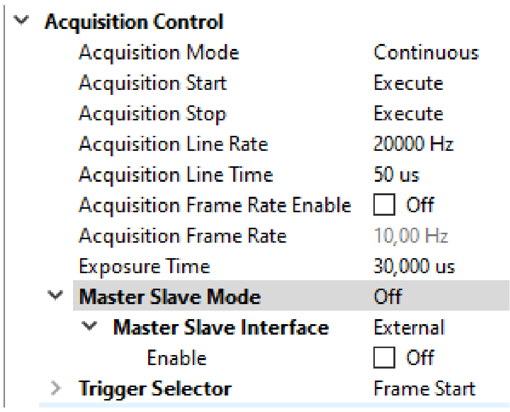
NOTE	An appropriate master-slave cable is required to connect the master camera to the slave camera(s) and to transfer the trigger signals. See section 5.1.7 for the pin layout of the I/O connector.

8.2.2 Setting up the cameras for master-slave synchronization

Use the feature **Master Slave Mode** to configure the camera as either master or slave. There are four different values:

Value	Meaning	Remark
Off	No master slave is selected.	Default
Master	Selects the camera to be Master.	
Slave	Selects the camera to be Slave.	
Auto Select	Camera uses the signal **AutoSelectMaster**, (see section 5.1.7), to detect automatically based on an external signal whether the camera is selected to be either master or slave.	This permits to use the same settings for all cameras.

For master slave mode the following features of the **Acquisition Control** feature group are used:



- **Master Slave Mode**
  Specifies the master/slave mode of the camera.
- **Master Slave Interface**
  Specifies the interface type to be used for master/slave.
- **Slave Delay Lines**
  Specifies the delay in number of lines for the slave camera. Values can be positive only. This feature is valid and available only for a slave camera.

Feature settings for the master camera:

- At the **Master Slave Mode** feature, select **Master**.
- At the **Master Slave Interface** feature, select either **External** or **Internal** as the desired interface available for the camera.
- At the **Enable** sub-feature, select the check box.

Feature settings for the slave camera:

- At the **Master Slave Mode** feature, select **Slave**.
- At the **Master Slave Interface** feature, select either **External** or **Internal** as the desired interface available for the camera.
- At the **Enable** sub-feature, select the check box.
- At the **Image Format Control** feature group, specify the same value for the **Height** feature as on the master camera.

8.2.3 Connecting master and slave camera(s)

The master/slave interface consists of a single timing signal for standard setup: Connect Pin 14 (line 9) of the master camera to pin 8 (line 4) of the slave camera.

In addition, the ground signal must be connected between master and slave cameras: pin 13 and 13 of the digital I/O port.

It is recommended to use suitable Chromasens cables:

Cable type	Order number
allPIXA evo Master Slave Trigger cable (5m)	CP000647
allPIXA evo Master Slave Hub cable (0.5m and 1.0m)	CP000715
allPIXA evo Trigger Cable (5m)	CP000716

NOTE:	The ground signal (digital I0: pin 13) must be connected in addition to the timing signal.

Example: Synchronizing two cameras:

1. Connect master and slave with appropriate cable
2. Optional: Provide trigger signals to master camera
3. Setting master-slave parameters on both cameras

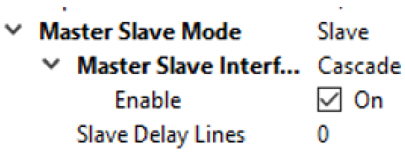
Feature	Master camera	Slave camera
Master Slave Mode	Master	Slave
Master Slave Interface	External	External
Slave Delay Lines	n.a.	<number of lines for delay>
Enable	On	On

8.2.4 Digital I/O port pin connection for master and slave camera

Master Slave Cascade (FW 2.2 and higher):

Master camera Pin			Slave camera Pin	
1	Line 1 + RS 422		1	nc
2	Line 2 + RS 422		2	nc
3	Line 3 Trigger Single ended		3	nc
4	RS 485		4	nc
5	LED OUT 1		5	nc
6	Line 1 - RS422		6	nc
7	Line 2 - RS422		7	nc
8	Line 4 Trigger o Master Slave Cascade IN		8	yellow
9	RS 485 to XLC4		9	nc
10	LED OUT 2		10	nc
11	Trigger GND		11	nc
12	LED OUT 3		12	nc
13	GND Master Slave	green	13	green
14	Line 9 Master Slave OUT	yellow	14	nc
15	LED OUT 4		15	nc

NOTE: For firmware 1.52.7 and lower for the 10k/15k allPIXA evo cameras, and for firmware 2.1.0 for 8k allPIXA evo cameras, for the slave cameras the **MasterSlaveInterface** feature must be set to **Cascade** to be compatible with the wiring above:



8.3 Modifying sensor sensitivity

The sensors of the allPIXA evo family permit to adjust the sensitivity of the sensor to fit your application. By default, the sensor is used with low full-well capacity to achieve maximum sensitivity. This results in a higher signal-to-noise ratio (SNR).

To increase SNR and thus to improve image quality, you can increase full-well capacity reducing sensitivity to a medium or to a low value. For the 10k and 15k cameras, three sensitivity values are available.

Sensitivity	Description	Full-well capacity
0	Low sensitivity for optimal SNR	40 ke
1	Medium sensitivity / high SNR	20 ke
2	Maximum sensitivity / standard SNR	10 ke

ke: kilo-electrons

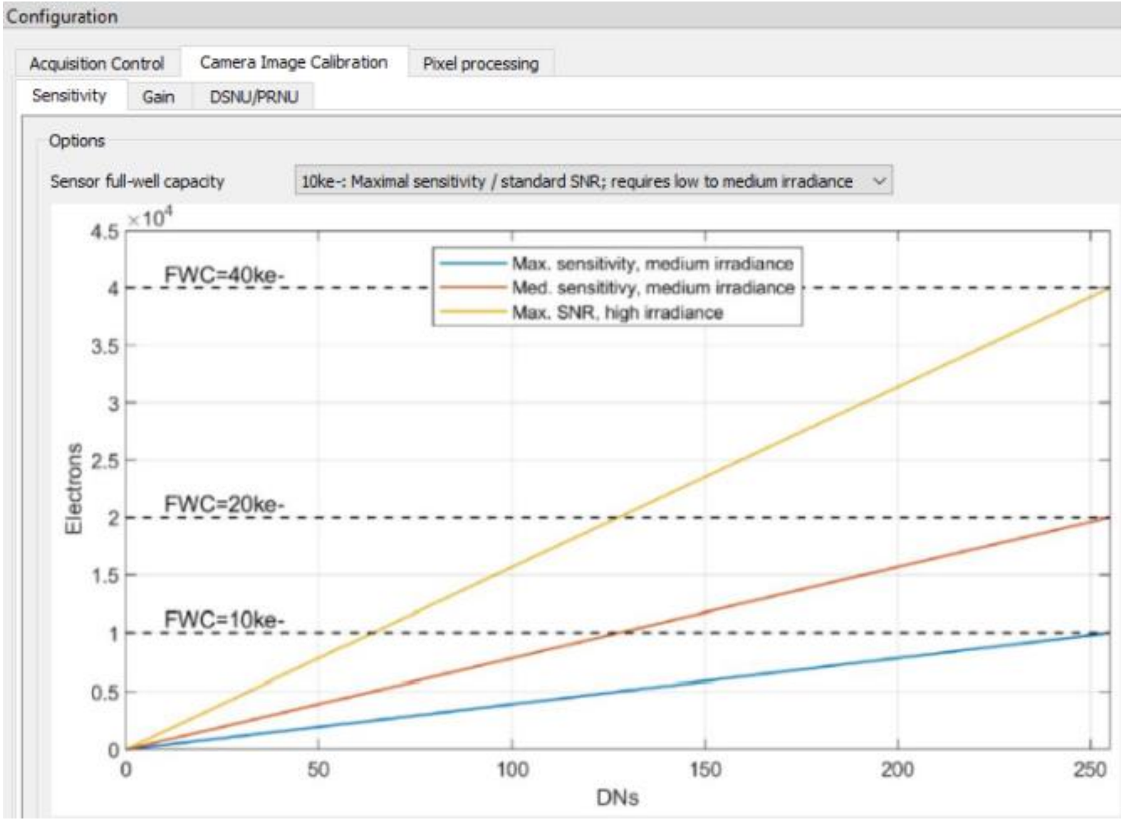
NOTE:	For detailed information about the possible values and settings of the sensor sensitivity of your camera model refer to the respective feature reference of your firmware packet. For example, for the 8k cameras, seven different sensitivity values are available.

