

allPIXA pro camera | Manual



CD40127

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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

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

1.1.2 Support

Should you ever have problems with the allPIXA pro camera that you cannot solve by yourself, look into this manual for additional information, check the troubleshooting chapter 10, contact your local distributor, or send us an e-mail.

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1.2 Firmware and software version in this manual

This document refers to the following version:

CST: Version 2.8.3
 Camera: Packet 3.02

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

1.3 List of abbreviations

Abbreviation	Meaning	Explanation
ADC	Analog digital converter	-
CCM	Color conversion matrix	The CCM supports the conversion from, for example, RGB to sRGB or any user-defined conversion
CDS	Correlated double sampling	-
CST	Camera setup tool	Chromasens camera parameter programming software
DSNU	Dark signal non-uniformity	Irregularity in the dark image
DVAL	Data valid	Pixel-by-pixel enable for Camera Link
FVAL	Frame valid	Frame signal for an image on the Camera Link (corresponds to VSync)
HSync	Horizontal synchronization	Frame signal for a line (corresponds to LVAL)
LED	Light emitting diode	-
LVAL	Line valid	Frame signal for a line on the Camera Link (corresponds to HSync)
PRNU	Photo response non-uniformity	Difference in sensitivity of the individual pixels
ROI	Region of interest	-
SLL	Scan line length	Number of pixels per line
VSync	Vertical synchronization	Frame signal for an image (corresponds to FVAL)

1.4 Definitions

Chromasens	Other used definitions	Explanation
Black-level correction	Background subtract, Offset correction	Removes the dark offset from each pixel
Shading correction	Flat-field correction	Corrects brightness inhomogeneities resulting from lens, light and non-uniformity of sensor pixels
RGB line distance	Line shift; Spatial correction	The tri-linear sensor has individual pixel lines for red, green and blue. Inside the camera the spatial differences are corrected.

Chromasens	Other used definitions	Explanation
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 in the illumination. This can be done in a single setup process or in a permanent process.
White reference		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.
Tap balance		The sensor has two taps. Tap balance ensures that both taps have the same signal levels at the junction for the same brightness.

1.5 Scope of supply of the allPIXA pro camera

You should check your device upon delivery to ensure that it is undamaged and complete.

The following components are supplied with the allPIXA pro camera:

- allPIXA pro camera packaging
Check the packaging for damage which may have occurred during transport.
- allPIXA pro camera
Check the camera for damage which may have occurred during transport.
The rating plate is located on the rear of the allPIXA pro 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 you use the camera, contact your local partners or 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 Information about the Camera Setup Tool (CST)

To download updates, refer to our website at <https://www.chromasens.de>. There you will find the software in the *download -> software area*.

Before you install and use CST, check whether a more recent CST or manual version is available. If you already have an installed version of the CST, you can check the version number in the **Help** menu. For information about CST usage, see chapter 6.

1.7 Design of a line scan camera system

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

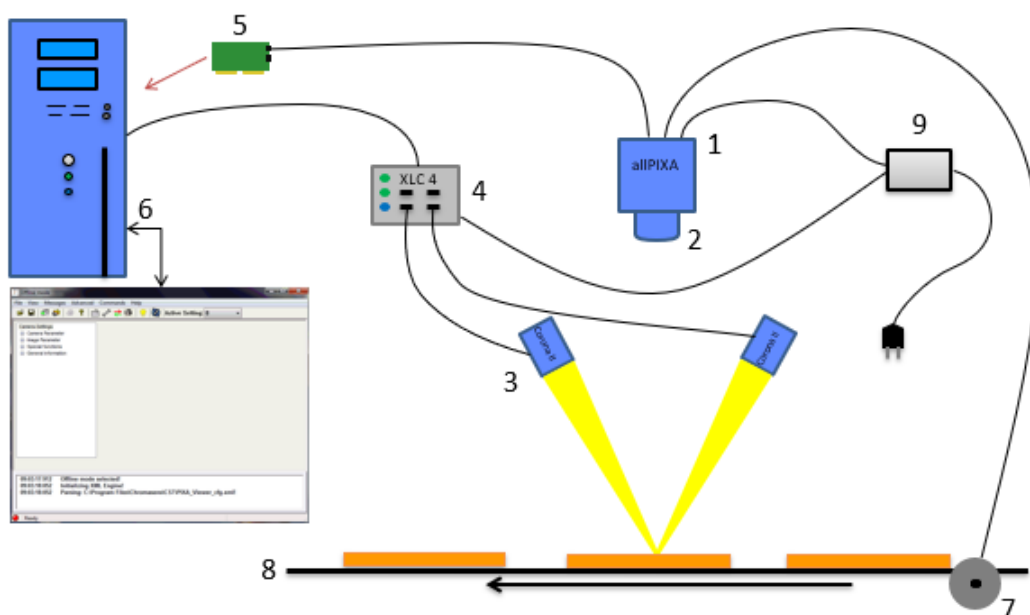


Figure 1: Design of a line scan camera application

Following components are necessary in a typical line scan camera application:

Component	No.
Line scan camera: An allPIXA pro camera which scans the image line-by-line and communicates with the frame grabber (5, PC plug-in card).	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 pro 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
Frame grabber (PC plug-in card): The image data are sent to a PC by use of a frame grabber with a Camera Link interface. The frame grabber establishes the necessary hardware connection to the PC (6).	5
PC: The PC system serves for 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 either to the allPIXA pro camera or the frame grabber.	7
Conveying unit: The conveying unit moves the scanned object past the allPIXA pro camera	8
Power supply: Both, the allPIXA pro camera and the illumination system, require a suitable power supply.	9

2 Specifications and definitions

The allPIXA pro camera family is available in the following maximum resolutions / line frequencies:

- 1,024 pixels / max. 156 kHz
- 4,096 pixels / max. 50,8 kHz
- 5,120 pixels / max. 40,8 kHz
- 6,000 pixels / max. 34,3 kHz
- 7,300 pixels / max. 29,7 kHz

If you are interested in further resolutions, do not hesitate to contact us.

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

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

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.

Via frame grabber the incremental encoder can be either sent to the CC bits of the Camera Link interface or it can be directly connected to the allPIXA pro camera. As a result, images with a consistent quality can be generated even at transport speeds with a high fluctuation rate.

The allPIXA pro camera parameters can be set with CST. Equipped with a Camera Link base / medium /full interface support, the allPIXA pro camera achieves a data rate in medium mode of up to 170 megapixels per second with 24-bit RGB, which is equal to 510 Mbytes/s. With Camera Link Full_64 interface the data rate is 680Mbytes/s and with Camera Link Full_80 interface the data rate is 850Mbytes/s.

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

Modularity of the allPIXA pro camera permits the use of various lenses such as C-mount, F-mount, M39x1/26", M42x1 and M72x0.75 connections. Additionally, the modular focus of LINOS / Qioptics is supported and the allPIXA pro camera can, therefore, be combined with all commercially available standard lenses.

2.1 Camera highlights

- Trilinear color line scan camera (trilinear CCD line scan sensor)
- 10 μ m pixel size
- High accuracy sensor alignment
- 24/30 bit (3 x 8/10 Bit) color information or 1 x 8/10/12 Bit mono information on the output side
- RGB spatial compensation in the camera (also sub-pixel correction, patented)
- 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
- Internal 14 bit A/D conversion per color channel
- Shading correction, fully automatic calculation internally in the camera or optionally calculated offline with CST
- Gamma correction, brightness and contrast controller, separate for each channel
- Multiple Color conversion matrix (CCM) and offset supported

- Internal keystone correction for multiple angle positioning of the camera
- Precise multi-camera synchronization
- Automatic insertion of machine and camera data inside the image (for example scanning speed, CRC, time stamp, Encoder position,..)
- Fully synchronized multi-channel LED flash control
- Robust metal housing
- Adjustable Camera Link clock
- Mono image output at individual color weights
- C-mount, F-mount, M39x1/26", M42x1, M72x0.75, modular focus (Qioptics / Germany)
- Other mounts and customized solutions on request
- Internal test image generator
- Option for area scanning with frame trigger inputs (light barriers)

2.2 Camera speed for available Camera Link modes and frequency

The allPIXA pro maximum line frequency depends on the selected Camera Link type and frequency. For information about different configurations, see the tables below.

allPIXA pro 4k (4096 pixel)

CL-Definition	Base Mode	Medium mode	Full64 mode	Full80_8Tap_10Bit	Full80_10Tap_8Bit	Mono output 2XE*	Mono output 1X3*
85.00 MHz	20,6 kHz	41,1 kHz	50,8 kHz	50,8 kHz	50,8 kHz	41,1 kHz	50,8 kHz
75.56 MHz	18,3 kHz	36,3 kHz	48,6 kHz	48,6 kHz	50,8 kHz	36,6 kHz	50,8 kHz
61.82 MHz	15,0 kHz	29,8 kHz	39,8 kHz	39,8 kHz	49,6 kHz	29,8 kHz	44,4 kHz

*) mono output in Camera Link Base mode (at 8; 10 or 12 Bits per Pixel)

allPIXA pro 5k (5120 pixel)

CL-Definition	Base Mode	Medium mode	Full64 mode	Full80_8Tap_10Bit	Full80_10Tap_8Bit	Mono output 2XE*	Mono output 1X3*
85.00 MHz	16,5 kHz	32,8 kHz	40,8 kHz	40,8 kHz	40,8 kHz	32,8 kHz	40,8 kHz
75.56 MHz	14,6 kHz	29,2 kHz	38,8 kHz	38,8 kHz	40,8 kHz	29,2 kHz	40,8 kHz
61.82 MHz	12,0 kHz	23,9 kHz	31,7 kHz	31,7 kHz	39,5 kHz	23,9 kHz	35,6 kHz

*) mono output in Camera Link Base mode (at 8; 10 or 12 Bits per Pixel)

allPIXA pro 6000px (6000 pixel)

CL-Definition	Base Mode	Medium mode	Full64 mode	Full80_8Tap_10Bit	Full80_10Tap_8Bit	Mono output 2XE*	Mono output 1X3*
85.00 MHz	14,1 kHz	28,1 kHz	34,3 kHz	34,3 kHz	34,3 kHz	28,1 kHz	34,3 kHz
75.56 MHz	12,5 kHz	25,0 kHz	33,3 kHz	33,3 kHz	34,3 kHz	25,0 kHz	34,3 kHz
61.82 MHz	10,2 kHz	20,5 kHz	27,2 kHz	27,2 kHz	34,0 kHz	20,5 kHz	30,5 kHz

*) mono output in Camera Link Base mode (at 8; 10 or 12 Bits per Pixel)

allPIXA pro 7.3k (7300 pixel)

CL- Definition	Base Mode	Medium mode	Full64 mode	Full80_ 8Tap_10Bit	Full80_ 10Tap_8Bit	Mono output 2XE*	Mono output 1X3**
85.00 MHz	11,6 kHz	23,1 kHz	29,7 kHz	29,7 kHz	29,7 kHz	23,1 kHz	29,7 kHz
75.56 MHz	10,3 kHz	20,6 kHz	27,3 kHz	27,3 kHz	29,7 kHz	20,6 kHz	29,7 kHz
61.82 MHz	8,4 kHz	16,8 kHz	22,4 kHz	22,4 kHz	27,9 kHz	16,8 kHz	25,13 kHz

*) mono output in 2XE Camera Link Base mode (at 8; 10 or 12 Bits per Pixel)

**) mono output in 1X3 Camera Link Base mode (at 8Bits per Pixel only)

2.3 Technical specification

Sensor	Trilinear CCD color line sensor
Pixel size	10 µm x 10 µm (10 µm pitch)
Line spacing	40 µm between R-G and G-B (4 Lines center to center)
Maximum pixel rate	226 megapixels/s 24 / 30Bit RGB
Maximum data rate on the Camera Link	Base: 255 Mbytes/s Medium: 510 Mbytes/s Full_64: 680 Mbytes/s Full_80: 850 Mbytes/s
Resolution	1,024 (Only OEM) / 4,096 / 5120 / 6000 / 7,300 px Other sensor resolutions are available on request
Maximum line frequency (Preliminary)	1.024 pixels: 156 kHz (only in special OEM configurations) 2.048 pixels: 90,7 kHz 4.096 pixels: 50.82 kHz 5.120 pixels: 40.8 kHz 6.000 pixels: 34.32 kHz 7.300 pixels: 29.72 kHz
Spectral sensitivity	360 nm to 960 nm
Video signal	3x8 or 3*10 bit on the Camera Link, 3x14 bit ADC
Interface	Camera Link with up to 85 MHz
Line scan operating mode	Free-run / external trigger (incremental encoder / line trigger)
Area scan operating mode	Image size either free-running, fixed, or based on trigger pulse width
Other interfaces	Power supply (6 pin Hirose, male) External IO (15 pin D-Sub, female) Serial RS-232 (9 pin D-Sub, female)
Camera mount	C-mount, F-mount, M39x1/26“, M42x1, M72x0.75, modular focus (LINOS / Qioptics), lens adapter and extension tubes
Certifications	CE, FCC compliant, RoHS

Power supply	24 VDC +/- 10 %; <19 W
Operating temperature	0°C to 60°C; 32°F to 140°F (housing temp.)
Housing dimensions	L = 102 mm, H = 100 mm, D = 77 mm
Weight	1.0 kg

NOTE Depending on the power supply, the power consumption might be up to 1 ampere at power-up for a short time. It is recommended to provide a power supply with 24VDC/1amp or with higher possible power consumption.

2.4 Mechanical specification

2.4.1 Mechanical dimensions of the allPIXA pro camera with up to 4.096 pixels

The following dimensions apply to the allPIXA pro camera with up to 4.096 pixels:

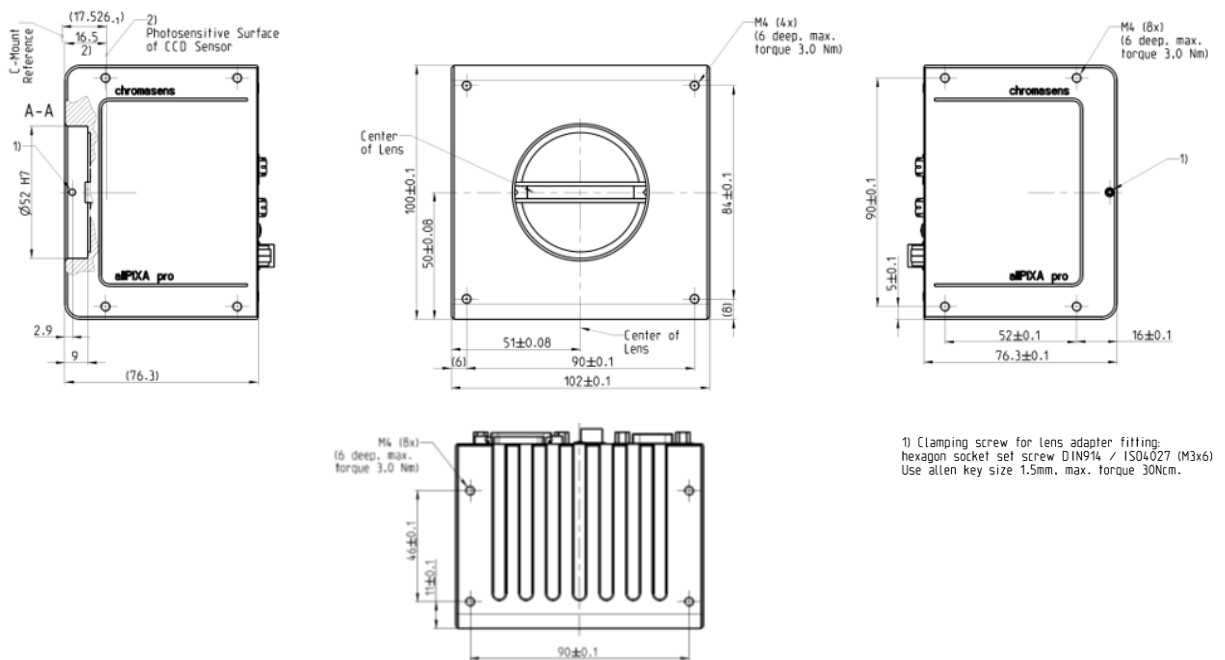


Figure 2: Mechanical dimensions of the allPIXA pro camera with up to 4.096 pixels

NOTE I Drawings and 3D-CAD-models are available on our homepage <https://www.chromasens.de/> in the download section related to the product

NOTE II The shown position of the CCD surface is given as resulting optical value including lengthening of the sensor glass. For pure mechanical calculation 0.24 mm has to be subtracted.

NOTE III For information about XYZ coordinate system and sensor alignment, see section 2.5.

2.4.2 Mechanical dimensions of the 5.120 pixel, 6.000 pixel and 7.300 pixel allPIXA pro camera

The following dimensions apply to the allPIXA pro camera with 5.120, 6.000 and 7.300 pixels:

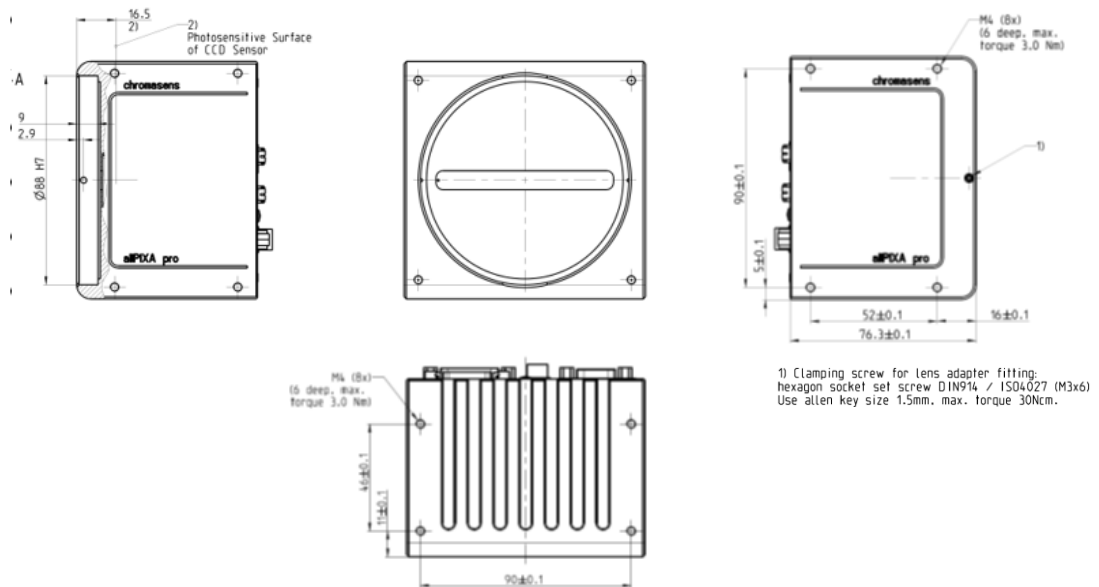


Figure 3: Mechanical dimensions of the allPIXA pro camera with 6.000 and 7.300 pixels

NOTE I	Drawings and 3D-CAD-models are available on our homepage https://www.chromasens.de/ in the download section related to the product
NOTE II	The shown position of the CCD surface is given as resulting optical value including lengthening of the sensor glass. For pure mechanical calculation 0.24 mm must be subtracted.
NOTE III	For information about the XYZ coordinate system and sensor alignment, see section 2.5.

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 2.4.

First pixel of sensor lines:

Left side

Color lines orientation:

Blue: top
Green: center
Red: bottom

Sensor alignment:

Position:

X: < +/- 100 μ m
 Y: < +/- 100 μ m
 Z: < +/- 100 μ m

Rotation about:

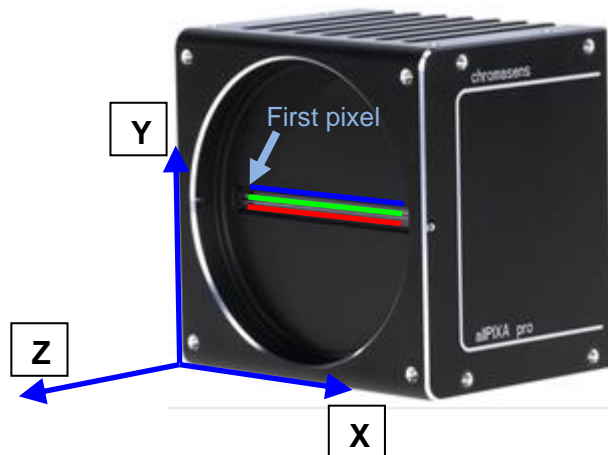
Y: < +/- 0.1 $^{\circ}$
 Z: < +/- 0.1 $^{\circ}$

Planarity of sensor surface:

< +/- 0.50 μ m

Sensor window:

Thickness: 0.7 mm
 Refraction index 1.5
 Optical path extension: 0.24 mm



Sensor alignment is an important issue for:

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

2.6 Adapter and accessories

2.6.1 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.

You can find the complete list of all accessories including descriptions and detailed drawings on our website at <https://www.chromasens.de/>.

2.6.3 Accessories for 4k camera S-Series

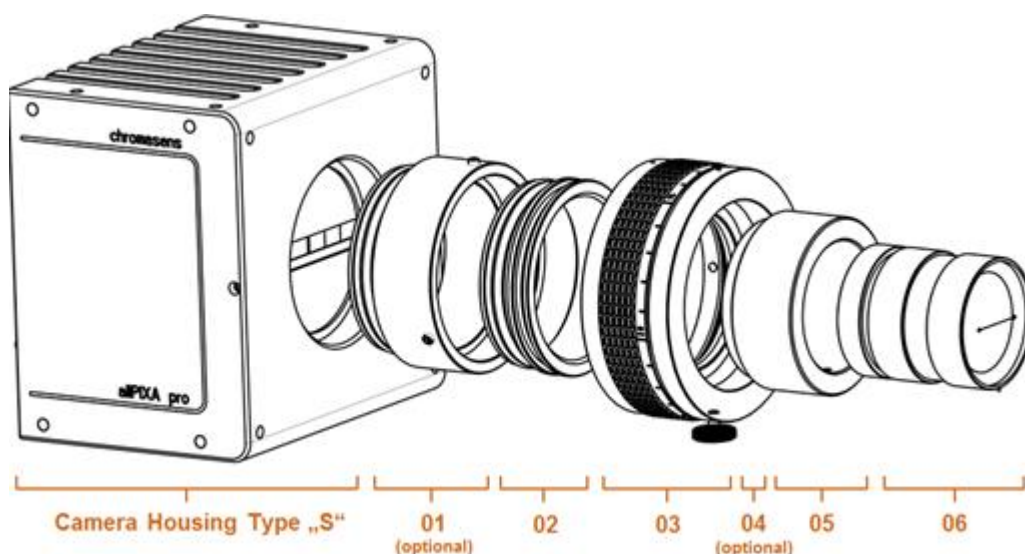


Figure 4: configuration scheme (housing type S)

Description	ID & Code
allPIXA pro - 4k	CP000476-4096-S
allPIXA pro - 4k with F-Mount	CP000482-0002

allPIXA pro camera Tubes 4k	Identification No.	Pos.
allPIXA camera-Tube-4k 20 mm	CP000389	01
allPIXA camera-Tube-4k 40 mm	CP000390	01
allPIXA camera-Tube-4k 60 mm	CP000391	01
allPIXA camera-Tube-4k 80 mm	CP000392	01
allPIXA camera-Tube-4k 100 mm	CP000393	01

allPIXA pro camera 4k direct mount Adapters	Identification No.	Pos.
allPIXA camera F-Mount Adapter	CP000385	02
allPIXA camera C-Mount-Adapter	CP000387	02
allPIXA camera 4K-Adapter M42x1-A45,46	CP000434	02
allPIXA camera Adapter-MF (to Modular Focus)	CP000386	02
allPIXA camera Adapter-M42x0,75 (to Schneider Unifoc 58 (T2))	CP000461	02
allPIXA camera Adapter-V-Mount (to Schneider Unifoc 12 (V-Mount))	CP000462	02

allPIXA pro camera 4k additional parts	Identification No.	Pos.
Additional parts (custom specific)	only on request	03 - 06

The complete list of all accessories including descriptions and detailed drawings you can find on our website <https://www.chromasens.de/>.

2.6.4 Accessories for 5k, 6.000px and 7.3k camera W-Series

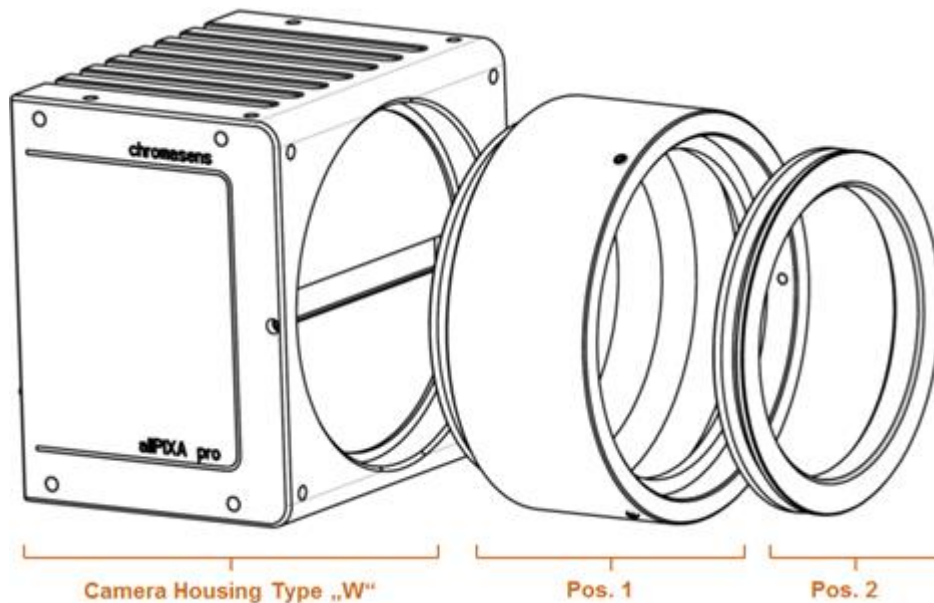


Figure 5: configuration scheme (housing type W)

allPIXA pro camera	Identification No.	Pos.
allPIXA pro – 5.120px	CP000476-5120-W	
allPIXA pro – 6.000px	CP000476-6000-W	
allPIXA pro - 7.3k	CP000476-7300-W	

allPIXA camera Tubes 7.3k	Identification No.	Pos.
allPIXA camera-Tubus-7.3k 20 mm	CP000423	01
allPIXA camera-Tubus-7.3k 40 mm	CP000424	01
allPIXA camera-Tubus-7.3k 60 mm	CP000425	01
allPIXA camera-Tubus-7.3k 80 mm	CP000426	01
allPIXA camera-Tubus-7.3k 100 mm	CP000427	01

allPIXA camera 7.3k mount Adapters	Identification No.	Pos.
Adapter - Modular Focus	CP000428	02
Adapter M72x0,75-RF	CP000457	02
allPIXA camera Adapter-M58x0,75 (to Schneider Unifoc 76)	CP000463	02

You find the complete list of all accessories including descriptions and detailed drawings on our website <https://www.chromasens.de/>.

NOTE For Modular Focus (CP000418) an adapter to the allPIXA pro camera system (CP000386 or CP000428) is necessary.

2.6.5 Mounting of the extension tube systems

The extension tubes are used to extend the image distance between the allPIXA pro camera (lens reference area) and the lens adapter. Individual extension tubes are available in 20 mm stages and can be interconnected.



Figure 6: allPIXA pro camera 7.3k with extension tubes

If it is necessary to adjust the image distance using extension tubes. They have to be combined and connected with grub screws (Allen key size 1.5 mm, maximum torque 30 Ncm).

In addition, it is necessary to secure the lens and the lens adapter plate with grub screws to the extension tubes.



Figure 7: Securing the extension tubes with grub screws



Figure 8: Mounting the lens adapter plate

2.6.6 Mounting of a lens adapter ring

The lens adapter ring is mounted in the lens adapter fit of the camera body (**Figure 9**).



Figure 9: Mounting the lens adapter ring in the fit of the camera body

The lens adapter ring is secured by grub screws (Allen key size 1.5 mm, max. torque 30 Ncm).



Figure 10: Securing the lens adapter ring to the camera

2.7 Environmental requirements

	Value
Temperature for camera operation	For information about the allowed housing temperature, see section 2.3
Air humidity during camera operation	20% - 85% relative air humidity, non-condensing
Storage / transport temperature	-20 °C - +85 °C; -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 a metal frame) to decrease temperature and for improved camera performance. For more information, see section 5.3

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 pro camera device is only permitted if it is in a faultless and safe condition. In the event of any fault or defect, the allPIXA pro camera, the machine or the system in which the allPIXA pro camera is installed, must be stopped immediately and the responsible person must be informed.
- Modifications and extensions to the allPIXA pro 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 pro camera.
- Compliance with the ambient conditions described in this manual is essential.

3.3 Safety instructions on the allPIXA pro camera



Risks from hot surfaces

The body of the allPIXA pro 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 pro camera runs with electric power. Before any work is carried out on the allPIXA pro 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 pro camera contains components and units which are sensitive to electrostatic charge.

Observe all precautionary measures for handling electrostatic sensitive equipment.

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

3.4 Purpose / applications

- The allPIXA pro 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 pro camera has been installed is responsible for compliance with relevant safety regulations, standards and directives. Commissioning of the allPIXA pro camera is only permitted if the machine or system, in which the allPIXA pro camera is installed, complies with the safety regulations and standards of the country in which the allPIXA pro camera runs.
- The owner of the machine or system with the installed allPIXA pro camera must verify the suitability of allPIXA pro camera for its intended use.
- Safety regulations of the country in which the device is used must be complied with it.
- The allPIXA pro camera may only be connected or used as described in this manual.
- The allPIXA pro 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 pro 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 pro camera. Such persons are qualified to work with the allPIXA pro 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 pro 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 pro camera is installed.
- The allPIXA pro camera and all connected peripherals must be checked regularly for visible external damages.

3.7 Safety instructions for maintenance / cleaning

- Before carrying out any service or maintenance work, the responsible staff must be informed.
- Deadlines and intervals for regular inspections must be complied with.
- Before starting maintenance, the allPIXA pro 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 pro camera.
- Necessary repairs may only be carried out by the 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 pro 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



Body of the allPIXA pro 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, please 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.