If you have lower speed, and enough illumination, you can select **Low sensitivity** on the value list to reach the highest dynamic range of the camera to have a good image quality even in areas with highest contrast (completely dark to absolute reflective; for example, pin inspection in electrical connectors).

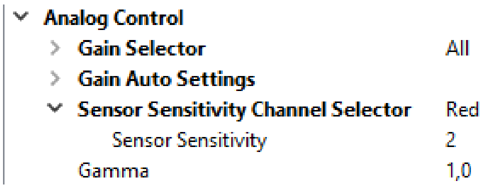
If you have high speed, not so much light, and flat objects, which do not require highest dynamic range (for example solar cell, web, or wafer inspection), you can work with maximum sensitivity to achieve good image quality.

To increase full-well capacity and to reduce sensitivity using GCT:

1. Start GCT and connect to the camera.
2. On the **View** menu, click **Camera Configuration**.
3. Select the **Camera Image Calibration** tab, and then click the **Sensitivity** subtab:



In the **Default** view of GCT, you find the sensitivity feature in the **Analog Control** feature group:



If you reduce sensitivity, you must also reduce the gain values. If you set sensitivity to the minimum value, you may need gain values in a lower range. (For information about the possible range, see feature reference, or tooltip.)

If you modify sensitivity and the gain values, the shading reference and black-reference data become invalid. Therefore, you must deactivate shading and black reference and create new data sets.

To update the references:

1. At the **Image Calibration Control** feature group, click **Dark Signal Non-Uniformity (DSNU)**, and click the currently used data set **LUT1** or **LUT2**.
2. Create new shading reference data as described in section 6.4.
3. At the **Image Calibration Control** feature group, click **Photo Response Non-Uniformity (PRNU) Selector**, and click the currently used data set **LUT1** or **LUT2**.

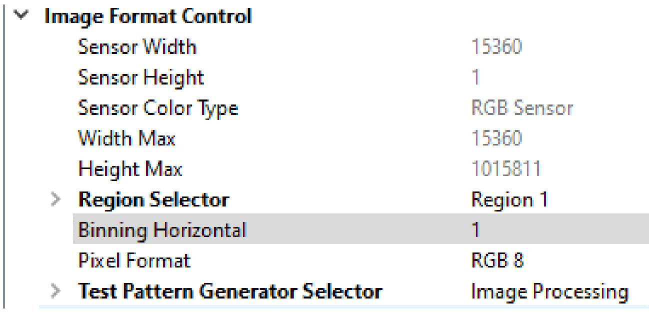
4. Create a new black-reference as described in section 6.3**Fehler! Verweisquelle konnte nicht gefunden werden.**.

8.4 Horizontal binning

If you activate horizontal binning, the values of several neighboring sensor pixels are combined and output as a single pixel. Thus, binning increases sensitivity and reduces horizontal resolution of the image.

To activate horizontal binning:

1. At the **Image Format Control** feature group, click the value at the **Binning Horizontal** feature:



2. Enter 2 in the value box.

Currently only the value 2 is supported by the allPIXA evo camera. If you select a higher value, an error code is returned.

If you change the value of the **Binning Horizontal** feature, the features **Width** and **Height** are scaled according to the binning value. You should check these features after changing the value of **Binning Horizontal**.

8.5 Color conversion

Color conversion offers two color transformation modules, color-to-color conversion, and color-to-gray conversion.

For color-to-color conversion you can specify a conversion matrix and offset values for the three colors. Colors are then converted due to the following formula:

$$\begin{pmatrix} ROut \\ GOut \\ BOut \end{pmatrix} = \begin{pmatrix} Gain00 & Gain01 & Gain02 \\ Gain10 & Gain11 & Gain12 \\ Gain20 & Gain21 & Gain20 \end{pmatrix} * \begin{pmatrix} RIn \\ GIn \\ BIn \end{pmatrix} + \begin{pmatrix} Offset0 \\ Offset1 \\ Offset2 \end{pmatrix}$$

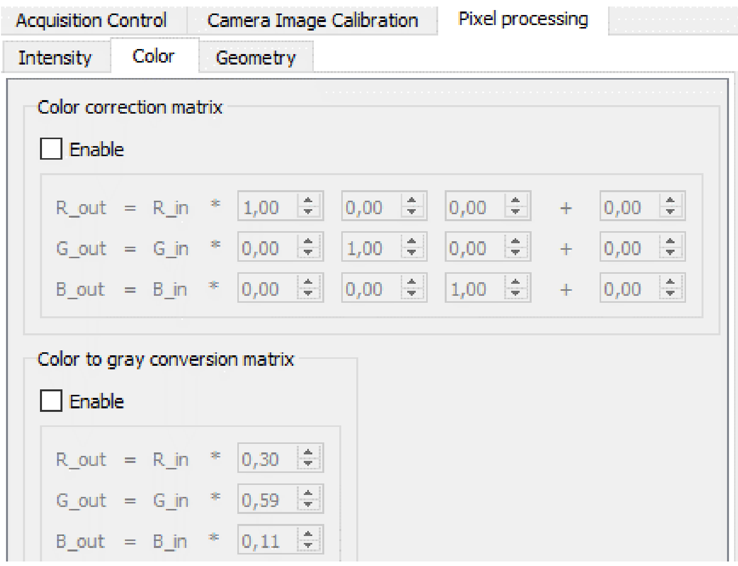
For color-to-gray conversion colors are converted due to the formula:

$$Gray = Gain0 * RIn + Gain1 * GIn + Gain2 * \ BIn$$

Color conversion can be specified comfortably on the **Camera Configuration** view.

To activate color conversion:

1. On the **View** menu click **Camera Configuration**.
2. Click the **Pixel processing** tab and then click the **Color** subtab:



3. Select the **Enable** check box of the desired conversion method and enter values in the respective data fields.

You can only activate one of the two conversion modes.

If you enable the **Color To Grey** module, the internal pixel format is changed to **Mono8**, and **Region Width** (**Image Format Control** feature group) and **Gain Control Region / Width** (**Analog Control** feature group) are adopted according to **Mono8** pixel format. If you disable the **Color To Grey** module, the pixel format is changed to **RGB8**.

9 Troubleshooting and Support

The troubleshooting information in this chapter may help you to identify common problems and lets you know how to solve them.

If you are not able to solve the problem with the information in this troubleshooting chapter, you may decide to contact Chromasens technical support for further help. Before you contact Chromasens technical support, take a look at the support form (see section 9.4) and prepare the answers or fill out the form completely. With this information you can make sure that you have most of the information available which is required for the technical support team to help you best with your problem.

9.1 Returning material (obtain an RMA number)

Before returning material to Chromasens you must request a RMA number (Return Material Authorization). This RMA number must be stated in all of your delivery documents if material is returned to Chromasens. Returned material without RMA number may not be processed in time and we also reserve the right to reject material without an RMA number.

To obtain an RMA number, contact Chromasens support first.

Chromasens GmbH
Max-Stromeyer-Straße 116
D-78467 Konstanz
Germany

Phone: +49 (0) 7531 - 876-0
Fax: +49 (0) 7531 - 876-303

E-Mail: support@chromasens.de
Internet: www.chromasens.de

For return of material you should use original packaging material to avoid any damages to the cameras.

9.2 Camera status identification by the camera status LED

The camera status LED indicates the current status of the camera. After boot-up is finished, the camera performs self-checks continuously. If an error is detected, the camera indicates this by changing the LEDs color.

LED color	Description
Off	No power is present at the camera, or the input voltage is out of the limits. (See also section 2.4 for power rating and section 5.1.1 for the pin layout)
Green continuous	Camera is in power up status.
Green blinking	Camera has power and is OK
Yellow	Camera is in warning state but is still operational. A typical reason for warning state is temperature too high.
Red	The camera is in error condition and not operational
Blue	Camera is OK and provides image data
green/blue alternate blinking	The camera is OK and provides image data frequently, based on a trigger signal

Yellow and Red indicates warning or error state: Please check the device error code feature to get more detailed information.

If the LED does not turn green immediately after switching on the power supply, the fuse may have blown because of e.g., incorrect input voltage. Please contact service.

9.3 Camera overheating protection

For safety reasons, the camera is equipped with an internal overheating protection.

Step 1: high-temperature warning:

If the camera internal temperature increases above the defined warning limit, the camera indicates this warning status by:

- Status LED of the camera turns yellow.
- Please check the DeviceErrorCode. In case of high temperature warning it is set to: **DEV_CTRL_WARNING_TEMPERATURE_TOO_HIGH**

Let the camera cool down and check environment. Improve cooling conditions of the camera if necessary.

Step 2: final safety shutdown:

If the temperature is still increasing and reaches the defined error limit the camera automatically switches to safety mode to protect the camera electronics from overheating. This camera state is indicated by:

- Status LED of the camera turns red
- Please check the DeviceErrorCode. In case of high temperature error it is set to:**DEV_CTRL_ERROR_TEMPERATURE_TOO_HIGH**
- The camera outputs an image with a pin stripe test pattern with black background.

To get the camera back from step 2 to normal operation:

1. Switch off the camera and let the camera cool down.
2. Check the environment and improve cooling if necessary.
3. Start the camera (power on)

For information about temperature level definitions, see sections 2.4 and 5.4.

9.4 Before contacting Chromasens technical support

If you have a problem with the camera and decide to contact Chromasens technical support, it is very important that you collect all relevant system information beforehand.

This may guarantee a quick and efficient problem-solving process together with Chromasens technical support.

To collect the most important information of your issue, you may use the following list as a guideline. You can also download the list from our website at https://www.chromasens.de/en/support/support

Please fill out this list and provide the information including the requested files before you contact Chromasens technical support.

Contact Data

Company name			
Name			
E-Mail		Phone	
Street		City	
Zip code		State/Country	
Contact person CS		Date	

Technical Information

System Information		
Camera type	☐allPIXA evo	☐ 8k ☐ 10k ☐ 15k
Camera serial number		
GCT version used		
Operating system		
Frame grabber (wave)		Type + manufacturer
Network adapter (evo)		Type + manufacturer

Problem Description	
Description of the problem: (as detailed as possible)	
When did the problem occur?	☐ after start ☐ during operation ☐ at a specific action, please describe:
How often did problem occur?	☐ once ☐ always ☐ regularly ☐ rarely please describe:
Did the application ever run ok	☐ yes ☐ no
If known, please describe the reason for the problem or any abnormal behaviors.	

Image and Parameter Files	
Camera feature settings	☐ (It is very important to provide a copy of the exact camera settings when the problem occurred)
Live images	☐ (Live or test images showing the problem. Save images in BMP format)
Message log	☐ (Message log, which can be shown in GCT by clicking **Show message log window**)

10 Appendix

10.1 Mechanical specification

NOTE I	Drawings and 3D-CAD-models are available on our homepage http://www.chromasens.de
NOTE II	The shown position of the sensor surface is given as resulting optical value including lengthening of the sensor glass. For more details, see section 2.5.
NOTE III	For information about the XYZ coordinate system and sensor alignment, see section 2.5.

10.1.1 Mechanical dimensions of the allPIXA evo 10k camera

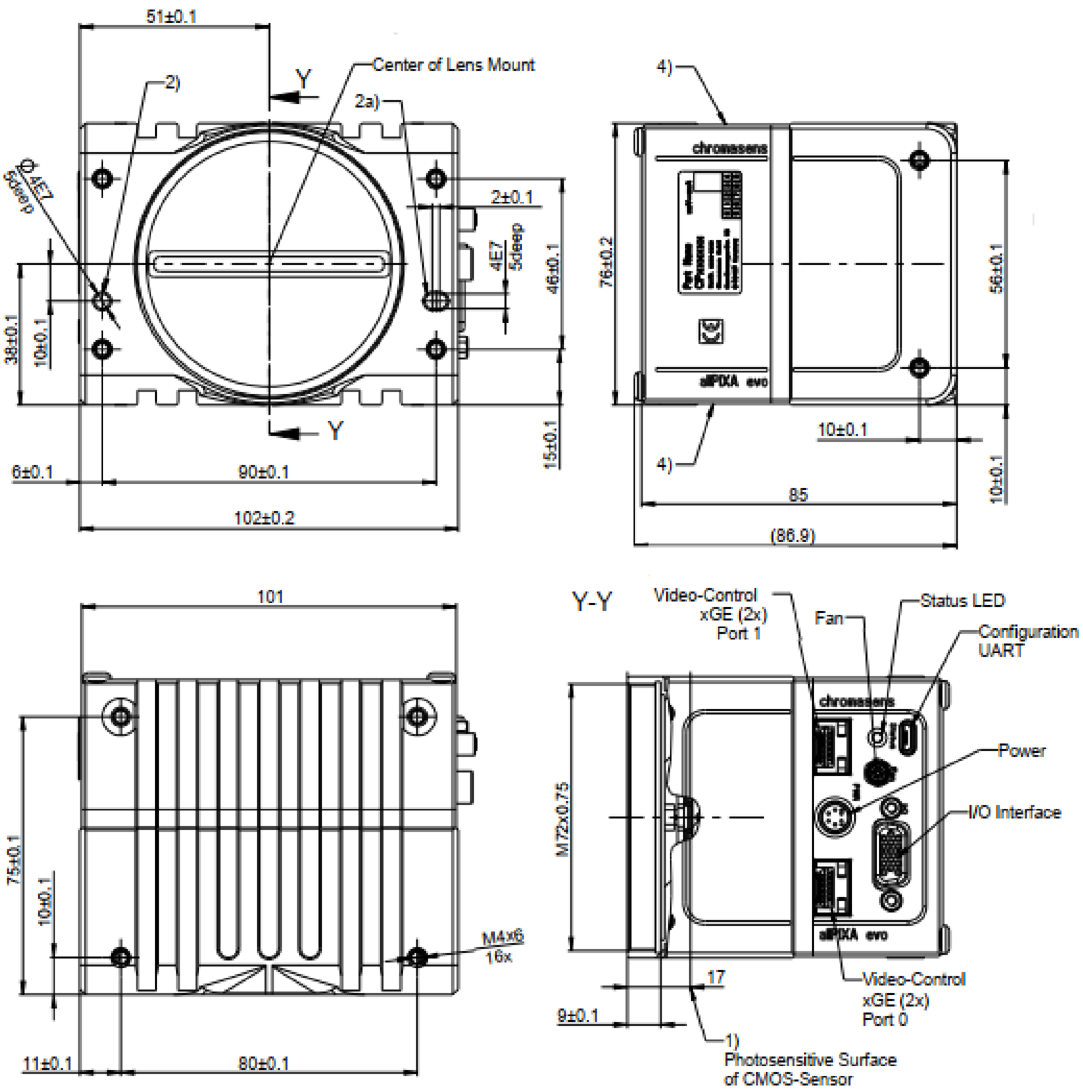


Figure 28: allPIXA evo 10k camera (GiGE interface)

For the camera with CoaXPress interface, two variants are available. For the Y variant, the interfaces are on the upper side of the camera, for the Z variant, they are on the backside of the camera.