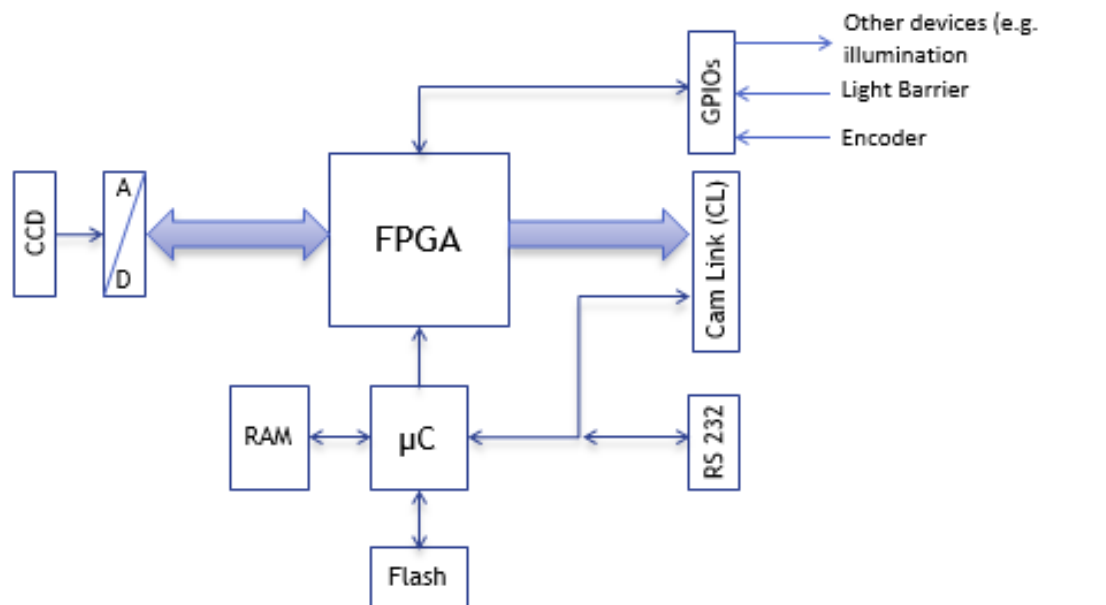
4 allPIXA pro – basic functionality

4.1 Basic design of the allPIXA pro camera

During operation an object is scanned by the CCD sensor. The analog signal is then transformed to a digital signal by the AD converter. The microcontroller with its RAM and flash memory supports the FPGA during image data processing to output the images through the Camera Link connector.

The allPIXA pro camera can be configured with CST via the Camera Link interface (CL-Ser.) or the RS 232 interface.

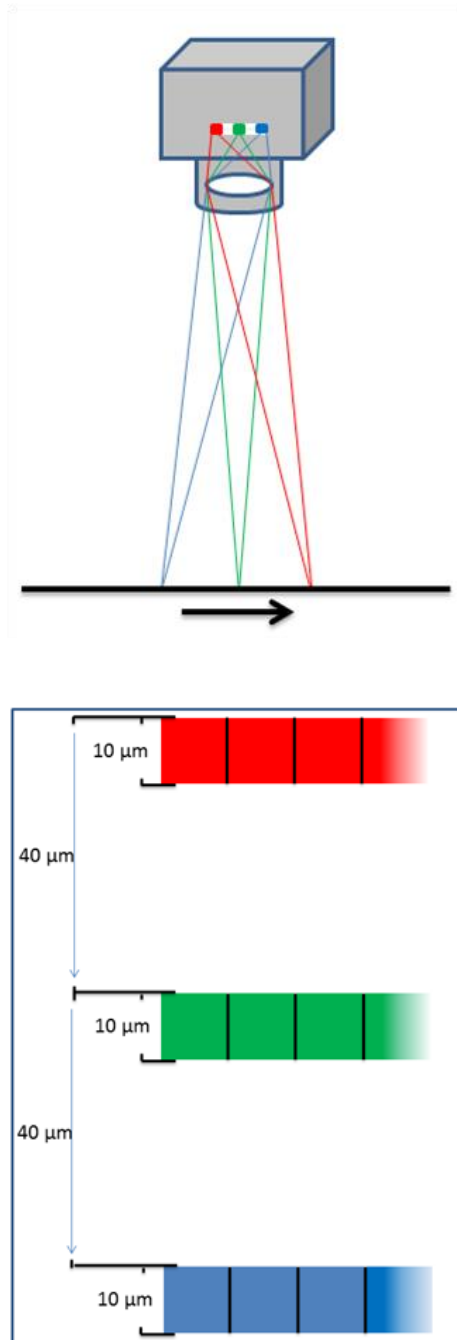
Signals from incremental encoders or light barriers can also be input by the GPIOs (general purpose inputs/outputs).



CCD	CCD sensor	Cam Link (CL)	camera connection
A/D	analog / digital converter	RS 232	serial interface
FPGA	integrated circuit for programmable logic circuits	GP IOs	multi-purpose inputs/outputs
µC	microcontroller		
RAM	random access memory; information is lost if power is removed		
Flash	memory for the program and reference data		

Figure 11: Basic design of the allPIXA pro camera (block diagram)

4.2 Design of the allPIXA pro camera line scan sensor



The allPIXA pro camera color line scan camera is equipped with a trilinear CCD line scan sensor with 3 spatially separated lines which are sensitive to 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 pro 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 8 bit for each image point.

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

Sensor pixels are 10 μm wide and 10 μm long. The distance between the color sensor lines is 40 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 12: allPIXA pro camera line scan sensor

4.3 The allPIXA pro camera line scan sensor readout principle

The odd and even pixels of each line are moved to the respective readout register. Therefore, the allPIXA pro camera simultaneously processes 3x2x2 channels - 3 colors, 2 taps and both (odd and even pixels).

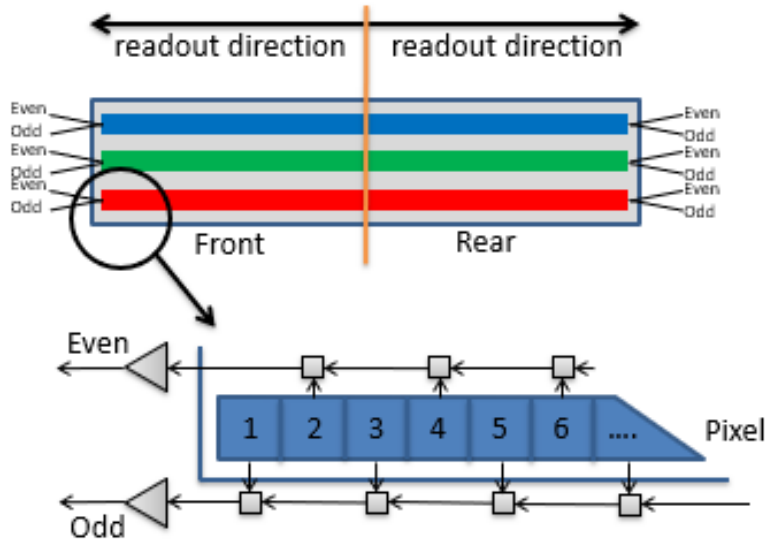


Figure 13: The allPIXA pro camera line scan sensor readout principle

4.4 Spectral sensitivity of the allPIXA pro camera line scan sensor

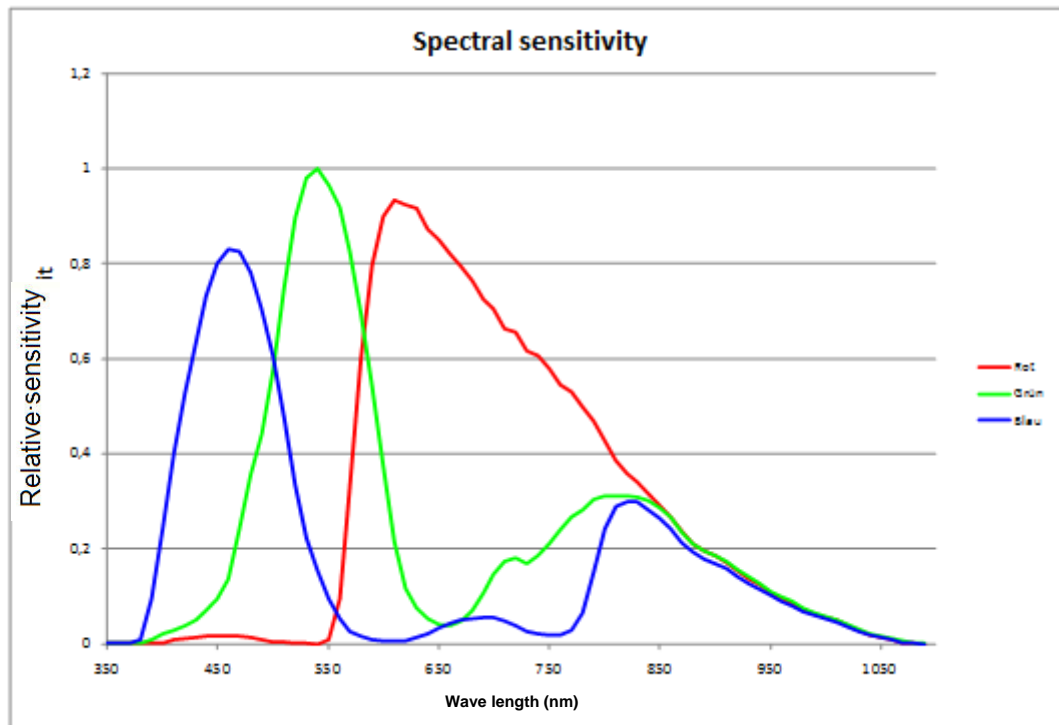


Figure 14: Spectral sensitivity of the line scan sensor

4.5 Image processing

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

4.5.1 Analog / digital image processing

The power block provides all required voltages which are available for the camera electronic components from the supplied 24 V DC.

The image is acquired by the CCD sensor and initially processed in analog mode, followed by an analog/digital converter. The digital image processing is performed in the FPGA.

The image data generated by the allPIXA pro camera are converted in the video interface to the Camera Link standard and then sent to the frame grabber.

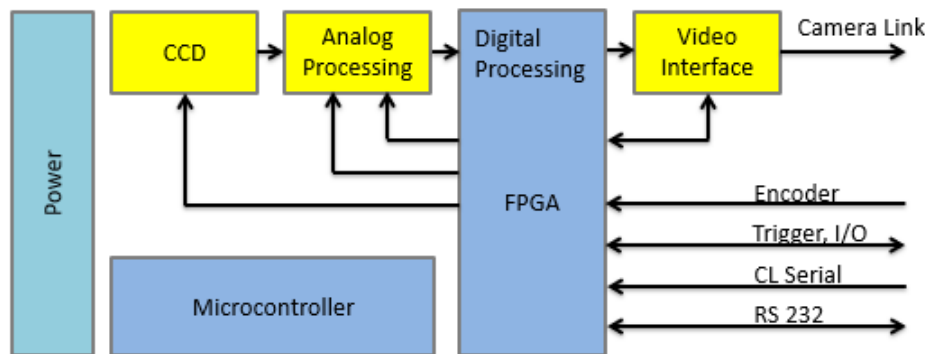


Figure 15: Process of the allPIXA pro camera image processing (block diagram)

The CCD sensor is read out by use of a shift register. The CDS (correlated double-sampling) process filters (extracts) the intended signal information from the received signals. After that process, the global amplification (gain) and offset values (black-level offset) are adjusted. In the last step, the analog information is converted to digital 14 bit values to forward these to the digital processing unit.

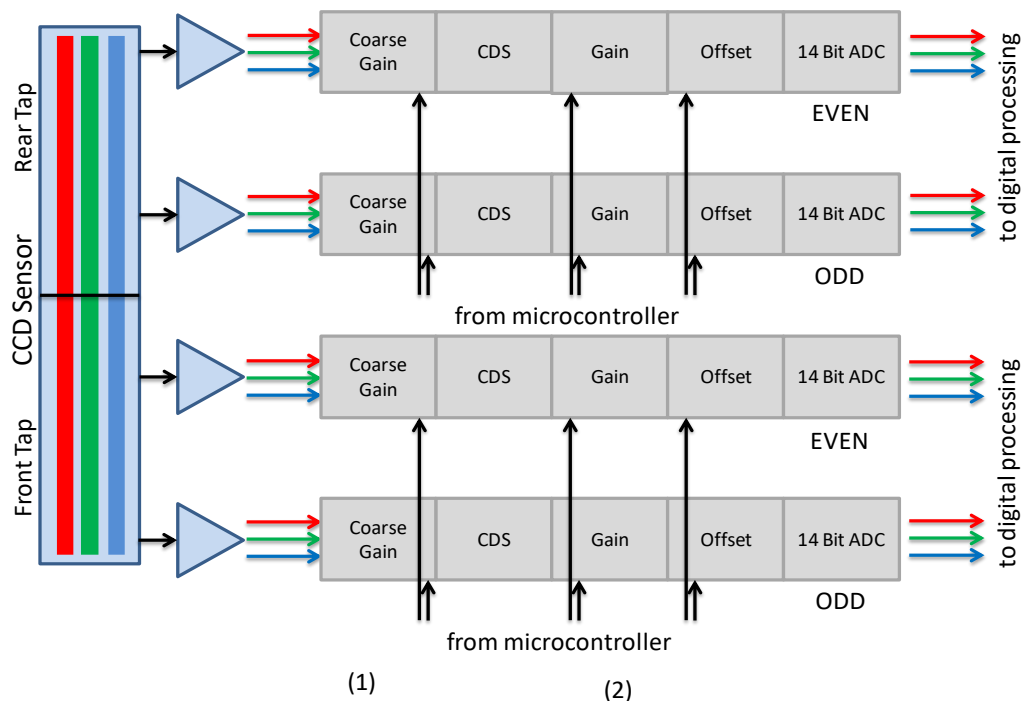


Figure 16: Analog process of the allPIXA pro camera (block diagram)

The signals are transferred from the analog-digital converter and run through a multiplexer that switches between the test image generator and the input signals as shown in **Figure 17**.

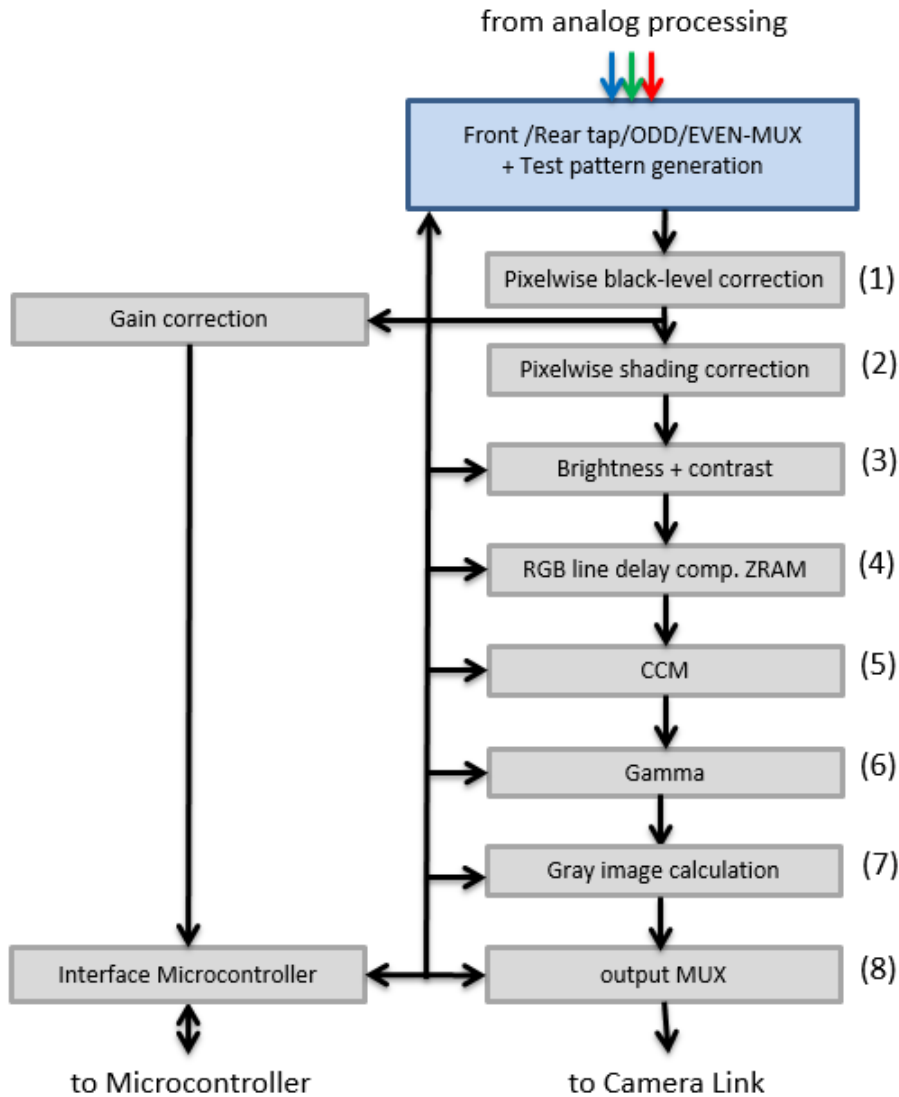


Figure 17: Digital process of the allPIXA pro camera (block diagram)

First, the pixel-by-pixel black-level correction (1) and shading correction (2) is 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 the 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 Camera Link connection (8).

4.5.2 Supported Camera Link modes

allPIXA pro - color camera with color output:

CL-Base 1Tx24b (1X1)

CL-Medium 2Tx24b (2XE)

CL-Medium 2Tx24b (1X2) Default

CL-Full64 8Tx8b (1X8 raw, RGB with 8 color planes per camera link clock)

CL-Full80 8Tx10b (1X8 raw, RGB with 8 color planes per camera link clock)

CL-Full80 10Tx8b (1X10 raw, RGB with 10 color planes per camera link clock)

allPIXA pro - color camera with mono output:

CL-Base 2Tx8b (2XE)

CL-Base 2Tx10b (2XE)

CL-Base 2Tx12b (2XE)

CL-Base 3Tx8b (1X3)

For more information about the Camera Link interface specification, refer to the GenICam standard.

For minimum integration time for different camera types at different Camera Link modes and output pixel clocks, see section 9.11.4.

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

The allPIXA pro 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) is eliminated.
- Both operations are carried out separately for every line (red, green, blue).
- The allPIXA pro camera offers four data sets for black-level correction and four data sets for shading correction. Therefore, you could deal with, for example, four different lighting systems by selecting the necessary data sets without transferring or generating new shading data.
- Calculation of the correction data sets can be performed 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 pro provides offline calculation of the references. You can select a scanned image and define a region of the image, in which shading correction data should be calculated. By averaging over a higher number of lines, distortions, for example by dust on the target, are eliminated. Therefore, it is possible to use an image with a moving white object.
- The allPIXA pro 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:

$$BRef(x) = VidRaw \text{ with black template or without illumination}$$

Mode Recording of white reference line:

$$WRef(x) = VidRaw(x) - BRef(x) \text{ with white template}$$

Mode / Correction (white and black correction is activated)

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

WRef(x)

This calculation is performed separately for all color separations (RGB).

- BRef Black-Reference value for each pixel in the line
- WRef White-Reference value for each pixel in the line
- 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

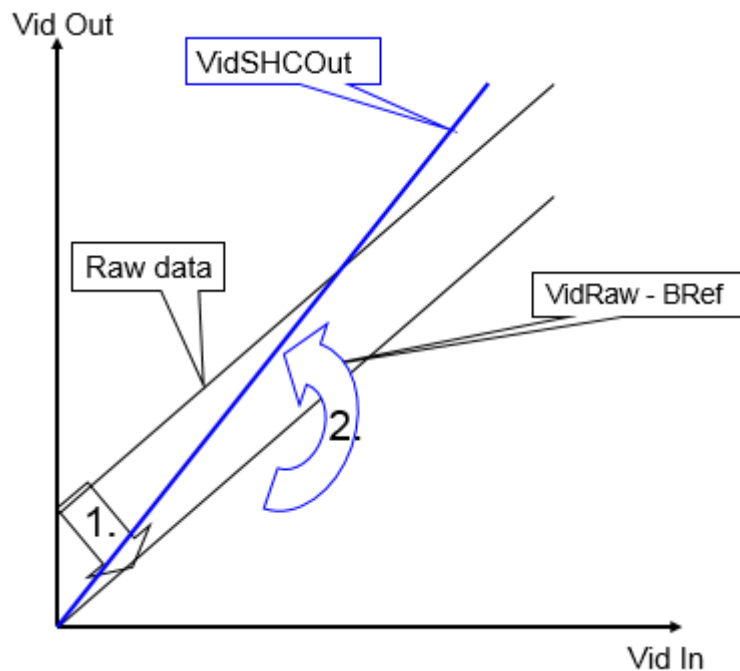


Figure 18: Offset and shading correction

- 1.: Black-level correction
- 2.: Shading (flat-field) correction

4.7 Feature: Image mode (frame scan mode)

The allPIXA pro camera is able to emulate a frame scan camera. Output data are in real frames and the VSync signal (or FVAL = frame valid signal) is generated. Therefore, the information about frame start and image size must be supplied to the camera.

The frame trigger signal can be supplied with the frame grabber either by CC-Bits CC2, CC3, CC4 or with a hardware signal by an IO port. The external signals must be configured by the IO Configurator via CST.

Image height (= number of lines) can be controlled by a fixed value or an external signal depending on the object size. For a more detailed description, see sections 9.8 and 9.9.

4.8 Monochrome image acquisition

Additionally, the color allPIXA pro camera permits to provide monochrome images which are generated internally from the color information. The weightage of the color channels during generation of a monochrome image can be set individually.

Due to the reduced data transmission rate of the mono image, the camera uses Camera Link Base mode for the transmission. Output modes of 8 /10/ 12 bit are available for monochrome image data. (See section 9.11.1)

4.9 White balancing with a closed-loop control

To keep the video values stable on a white reference target, the allPIXA pro 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 is 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 pro camera enables you 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.

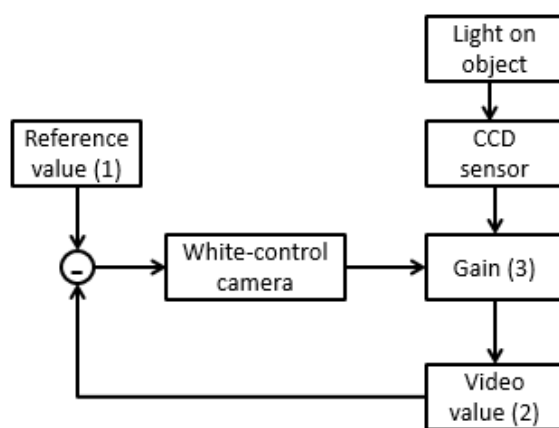


Figure 19: Closed-loop control for white balancing

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 the warming up or the aging of the light source.

4.10 Setting concept

Furthermore, the allPIXA pro camera offers a comprehensive setting concept:

Up to 18 different settings can be stored 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, 18 settings are available.
- Setting 19 is write-protected; the factory default setting is stored in setting 19 and can be copied to other settings.
- The camera always starts up with setting 1.

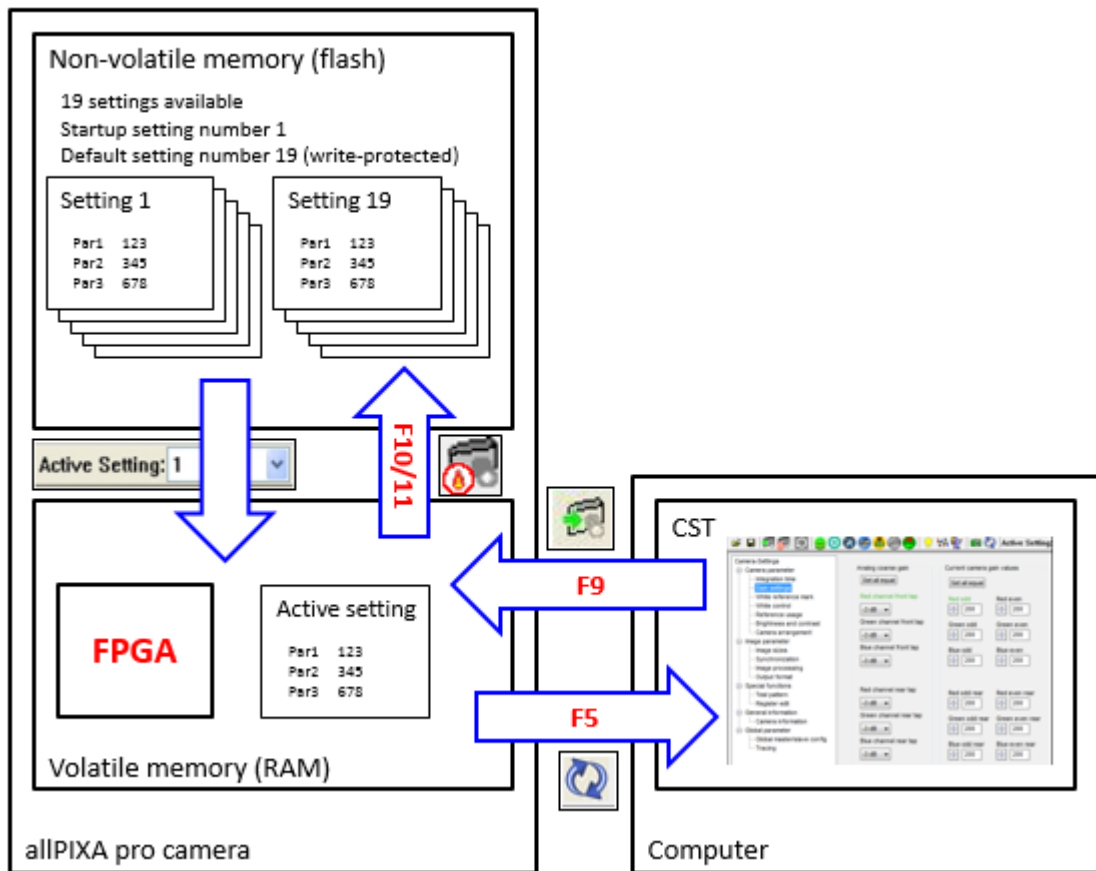


Figure 20: Setting concept

4.10.1 Restore factory default

The originally delivered camera setting can be restored by loading setting 19 and saving it into the working setting (for example setting 1).

For more information, how to save settings to different setting position, see section 6.9.

4.11 Chromasens API - communication

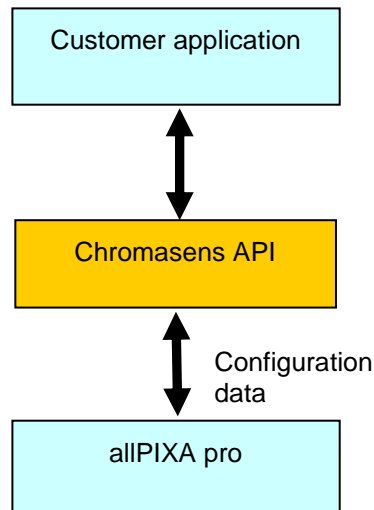


Figure 21: Chromasens API

The Chromasens API supports a set of functions to easily communicate with the allPIXA pro camera.

With these functions, connection to the camera can be established via Camera Link or serial RS232 connection.

Internal working parameters of the camera can be read and modified.

Convenience functions for calibration of the camera are provided.

Calibration of the camera can be performed to adapt to current illumination conditions.

Functions for low level communication are also implemented in the Chromasens API.

A detailed description, example code and the necessary DLLs for integration are provided in the CSAPI package, which can be downloaded from the allPIXA pro download area on our website.

5 Installing the allPIXA pro camera

5.1 Interface and status LED

On the back side of the camera you find the following interfaces:

- Two Camera Link ports (port 1 and 2) for image signaling and for communication between the allPIXA pro camera and the PC
- A digital port (IO interface D-Sub 15 female) for the incremental encoder signal, light barriers and other freely programmable inputs and outputs
- A serial port (serial RS 232 D-Sub 9 female, Config UART) for additional communication for example configuration signals) between the allPIXA pro camera and the PC
- A power connection (Hirose HR10A-7R-6P, male) for power supply
- A multi-color LED for indicating the allPIXA pro camera status

NOTE If you use a USB to Serial converter for the connection via RS232, it is recommended to use a converter with FTDI Chipset (Prolifex chipsets may generate problems if they are connected to the camera).

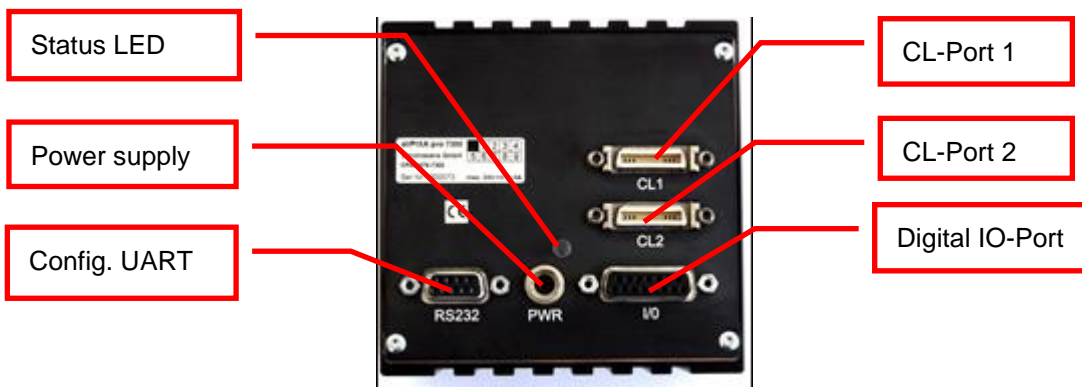



Figure 22: The allPIXA pro camera connections and status LED

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 the input voltage and currents, see section 2.3.

5.1.2 Config UART (serial RS 232)

Serial connection to the PC can be established by use of a 9-pin D-Sub connector (male) via the interface of serial RS 232 (V24).