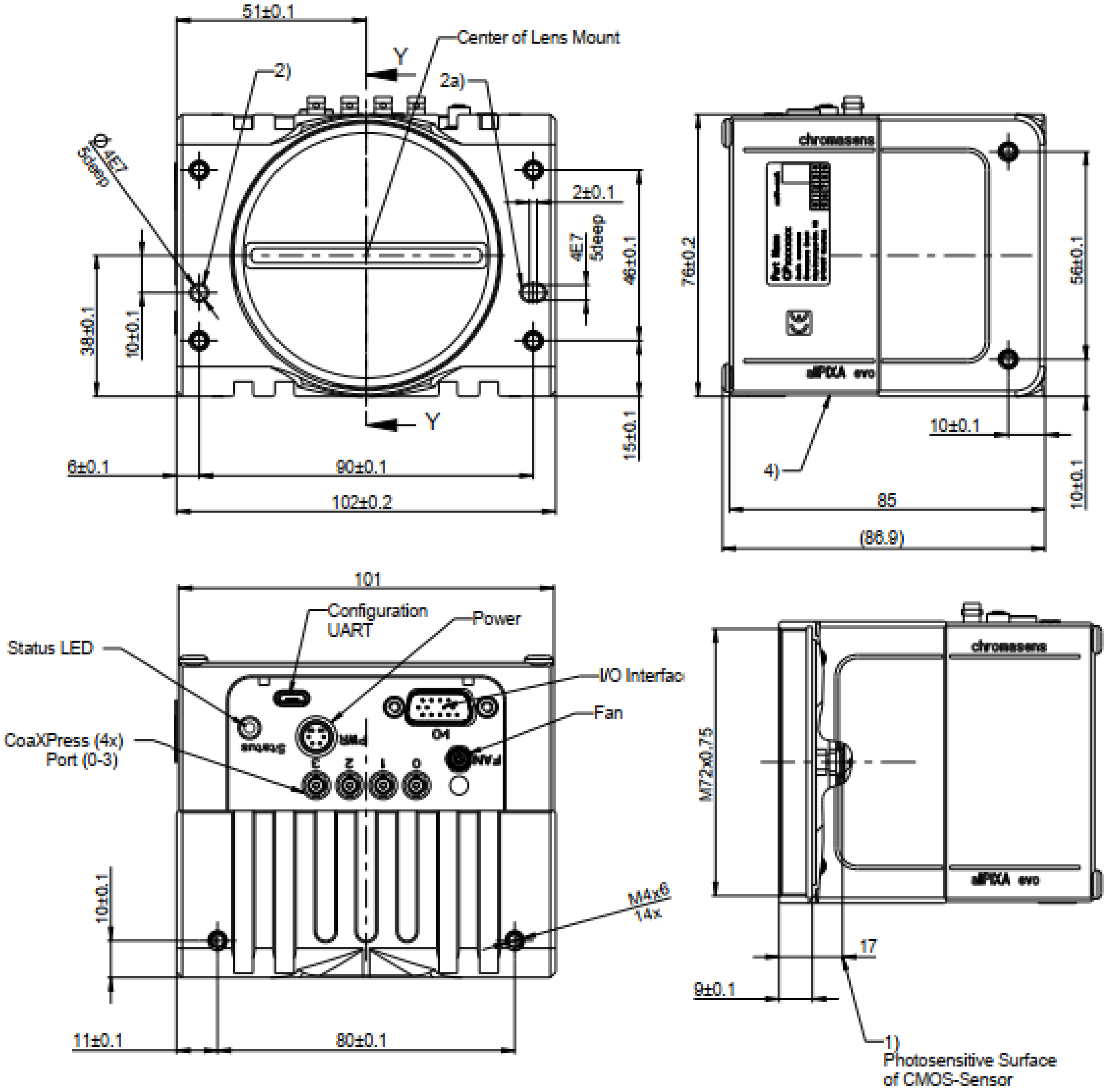


Figure 29: allPIXA evo 10k camera (CoaXPress interface, Y variant)

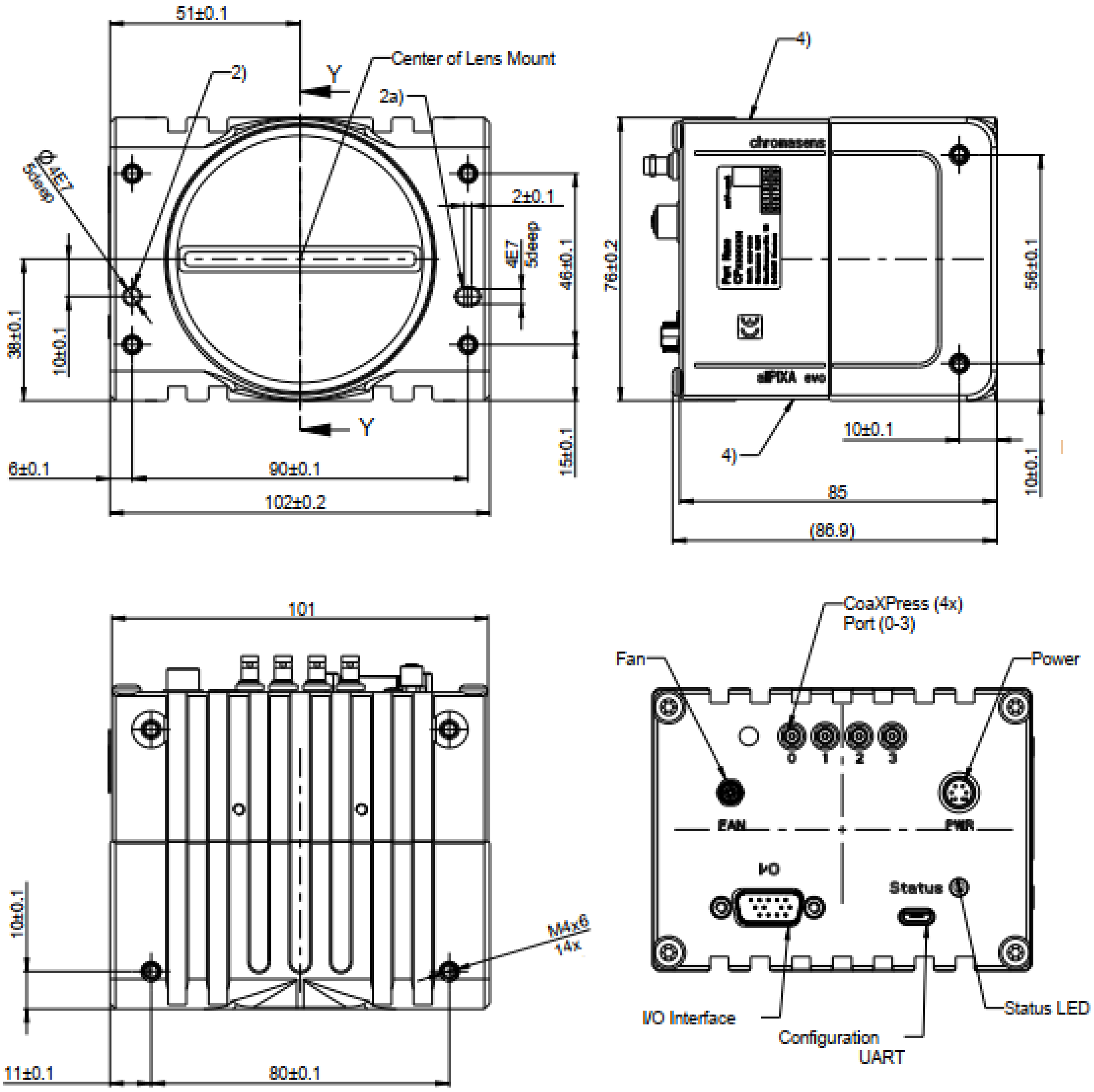


Figure 30: allPIXA evo 10k camera (CoaXPress interface, Z variant)