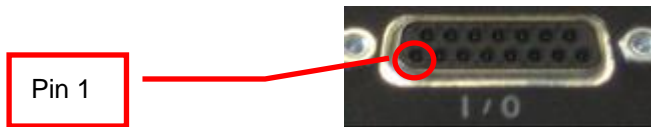
Pin no.	Description
1	Not connected
2	Transmit data
3	Receive data
4	Used for internal function, do not connect
5	Ground
6	Not connected
7	Hardware Reset Input. Should be left open if unused
8	Not connected
9	Not connected



5.1.3 Digital IO port

You need a 15-pin D-Sub connector (male) to establish a connection to the digital I/O interface (x5) of the allPIXA pro camera.

Pin no.	Level	Description	Default function
1	RS 422	GPIO_P0 (input)	Incremental encoder (high)
2	RS 422	GPIO_P1 (input)	Light barrier (high)
3	LVC MOS	GPIO_5 (BiDir, PullUp)	Can be used for light barriers or nSelMaster (Bridge to 0 V) Only pin 3: V_{in} 5,0 V max.
4	LVC MOS	GPIO_6 (BiDir, PullDown)	Selectable with IO-Config
5	3.3 V over 100 Ohm	Power	Output
6	LVC MOS	GPIO_8 (BiDir, PullDown)	Master/Slave-interface
7	0 V	Ground	-
8	LVC MOS	GPIO_10 (BiDir, PullDown)	Master/Slave-interface
9	RS 422	GPIO_N0 (input)	Incremental encoder (low)
10	RS 422	GPIO_N1 (input)	Light barrier (low)
11	0 V	Ground	-
12	LVC MOS	GPIO_7 (BiDir, PullDown)	Selectable with IO-Config
13	0 V	Ground	-
14	LVC MOS	GPIO_9 (BiDir, PullDown)	Selectable with IO-Config
15	5 V over 100 Ohm	Power supply	Output



NOTE 1	Power supply: With a 100 Ohm series resistor; RS422: RS422 standard LVCMOS: With 10 Ohm series resistor
NOTE 2	The logical functions of the IO pins can be modified in the application. The CST tool provides the IO Configurator which permits to adapt the assignment of logical functionality to the hardware pins of the connector.
NOTE 3	Although RS422 is a differential signal, a proper ground connection is required additionally between the source (for example encoder) and the drain (for example the camera)
NOTE 4	The allPIXA pro camera contains an internal termination for the RS422 signal lines. The advantage of the internal termination is that you do not have to take care about termination if the RS422 is used as an interface between two devices. On the other hand, it is not possible to connect two (or more) cameras to one sender. If connection of more than one camera to one RS422 source is required, additional hardware must be used. Alternatively, using the master/slave configuration might be an option.

5.1.4 LVCMOS and RS422 levels

	V_{IL}		V_{IH}		V_{OL}	V_{OH}
I/O standard	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! (Except pin 3 with max 5,0V) Use a level converter, if necessary (for example 74 LVC14). Non-compliance can result in irreparable damages to the allPIXA pro camera!
---------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

5.1.5 Video Camera Link port 1 and 2

Camera Link cables are available in different lengths varying from 1m to 10m. For connection to the allPIXA pro camera you need a 26-pin MDR mini-D ribbon (male) connector.

NOTICE	Take notice that for long cable lengths (more than 6 m) high-quality cables are recommended. Alternatively, you can reduce the Camera Link transmission speed using CST configuration (see section 9.11.3). The setup of frame grabber, cable and camera must be tested in advance to guarantee the required functionality.
---------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

5.1.6 Status LED

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

Color	Description
Green	Camera ready (FVAL inactive)
Red	Error (FVAL inactive)
Blue	allPIXA pro camera image output (FVAL active)

5.2 Mechanical installation

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

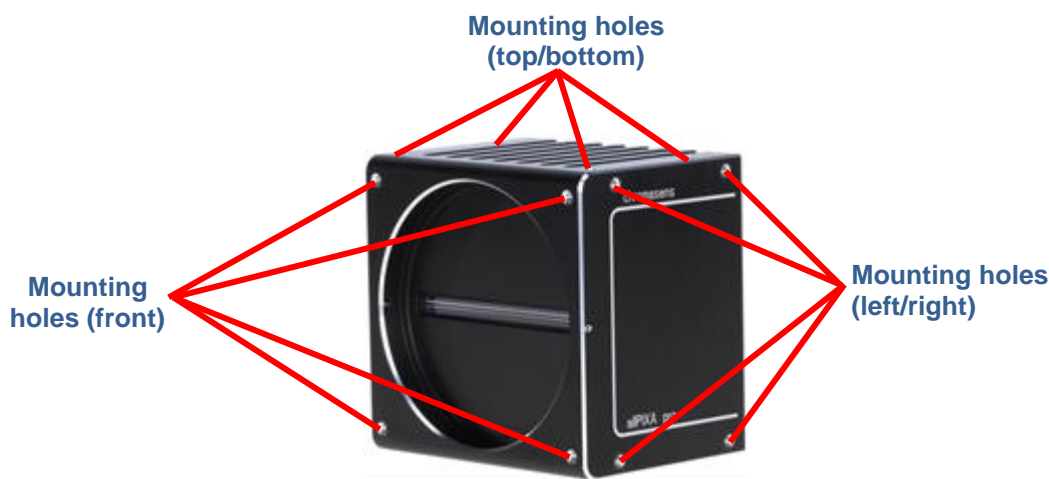


Figure 23: Mechanical connection points of the allPIXA pro camera

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

For information about the exact mechanical dimensions, see section 2.4.

5.3 Thermal links / cooling

The camera works within the defined temperature range (see sections 2.3 and 2.7). 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 pro camera.

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

Should there be any questions left, or should you be not sure how to adapt the allPIXA pro 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 or read out by use of CST is:

- Board temperature: 80°C
- Sensor temperature: 70°C

5.4 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.

5.4.1 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 24* you can see the optimum tracking of the conveyor belt, i.e. the conveyor belt runs completely straight. 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 24* 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. Consequence is that the image generated by the three color lines is not aligned, resulting in chromatic aberration which occurs laterally to the transport position.

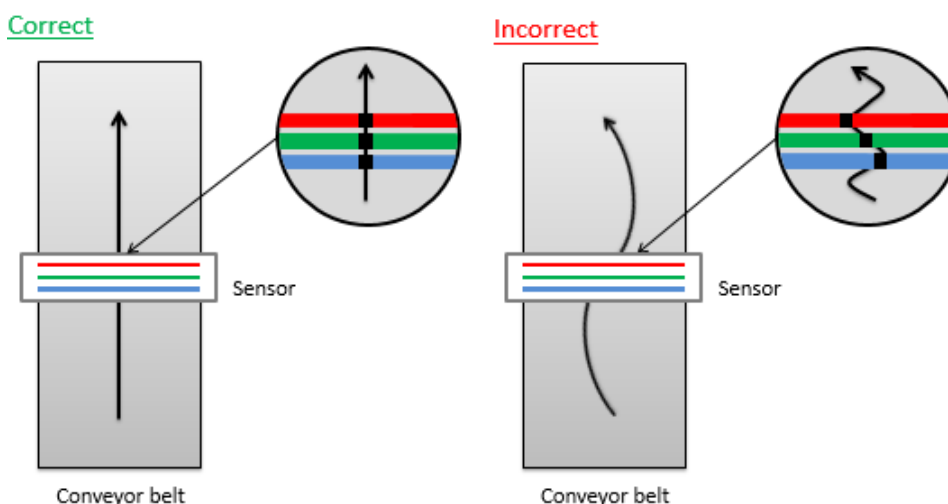


Figure 24: Optimum conveying belt tracking

5.4.2 Perpendicularity of the sensor to the direction of transport

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

In the left-hand section of *Figure 25* you can see the optimum alignment of the camera, i.e. it is aligned perpendicularly to the direction of transport. 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 25* you can see one situation in which the camera is not aligned perpendicularly to the transport position and then the same point on the object is imaged at different positions on the trilinear sensor. Consequence can be that the image generated by the 3 color lines is not aligned, resulting in chromatic aberration on the image.

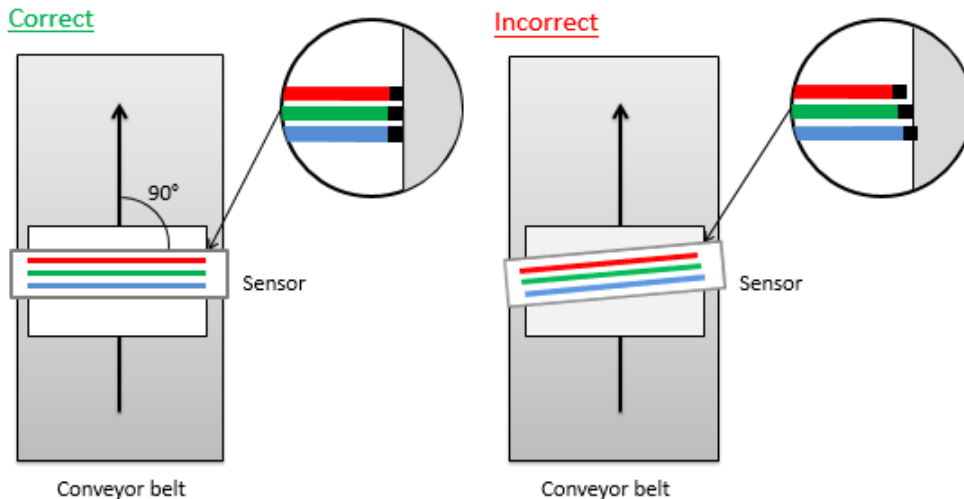


Figure 25: Rectangularity of the sensor to the object

5.4.3 Rotation around the longitudinal axis of the line scan sensor

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

The center section of *Figure 26* shows the optimum alignment of the camera, i.e. it is aligned parallel to the direction of transport.

If the allPIXA pro camera is installed in the rotated position around the longitudinal axis of the line scan sensor, chromatic aberration would occur in the image and the scale would change on the 3 color lines. Chromatic aberration increases symmetrically towards the outer edge.

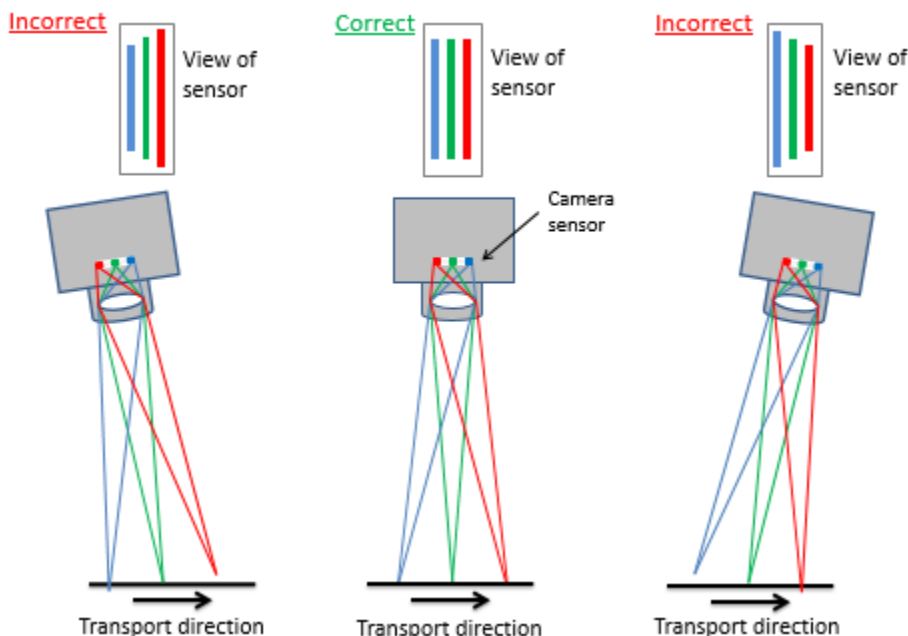


Figure 26: Rotation around the longitudinal axis of the line sensor

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

If it is not possible to place the camera in the best orientation, the allPIXA pro camera offers the **Keystone correction** function:

If you activate the **Keystone correction** function, the allPIXA pro camera can correct this error. For more information about keystone correction, see section 9.10.6 “Use keystone correction”.

5.4.4 Rotation around the transverse axis of the line sensor

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

In the center section of *Figure 27* you can see the optimum alignment of the camera, i.e. it is aligned parallel to the direction of transport.

If the allPIXA pro camera is installed in a rotated position around the transverse axis of the line scan sensor, result would be a chromatic aberration laterally to the direction of transport, and the size and color would change in relation to the angle.

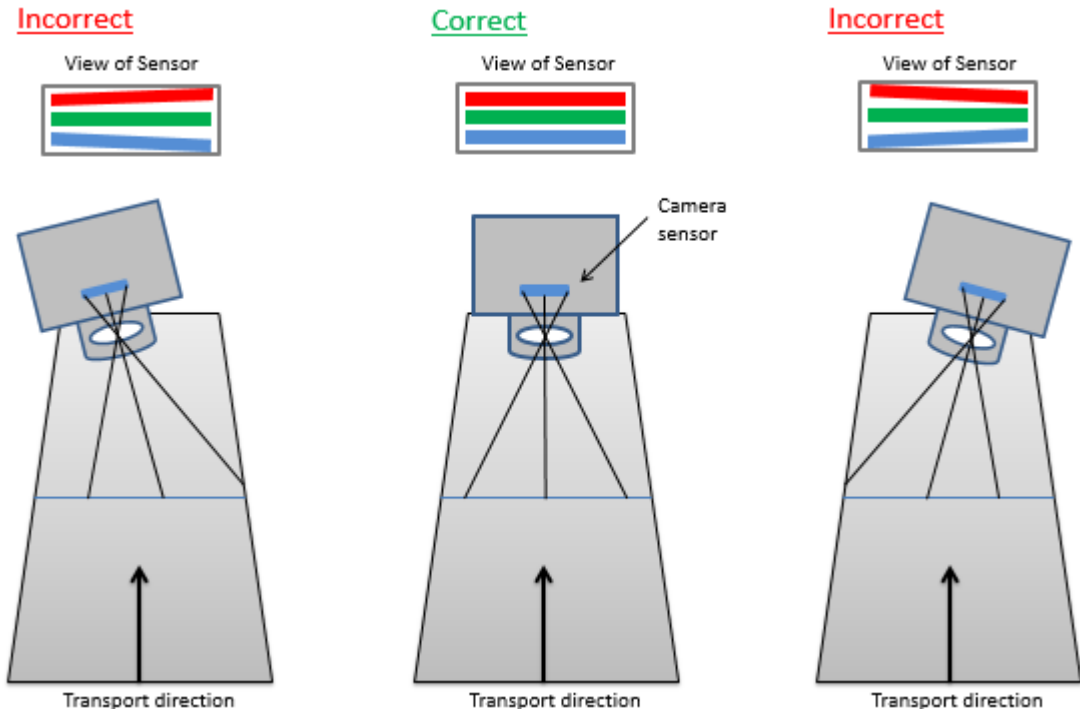


Figure 27: Rotation around the transverse axis of the line scan sensor

5.5 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 pro camera or to its connected components.

NOTICE

When the allPIXA pro 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. 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 might be necessary to establish contact between the housing and / or the outer shield of the Camera Link cable to the installation's electrical ground.

The mounting threads for the housing are not isolated; therefore, you may use any other kind of 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.

Power:	24 VDC +/-
	10 %;
	1A; typical
4.5 W	



Figure 28: Connecting the allPIXA pro camera to the power supply

5.6 Connecting the camera to the PC

The camera is connected to the PC by a Camera Link cable.

NOTE Camera Link cables are supplied ready for use in different lengths varying from 1 m to 10 m. You need a 26-pin MDR mini-D ribbon (male) connector for connection to the allPIXA camera.

Camera Link specification limits a max cable length of up to 6 m for a pixel clock of 85 MHz. The setup of camera, cable and frame grabber must be tested in advance.

1. Connect the Camera Link cable:

- Camera Link Port 1 or 1+2 of the allPIXA pro camera (Port 1+2 supports full data rate; take notice that only with port 1, the half data rate is supported).
- Frame grabber installed in the PC.

NOTE Take care to connect the first port of the camera with the first port of the frame grabber.

Changing might cause a switch between front and rear tap, some grabbers only offer the serial connection through the first port.

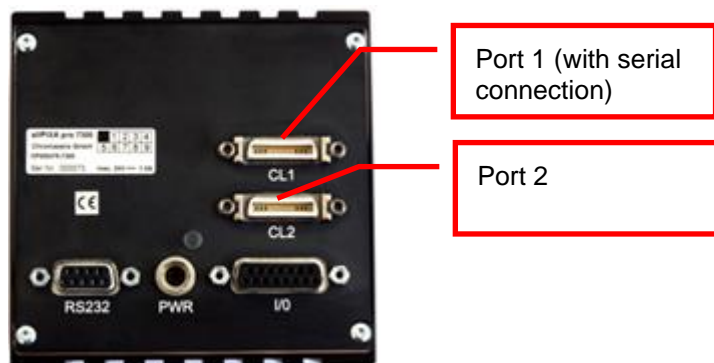


Figure 29: Connecting the allPIXA pro camera to the frame grabber

5.7 Update the firmware of the allPIXA pro camera

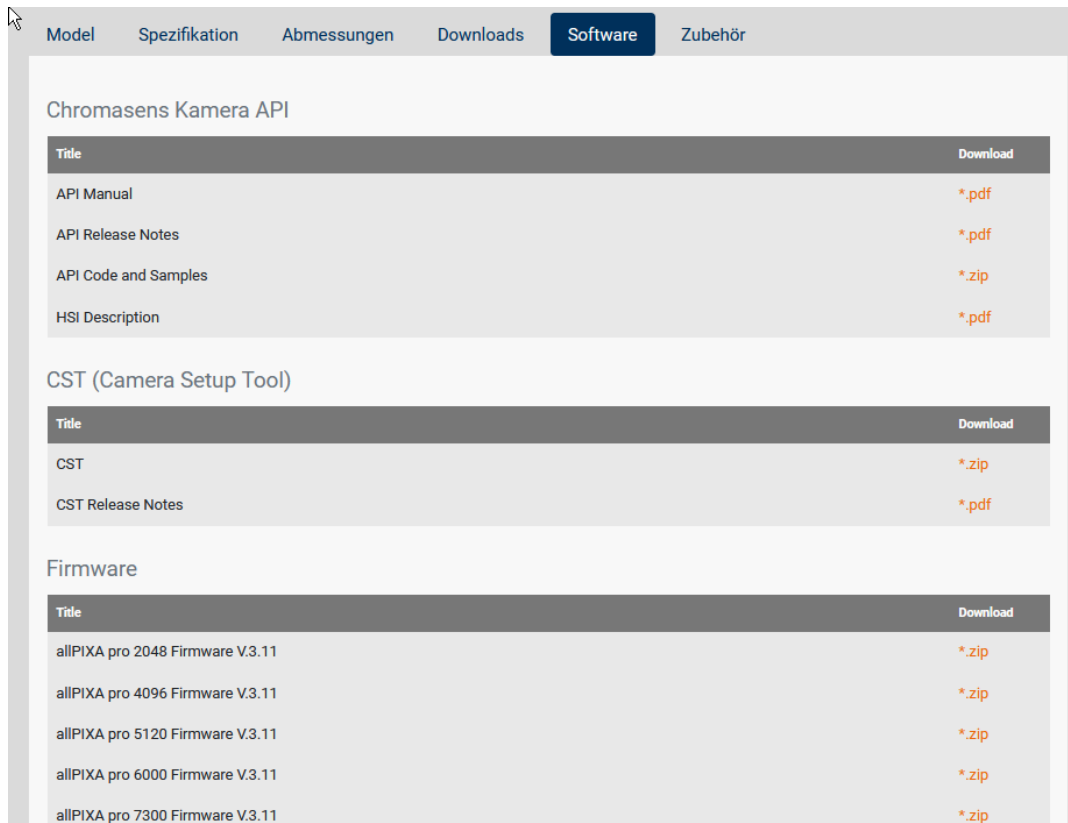


Never disconnect the power or the connection to the camera during the update procedure.

Perform the following steps to update the camera safely.

To update the firmware:

1. Go to the Chromasens website: <https://www.chromasens.de/>.
2. Click **Products** and click **Line Scan Cameras** in the product list.
3. Click **allPIXA pro**.
4. Click **Software** and choose the correct package for your camera type



The screenshot shows the 'Software' tab selected in a navigation menu. Below the menu, there are three sections: 'Chromasens Kamera API', 'CST (Camera Setup Tool)', and 'Firmware'. Each section contains a table with 'Title' and 'Download' columns.

Chromasens Kamera API	
Title	Download
API Manual	*.pdf
API Release Notes	*.pdf
API Code and Samples	*.zip
HSI Description	*.pdf

CST (Camera Setup Tool)	
Title	Download
CST	*.zip
CST Release Notes	*.pdf

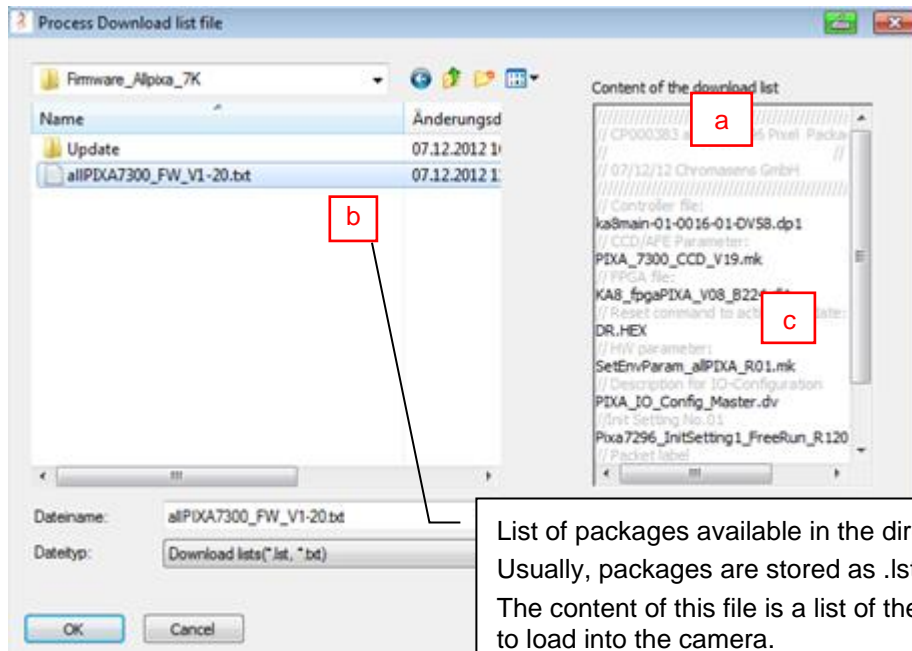
Firmware	
Title	Download
allPIXA pro 2048 Firmware V.3.11	*.zip
allPIXA pro 4096 Firmware V.3.11	*.zip
allPIXA pro 5120 Firmware V.3.11	*.zip
allPIXA pro 6000 Firmware V.3.11	*.zip
allPIXA pro 7300 Firmware V.3.11	*.zip

5. After the download unzip the files to local directory.
6. Perform the following steps to send the package to the camera.

1

- Run CST and select the correct port to connect with the camera.

- Click **Send package to camera**:



2

- Select the firmware package.

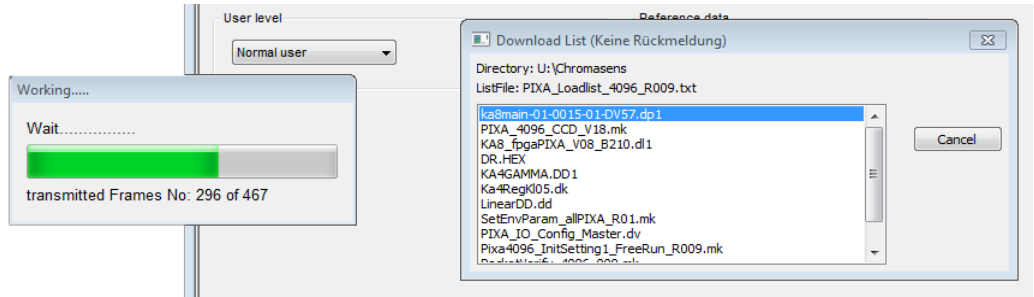
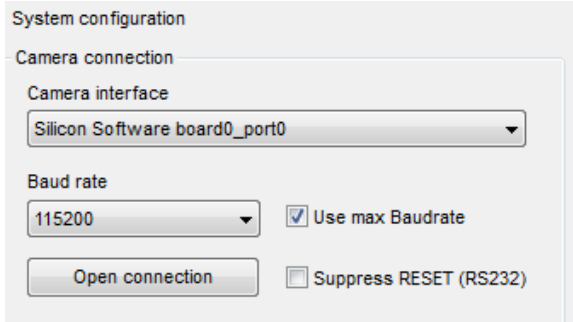
Make sure that you use the correct package for your camera. Depending on the used CCD sensor, different download packages must be used.


The naming of the package contains the length of the CCD sensor:
allPIXA camera_ **CCDLENGTH**_FW_ **VERSION**.txt
(for example, allPIXApro_7300_FW_P302.txt)

This file should be used in an allPIXA camera with the line length of 7.300 and it contains the package version 3.02.

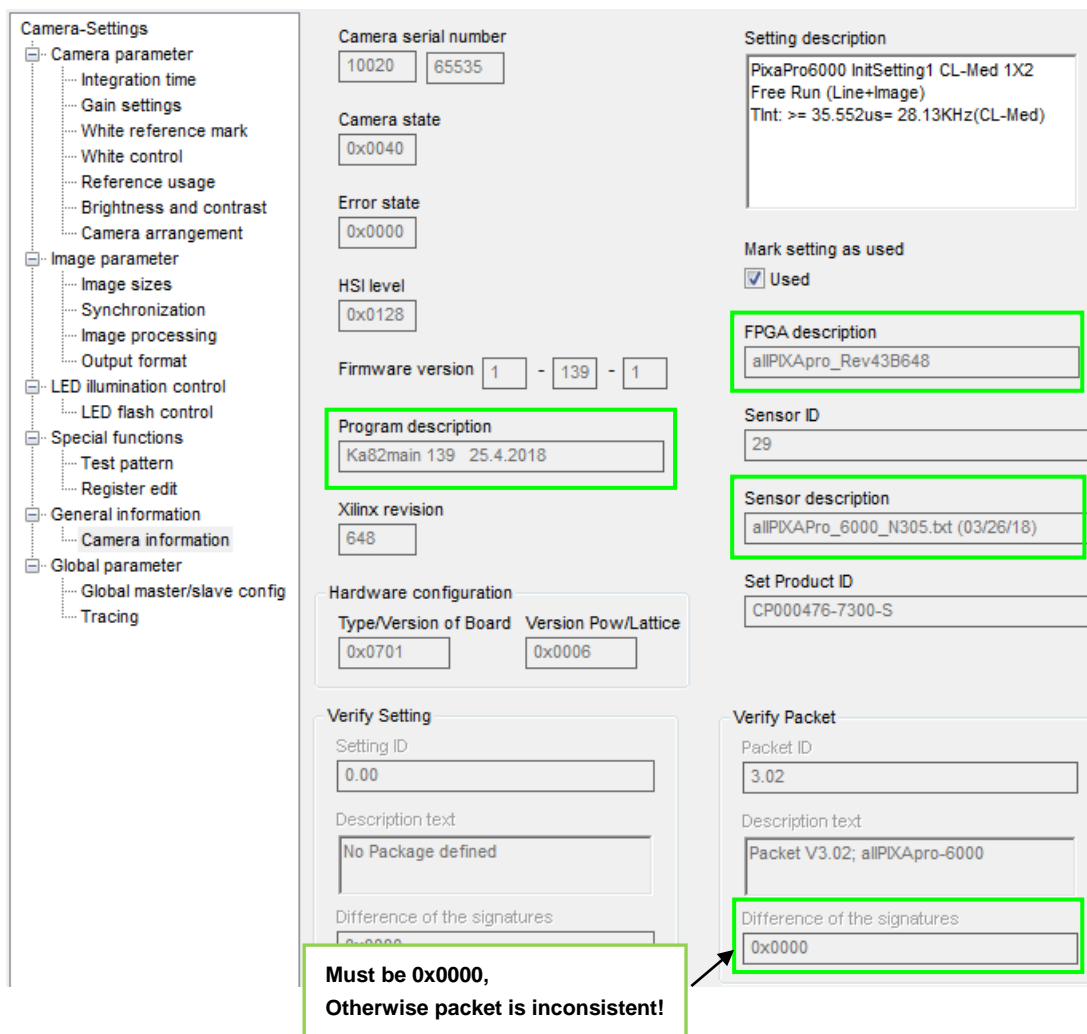
- Click **OK**.

When you click **OK**, download starts immediately.

3	<p>The progress and the files that are downloaded to the camera are displayed in the Download List box.</p> <p>The Working message box with the progress bar displays the progress of the current file:</p>  <p>Download is finished when the Download List box and the Working box are closed.</p> <p>Then the log message view of the CST displays the following message:</p> <p>14:07:27:409 Package download complete</p>
4	<ul style="list-style-type: none"> • Switch off the power of the camera. • Wait 5 seconds. • Turn power on again. <p>Wait until the status LED of the camera is illuminated blue again. Depending on your setting, the LED could also be flashing blue.</p>
5	<ul style="list-style-type: none"> • Click Open connection to connect CST to the camera. <p>It is not necessary to restart CST.</p> 

- On the toolbar, click **Show settings** , and then click **Camera information**.
- Check that camera firmware and FPGA have the desired versions:

6



**Must be 0x0000,
Otherwise packet is inconsistent!**

Green frames indicate the current firmware, CCD and FPGA versions on the camera. Now the camera is ready for operation again.

NOTE Camera parameters, such as IO-Configurator settings, and position and target values of the white reference, are contained in the camera settings. The firmware packet contains a settings file, but by default it is not transferred to the camera. Therefore, it is not necessary to save settings to files before a firmware update is performed.

6 Configuring the camera with the Camera Setup Tool

6.1 Installing the Camera Setup Tool (CST)

To download the latest release of CST, use the link <https://www.chromasens.de/> You will find the CST in the Software section of the allPIXA pro product page.