10.1.2 Mechanical dimensions of the allPIXA evo 15k camera

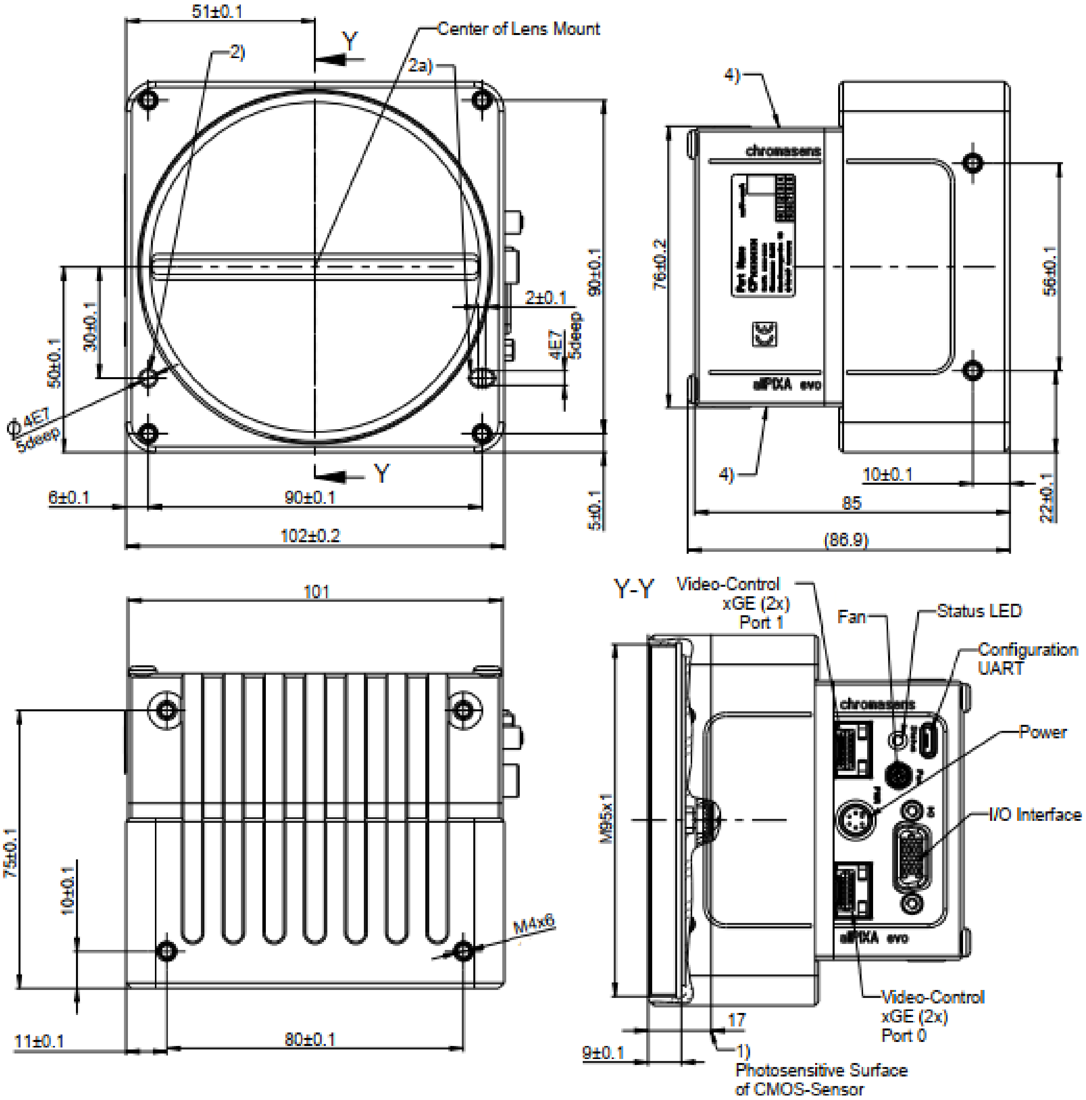


Figure 31: allPIXA evo 15k camera (GiGE interface)

For the camera with CoaXPress interface, two variants are available. For the Y variant, the interfaces are on the upper side of the camera, for the Z variant, they are on the backside of the camera.

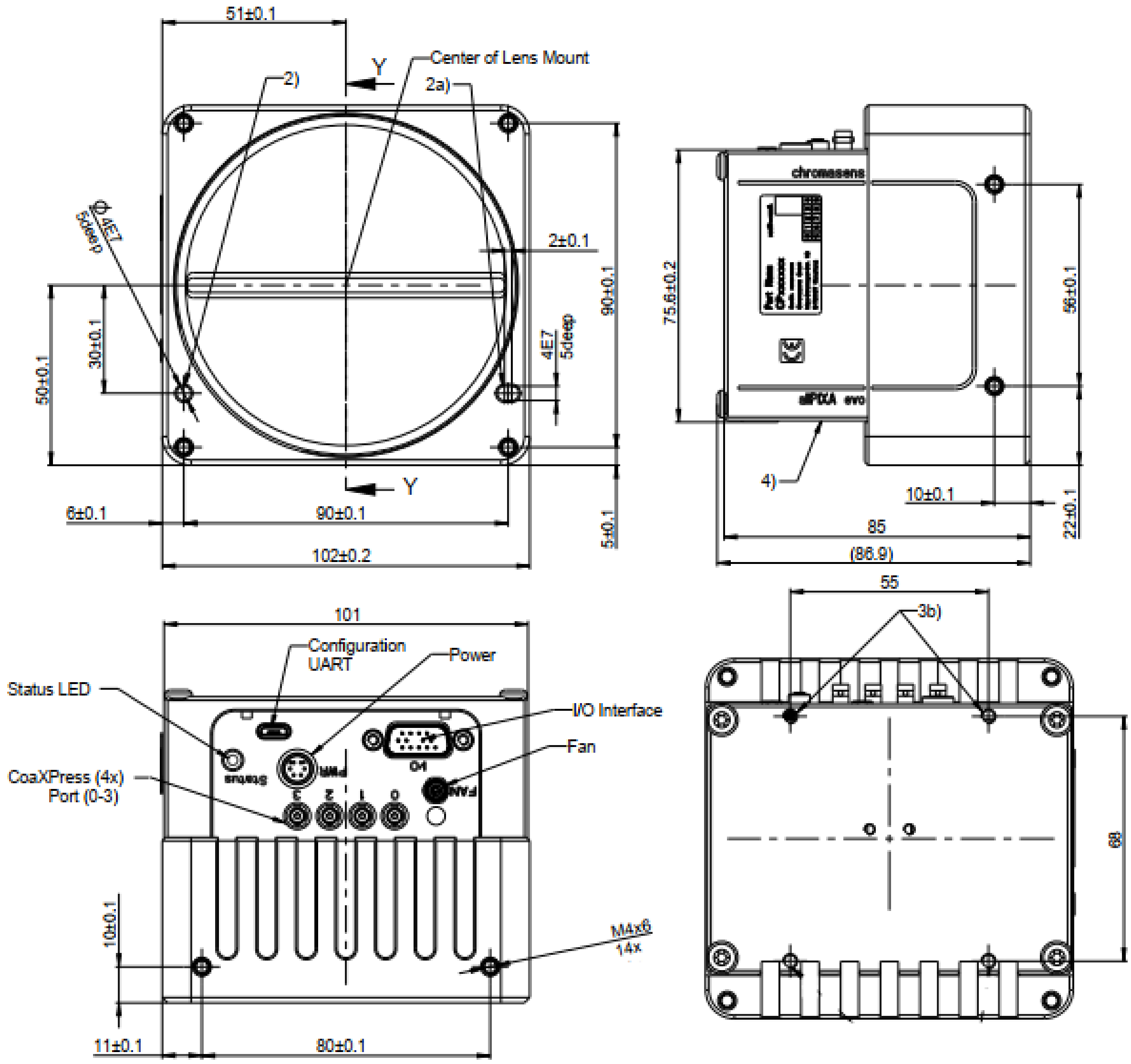


Figure 32: allPIXA evo 15k camera (CoaXPress interface, Y variant)

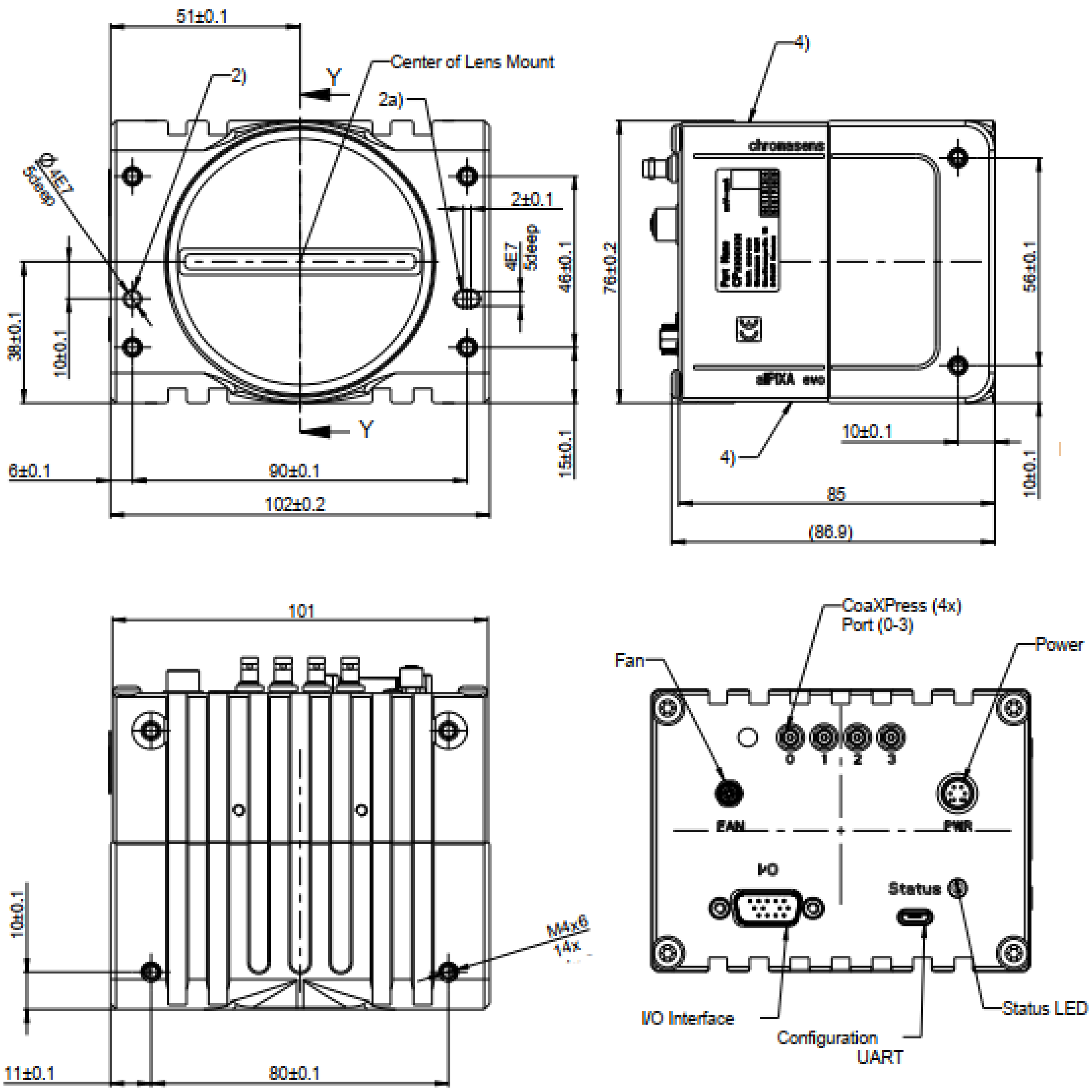


Figure 33: allPIXA evo 15k camera (CoaXPress interface, Z variant)

10.1.3 Mechanical dimensions of the allPIXA evo 8k camera

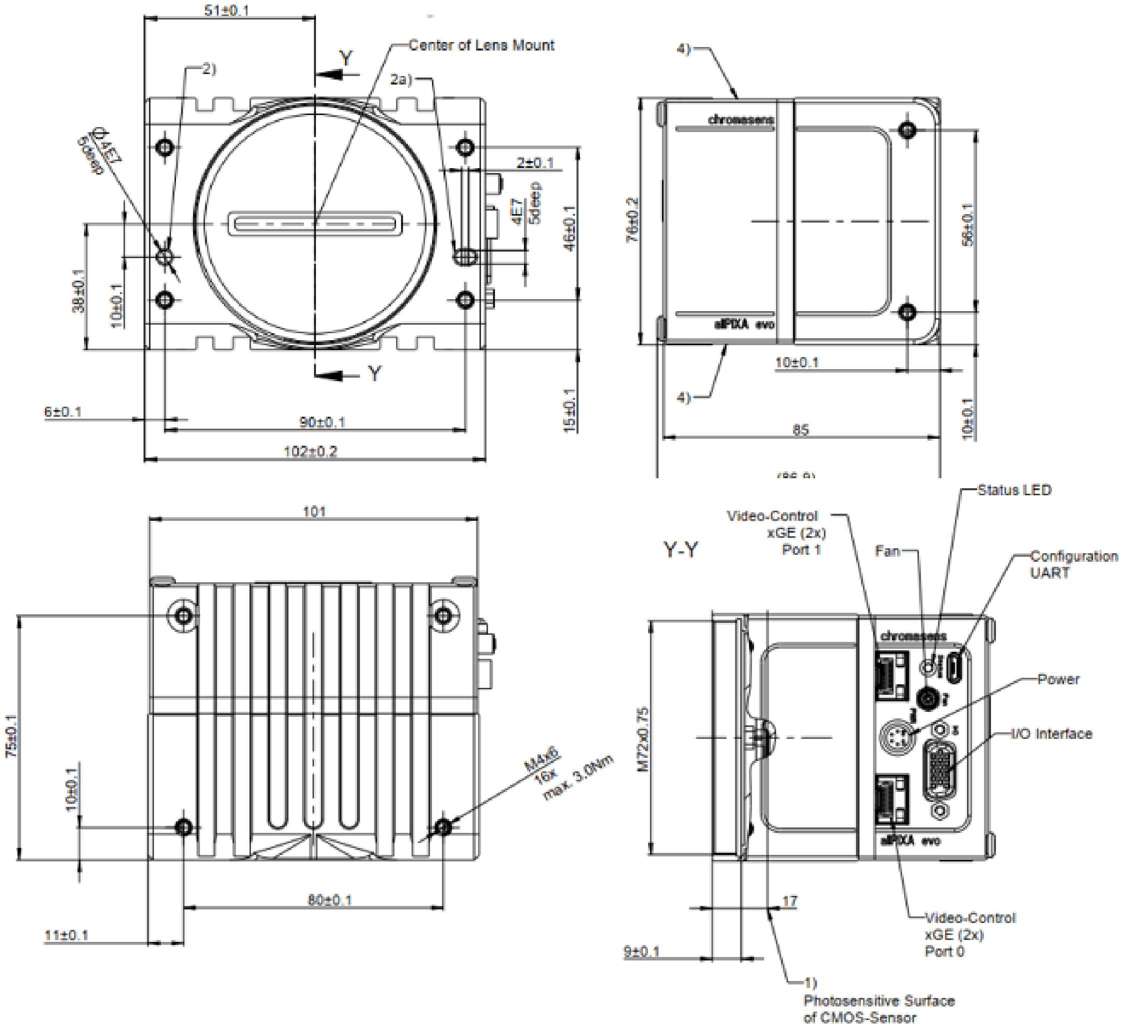


Figure 34: allPIXA evo 8k camera (GiGE interface)

For the camera with CoaXPress interface, two variants are available. For the Y variant, the interfaces are on the upper side of the camera, for the Z variant, they are on the backside of the camera.