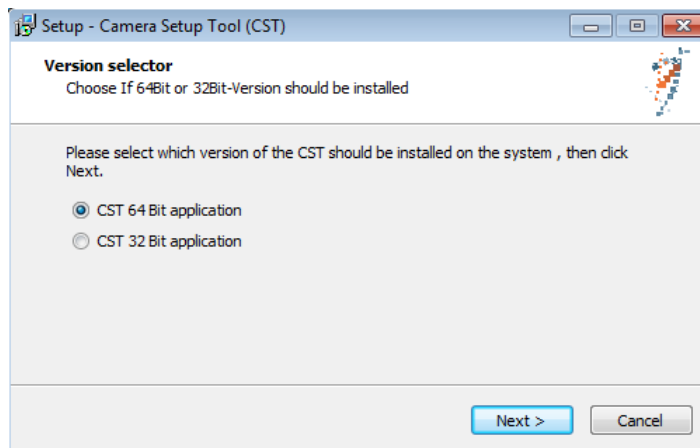
6.1.1 System Requirements

- Microsoft Windows 7, Windows 8.1, Windows 10, 32 bit or 64 bit.
- PC with a Frame Grabber “Camera Link medium” and optionally a serial interface RS232.

6.1.2 Installation of the CST Software

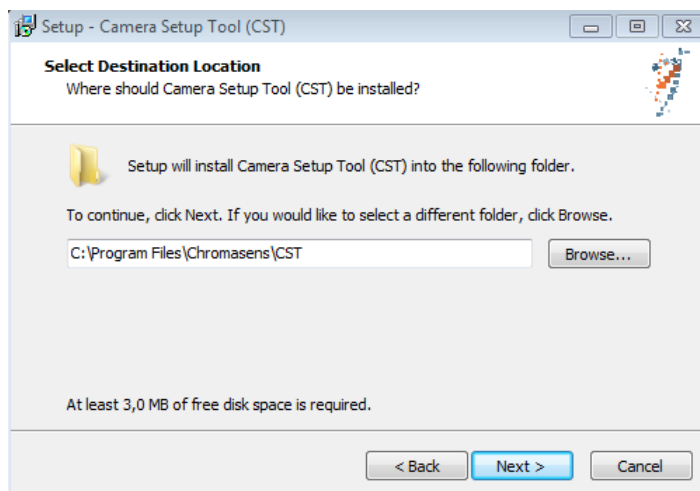
To install CST on your PC:

7. Start the setup program.
8. If the operating system is a 64-bit version, the **Version selector** page is shown:



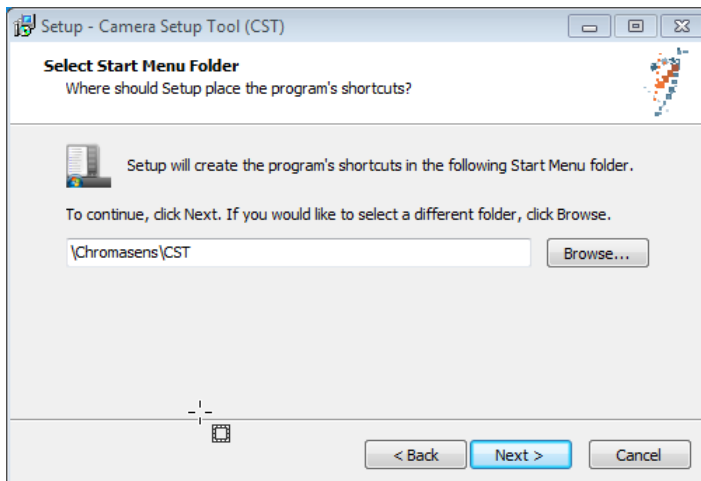
In this case, select the version that should be installed, and then click **Next**.

The **Select Destination Location** page is shown:



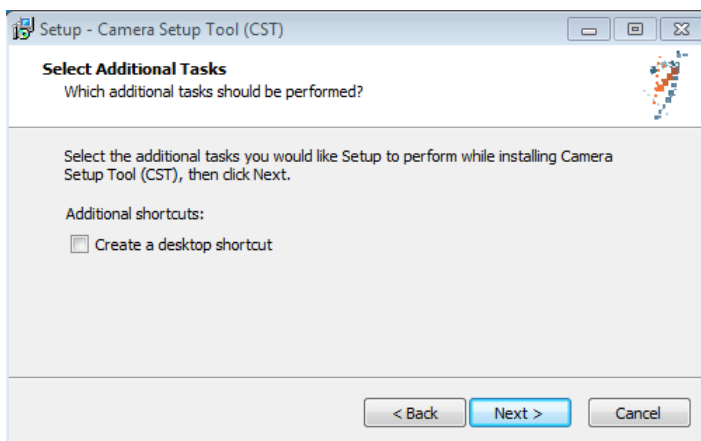
9. Select the folder in which the CST software should be installed and then click **Next**.

The **Select Start Menu Folder** page is shown:



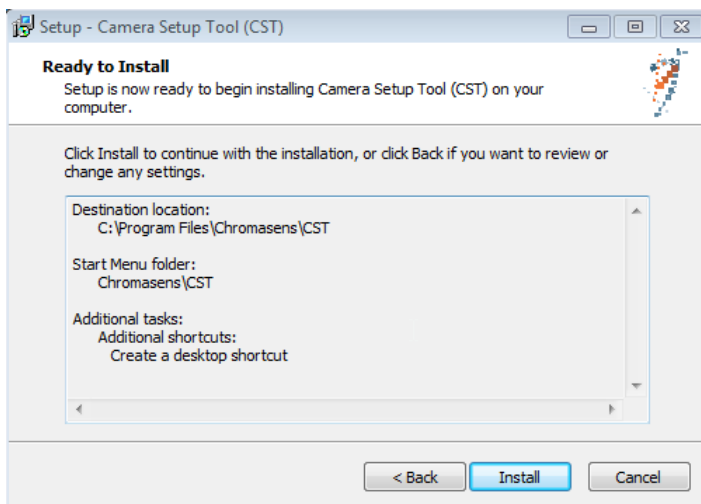
10. Select the start menu folder in which the shortcut to the CST software should be created, and then click **Next**.

The **Select Additional Tasks** page is shown:



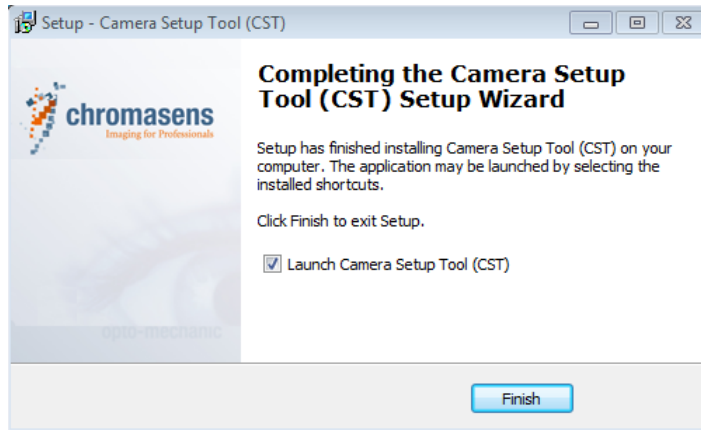
11. If an icon should be created on the desktop, select the check box, and then click **Next**.

The **Ready to Install** page is displayed. It shows the installation parameters that you have specified:



12. To start installation of the CST software, click **Install**.

When the software has been installed successfully, the following page is displayed:



The CST software is now ready for use.

6.1.3 Establishing communication between camera and PC

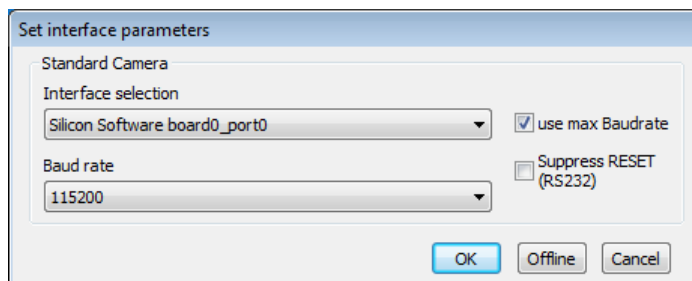
This paragraph describes basic settings of the CST software that are used to establish communication between PC and camera. When you have specified these parameters, you can configure the camera.

To establish communication between camera and PC:

1. Double-click the CST icon on the PC desktop.



The **Set interface parameters** dialog box is shown:



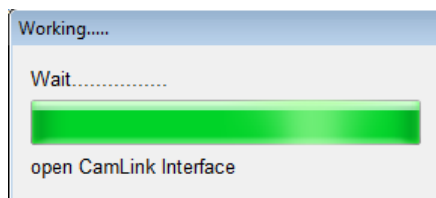
2. Select the PC interface for the communication either via Camera Link or external serial port.
3. In the **Baud rate** list, click the desired baud rate for communication.

Alternatively, select the **Use max. Baud rate** check box to start automatic setup of the baud rate. CST and the allPIXA camera then determine the fastest possible baud rate up to 115 kBaud. If the frame grabber/interface does not support 115 kBaud, clear the **Use max. Baudrate** check box.

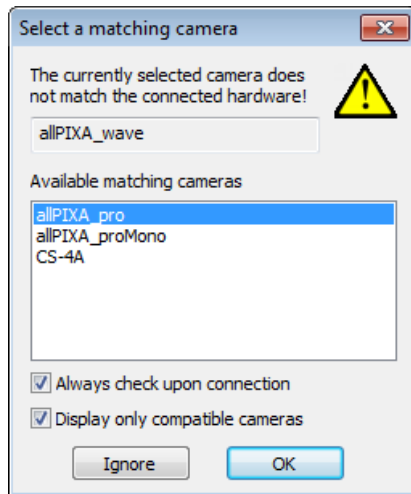
The default baud rate is 19.2 kBaud.

4. Click **OK**.

The CST software now establishes communication to the camera:



- If CST has just been installed for the first time, or if a different camera model was connected earlier, the following dialog box is shown:

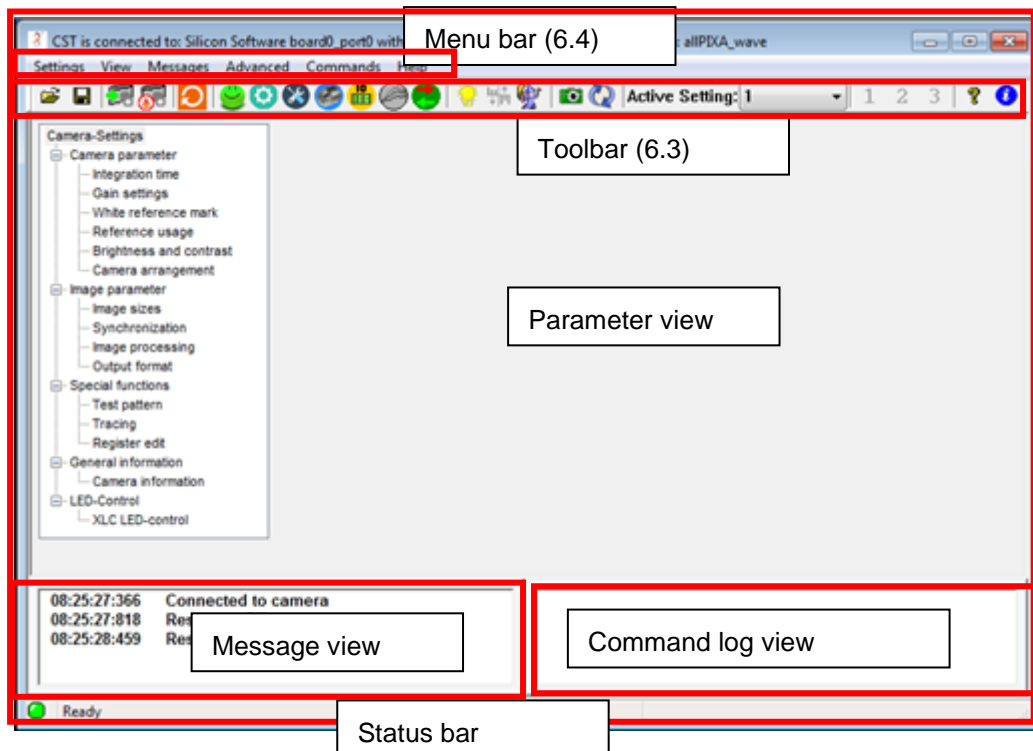


Check that **allPIXA wave** is selected in the **Available matching cameras** list, and then click **OK**.

6.2 CST program window

The CST program window comprises 5 areas:

- Toolbar: Direct access to functions and data (section.6.3)
- Menu bar: Access to all functions (section. 6.4)
- Parameter view: Displaying the data
- Status bar: Displaying the status of the connection
- Message view






















6.3 Toolbar

The toolbar for the CST provides the following functions:



Figure 30: CST Toolbar

Button	Function
	Load setting from file
	Save setting to file
 F9	Transfer setting to camera
 F10	Burn setting permanently
	Reset camera
	Show simple setup view. This page shows the most important parameters of the camera on one page. Very useful for first-time users.
	Show settings Shows basic parameter settings pages, for example integration time.
	Set system configuration: <ul style="list-style-type: none"> • Transfer setting data to and from the camera • Firmware update • Reset the camera • Open new “Camera Connection” • Set the user level for CST
	Show encoder setup Encoder-related and line-trigger-related settings
	Show settings for user-configurable IO
	Show contrast values and sensor line profile
	Show current camera values This function permits to monitor the current values of important parameters of the allPIXA wave camera (for example temperature, current values of the reference for the operating point, states of the inputs, etc.)
	Perform white balancing
	Perform tap balancing

Button	Function
	Start reference wizard. The wizard guides you through the process of generating references for offset and flat-field (shading) correction.
	Show camera state and reset errors
	Refresh current camera parameters (F5)
Active Setting: 1	Select and display the currently used setting
1 2 3	Buttons for user-defined functions (3 available)
	Show information about CST
	Collects information about the PC system, the installed grabbers, and the connected camera. This information is very useful for the Chromasens support if you need assistance.

6.4 CST menu bar

The menu bar provides the following menus:

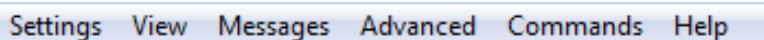


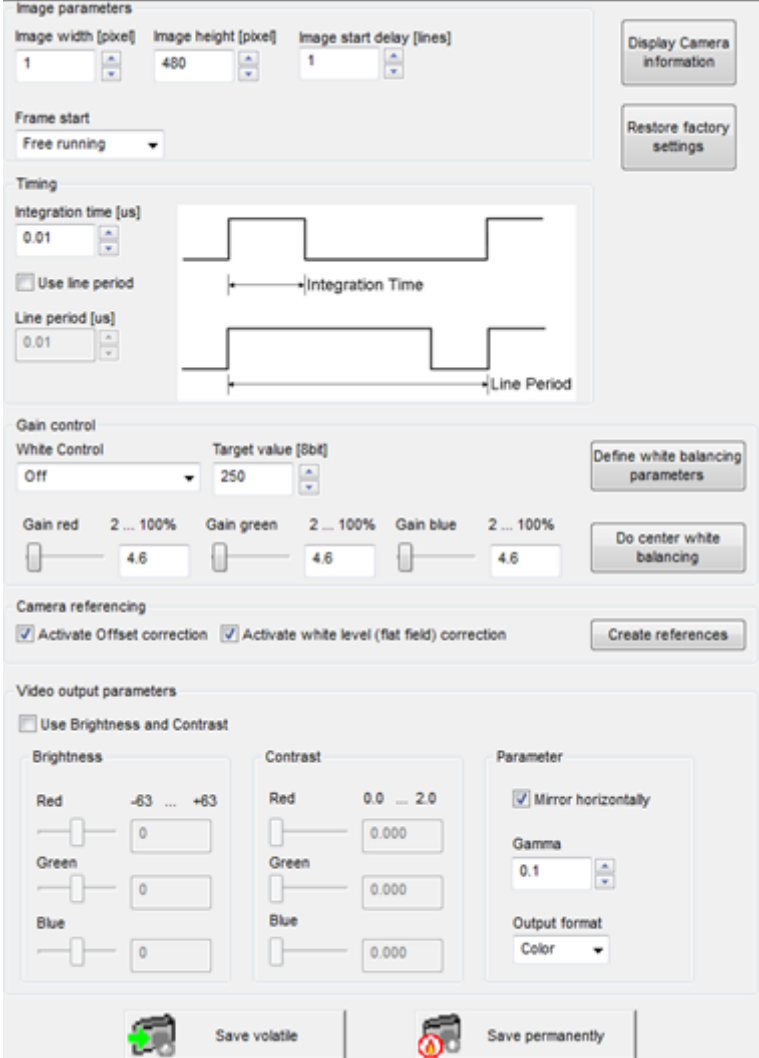
Figure 31: CST Menu Bar

Settings	Open setting from disk	Open a setting from disk. Useful to check a former configuration. After loading a file from disk it is also possible to transfer it to the camera by the "Send setting to camera" function.
	Save setting to disk	Save current settings to disk
	Transfer setting to volatile camera memory (F9)	Transfer settings to volatile (non-permanent) camera memory. After a reset or a power cycle the changes get lost.
	Burn current setting permanently (F10)	Permanently burn camera settings to the currently used setting
	Burn current setting permanently as (F11)	Permanently burn camera settings to a different setting
	Clear settings	Delete settings from camera memory
	Exit	Close CST

View	Toolbar	Enable/disable the toolbar
	Status bar	Enable/disable the status bar
	Simple setup	Show the simple setup page. This page shows the most important parameters of the camera on one page. Very useful for first time users.
	Camera settings	Open basic parameter settings pages, for example integration time
	IO-Configurator	Show the settings for the user-configurable inputs and outputs of the camera
	Encoder setup	Encoder and line-trigger-related settings
	System configuration	Set system settings: <ul style="list-style-type: none"> • Transfer setting data to and from the camera • Firmware update • Reset the camera • Open new “Camera Connection” • Change the viewer configuration file to adapt the displayed parameters to your camera • Set the user level for the CST
	Current camera values	Display live camera values such as voltages, temperatures, gain values, or similar. This function permits to monitor the current values of important parameters of the allPIXA camera in live mode (for example the temperature, the current values of the reference for the operating point or the statuses of the inputs etc.)
Messages	Arrange protocol views vertically	
	Arrange protocol views horizontally	
	Show command message view	Activates the command log view. The communication data are logged here.
	Clear logging views	Clear the message view
	Save logging messages	Save the message window to a log-file for support cases and debugging the system.
	Show detailed command views	Activates the command log view. Additionally, the communication data are logged in a more detailed way.

Advanced	Register edit	Open a window for editing and reading registers directly on the camera. Attention: Only for advanced users.
	Bootstrap board	For service only.
	Get Camera Trace	Return internal camera loggings. May be requested by the Chromasens support to get detailed information about a possible problem.
	Verify Packet/Setting	This can be used to create consistent Setting or Firmware/FPGA packages. A checksum is generated for this setting or Firmware package. As soon as something is changed here, the checksum is no longer consistent and can be detected by the camera.
	Create HSI-Checksum	Function for development purposes only. If a value in an HIS file changes, the checksum is no longer valid. This function recalculates the checksum and enters it into the file.
	Edit Color Conversion Matrix	You can edit the four color correction tables saved inside the camera.
	Set IP address	If a connection to a GigE-camera should be established, the IP-address can be set here
	Get current camera state	With this function, you can easily check the camera status.
	Restore factory settings	Restores factory settings from internal camera memory.
Commands	Reset Camera	Reset the camera.
	Process white balancing	Perform an automated white balancing on the camera
	Initiate tap balancing	Perform a balancing procedure between the two camera taps to eliminate the differences at the tap border.
	Generate references (Wizard)	Open the reference wizard. The wizard guides you through the process of generating references for offset and flat-field (shading) correction.
	Send user command	Buttons for user-defined functions (3 available)
	Configure user commands	Configuring the buttons for the user-defined functions.
Help	Information about CST	Info button for getting the released version of CST
	Show system info	Collects information about the PC system, the installed grabbers, and the connected camera. This information is very useful for the Chromasens support if you need assistance.

6.5 Simple setup view (overview)

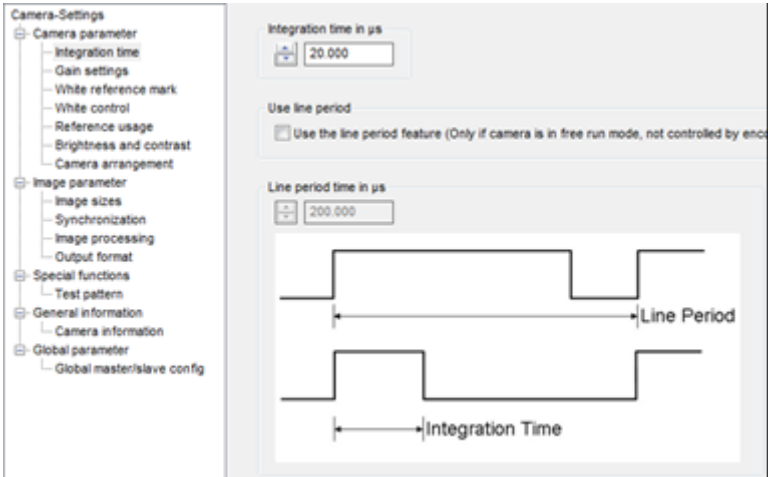
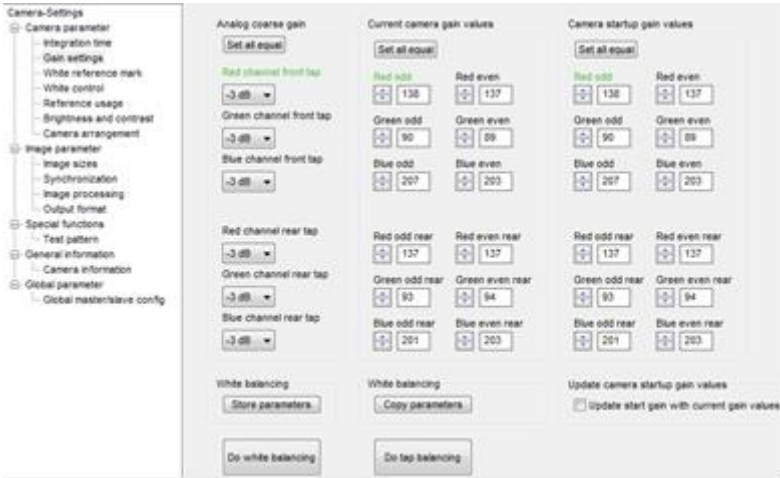
Page	Function
<p>Simple setup view</p>  <p>The screenshot shows the 'Simple setup view' interface with the following sections:</p> <ul style="list-style-type: none"> Image parameters: Image width [pixel] (1), Image height [pixel] (480), Image start delay [lines] (1). Buttons: Display Camera information, Restore factory settings. Frame start: Free running (dropdown). Timing: Integration time [us] (0.01), Line period [us] (0.01). Includes a timing diagram showing integration time and line period. Gain control: White Control (Off), Target value [Sbit] (250). Buttons: Define white balancing parameters, Do center white balancing. Gain sliders for red, green, and blue (all at 4.6). Camera referencing: Activate Offset correction (checked), Activate white level (flat field) correction (checked). Button: Create references. Video output parameters: Use Brightness and Contrast (unchecked). Brightness sliders for Red, Green, Blue (all at 0). Contrast sliders for Red, Green, Blue (all at 0.000). Parameter: Mirror horizontally (checked), Gamma (0.1), Output format (Color). Bottom bar: Save volatile (with green plus icon), Save permanently (with red warning icon). 	<p>Functions:</p> <ul style="list-style-type: none"> • Set all basic parameters of the camera to quickly receive a well-calibrated image • Section: 8.1

6.6 Basic camera parameter settings (overview)

Basic parameters of the camera are split into different groups:

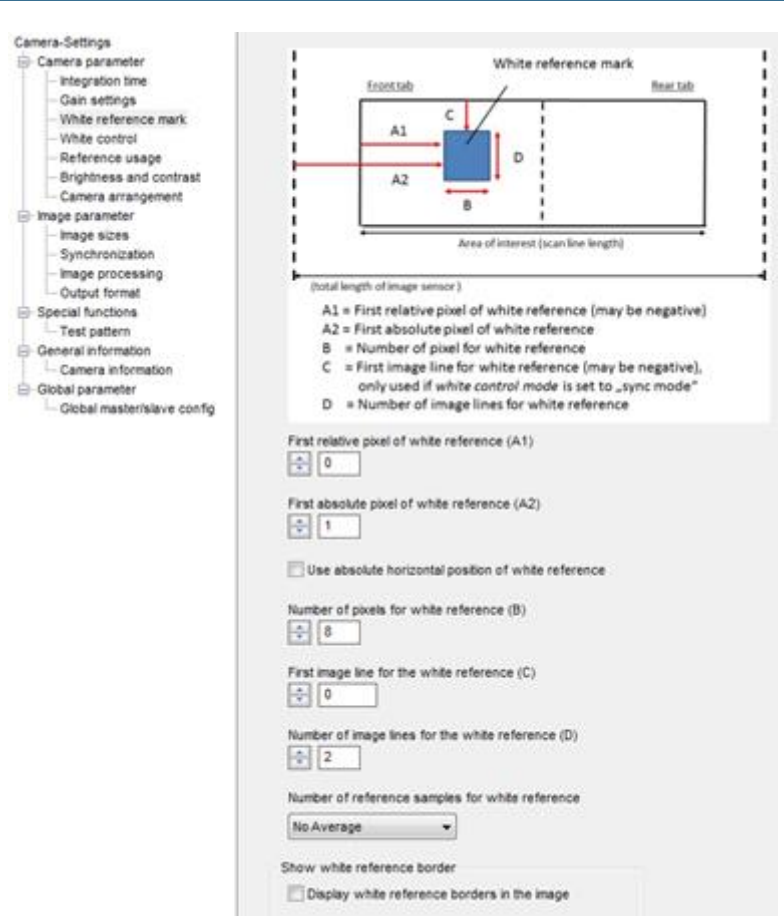
6.6.1 Camera parameters

This part contains the parameters related to the following:

Page	Function
<p>Camera settings – Camera Parameter – Integration time</p> 	<p>Integration time:</p> <ul style="list-style-type: none"> • Set the integration time • Set the line period mode • Set the line period time <p>Section: 9.1</p>
<p>Camera settings – Camera Parameter – Gain Settings</p> 	<p>Camera Gain Settings:</p> <ul style="list-style-type: none"> • Analog coarse gain • Current gain values <p>Section: 9.2</p>

Page **Function**

Camera settings – Camera Parameter – White reference mark



White reference mark:

- Set the position and size of the zone for the closed-loop control

Section: 9.3

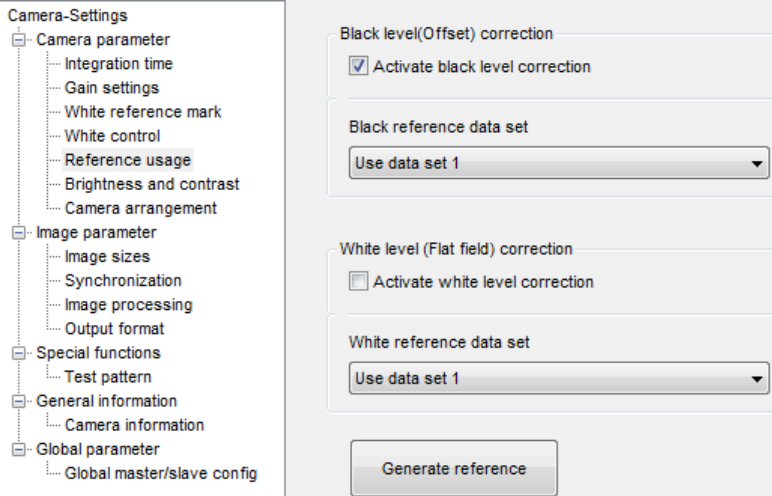
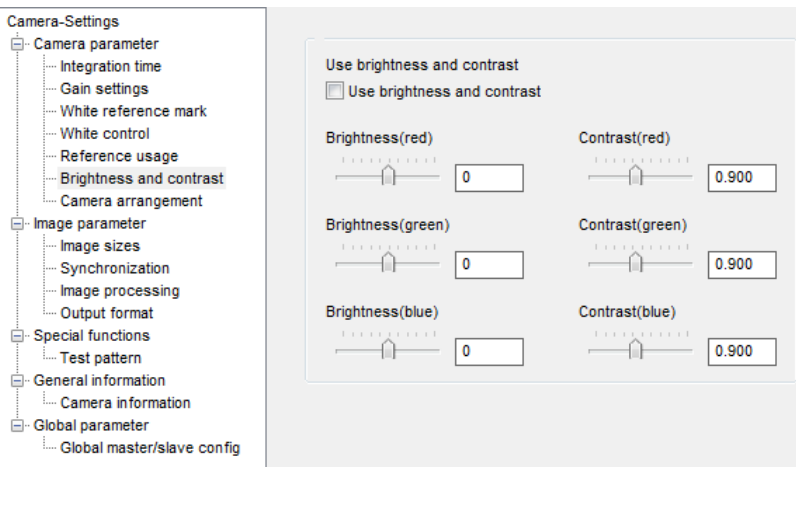
Camera settings – Camera Parameter – White control

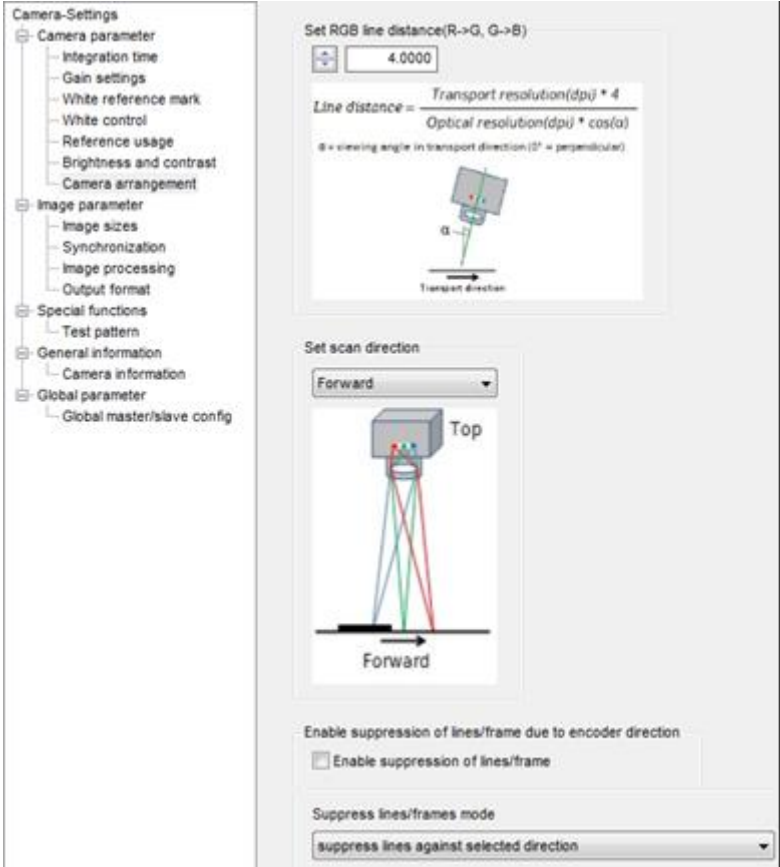


White control:

- Target reference values
- Current reference levels
- White control

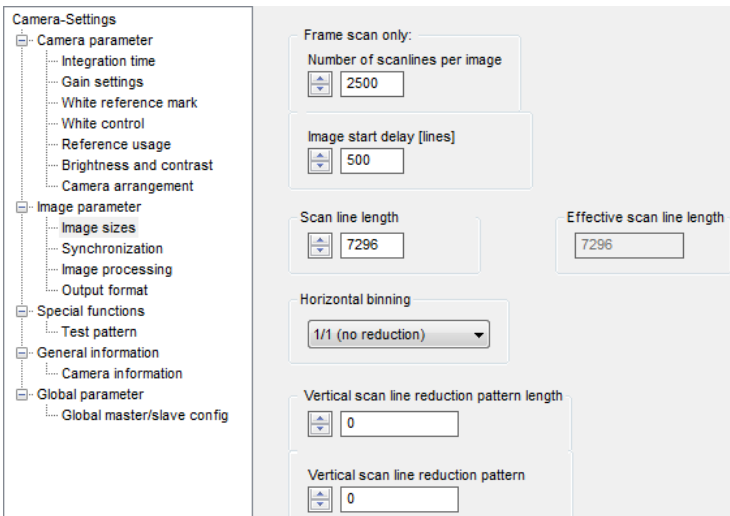
Section: 9.4

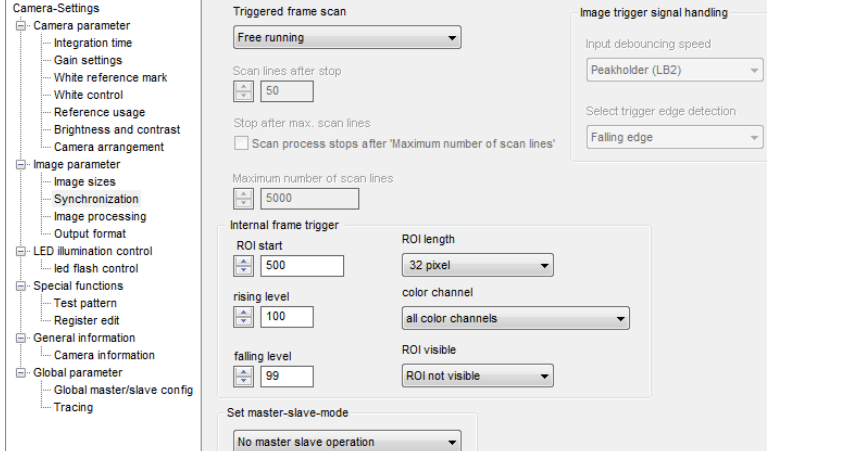
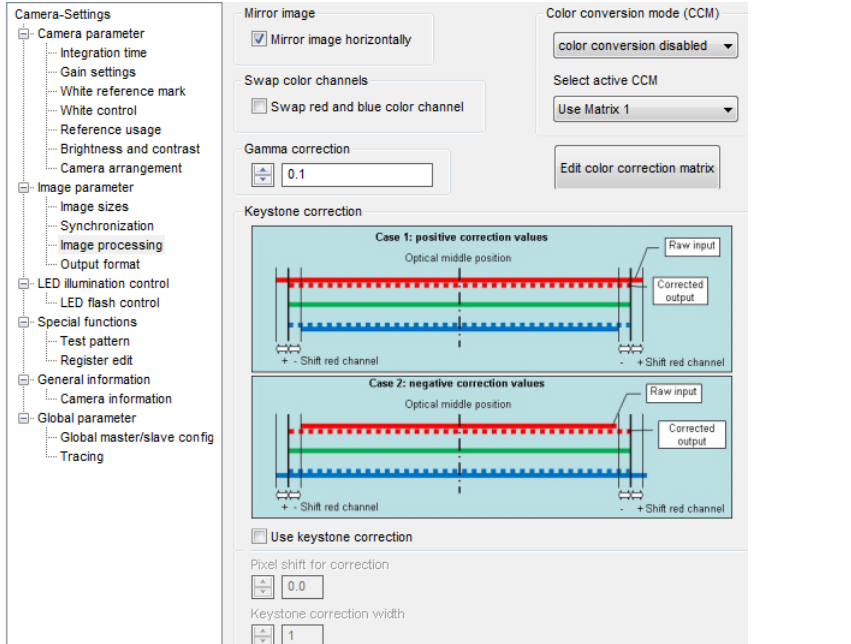
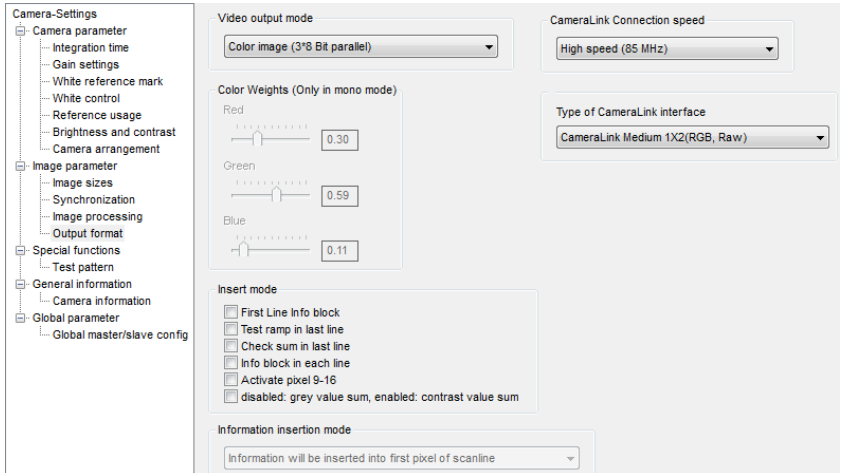
Page	Function
Camera settings – Camera Parameter – Reference usage	
	<p>Reference usage:</p> <ul style="list-style-type: none"> • Activate shading correction • Activate black-level correction • Select the data set for shading and black-level correction <p>Section: 9.5</p>
Camera settings – Camera Parameter – Brightness and Contrast	
	<p>Brightness and Contrast:</p> <ul style="list-style-type: none"> • Digital gain • Digital offset <p>Section: 9.6</p>

Page	Function
Camera settings – Camera Parameter – Camera arrangement	
	<p>Camera arrangement:</p> <ul style="list-style-type: none"> • Set the line shift/spatial correction • Set the scan direction • Specify line suppression <p>Section: 9.7</p>

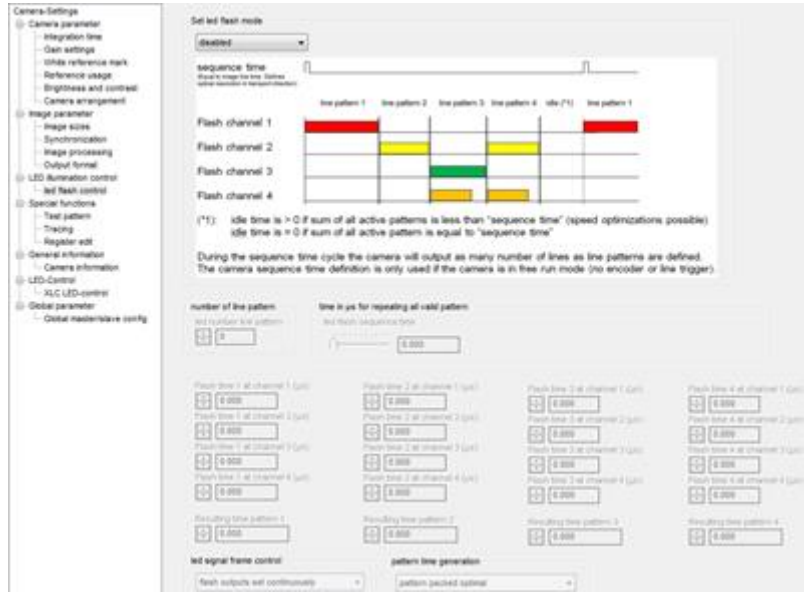
6.6.2 Image parameter

This part contains the parameters related to the image.

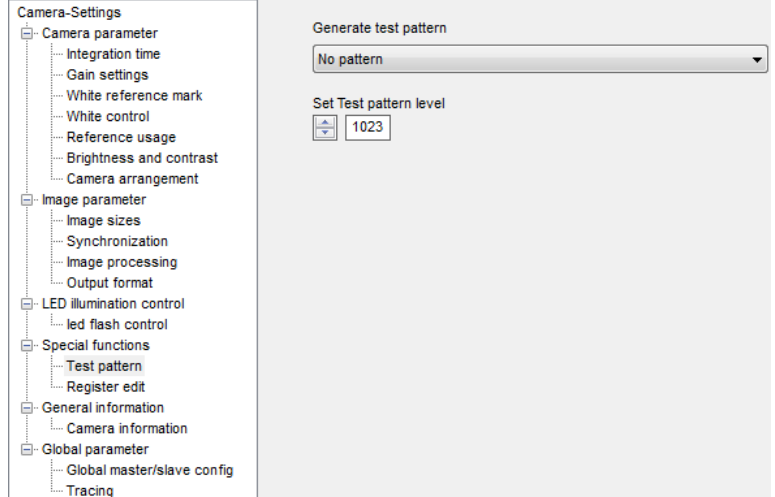
Page	Function
Camera settings – Image Parameter – Image sizes	
	<p>Image size:</p> <ul style="list-style-type: none"> • Set the parameters related to the image size <p>Section: 9.8</p>

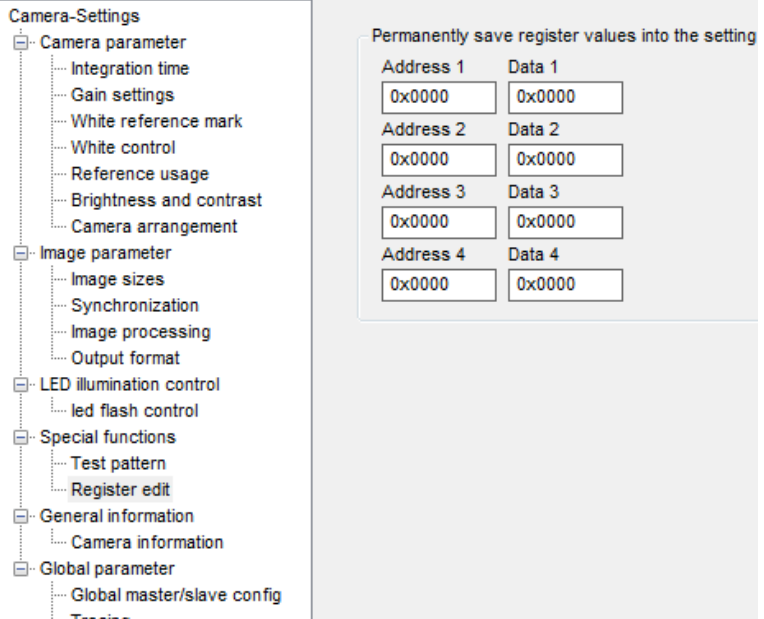
Page	Function
Camera settings – Image Parameter – Synchronization	
 <p>The screenshot shows the 'Synchronization' settings in the 'Image parameter' section. Key settings include: 'Triggered frame scan' set to 'Free running', 'Scan lines after stop' at 50, 'Maximum number of scan lines' at 5000, 'Internal frame trigger' with 'ROI start' at 500 and 'ROI length' at 32 pixel, 'rising level' at 100, 'falling level' at 99, and 'Set master-slave-mode' set to 'No master slave operation'.</p>	<p>Synchronization:</p> <ul style="list-style-type: none"> • Set the parameters for triggering the frame scan modes • Select the synchronization with other cameras (Master/slave mode) <p>Section: 9.9</p>
Camera settings – Image Parameter – Image processing	
 <p>The screenshot shows the 'Image processing' settings. Key settings include: 'Mirror image' checked for 'Mirror image horizontally', 'Color conversion mode (CCM)' set to 'color conversion disabled', 'Gamma correction' at 0.1, and 'Keystone correction' with 'Use keystone correction' checked. Two diagrams illustrate 'Case 1: positive correction values' and 'Case 2: negative correction values' for keystone correction, showing 'Raw input' and 'Corrected output' with 'Shift red channel' adjustments.</p>	<p>Image processing:</p> <ul style="list-style-type: none"> • Activate image mirroring • Activate color correction • Activate and set parameters for the keystone functions <p>Section: 9.10</p>
Camera settings – Image parameter – Output format	
 <p>The screenshot shows the 'Output format' settings. Key settings include: 'Video output mode' set to 'Color image (3*8 Bit parallel)', 'CameraLink Connection speed' at 'High speed (85 MHz)', 'Color Weights' for Red (0.30), Green (0.59), and Blue (0.11), and 'Information insertion mode' set to 'Information will be inserted into first pixel of scanline'.</p>	<p>Output format:</p> <ul style="list-style-type: none"> • Set the pixel clock on Camera Link • Select the port type medium or base • Different parameters for data transfer on Camera Link • Insert information into image data <p>Section: 9.11</p>

6.6.3 LED illumination control

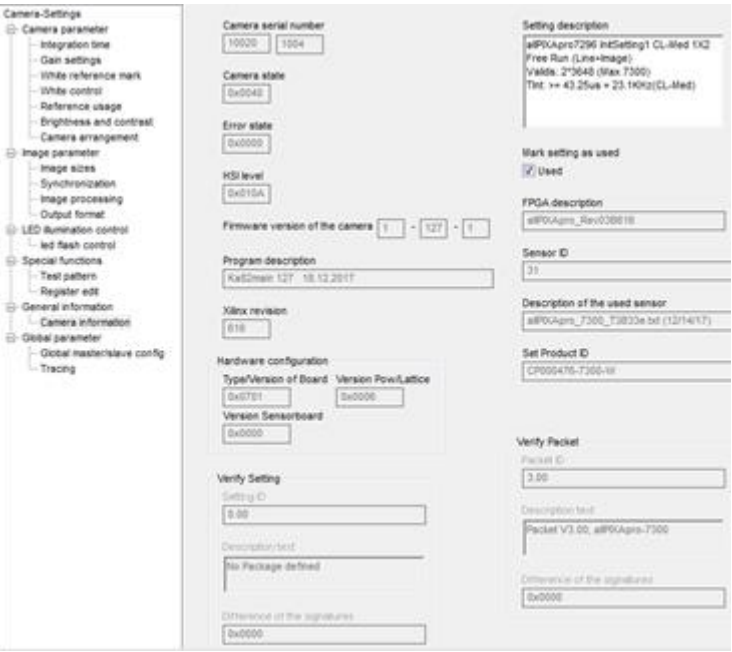
Page	Function
Camera settings – LED illumination control – LED flash control	
	<p>LED flash control:</p> <ul style="list-style-type: none"> • LED number line pattern • LED flash sequence time • Pattern specification <p>Section: 9.12</p>

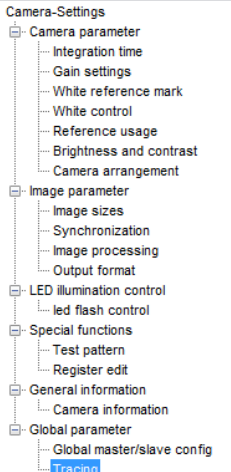
6.6.4 Special functions (test pattern / register edit)

Page	Function
Camera settings – Special functions – Test pattern	
	<p>Test pattern:</p> <ul style="list-style-type: none"> • Test images can be generated inside the camera <p>Section: 9.13.1</p>

Page	Function
Camera settings – Special functions – Register edit	
	<p>Register edit:</p> <ul style="list-style-type: none"> You can edit registers directly. The data are saved on the camera when the setting is burned. Use this function carefully. It may cause a damage of the firmware or cause malfunction of the camera. <p>Section: 9.14</p>

6.6.5 General information

Page	Function
Camera settings – General information – Camera information	
	<p>Camera information:</p> <ul style="list-style-type: none"> Information about firmware on the camera Attach a screen shot of this page for all support questions. <p>Section: 9.15</p>


Page	Function
Camera settings – Special functions – Tracing	
	<p>Tracing:</p> <ul style="list-style-type: none"> • Debugging functions <p>Section: 9.16</p>

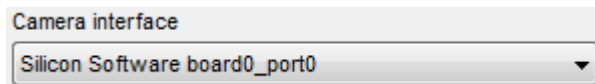
6.7 Opening serial connection to a camera

You can open a different port or re-open the same port directly. It is not necessary to restart CST and to select it in the dialog box shown during start-up.

Button	Function key	Menu
		View/System configuration

To open serial connection to a camera:

1. On the toolbar, click **Show system configuration** .
2. In the **Camera interface** list, click the desired camera connection:



3. In the **Baud rate** list, click a baud rate, or select the **Use max. Baud rate** check box:



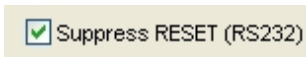
If the **Use max. Baud rate** check box is selected, CST and the camera try to get connected with the highest possible data rate.

4. Click **Open connection**:



The default baud rate of the camera is 115200 Baud at power up.

Some PCs set the reset on RS232 to high as default. Therefore, this option has to be disabled. This refers only to serial ports of the PC; it does not affect the ports provided by the Camera Link.



6.8 Transferring data to the camera

Button	Function key	Menu
	F9	Settings/Transfer setting to volatile camera memory

Changes in the setting must be transferred to the camera.

- NOTE**
- Data edited in CST are not transferred automatically to the camera
 - Data edited in CST are not transferred to the camera when you press **Enter**
 - Data are lost during a reset or a restart of the camera if they were not saved to persisting memory
 - If a new setting is loaded, or if the current setting is reloaded, unsaved data get lost

6.9 Saving data to the camera permanently


Up to 18 different settings are available in the camera. Setting 19 is reserved for the backup of the default setting.

We recommend to use settings 1 to 9 for working settings and setting 10 to 18 for backup settings.

The currently selected setting is displayed in the toolbar:

Active Setting:

To save the data to the currently selected setting, use the following:

Button	Function key	Menu
	F10	Settings/Burn current setting permanently

To save the data to different setting in the camera, use the following:

Button	Function key	Menu
	F11	Settings/Burn current setting permanently as

To save data to a different setting:

1. Press **F11**.

The **Burn setting as** dialog box is shown:




The dialog box titled "Burn setting as" contains a label "Burn setting as no:" followed by a dropdown menu showing the number "1". To the right of the dropdown are two buttons: "OK" and "Cancel".

2. In the **Burn setting as no** list, click the desired setting number, and then click **OK**.

- NOTE** First, changes made inside CST must be transferred to the camera. If they are not transferred, they get lost. These functions take the data from the volatile memory in the camera for burning.

6.10 Refreshing data from the camera in CST

Some data have been changed in the camera or in the setting by the camera itself, for example by the closed-loop control for white balancing. To update the current data in CST, click the refresh button:

Button	Function key	Menu
	F5	

6.11 Select a setting on the camera

To select a different setting on the camera:

- In the **Active Setting** list, click the number of the respective setting.



NOTE Changes which have not been transferred and burned on the last edited setting get lost.

6.12 Saving settings to the PC

For saved camera settings, two different file types are available:

- *.mk-Files:**
Binary file. The file contents can be transferred to the camera directly.
- *.set-Files:**
File in XML format. Such files can be edited manually but this is only recommended for advanced users. Use CST to edit the files safely. Such files can also be downloaded to the camera, but CST compiles them to the binary format beforehand.



6.12.1 Saving settings from CST to hard disk

Button	Function key	Menu
		Settings/Save setting to disk

With this function you can save the setting data currently present in CST to a *.set or .mk file.

NOTE Changes at the camera, for example caused by automatic white control, are not saved in the files. Therefore, click the refresh button first, before you save the data to hard disk.

6.12.2 Saving settings from the camera to hard disk

Button	Function key	Menu
		View/System configuration
		

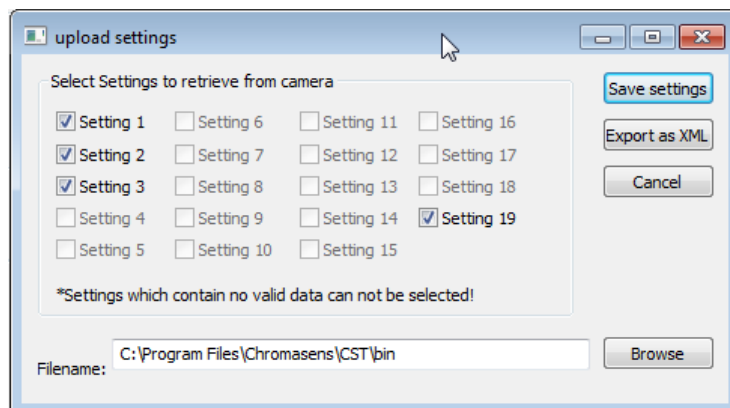
With this function, you can save permanently saved camera settings to a *.mk file in binary format or to an *.set file in XML format.

NOTE Changes get lost if they are not saved permanently to a setting.

To save camera settings to a file:

1. On the toolbar, click **Show system configuration** , and then click **Save multiple settings to disk**.

The **Upload Settings** dialog box opens and shows enabled check boxes for all available camera settings:



2. Specify the settings that should be saved by selecting or clearing check boxes as needed:
3. To specify the file name, enter path and file name in the **Filename** box, or click **Browse** to open a **File** dialog box.
4. To save the settings in binary format as *.mk file, click **Save settings**, or to save them in XML format as *.set file, click **Export as XML**.

Each selected setting is saved to a separate file, at which the setting number is appended to the file name.


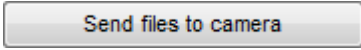
6.13 Transferring saved settings from the PC to the camera

NOTE If you transfer settings to the camera, settings with the same number are overwritten.

There are two methods available for transferring settings to the camera:

- Transfer settings directly to the camera
- Open the setting in CST and transfer data in a second step to the camera.

1. Transferring settings with direct transfer:

Button	Function key	Menu
		View/System configuration
		

2. Transferring settings with CST:

Button	Function key	Menu
		Settings/Open setting from disk

A standard file dialog box opens and you can select *.set files or *.mk files. The setting is then shown in CST, but it is not sent to the camera.

As next step, press **F9** to send the setting to the camera. Then press **F10** to burn the setting as setting 1, or press **F11** to burn it to a setting with a different number.

6.14 Deleting settings on the camera

You can delete burned settings on the camera.

Button	Function key	Menu
		Settings/Clear settings

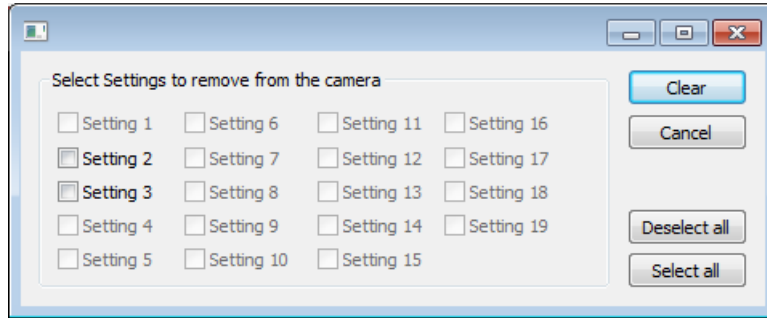
NOTE I It is **not allowed** to delete setting 1. If setting 1 has been changed erroneously, you can restore the default setting 1 by clicking **Restore factory settings** on the **Simple setup view**, without having to deal with download packages. In this case, the setting is restored from internal camera memory.

Alternatively, you can download the initial setting 1 to the camera. The required file is included in the software package, which is available for download. The file is called *PIXAproXXXX_InitSetting1_FreeRun_Rnnn.mk* . where XXXX is related to the allPIXA camera model and nnn is the revision of the firmware package.

NOTE II This function is only available if **User level** has been set to **Guru**.

To delete settings on the camera:


1. On the **Settings** menu, click **Clear settings**.
2. In the **Clear Settings** dialog box, which shows enabled check boxes for all available camera settings, select check boxes as needed:




3. To delete the specified settings, click **Clear**.

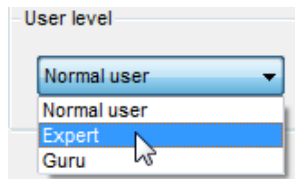
6.15 Setting the user level in CST

CST provides three different user levels. In **Normal user** level, several parameters and functions are not available, which helps to prevent undesired changes by inexperienced users. Only in **Guru** level, all features are available.

Button	Function key	Menu
		

To switch to a different user level:

1. On the toolbar, click **Show system configuration** .
2. In the **User level** list, click the desired level:



NOTE We recommend to work with **Normal user** level as much as possible to avoid erroneous settings.


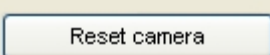
The following table shows which commands of the **Advanced** menu are enabled in the different user levels:

Name	Normal User	Expert	Guru
Register edit			X
Bootstrap board			X
Get camera trace		x	X
Verify packet/setting			X
Create HIS checksum			X
Edit color conversion matrix			X
Set IP address		X	X
Get current camera state	X	X	X
Restore factory setting			X

For information about available parameters in the different user levels, see section 9.19.


6.16 Resetting the camera

You can reset the camera from CST:

Button	Function key	Menu
		View/System configuration
		

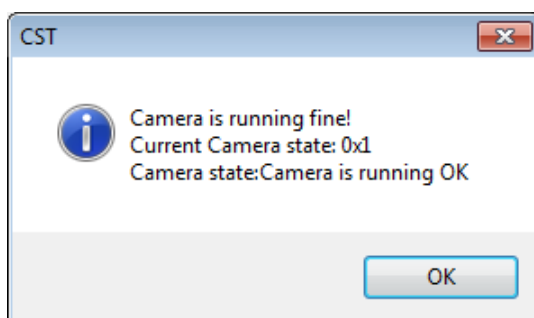
On the camera a reset is performed, and afterward CST is automatically re-connected to the camera.

6.17 Checking the camera status

Button	Function key	Menu
		Advanced/Get current camera state


When you click this button, detailed information about camera state and the currently present errors are read, and currently presented errors are cleared and acknowledged.

If the camera is OK, the following dialog box is shown:




6.18 Choosing a different configuration file for the parameter display

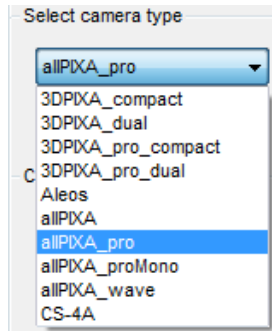
You can modify the **Parameter** view of CST according to the camera type.

Button	Function key	Menu
		View/System configuration

To switch to a different configuration file:

1. On the toolbar, click **Show system configuration** .
2. In the **Select camera type** list, click the respective item:

The default viewer configuration for the allPIXA pro camera is allPIXA_pro.



The changes are applied to the **Parameter** view immediately. The settings are stored in the registry, and CST uses the new viewer file when it is started next time.

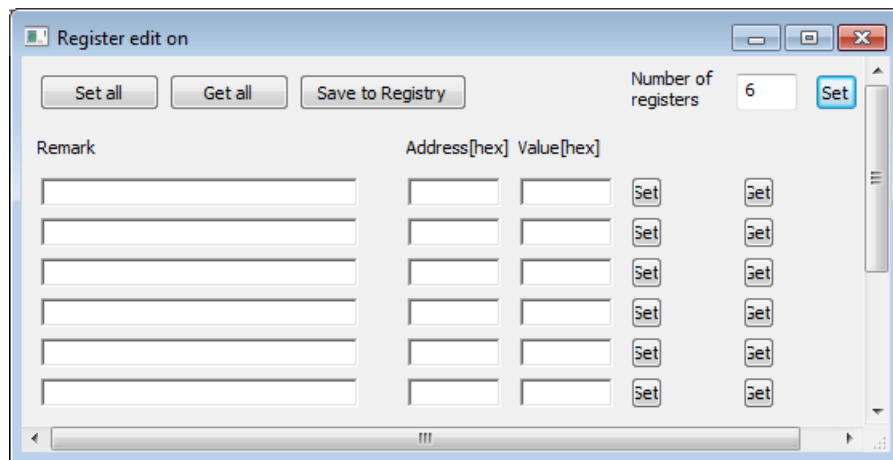
According to the different viewer file, some parameters are visible or hidden.

6.19 Register Edit

You can read and prepare registers in the camera.

Button	Function key	Menu
		Advanced/Register edit

Compared to the register edit of the basic settings (section 6.6.4), this register edit is for non-permanent memory. Each loading or sending of a setting overwrites the changes. The intended use is for debugging the system:



You can edit different registers directly. If you click **OK**, register names (**Remark**) and the address are saved on hard disk and are available for the next time.

All values are used/represented as Hex-values (e.g. 256 = 0x256)

By clicking **Set** or **Get**, you can work with a single register. By clicking **Set all** or **Get all**, you can edit all registers in the list.

To change the numbers of displayed registers, enter the new number into the **Number of registers** box, and then click **Set**.

You could store the register settings including remark at the Registry by pressing **Save to Registry**

NOTE This function is only for trained users.