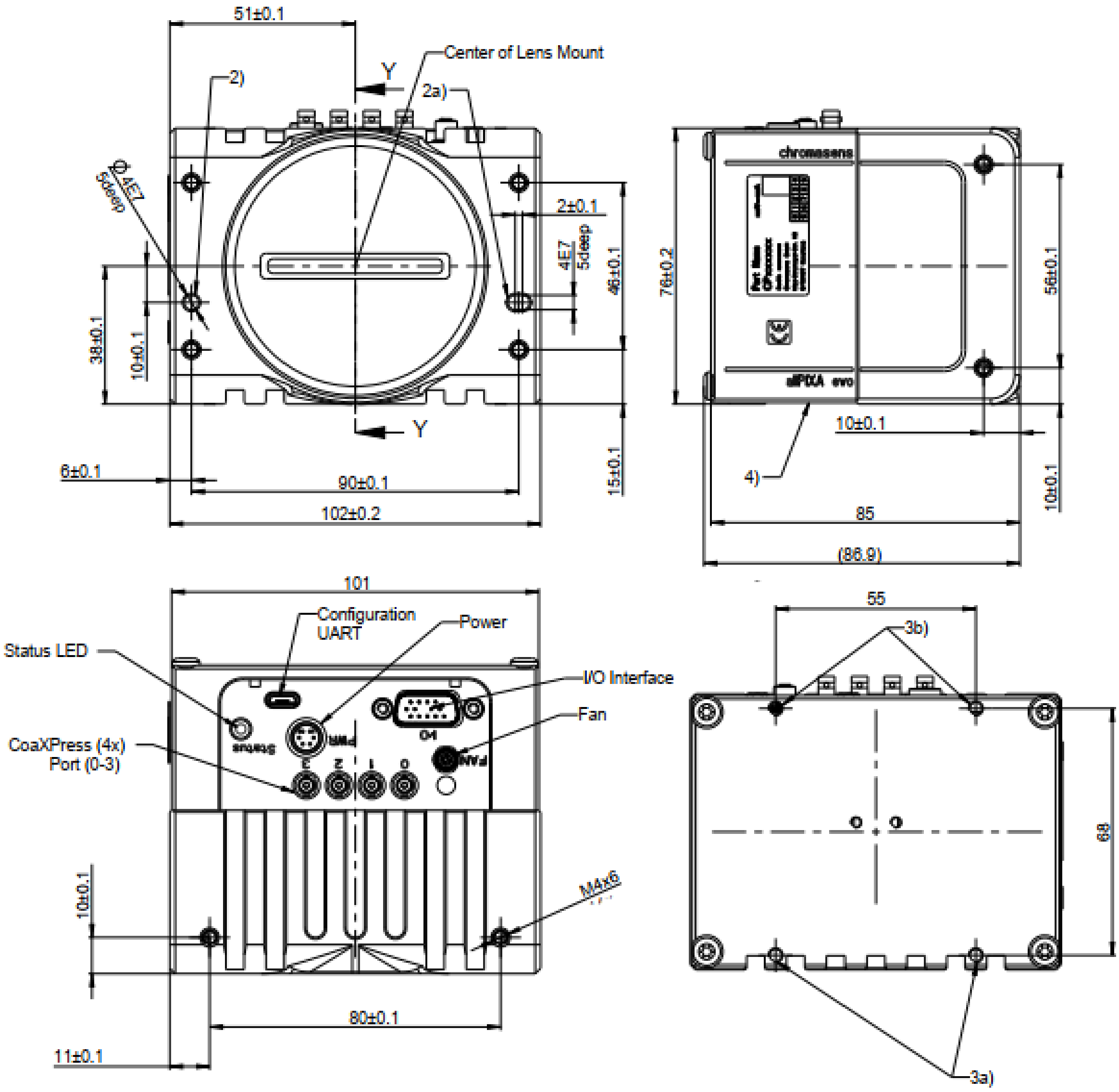


Figure 35: allPIXA evo 8k camera (CoaXPress interface, Y variant)

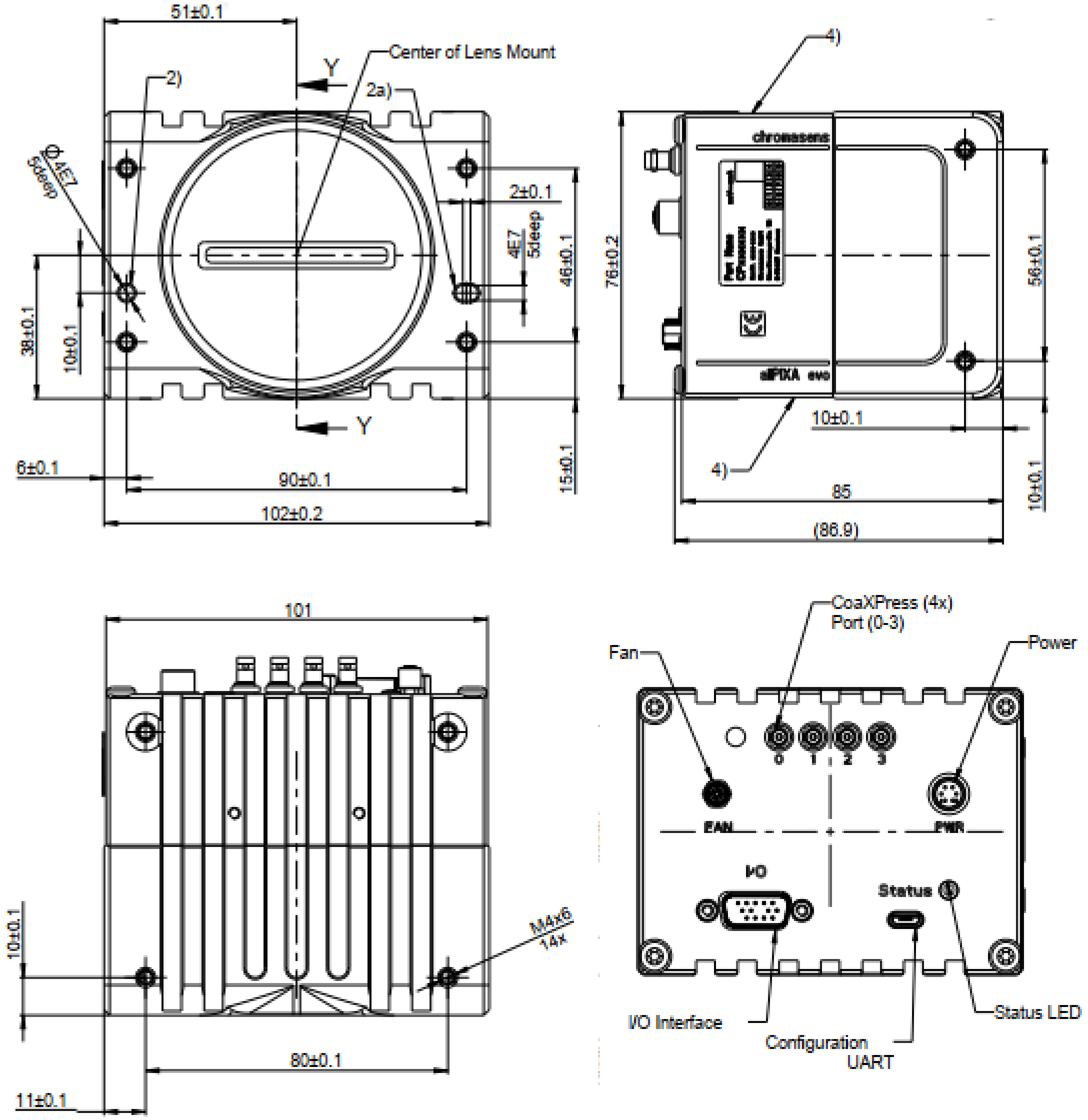


Figure 36: allPIXA evo 8k camera (CoaXPress interface, Z variant)

10.2 Adapter and accessories

10.2.1 Lenses, adapters, and mounts

Chromasens offers a large variety of accessories which are designed to provide maximum flexibility and to get most out of the camera.

For the allPIXA evo cameras, special adapters are available that permit to use the accessories of the allPIXA pro cameras.

You can find the complete list of all accessories including descriptions and detailed drawings in on our website at www.chromasens.de/user.

NOTE	For more information about accessories, refer to the corresponding accessories catalogue.

10.2.2 Cooling kits

10.2.2.1 Cooling kits and fans (heat sinks)

For all evo cameras, passive and active cooling kits are available, which can be mounted to the back, upper, or lower side of the camera:

Figure 37: Cooling Kit for the 8k allPIXA evo cameras

Use heat conducting pads between camera and cooling adapter. Different pads are included. Choose the pad which fits best to the camera side.

In addition, active cooling kits with fan are available, which can be mounted in the same way as the passive cooling kit. Its power supply cable can be connected to the camera (see section 5.1.

Description	Identification No.
allPIXA evo PIN Cooling	CP000643
allPIXA evo FAN Cooling	CP000644

10.3 Camera system design / lens selections

10.3.1 Calculating the object-to-image distance

You need the following parameters for calculating the optical setup:

- Image size (Sensor size of camera (**which is in use**))
- Object size/width
- Focal length (from data sheet of the lens)
- Principal main plain distance (from data sheet of the lens)

First, calculate the magnification:

$$m = \frac{ImageSize/mm}{ObjectSize/mm}$$

After getting the result for the magnification, calculate the object-to-image distance by following:

Calculate the image distance:

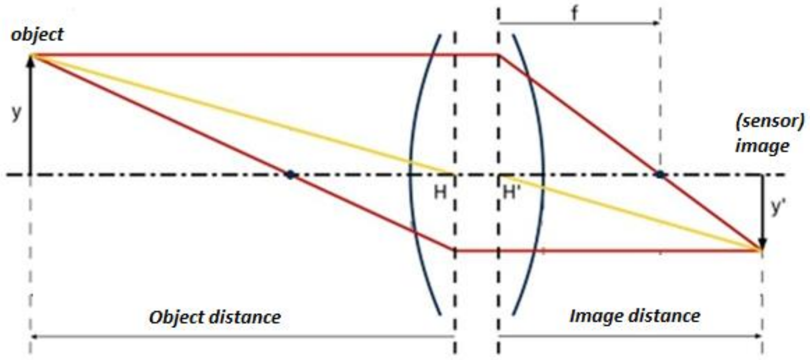
$$ImageDistance = FocalLength * (m + 1)$$

Calculate the object distance:

$$ObjectDistance = FocalLength * \left(\frac{m + 1}{m}\right)$$

Calculate the object-to-image distance with note of the main plain distance:

$$ObjectImageDistance = ImageSize + ObjectSize + Main\ plain\ distance$$



- f = focal length
- y = object size
- y' = image size

You can see a calculation example on the next page.