7 Camera system setup – first steps




7.1 Installing the camera

Prepare the general setup:	
1	<p>Prepare the camera and lens</p> <ul style="list-style-type: none"> • Select the correct lens and accessories to operate your camera in the desired environment. (For more information about lens and tube selection, see section 11.2) • Install the lens and adapters correctly. For detailed description of the lens and mount installation, see section 2.6.
2	<p>Prepare the right cabling for your application</p> <ul style="list-style-type: none"> • Camera Link cable: The allPIXA pro provides MDR connectors. Check the plugs of your frame grabber to decide whether you need MDR-MDR or MDR-SDR Camera Link cables. • Power supply: Hirose 6-pin plug (HR10A-7P-6S). The allPIXA pro connecting interfaces are described in section 5.1. • Connect the camera to power supply (24 VDC +/- 10 %; 1A; typical 16 W) and your frame grabber (section 5.6)
3	<p>Install the frame grabber on your PC by following the manufacturer's description</p> <ul style="list-style-type: none"> • Set the configuration of the frame grabber to adjust it to the configuration of the allPIXA pro camera. For information about the Camera Link modes, see section 4.5.2.
4	<p>Adjust the focusing point of your illumination unit and position it correctly</p> <ul style="list-style-type: none"> • Refer to the manual of the illumination manufacturer for proper installation of the illumination. • Make sure the illumination is correctly positioned to illuminate the scanning area.
5	<p>Mechanically install the camera into your machine</p> <ul style="list-style-type: none"> • 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 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 16,5 mm (optical photosensitive surface) behind the front surface of the allPIXA pro camera. You can find the detailed sensor position description in section 2.4.

7.2 Starting up the system

Start up the camera:


You can set camera parameters using the Camera Setup Tool (CST). For information about installation of CST, see section 6.1.


- Turn on illumination and camera.
- Start CST (Camera Setup Tool) (chapter 6)
- Set up communication between PC and camera (section 6.1.3).
- To set the correct Camera Link configuration and the connection speed, click **Show settings**  on the toolbar, click **Output format**, and then specify the parameters. Image size and output format of the camera must match the frame grabber settings.
- Click **Transfer setting to camera**  to save the setting into volatile memory.
- To specify first parameter adjustments, click **Show simple setup view**  on the toolbar.


Now, you should be able to grab and see an image in your frame grabber tool.

If your frame grabber is not able to receive an image, refer to the frame grabber manual or contact the support service of the frame grabber manufacturer.

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

(You can select the user level in the system configuration . For more information, see section 6.15)

NOTE After setting a parameter, **always** click **Transfer setting to camera**  or press **F9** to transfer settings to volatile memory!

Click **Burn setting permanently**  or press **F10** to burn the setting into the camera!

For more information about the toolbar buttons, see section 6.3.


7.3 Adjust camera to the environment (camera calibration)

Prepare the camera for calibration (see also section 8.2).

- Set the camera to free-running mode
- Place a white reference target covering the full scanning area

NOTE

If the white reference target is placed in the best focus plane of the camera, any features on its surface (for example dust, scratches) end up in the calibration profile of the camera. To avoid this if you use a static (non-moving) white reference target, use 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. If this is not possible, you could place the reference target a little bit out of the best focus plane; but take care that the illumination of the target doesn't change too much.

You can find the most important parameters and functions on the simple setup page  (see section 8.1).

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



Check your line scan system application:

1

- **Illumination setting:**
Switch on the lighting and ensure that the adjustment of the lighting provides best illumination on the target.
- **Frame grabber setting:**
Check your frame grabber setting. Make sure that the grabber configuration matches the allPIXA pro camera.
- **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.

Set the integration time:


2

- On the toolbar, click **Show simple setup view** , and then specify the integration time.
You can find an instruction for calculation in the appendix (section 11.2.3).
Make sure the integration time is supported by your camera- and Camera Link - configuration (see section 9.11.3).
- Click **Transfer setting to camera** , or press **F9** to save the setting to volatile memory.

Set the operating point (white balancing, section 8.2):

3

The camera has the correct gaining values after this step.

- On the toolbar, click **Perform white balancing**  for automatic white balancing or
- Follow the instructions in section 8.2.3 for manual white balancing.

This step has to be performed again, for example, after changing the light or the f-stop.

Refer to section 8.2 for a detailed description on how to set the operating point.

Perform a tap balancing (section 8.2):

4

The camera seamlessly levels out the video signal of the two taps of the camera. The resulting image has the same brightness in the center at the tap borders after this step.





- On the toolbar, click **Perform tap balancing** .

Tap balancing can only be performed correctly if continuous white control is disabled.

For a detailed description how to perform tap balancing, see section 8.2.

Generate the black-level reference (section 8.3):




5

- On the toolbar, click **Start reference wizard** .
- Click **Black (offset) level reference** and **Create reference internally**.
- Click **Next** , and follow the instructions of the wizard.
- On the toolbar, click **Show simple setup view** , and then select the **Activate offset correction** check box.
- Click **Transfer setting to camera** , or press **F9** to save the setting to volatile memory.

For information about creation of a black-level reference, see section 8.3.

Generate the shading reference / flat-field correction (section 8.4):

6


- On the toolbar, click **Start reference wizard** , and follow the description in section 8.4.
- On the toolbar, click **Show simple setup view** , and then select the **Activate white-level (flat-field) correction** check box.
- Click **Transfer setting to camera** , or press **F9** to save the setting to volatile memory.

For information about creation of a shading reference, see section 8.4.

Save the settings:

7

- On the toolbar, click **Burn setting permanently**  to save settings into the camera permanently.
- You may choose different settings () to configure your system to different applications. You can create backups by saving the setting into another setting (section 6.9) or by saving the settings to disk (section 6.12).

NOTE If you select a different setting, changes that have not been saved permanently into the camera by clicking  get lost.

7.4 Line trigger / encoder functions and image enhancement functions


Add image processing functions:

1

- You can add digital image processing functions.
- Study the sections 9.6 to 9.10 onward to find out which image processing functions are offered by the allPIXA pro.


Set the line trigger or encoder functions

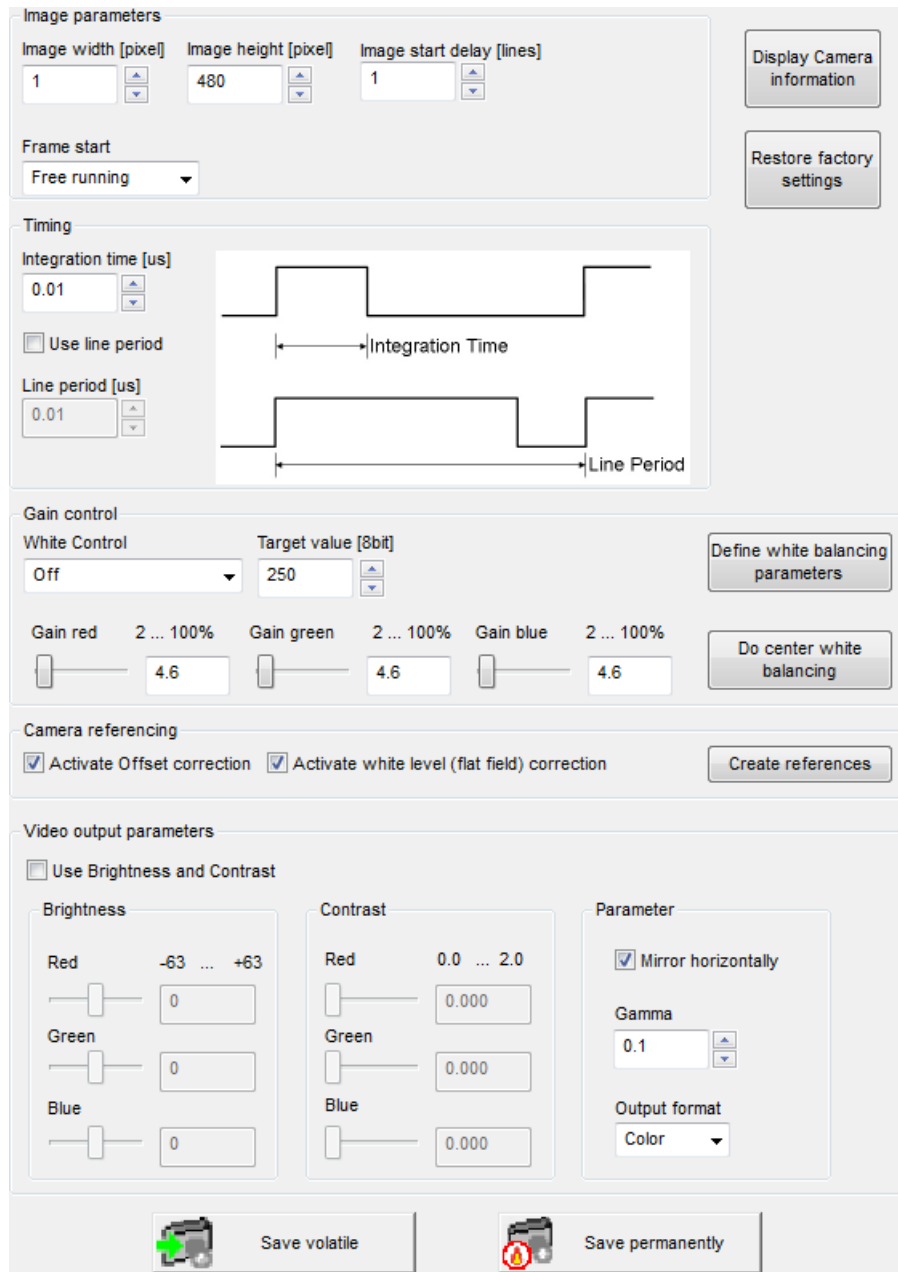
2

- Connect the encoder or line trigger with the frame grabber or directly with the camera. If the encoder is connected to the frame grabber, make sure that the signal is transferred to CC1 or CC2 (for more detailed setup, see section 8.6).
- Define the correct input signal port for the signals (see also section 8.6).
- Click **Show encoder setup**  to open the **Encoder setup** page (see section 9.17).
- Set the parameters in CST for the encoder or line trigger mode.

8 Camera operation

8.1 Easy camera configuration by use of the simple setup view

On the toolbar, click **Display simple setup view**  to enter the simple setup page which comprises the most important parameters and functions on a single page.



The screenshot shows the 'Simple Setup View' interface for a camera. It is organized into several functional sections:

- Image parameters:** Includes fields for 'Image width [pixel]' (set to 1), 'Image height [pixel]' (set to 480), and 'Image start delay [lines]' (set to 1). A 'Frame start' dropdown is set to 'Free running'.
- Timing:** Features 'Integration time [us]' (0.01) and 'Line period [us]' (0.01) fields. A checkbox 'Use line period' is present. A timing diagram shows the relationship between 'Integration Time' and 'Line Period'.
- Gain control:** Includes 'White Control' (set to 'Off') and 'Target value [8bit]' (set to 250). Below are sliders for 'Gain red', 'Gain green', and 'Gain blue', all set to 4.6.
- Camera referencing:** Contains checkboxes for 'Activate Offset correction' and 'Activate white level (flat field) correction', along with a 'Create references' button.
- Video output parameters:** Includes a 'Use Brightness and Contrast' checkbox. It has sliders for 'Brightness' (Red, Green, Blue) and 'Contrast' (Red, Green, Blue). A 'Parameter' section includes a 'Mirror horizontally' checkbox, a 'Gamma' field (0.1), and an 'Output format' dropdown (set to 'Color').
- Toolbar:** At the bottom, there are two buttons: 'Save volatile' (with a green plus icon) and 'Save permanently' (with a red warning icon).

The parameters are placed in a functional order to give you an orientation which parameters should be set first. Start with the topmost parameter.



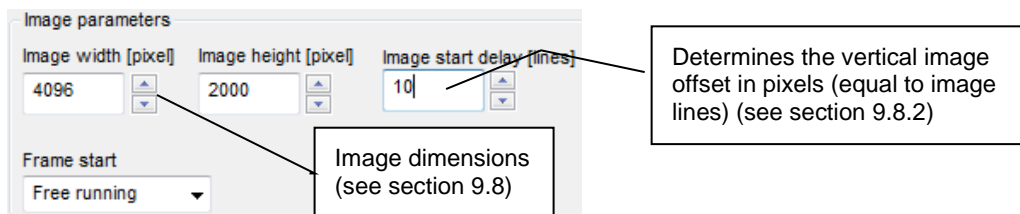
NOTE When you change a parameter, always click **Transfer setting to camera**  on the toolbar, or press **F9** afterward to transfer the settings to volatile memory! Click **Burn setting permanently**  or press **F10** to burn the setting into the camera!

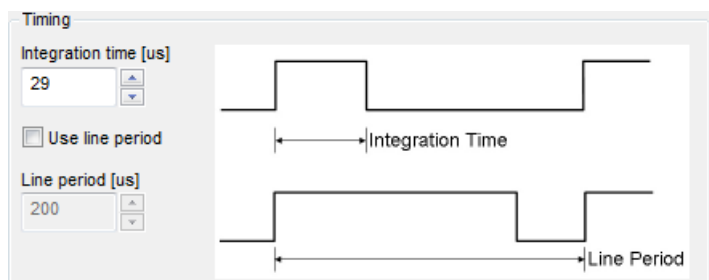
Image parameters:

In this area specify the image parameters as desired for your line scan camera system application:



1. In the **Image width** box, enter the scan line length (see section 9.8.3).
The defined image width is also the number of pixels that are output to the frame grabber via Camera Link. The image width is always centered.
2. If you use a frame scan mode, enter values at **Image height** and **Image start delay**.
3. In the **Frame start** list, specify image output by selecting **Free-running** or **Triggered** (frame trigger).
4. Alternatively, if you want to work with a line trigger, click **Show encoder setup** on the toolbar, select the **Enable encoder** check box, and click **Line trigger mode** in the **Synchronization mode** list. For more information, see section 9.17.

Timing:



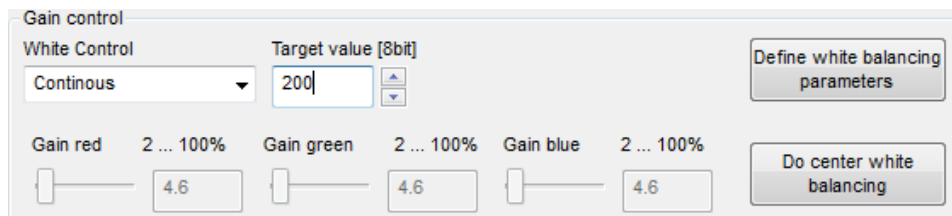
You can specify the integration time (9.1.1).

If you need the line period feature (see section 9.1.3), select the **Use line period** check box.

In triggered frame scan mode, the camera waits for a frame trigger input to start image acquisition. The grabbed image has the specified number of image lines defined in the image parameters.

Gain control:

To achieve good image quality, specify gain and white-reference parameters:



At the **White control** list specify, whether white control/balancing should operate continuously, only once per frame, or whether it should be switched off. If you select **Continuous**, the camera gain values are adjusted continuously during the scanning process.

You can specify the target value for white control, which is given as 8 bit value (0-255). The camera tries to reach the set target value (section 9.4.1) by adjusting the analog camera gain values.

You can specify the camera gain values manually (section 9.2.2).

Alternatively, you can set the camera gain values automatically by clicking **Do center white-balancing**. The white control field is moved to the middle of the image. Then the camera performs a white-balancing based on the value specified at **Target value** and sets the new gain values.

If you click **Define white balancing parameters**, the **White reference mark** page is shown on which you can specify all white balancing parameters manually following the description in section 8.2.3.

Perform a tap balancing by clicking **Perform tap balancing**  on the toolbar.

Camera calibration:

Determine whether offset correction and flat-field (shading) correction should be used:

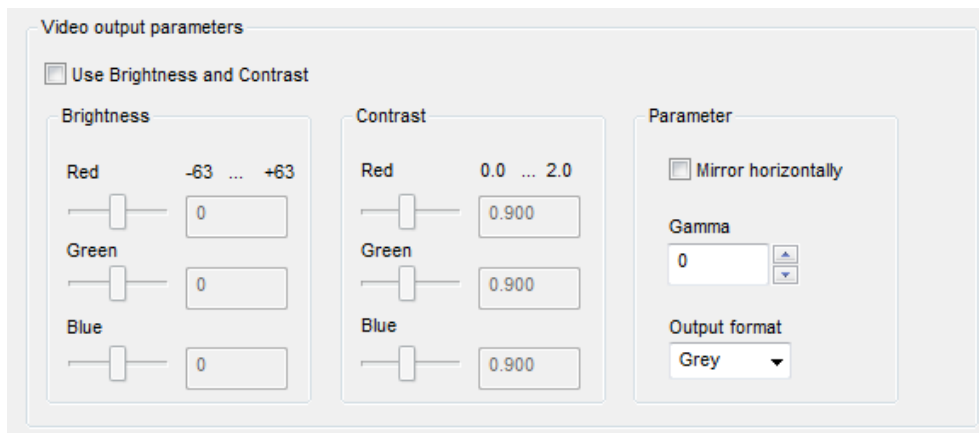


If the references for black-level and flat-field correction were already generated, simply activate/deactivate them by selecting or clearing the respective check box.

Click **Create references**, to start the reference wizard, and follow the instructions of the wizard to generate a black-level reference (section 8.3) or a white-level (shading) reference (section 8.4).

Video output parameters:

You can specify further digital image processing by setting the desired output parameters:



If the brightness and contrast parameters should be applied to the image, select the **Use Brightness and Contrast** check box. For more information about these parameters, see section 9.6.

Parameter description:

Brightness

The specified value is added to the output value. The values are in the 8-bit range.

Contrast

The output values are multiplied by the specified value. This is very useful to desaturize images after the flat-field correction.

Mirror horizontally

If you select this check box, the output image is mirrored. For example, if you use an output width of 4096 pixels, input pixel 4095 is output as pixel 0 and input pixel 0 is output as pixel 4095.

Gamma

A gamma correction table is applied to the image.

$$\text{video_out_level} = \text{video_in_level}^{1/\text{Gamma}}$$

This is valid for values > 0.4. If 0.1 is selected for the gamma value, a special table for sRGB conversion is used; with the value 0.2 a special table for special multi-spectral applications is used.

To disable gamma correction, set **Gamma** to 0.

Output format

The camera can be set to output color or gray images. If set to gray, only one Camera Link connection is used. The data are transmitted on Camera Link port 1. Port 2 is idle.

For a detailed description of the transmission of data according to the Camera Link specification, see section 4.5.2.

Transfer and burn setting:

To transfer your setting into camera memory, click **Save volatile**

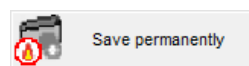


Alternatively, you can click **Transfer setting to camera**



Changes get lost if you select a different setting, or if you reset the camera or switch it off.

To burn your setting permanently into the camera, click



Alternatively, you can transfer the setting to the camera and then click **Burn setting permanently**



Restoring the default factory setting:

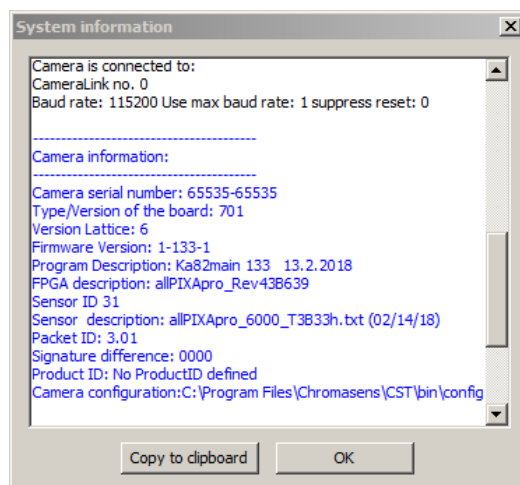
Restore factory settings

By clicking you can overwrite the current setting with the setting used for the commissioning of the camera at the Chromasens production facility. This only affects the currently active setting.

Obtaining camera information:

Display Camera information

To obtain camera information, click **Display camera information**. The following dialog box is shown:



If there are any problems with the camera or the parameter settings, it is very helpful for the Chromasens support to obtain the camera information.

To add this information to an email to Chromasens support, click **Copy to clipboard** and paste the information into your email.

8.2 Perform a white and tap balancing on the camera

You can perform white balancing automatically (see section 8.2.2) or manually (see section 8.2.3)

For more information about gain levels, see section 9.2.1.

8.2.1 System preparation for white and tap balancing

Setup

- Set the camera to free-running mode (disable encoder and frame trigger)
- Use a white balancing reference that covers the entire scanning range.

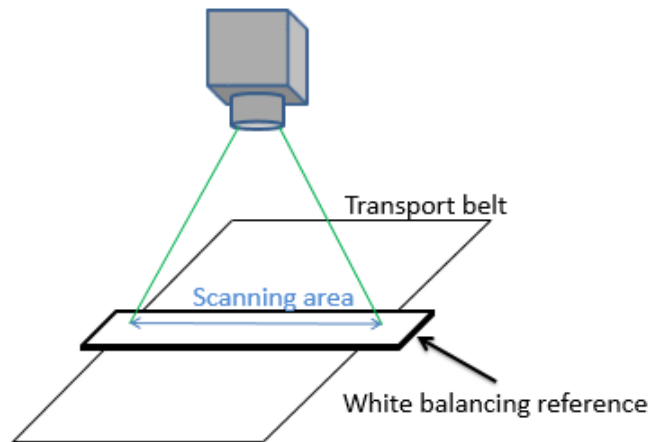


Figure 32: allPIXA pro camera with a white balancing reference

- Check the alignment of the illumination and the allPIXA pro camera using a suitable viewer (for example the line plot display of your frame grabber software).

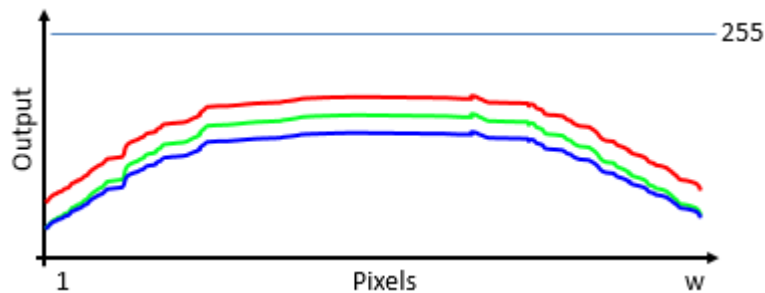


Figure 33: Line plot display

8.2.2 Setting the operation point automatically

- NOTE**
- The position of the white reference mark (control zone) and the target gain value for the control zone are used as specified in the setting (see section 9.3)
 - This operation only takes place in the currently selected setting.
 - This function must receive line data inside the camera. If the camera is set to line trigger or encoder mode and the transport is not moving, an error occurs.
 - Set the camera to internal line trigger.

1

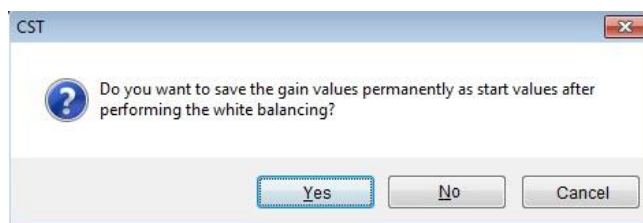
Prepare the setup for the operation.

- Make sure that black-level correction is enabled (see section 9.5.1)

2

- On the toolbar, click **Perform white balancing** .

A dialog box is shown:



- If you want to use the determined gain values as startup values (recommended), click **Yes**. Otherwise click **No**.

If the process succeeds, **White balancing succeeded** appears in the message box.

Possible errors:

3

White balancing error occurred. Error code No: 0x10D: no reference data

→ Camera is not in free-running mode (line and/or frame), but there are no trigger signals and thus no reference data are available.

⇒ Adapt your configuration accordingly.

White balancing error occurred. Error code No: 0xF6: maximum gain exceeded

→ Digital gain value exceeds internal limit.

⇒ Increase analog coarse gain or increase illumination intensity. (see also section 9.2.1)

White balancing error occurred. Error code No: 0x41: minimum gain exceeded

→ Digital gain value has reached lower limit.




⇒ Decrease analog coarse gain or reduce illumination intensity.

White balancing error occurred. Error code No: 0xF7: White balance cannot be leveled

→ White balance process has exceeded time limit but up to now no error has occurred. White balance may last very long if white reference area is large, line period is high.

⇒ Restart of white balance may finish the process successful.

For a special single camera color channel calibration (individual red/green and blue calibration), see section 8.2.4.

4	<ul style="list-style-type: none"> On the toolbar, click Perform tap balancing .
5	<ul style="list-style-type: none"> On the toolbar, click Refresh current camera parameters . <p><u>Optional:</u></p> <ul style="list-style-type: none"> On the Gain settings page, check the Current camera gain values. It is recommended to keep the gaining values in the range of 150 to 300 for best image quality. If they are near or above 300, it is recommended to increase the values of Analog coarse gain and repeat from step 2. <p>For more information about analog coarse gain, see section 9.2.1.</p>
6	<ul style="list-style-type: none"> On the toolbar, click Burn setting permanently .

8.2.3 Setting the operation point manually

Manual operating point setting serves to determine the area which is viewed by the allPIXA pro camera for carrying out the shading correction.

The pattern below describes the principle of analog image processing.

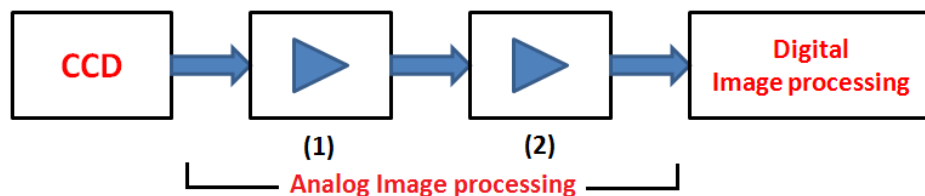


Figure 34 Analog image processing comprises two levels.

- 1) Analog coarse gain: Pre-Amplification factor;
for rough adjustment of the sensor signal to the main amplifying level.
- 2) Current camera gain values: Main analog amplifying level;
for fine-adjustment of analog gaining.

For more information about camera gain adjustment, see section 9.2.1.

Gain and reference settings

- On the **White control** page, check that the **Enable continuous white control** check box **a** is cleared.
- In the **Position and mode for white reference mark** list **b**, **Automatic master detection out of area position** must be selected.

This parameter is not visible if **User level** has the value **Normal user** or **Expert**. In this case, the parameter has the desired value by default.

Camera-Settings

- [-] Camera parameter
 - Integration time
 - Gain settings
 - White reference mark
 - White control**
 - Reference usage
 - Brightness and contrast
 - Camera arrangement
- [-] Image parameter
 - Image sizes
 - Synchronization
 - Image processing
 - Output format
- [-] LED illumination control
 - led flash control
- [-] Special functions
 - Test pattern
 - Register edit
- [-] General information
 - Camera information
- [-] Global parameter
 - Global master/slave config
 - Tracing

Target white reference values

Set all equal

Red odd	Red even
800	800
Green odd	Green even
800	800
Blue odd	Blue even
800	800
Red odd rear	Red even rear
800	800
Green odd rear	Green even rear
800	800
Blue odd rear	Blue even rear
800	800

Current White reference levels

Set all equal

Red odd	Red even
762	1014
Green odd	Green even
800	1016
Blue odd	Blue even
768	828
Red odd rear	Red even rear
764	981
Green odd rear	Green even rear
764	1014
Blue odd rear	Blue even rear
757	757

White Control

a Enable continuous white control

Position and mode for white reference mark

b Automatic master detection out of area position

White control mode

- Gain control using area range
- Use Maximum video level (only used for specific applications)
- Use sync mode: acquiring references is synchronized with area scan
- stop gain control if level < 'Stop gain control * last gain value
- stop gain control by variance value

Gain control stop factor

0.7996

Set gain control stop by variance

0

Select active channels for white control

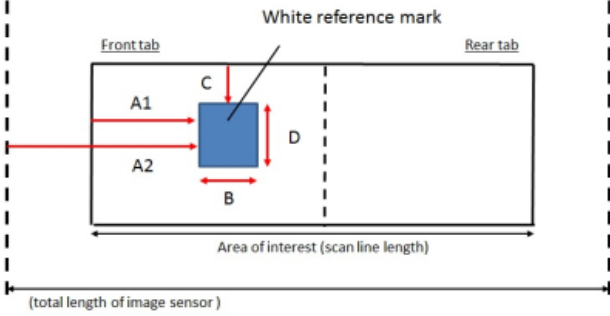
- Red
- Green
- Blue

1

Selection and adjustment of the white reference mark position

Camera-Settings

- Camera parameter
 - Integration time
 - Gain settings
 - White reference mark**
 - White control
 - Reference usage
 - Brightness and contrast
 - Camera arrangement
- Image parameter
 - Image sizes
 - Synchronization
 - Image processing
 - Output format
- Special functions
 - Test pattern
- General information
 - Camera information
- Global parameter
 - Global master/slave config



A1 = First relative pixel of white reference (may be negative)
 A2 = First absolute pixel of white reference
 B = Number of pixel for white reference
 C = First image line for white reference (may be negative),
 only used if *white control mode* is set to „sync mode“
 D = Number of image lines for white reference

First relative pixel of white reference (A1)
 A

First absolute pixel of white reference (A2)

Use absolute horizontal position of white reference

Number of pixels for white reference (B)
 B

First image line for the white reference (C)
 C

Number of image lines for the white reference (D)
 D

Number of reference samples for white reference

Show white reference border
 Display white reference borders in the image


2

- On the **White reference mark** page, specify the parameters **A** to **D** for the position and size of the white reference mark. It should be at the brightest region of the image. Often this is the center of the image.
- To check your parameter settings, you can temporarily select the **Display white reference borders in the image** check box.


Note:

The reference mark area **may not** include the TAP border.
 If the front and rear TAPs are defined to be independent, the defined reference mark area is mirrored into the other TAP.

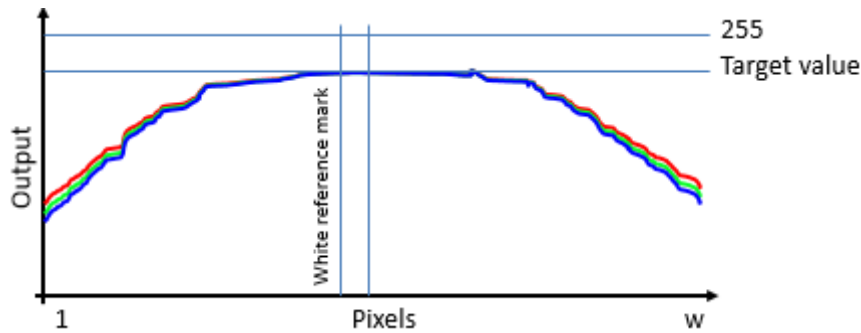
3

- Click **Transfer setting to camera**  (or press **F9**).
 Current camera parameters are saved non-permanently in the camera.

Setting of Target White Reference Values (Video Levels)

- On the tree view, click **White control**.
- Set the **Target white reference values** a for the master tap.
(= front tap in the example below).
The range is from 0 – (1023 - the max dark value)
(recommended values are about 800 (10-bit values) for a white reference target)
- On the toolbar, click **Transfer setting to camera**  .

The target video levels must be set in such a way that the brightest image points are set below the saturation point. Take notice that the brightest scanned reference should not bring the AD converter to saturation. If the objects are brighter than the current white reference to be scanned during subsequent operation, the distance to saturation must be increased by this ratio (max. = 255- the max dark value of the offset reference at the white reference mark area).

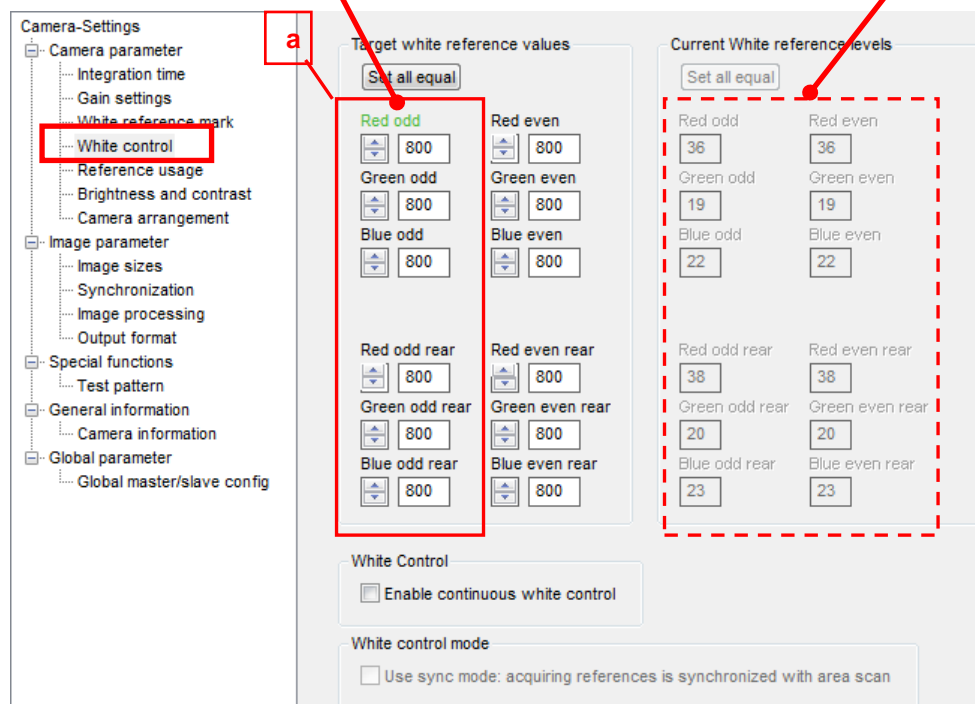


4

Use the **Current white reference levels** displayed on the right as a starting point.

Target white-reference settings for **front tap**.

Current white-reference levels



Target white reference values

Set all equal

Red odd	800	Red even	800
Green odd	800	Green even	800
Blue odd	800	Blue even	800
Red odd rear	800	Red even rear	800
Green odd rear	800	Green even rear	800
Blue odd rear	800	Blue even rear	800

White Control

Enable continuous white control

White control mode


Use sync mode: acquiring references is synchronized with area scan

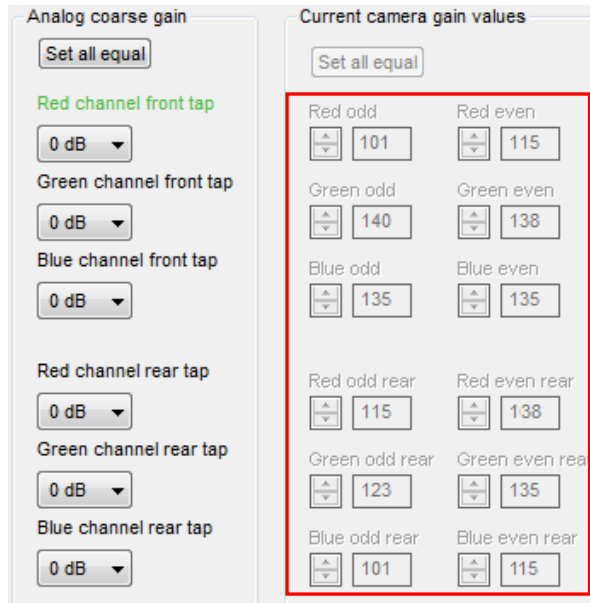
Current White reference levels

Set all equal



Red odd	36	Red even	36
Green odd	19	Green even	19
Blue odd	22	Blue even	22
Red odd rear	38	Red even rear	38
Green odd rear	20	Green even rear	20
Blue odd rear	23	Blue even rear	23

Check/re-adjust video levels

- On the toolbar, click **Refresh current camera parameters**  after you have entered the target white reference values (see step 4).
- On the tree view, click **Gain settings**, and then check the **Current camera gain values**. They should be in a range between 150 and 300:




Analog coarse gain		Current camera gain values	
<input type="button" value="Set all equal"/>		<input type="button" value="Set all equal"/>	
Red channel front tap	0 dB	Red odd	Red even
Green channel front tap	0 dB	101	115
Blue channel front tap	0 dB	Green odd	Green even
Red channel rear tap	0 dB	140	138
Green channel rear tap	0 dB	Blue odd	Blue even
Blue channel rear tap	0 dB	135	135
		Red odd rear	Red even rear
		115	138
		Green odd rear	Green even rear
		123	135
		Blue odd rear	Blue even rear
		101	115

- If a current gain value exceeds 300, you could increase the corresponding value at **Analog coarse gain**. If a current gain value is below 150, you could reduce the corresponding value at **Analog coarse gain**.
- If you modified parameters, click **Transfer setting to camera**  on the toolbar, and then start again with step 5.
- If you do not achieve satisfying results, you could also adjust values at **Target white reference values** on the **White control** page (refer to step 4).
- On the toolbar, click **Transfer setting to camera**  to save the settings non-permanently on the camera.

Tap balancing

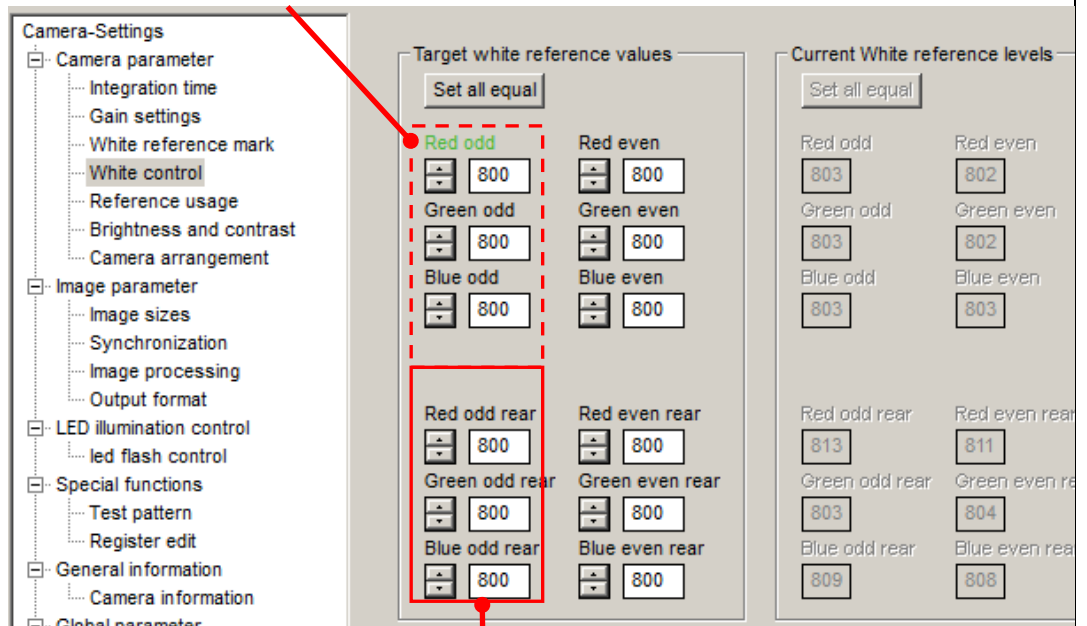
- On the toolbar, click **Perform tap balancing** .

The values for the slave tap (= rear tap in the example shown below) are aligned with the master tap.

- Click **Refresh current camera parameters** .

Example with the front tap as the master tap and the rear tap as the slave tap:

Target white reference settings for **front** tap.



The screenshot shows the 'Camera-Settings' menu on the left, with 'White control' selected. The main interface is divided into two panels: 'Target white reference values' and 'Current White reference levels'.

Target white reference values:

Set all equal	
Red odd	Red even
800	800
Green odd	Green even
800	800
Blue odd	Blue even
800	800
Red odd rear	Red even rear
800	800
Green odd rear	Green even rear
800	800
Blue odd rear	Blue even rear
800	800

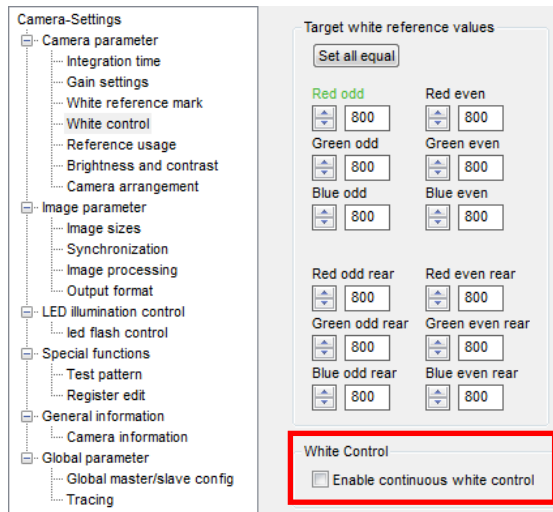
Current White reference levels:

Set all equal	
Red odd	Red even
803	802
Green odd	Green even
803	802
Blue odd	Blue even
803	803
Red odd rear	Red even rear
813	811
Green odd rear	Green even rear
803	804
Blue odd rear	Blue even rear
809	808

Target white reference settings for **rear** tap.

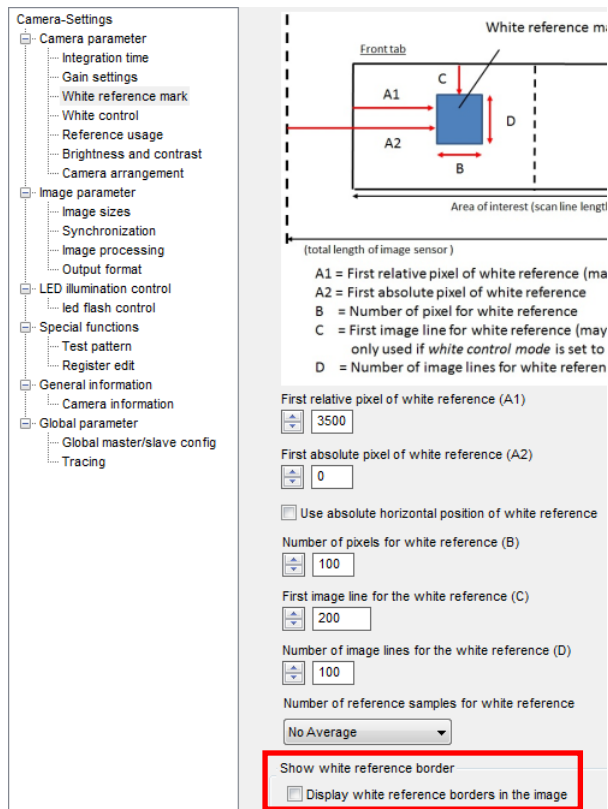
Disable white control

- If the result of white control is acceptable, clear the **Enable continuous white control** check box on the **White control** page:



- On the **White reference mark** page, clear the **Display white reference borders in the image** check box:

7



Transfer settings to the camera

8

- On the toolbar, click **Transfer setting to camera** , or press **F9**.



Save settings

9

- On the toolbar, click **Burn setting permanently** , or press **F10**.

8.2.4 Independent color channel white balancing

For special tasks a special illumination setup may be necessary. If an inspection task is performed in which in each color channel different information is evaluated by use of a special illumination per channel, the balancing procedure must be performed individually per channel.

1	<p>Prepare the setup for the operation</p> <ul style="list-style-type: none"> Make sure that black-level correction is enabled (see section 9.5.1)
2	<p>Select channel</p> <ul style="list-style-type: none"> On the White control page, select Red as active channel (9.4.8): <div style="border: 1px solid #ccc; padding: 5px; width: fit-content; margin: 10px auto;"> <p style="margin: 0;">Set active channels for white control</p> <p><input checked="" type="checkbox"/> Red</p> <p><input type="checkbox"/> Green</p> <p><input type="checkbox"/> Blue</p> </div> <p>Take notice that the Select active channels for white control check boxes are only visible if User level is set to Guru in the System configuration.</p>
3	<p>Turn on the illumination for the red channel</p>
4	<p>Put the appropriate calibration chart in front of the camera</p>
5	<p>Perform the balancing steps according to section 8.2.</p>
6	<p>Repeat steps 2 to 4 for the other color channels:</p> <div style="display: flex; align-items: center; justify-content: space-around;"> <div style="border: 1px solid #ccc; padding: 5px; width: 150px;"> <p style="margin: 0;">Set active channels for white control</p> <p><input type="checkbox"/> Red</p> <p><input checked="" type="checkbox"/> Green</p> <p><input type="checkbox"/> Blue</p> </div> <p style="margin: 0;">and</p> <div style="border: 1px solid #ccc; padding: 5px; width: 150px;"> <p style="margin: 0;">Set active channels for white control</p> <p><input type="checkbox"/> Red</p> <p><input type="checkbox"/> Green</p> <p><input checked="" type="checkbox"/> Blue</p> </div> </div>
7	<p>Transfer settings to the camera</p> <ul style="list-style-type: none"> On the toolbar, click Transfer setting to camera  or press F9.
8	<p>Save settings</p> <ul style="list-style-type: none"> On the toolbar, click Burn setting permanently  or press F10.

For information about an individual offset (shading) correction on each color channel, see section 8.4.4

8.3 Generating black (offset) reference

Creation of a black-level reference is only necessary during commissioning or if the gain values are changed considerably.

You have three options to generate a black reference:

1) Create a black (offset) reference internally (see section 8.3.1)

Use this function if you want to perform offset correction directly inside the camera.



2) Use a stored black (offset) level reference image (see section 8.3.2)

Use this function if you have a stored black-level reference image on your hard disk.

3) Prepare camera to acquire a black (offset) reference (see section 8.3.3)

Use this function if you do not have a black-level reference image and want to generate a black reference with an image acquisition software. You can directly perform an offset correction after grabbing the black reference. The reference wizard guides you through this process.

8.3.1 Create a black (offset) reference internally

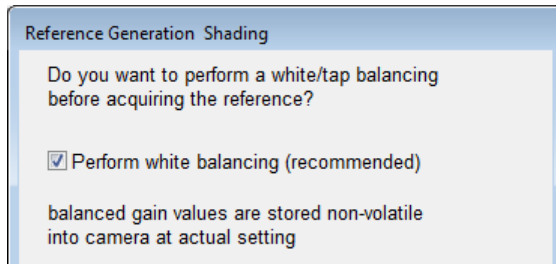
Get the camera to the desired working point	
1	<p>Prepare the camera</p> <ul style="list-style-type: none"> Place a white reference in front of the camera Check the lighting and focusing Disable continuous white control Save the parameters to the camera
Start the reference wizard	
2	<ul style="list-style-type: none"> On the toolbar, click Start reference wizard .
Select reference type and image source	
3	<ul style="list-style-type: none"> Click Black (offset) level reference. Click Create reference internally: <div style="border: 1px solid #ccc; padding: 10px; margin: 10px 0;"> <p style="text-align: center; margin: 0;">Reference Generation Shading</p> <p>1 - Choose type of reference</p> <p><input checked="" type="radio"/> Black(offset) level reference</p> <p><input type="radio"/> White(flat field) level reference</p> <hr/> <p>2 - Select image source</p> <p><input type="radio"/> Load reference image from disk</p> <p><input type="radio"/> Prepare camera to acquire a raw image</p> <p><input checked="" type="radio"/> Create reference internally</p> </div> <ul style="list-style-type: none"> Click Next .

Optional: White balancing


Decide whether you want to perform a white balancing:

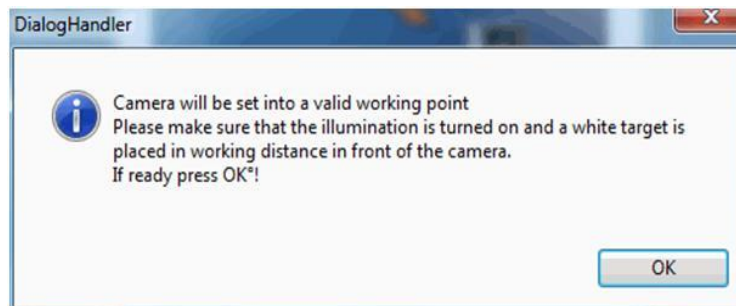
To achieve the best performance / image quality, it is recommended to perform white balancing. By performing a white balancing, the camera gain values are set correctly to acquire the desired image for a black-level reference.

- If you don't want to perform a white balancing, clear the **Perform white balancing** check box and continue with **Step 5**.



4

- Click **Next** . The following dialog box is shown:

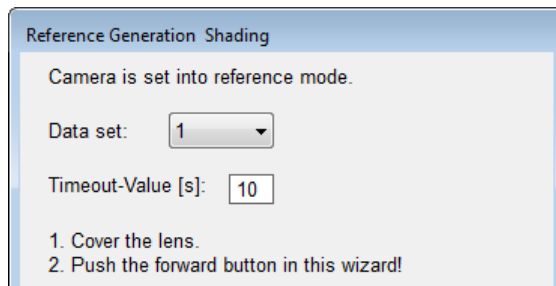


- Follow the instructions in the message box and then click **OK**.


Note: Changes that have not been saved at this point get lost.

Start black-level correction:

- In the **Data set** list, select the data set, in which the offset reference should be generated and stored:



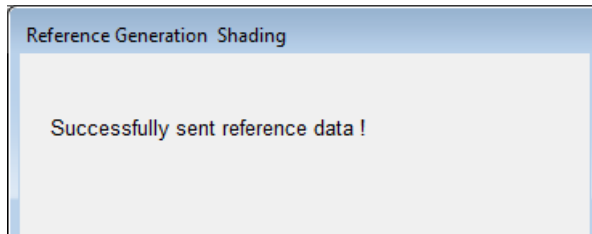
5

- In the **Timeout value** box, enter the timeout value in seconds.
- Cover the lens so that the sensor is completely dark.
- Click **Next** .

Wait for result

6

A progress bar is shown while the reference is created and stored. When it has finished successfully, the wizard shows the following message:




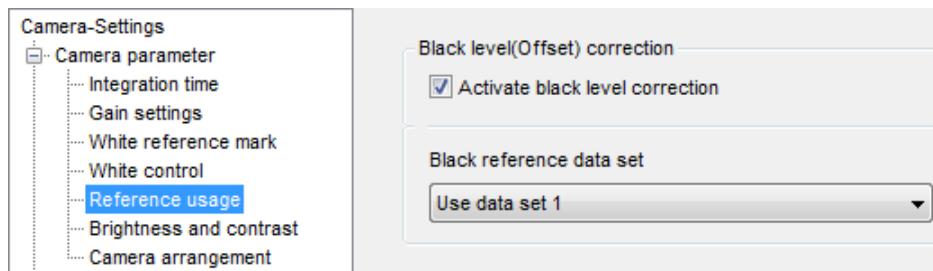
To close the wizard and to restore the camera settings, click **Next**




Activate black-level correction and check the result on the image.

7

- On the toolbar, click **Show settings** , and then click **Reference usage**.
- To check black-level correction, select the **Activate black-level correction** check box and check that the just updated data set is used:






At least a few pixels should have a value greater than 0 (for example 1 or 2) in the black image with activated black-level correction and covered lens. Otherwise, (if **all** pixels are 0) the image is over-compensated, and you should repeat the steps for reference generation.

- Click **Transfer setting to camera**  to save the setting to volatile memory.
- You may proceed to section 8.4 to generate a shading reference.

8.3.2 Use a stored black (offset) level reference image

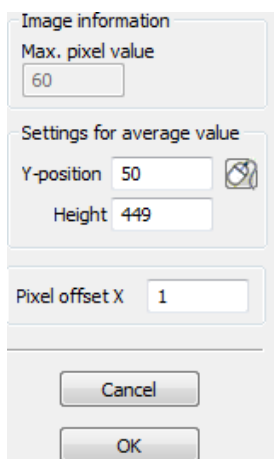
The creation of a black-level reference is only necessary if the gain values are changed considerably.

1	Start the reference wizard
1	<ul style="list-style-type: none"> On the toolbar, click Start reference wizard .
2	Select reference type and source
2	<ul style="list-style-type: none"> Click Black (offset) level reference. Click Load reference image from disk: <div style="border: 1px solid #ccc; padding: 10px; margin: 10px 0;"> <p>Reference Generation Shading</p> <p>1 - Choose type of reference</p> <p><input checked="" type="radio"/> Black(offset) level reference</p> <p><input type="radio"/> White(flat field) level reference</p> <p>2 - Select image source</p> <p><input checked="" type="radio"/> Load reference image from disk</p> <p><input type="radio"/> Prepare camera to acquire a raw image</p> <p><input type="radio"/> Create reference internally</p> </div> <p>Click Next .</p>
3	Select offset reference image
3	<ul style="list-style-type: none"> Click Select file: <div style="border: 1px solid #ccc; padding: 10px; margin: 10px 0;"> <p>Reference Generation Shading</p> <p>1 - Select reference image</p> <p style="text-align: right;">C:\temp\BlackRef.tif</p> <p style="text-align: center;"><input type="button" value="Select file"/></p> </div> <ul style="list-style-type: none"> In the file dialog box, select the reference file, and click Open. Click Next .

Define the area where the reference values should be calculated

4

The dialog box shows the reference image. On the right side, the following parameters are shown:



- At the **Y position** box and the **Height** box, specify the area which should be used to calculate the reference values.

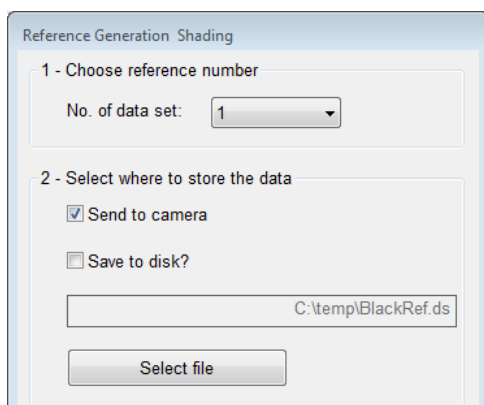
Use at least 100 lines for calculating the reference values to eliminate noise. The values used for the reference are calculated by averaging each column in the selected area.

- Click **OK**.

Saving reference data

5

- In the **No. of data set** list, click the number of the data set in which the reference data should be stored:



- If the reference data should not be sent to the camera, clear the **Send to camera** check box.
- To save the reference data to a file as backup, select the **Save to disk?** check box, and then click **Select file** to specify folder and file name.


- Click **Next** .

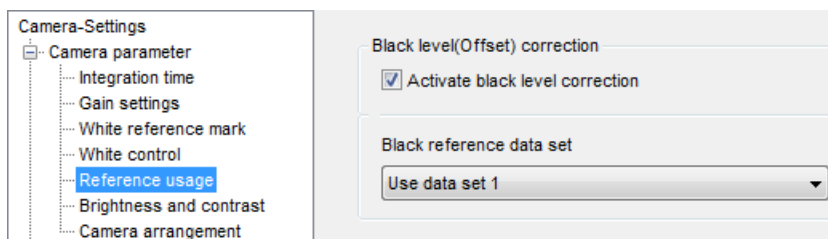
If the reference data are sent to the camera, a progress bar is shown, and the camera is reset afterward to make sure that the initial settings are again active. The last used setting is activated automatically.

- Again click **Next**  to close the wizard.


Activate black-level correction and check the result in the image.

6

- On the toolbar, click **Show settings** , and then click **Reference usage**.
- To check black-level correction, select the **Activate black-level correction** check box and check that the just updated data set is used:



At least a few pixels should have a value greater than 0 (for example 1 or 2) in the black image with activated black-level correction and covered lens. Otherwise, (if **all** pixels are 0) the image is over-compensated, and you should repeat the steps for reference generation.

- Click **Transfer setting to camera**  to save the setting to volatile memory.
- You may proceed to section 8.4 to generate a shading reference.

8.3.3 Prepare camera to acquire a black (offset) reference

The creation of a black-level reference is only necessary during commissioning or if the gain values are changed considerably.



Make sure that all changes made to your current setting are saved permanently to the camera before you use the Reference wizard. Otherwise, all changes get lost!

Get the camera to the desired working point

1

- Place a white reference in front of the camera
- Check lighting and focusing
- Disable continuous white control
- Save the parameters to the camera

Start the reference wizard

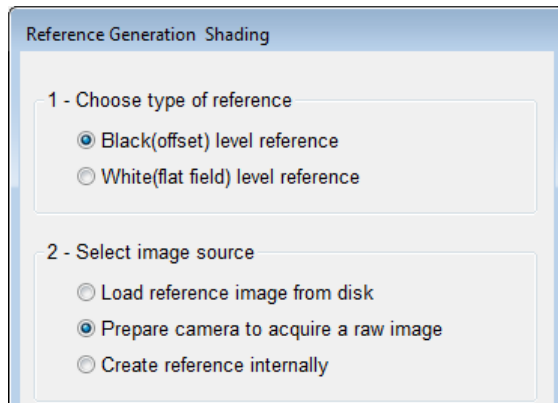
2

- On the toolbar, click **Start reference wizard**  .

Select reference type and image source

3

- Click **Black (offset) level reference**.
- Click **Prepare camera to acquire a raw image**:



- Click **Next** .

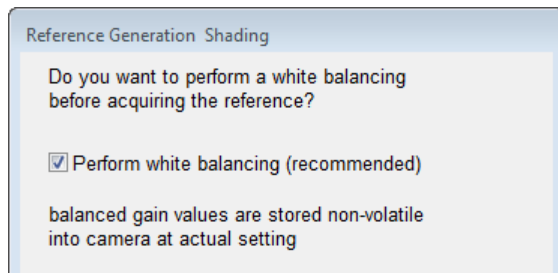
Optional: White balancing


Decide whether you want to perform a white balancing:

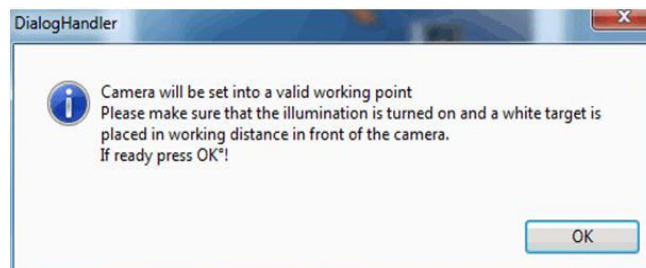
To achieve the best performance / image quality, it is recommended to perform white balancing. By performing a white balancing, the camera gain values are set correctly to acquire the desired image for a black-level reference.

- If you don't want to perform white balancing, clear the **Perform white balancing** check box and continue with Step 5.

4



- Click **Next** . The following dialog box is shown:



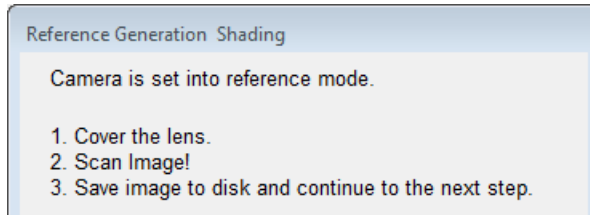
- Follow the instructions in the message box, and then click **OK**.


Note: Changes that have not been saved at this point get lost.

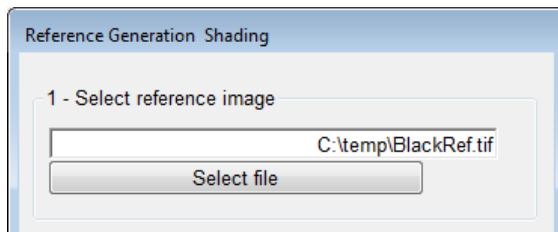
Acquire a black reference:


5

- Perform the steps shown on the next page of the wizard:



- Cover the lens so that there is no light on the sensor.
- Grab an image using the appropriate acquisition software.
- Save the image to a file, and then click **Next** .
- On the next page of the wizard, click **Select file**:

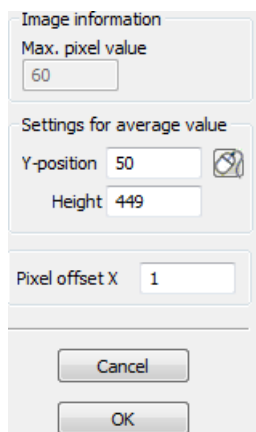


- Select the reference file in the appearing file dialog box, and then click **OK**:
- Click **Next** .

Define the area where the reference values should be calculated

6

The dialog box shows the reference image. On the right side, the following parameters are shown:



- At the **Y position** box and the **Height** box, specify the area which should be used to calculate the reference values.