Example:

Camera:	allPIXA evo camera 15k	86 mm (5.6µm/pixel * 15360 pixels)
Object width/size:		450 mm
Lens:		90.1 mm real focal length
		-2.5 mm principal main plain distance

$$m = \frac{ImageSize}{ObjectSize} = 0.162$$

$$ImageDistance = FocalLength * (m + 1) = 104.72\ mm$$

$$ObjectDistance = FocalLength * \left(\frac{m + 1}{m}\right) = 645{,}51\ mm$$

$$ObjectImageDistance = ImageSize + ObjectSize + Main\ plain\ distance = 747.73$$

(w/o glass plates in the optical path)

10.3.2 Calculating the distance rings (tubes) for the allPIXA evo camera

Some applications require distance rings (tubes) for mounting the lens in the right position on the allPIXA evo camera. This section shows an example how to calculate the length of the distance ring.

To calculate the needed distance rings, you have to get some information about the optical setup:

Optical parameter:

- Real focal length (from data sheet)
- Image distance (calculated)

Parameters of the lens:

- Back flange length at infinite distance (from data sheet)

Parameters of additional focusing unit:

- Minimum offset distance of the unit from flange of the lens
- Maximum offset distance

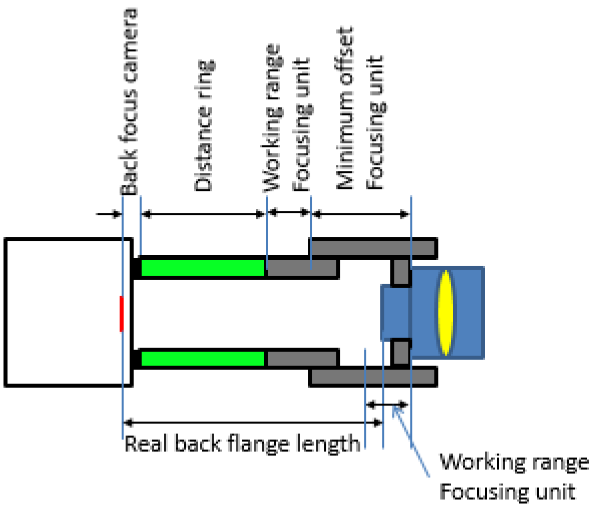


***Figure* 38**

Example:

Camera:	allPIXA evo camera	
Lens:	Linos Apo Rodagon 90 mm	
	90.1 mm real focal length	
	93.5 mm flange length@infinite	
Focusing unit:	Modular Fokus	
	Minimum offset	20 mm
	Maximum offset	45 mm
Object width/size:	450 mm	

1. **Calculating image distance:**

   a. Calculating the magnification:

$$m = \frac{ImageSize/mm}{ObjectSize/mm}$$

   b. Calculating the image distance:

$$ImageDistance = FocalLength * (m + 1)$$

   Result is: 104,72 mm

2. Calculating the difference between image distance@infinite and flange length@infinite:
   Image distance@infinite converged to focal length: 90.1 mm
   Difference: 93.5 mm -90.1 mm = 3.4 mm

3. Calculating flange distance at working point:
   Flange distance@working point: 104.72 mm + 3.4 mm =108.12 mm

4. Calculating the sum of the distances:

Real flange distance:	+	108.12
Back focus of the allPIXA evo camera:	-	17.526 mm (C-Mount)
Minimum offset focusing unit:	-	20.0 mm
Sum:	=	70.954 mm

   Therefore, we use a **distance ring of 60.0 mm**. This covers flange distances from 97.526 mm up to 122.56 mm.

10.3.3 Calculating the integration time

The relationship between the line frequency and the integration time is as follows:

$$IntegrationTime/sec. = \frac{1}{LineFreuquency/Hz}$$

For the calculation of the integration time the following parameters are necessary:

- Maximum or nominal speed of the transport (mm/s)
- Desired transport resolution (mm/pixel or dpi)

Calculate the integration time with the formula as follows:

$$\boldsymbol{IntegrationTime} = \frac{\boldsymbol{TransportResolution}\ (\frac{\boldsymbol{mm}}{\boldsymbol{pixel}})}{\boldsymbol{NominalSpeed}\ (\frac{\boldsymbol{mm}}{\boldsymbol{s}})}$$

Note: If the transport resolution is stated in dpi and the speed in metric values, the values must be converted (1 inch= 25,4 mm).

10.4 EC conformity declaration

chromasens Imaging for Professionals	EU Declaration of Conformity	DCE_CP000590_R02

We declare that the following products comply with the requirements of the listed directives and standards. Each type listed below, stands for all its related model variants.

Designation:	High speed CMOS line scan camera with Dual 10 GigE-Interface
Series:	Chromasens allPIXA evo
Types:	**CP000590**-XXk-h-nnnn (all derivations)

Manuafcturer authorized representive:	**Chromasens GmbH** Max-Stromeyer-Str. 116 D-78467 Konstanz Germany www.chromasens.com

The object of the declaration described above is in conformity with the relevant Union harmonization legislation:

Electromagnetic compatibility	2014/30/EU	of February 26, 2014
RoHS	2011/65/EU	of June 8, 2011

Applied standards:

Risk Assessment:

- DIN EN ISO 12100:2011-03

Electromagnetic Compatibility Emission:

- DIN EN 61000-6-4: 2007 + A1: 2011
- DIN EN 55032:2016

Electromagnetic Compatibility Immunity:

- DIN EN 61000-6-2:2005
- DIN EN 61000-4-2:2009
- DIN EN 61000-4-3:2011
- DIN EN 61000-4-4:2013
- DIN EN 61000-4-5:2019
- DIN EN 61000-4-6:2014

The notified body (Reg. No. D-PL-19366-01-01) performed measurements of Electromagnetic compatibility and issued the certificate: 19PBI116308-01, dated 28-11-2019

Konstanz, November 29, 2019

Martin Hund, CEO

chromasens Imaging for Professionals	**EU Declaration of Conformity**	DCE_CP000620_8K DXGE _R01

We declare that the following products comply with the requirements of the listed directives and standards. Each type listed below, stands for all its related model variants.

Designation:	High speed CMOS line scan camera with Dual 10 GigE-Interface
Series:	Chromasens allPIXA evo 8K DXGE
Types:	**CP000620-h-08K-11**-xx-yy-n (all derivations**)**
Manuafcturer authorized representive:	**Chromasens GmbH** Max-Stromeyer-Str. 116 D-78467 Konstanz Germany www.chromasens.com

The object of the declaration described above is in conformity with the relevant Union harmonization legislation:

Electromagnetic compatibility	2014/30/EU	of February 26, 2014
RoHS	2011/65/EU	of June 8, 2011

Applied standards:

Risk Assessment:

- DIN EN ISO 12100:2011-03

Electromagnetic Compatibility Emission:

- DIN EN 61000-6-4: 2020-09
- DIN EN 55032:2016-02

Electromagnetic Compatibility Immunity:

- DIN EN 61000-6-2:2019-11
- DIN EN 61000-4-2:2009-12
- DIN EN 61000-4-3:2021-11
- DIN EN 61000-4-4:2013-04
- DIN EN 61000-4-5:2019-03
- DIN EN 61000-4-6:2014-08

The notified body (Reg. No. D-PL-19366-01-01) performed measurements of Electromagnetic compatibility and issued the certificate: 21PBI010008-01, dated 2022-01-13

Konstanz, February 07, 2022

Martin Hund, CEO

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