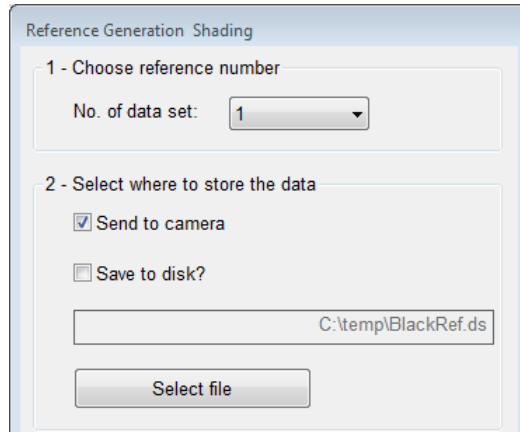
Use at least 100 lines for calculating the reference values to eliminate noise. The values used for the reference are calculated by averaging each column in the selected area.


- Click **OK**.

Saving reference data

7

- In the **No. of data set** list, click the number of the data set in which the reference data should be stored:




- If the reference data should not be sent to the camera, clear the **Send to camera** check box.
- To save the reference data to a file as backup, select the **Save to disk** check box, and then click **Select file** to specify folder and file name.
- Click **Next** .

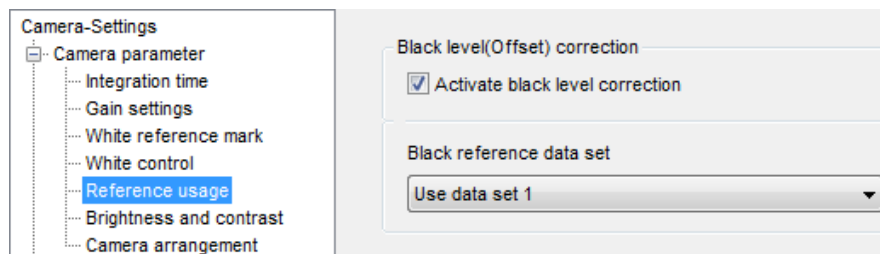
If the reference data are sent to the camera, a progress bar is shown, and the camera is reset afterward to make sure that the initial settings are again active. The last used setting is activated automatically.

- Again click **Next**  to close the wizard.


Activate black-level correction and check the result on the image.

8

- On the toolbar, click **Show settings** , and then click **Reference usage**.
- To check black-level correction, select the **Activate black-level correction** check box and check that the just updated data set is used:



At least a few pixels should have a value greater than 0 (for example 1 or 2) in the black image with activated black-level correction and covered lens. Otherwise, (if **all** pixels are 0) the image is over-compensated, and you should repeat the steps for reference generation.

- Click **Transfer setting to camera**  to save the setting to volatile memory.
- You may proceed to section 8.4 to generate a shading reference.

8.4 Generating shading/ flat-field reference

To generate a shading / flat-field reference, click **Start reference wizard**  on the toolbar.

You have three options to generate a shading reference

1) Create a white(gain) reference internally (see section 8.4.1)

Use this function if you want to perform shading/flat-field correction directly inside the camera.

2) Use a stored white (gain) level reference image (see section 8.4.2)

Use this function if you have a stored white/shading reference image on your hard disk.


This function should also be used if you need to use separate images for the single color channels (for example if you work with different illumination setups, flash illumination, etc.)

3) Prepare camera to acquire a white (gain) reference (see section 8.4.3)

Use this function if you do not have a white level reference image and want to generate a white/shading reference with an image acquisition software. You can directly perform an offset correction after grabbing the black reference. The wizard guides you through this process.

8.4.1 Create white (gain) reference internally

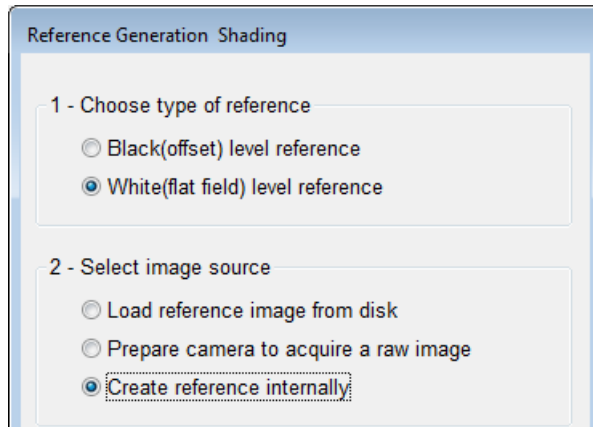
Creation of a shading reference is only necessary during commissioning or if the gain values are changed considerably.

Get the camera to the desired working point	
1	<ul style="list-style-type: none"> • Place a white reference in front of the camera • Check the lighting and focusing • Disable continuous white control • Save the parameters to the camera • Optional: Activate black-level correction • Optional: Perform white balancing <p>Note: If the white reference target is placed in the best focus plane of the camera, any features on its surface (for example dust, scratches) end up in the calibration profile of the camera. To avoid this if you use a static (non-moving) white reference target, use 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. If this is not possible, you could place the reference target a little bit out of the best focus plane; but take care that the illumination of the target does not change too much.</p>
Start the reference wizard	
2	<ul style="list-style-type: none"> • On the toolbar, click Start reference wizard .

Select reference type and image source

3

- Click **White (flat-field) level reference** and **Create reference internally**:



- Click **Next** .

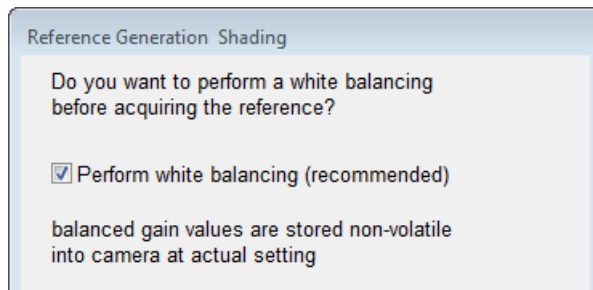
Optional: White balancing


Decide whether you want to perform a white balancing:

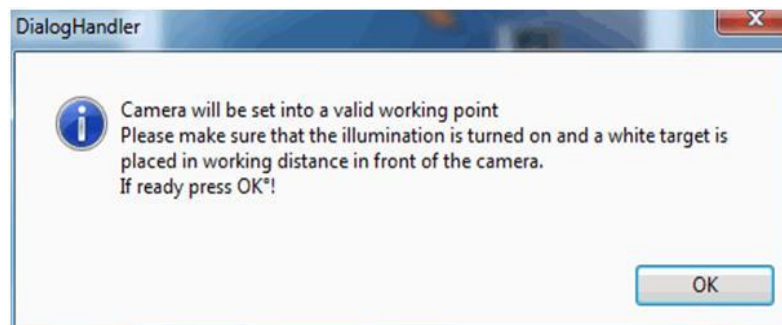
To achieve the best performance / image quality, it is recommended to perform white balancing. By performing a white balancing, the camera gain values are set correctly to acquire the desired image for a black-level reference.

- If you don't want to perform white balancing, clear the **Perform white balancing** check box and continue with Step 5.

4



- Click **Next** . The following dialog box is shown:



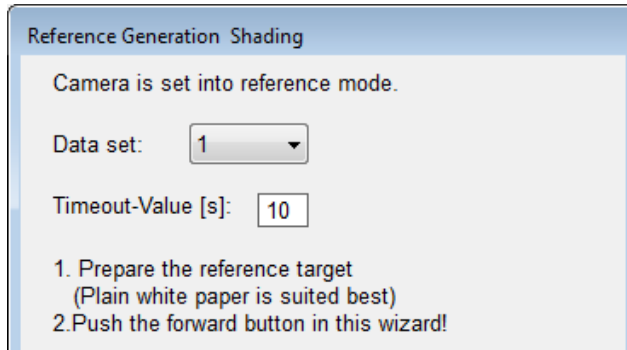
- Follow the instructions in the message box, and then click **OK**.

Note: Changes that have not been saved at this point get lost.

Start the shading correction:

5

- In the **Data set** list, select the data set, in which the offset reference should be generated and stored:



- In the **Timeout value** box, enter the timeout value in seconds.
- Move the target slightly or defocus the lens to avoid streaky images, if necessary.

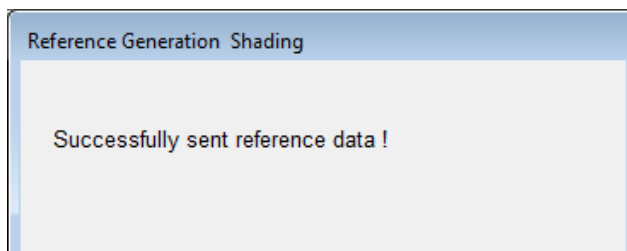
Note: Any features on the target surface (for example dust, scratches) end up in the calibration profile of the camera. To avoid this if you use a static (non-moving) white reference target, use a clean white ceramic or plastic material, not paper. Ideally, the white object should move during the calibration process because the movement results in an averaging process and the camera diminishes the effects on any small variation in the white reference.


- Click **Next** .

Wait for result


6

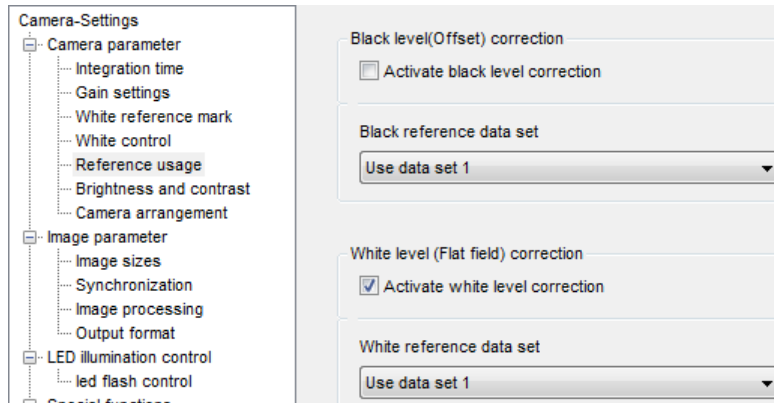
A progress bar is shown while the reference is created and stored. When it has finished successfully, the wizard shows the following message:



- To close the wizard and to restore the camera settings, click **Next** .

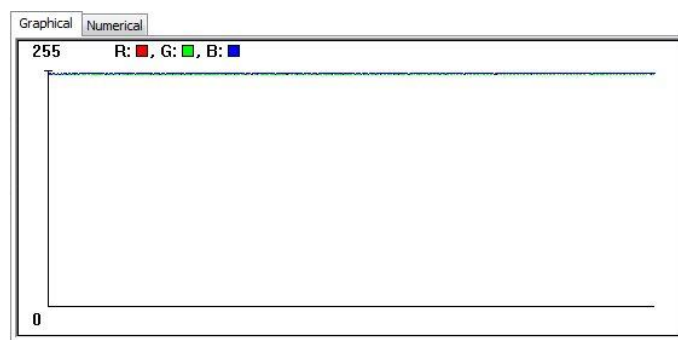
Activate shading correction and check the result on the image.

- On the toolbar, click **Show settings** , and then click **Reference usage**.
- To check white-level correction, select the **Activate white-level correction** check box and check that the just updated data set are used:

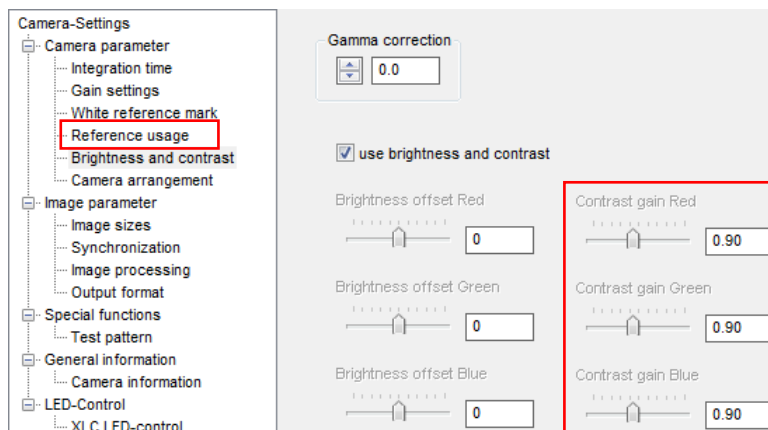


- Click **Transfer setting to camera**  to save the setting to volatile memory.

Brightness of the newly scanned white balancing reference should be exactly at the saturation limit. (255 @8Bit).



Note: At a later point, the image can be "desaturated" to a target value off, for example, 230 for a white paper by use of a contrast adjustment of $230/255=0,90$.






Save the setting

- On the toolbar, click **Burn setting permanently** , or press **F10** to save the setting permanently into the camera.

8.4.2 Use a stored white (gain) reference image

Creation of shading reference is only necessary during commissioning or if the gain values are changed considerably.

Note: If the white reference target is placed in the best focus plane of the camera, any features on its surface (for example dust, scratches) end up in the calibration profile of the camera. To avoid this if you use a static (non-moving) white reference target, use 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. If this is not possible, you could place the reference target a little bit out of the best focus plane; but take care that the illumination of the target doesn't change too much.

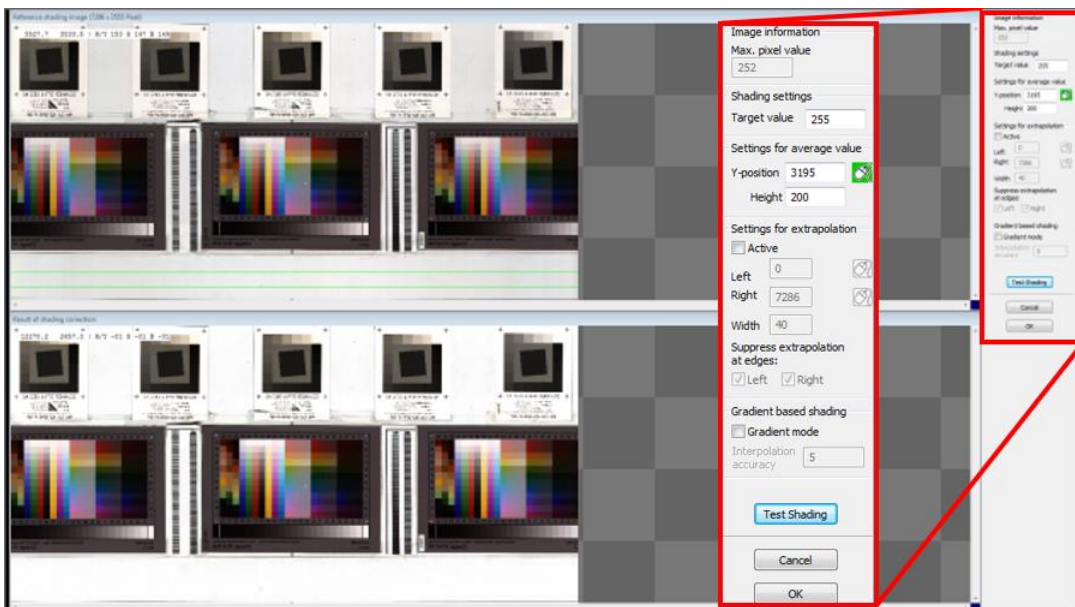
1	Start the reference wizard
2	<ul style="list-style-type: none"> On the toolbar, click Start reference wizard .
2	<p style="background-color: #1f4e79; color: white; text-align: center; padding: 2px;">Select reference type and source</p> <ul style="list-style-type: none"> Click White (flat-field) level reference. Click Load reference image from disk: <div style="border: 1px solid #ccc; padding: 5px; margin: 10px 0;"> <p style="font-size: small; margin: 0;">Reference Generation Shading</p> <p>1 - Choose type of reference</p> <p><input type="radio"/> Black(offset) level reference</p> <p><input checked="" type="radio"/> White(flat field) level reference</p> <hr/> <p>2 - Select image source</p> <p><input checked="" type="radio"/> Load reference image from disk</p> <p><input type="radio"/> Prepare camera to acquire a raw image</p> <p><input type="radio"/> Create reference internally</p> </div> <ul style="list-style-type: none"> Click Next .
3	<p style="background-color: #1f4e79; color: white; text-align: center; padding: 2px;">Choose white reference image</p> <ul style="list-style-type: none"> Click Select file: <div style="border: 1px solid #ccc; padding: 5px; margin: 10px 0;"> <p style="font-size: small; margin: 0;">Reference Generation Shading</p> <p>1 - Select reference image</p> <p style="border: 1px solid #ccc; padding: 2px; margin: 5px 0;">C:\Pictures\ShadingRef.tif</p> <p style="text-align: center; margin: 5px 0;"><input type="button" value="Select file"/></p> </div> <ul style="list-style-type: none"> In the file dialog box, select the reference file, and click Open. Click Next . <p>Note: For special applications, the three color levels can also originate from various images. In this case select the check box. The page then changes, and you can select separate files for the three color channels.</p>

Define the area where the reference values should be calculated (a)

- If it is not possible to cover the full scanning width with a white reference target (see sample image in **Step 4**), for example due to mechanical conditions, the resulting black image borders on the left and right side can also be substituted by extrapolated values. So, the bright area is extended outwards.
→ Proceed with **Step 5**.
- Specify the area from which the reference values should be calculated: in the **Y position** box, enter the number of the first line, in the **Height** box the number of lines to be used.
Use at least 100 lines for calculation of the reference values to eliminate noise. The values used for the reference are calculated by averaging each column in the selected area.

Sample image if your white reference target covers the full field of view of the camera:

4



- Click **OK**, and then proceed with **Step 6**.

Define the area where the reference values should be calculated (b)

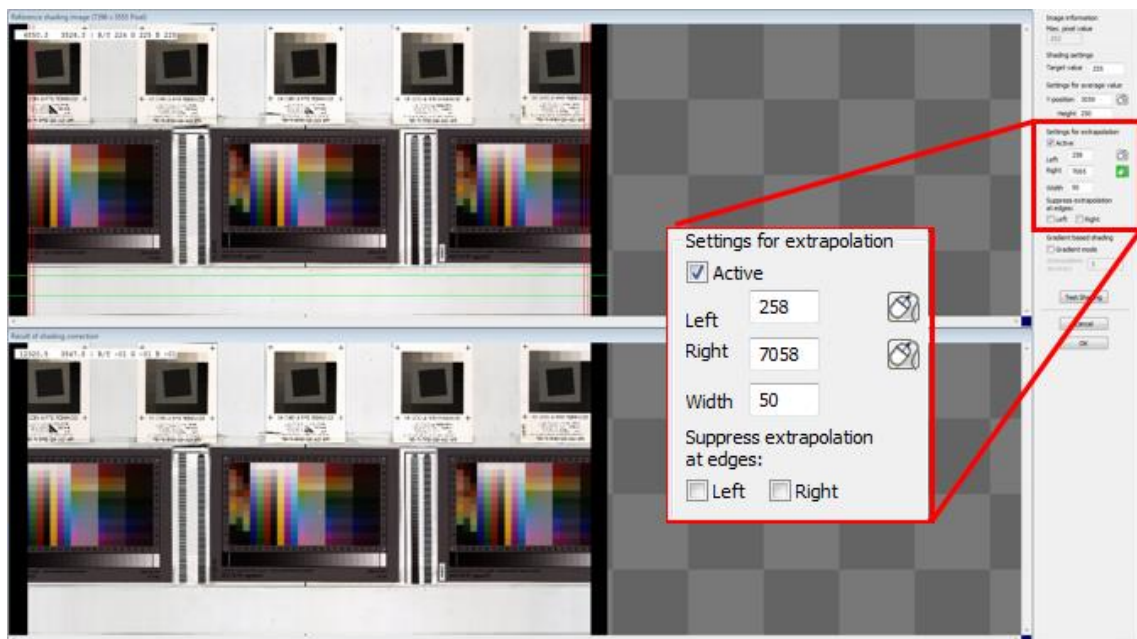
If it is not possible to cover the full scanning width with a white reference target (for example due to mechanical conditions), the resulting black image borders on the left and right side can also be substituted by extrapolated values. So the bright area is extended outward.

- Specify the area from which the reference values should be calculated: in the **Y position** box, enter the number of the first line, in the **Height** box the number of lines to be used.


Use at least 100 lines for calculation of the reference values to eliminate noise. The values used for the reference are calculated by averaging each column in the selected area.

Sample image if the white reference target only partially covers the field of view of the camera:

5



- Mark the edges of the white reference:**
 - In the **Settings for extrapolation** area, select the **Active** check box.
 - Specify the areas for extrapolation: In the **Left** and **Right** boxes, enter the start positions, and in the **Width** box the width as number of pixels. Place the areas near the left and right edge of the white reference target.

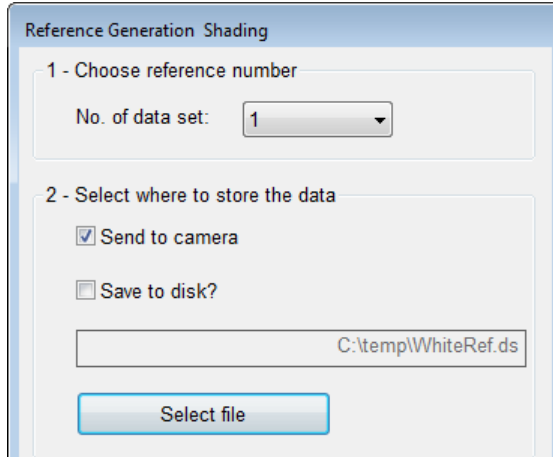
Instead of entering values for the start positions, you can click  and then click the respective start position on the image.

- Click **OK**, and then proceed with **Step 6**.

Saving reference data

6

- In the **No. of data set** list, click the number of the data set in which the reference data should be stored:




- If the reference data should not be sent to the camera, clear the **Send to camera** check box.
- To save the reference data to a file as backup, select the **Save to disk** check box, and then click **Select file** to specify folder and file name.

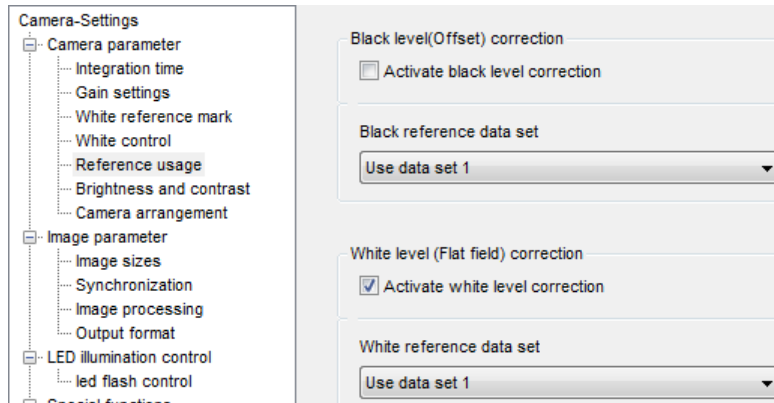
- Click **Next** .


If the reference data are sent to the camera, a progress bar is shown, and the camera is reset afterward to make sure that the initial settings are again active. The last used setting is activated automatically.

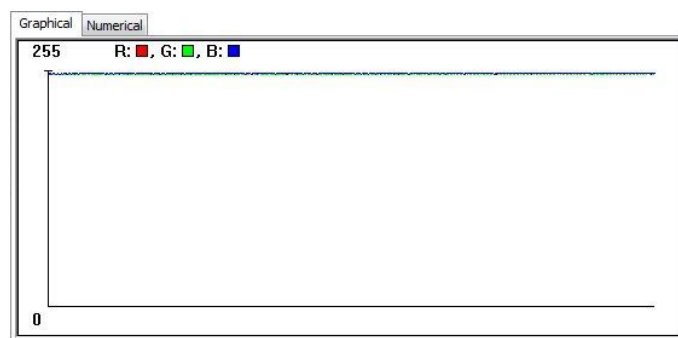
- Again click **Next**  to close the wizard.

Activate shading correction and check the result on the image.

- On the toolbar, click **Show settings** , and then click **Reference usage**.
- To check white-level correction, select the **Activate white-level correction** check box and check that the just updated data set is used:

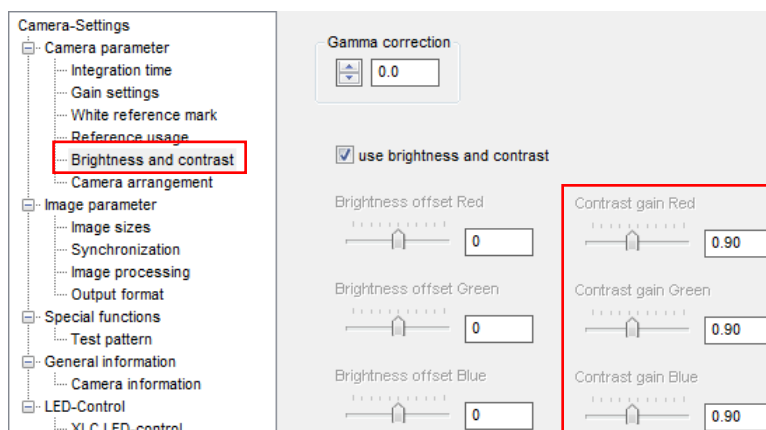


- Click **Transfer setting to camera**  to save the setting to volatile memory. Brightness of the newly scanned white balancing reference should be exactly at the saturation limit. (255 @8Bit).



7

Note: At a later point, the image can be "desaturated" to a target value off, for example, 230 for a white paper by use of a contrast adjustment of $230/255=0,90$.



Save the setting

8



- On the toolbar, click **Burn setting permanently** , or press **F10** to save the setting permanently into the camera.

8.4.3 Prepare camera to acquire a white (gain) reference

The creation of shading reference is only necessary during commissioning or if the gain values are changed considerably.



Make sure that all changes made to your current setting are saved permanently to the camera before you use the Reference wizard. Otherwise, all changes get lost!

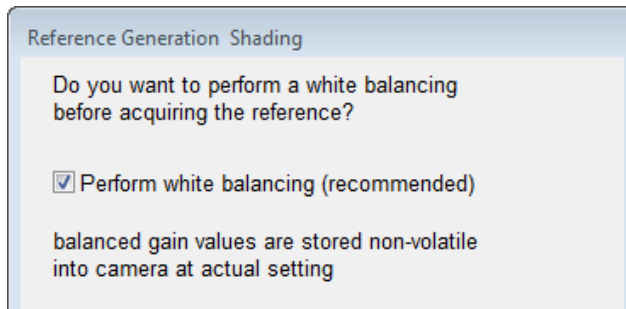
1	Get the camera to the desired working point
	<ul style="list-style-type: none"> Place a white reference in front of the camera Check the lighting and focusing Disable continuous white control Save the parameters to the camera Optional: Activate black-level correction Optional: Perform a white balancing <p>Note: If the white reference target is placed in the best focus plane of the camera, any features on its surface (for example dust, scratches) end up in the calibration profile of the camera. To avoid this if you use a static (non-moving) white reference target, use 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. If this is not possible, you could place the reference target a little bit out of the best focus plane; but take care that the illumination of the target doesn't change too much.</p>
2	Start the reference wizard
	<ul style="list-style-type: none"> On the toolbar, click Start reference wizard .
3	Select reference type and image source
	<ul style="list-style-type: none"> Click White (flat-field) level reference. Click Prepare camera to acquire a raw image: <div style="border: 1px solid #ccc; padding: 10px; margin: 10px 0;"> <p>Reference Generation Shading</p> <p>1 - Choose type of reference</p> <p><input type="radio"/> Black(offset) level reference</p> <p><input checked="" type="radio"/> White(flat field) level reference</p> <p>2 - Select image source</p> <p><input type="radio"/> Load reference image from disk</p> <p><input checked="" type="radio"/> Prepare camera to acquire a raw image</p> <p><input type="radio"/> Create reference internally</p> </div> <ul style="list-style-type: none"> Click Next .

Optional: White balancing


Decide whether you want to perform a white balancing:

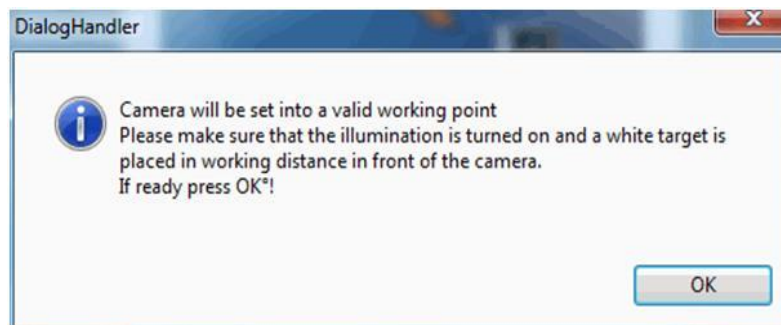
To achieve the best performance / image quality, it is recommended to perform white balancing. By performing a white balancing, the camera gain values are set correctly to acquire the desired image for a black-level reference.

- If you don't want to perform white balancing, clear the **Perform white balancing** check box and continue with Step 5.



4

- Click **Next**  . The following dialog box is shown:

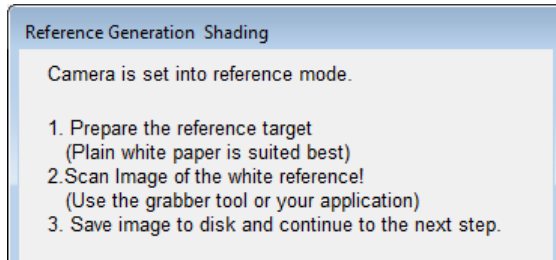



- Follow the instructions in the message box, and then click **OK**.

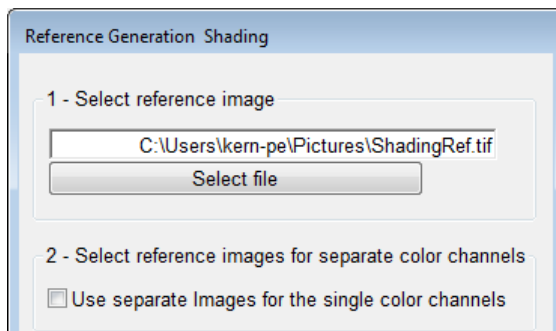
Note: Changes that have not been saved at this point get lost


Acquire a shading reference:

- Perform the steps shown on the next page of the wizard:



- Prepare the reference target.
- Grab an image of the white reference target.
Preferably use a moving target to avoid wrong data due to dirt.
- Save the image to a file, and then click **Next** .
- On the next page of the wizard, click **Select file:**



- Select the reference file in the appearing file dialog box, and then click **OK**.
- Click **Next** .

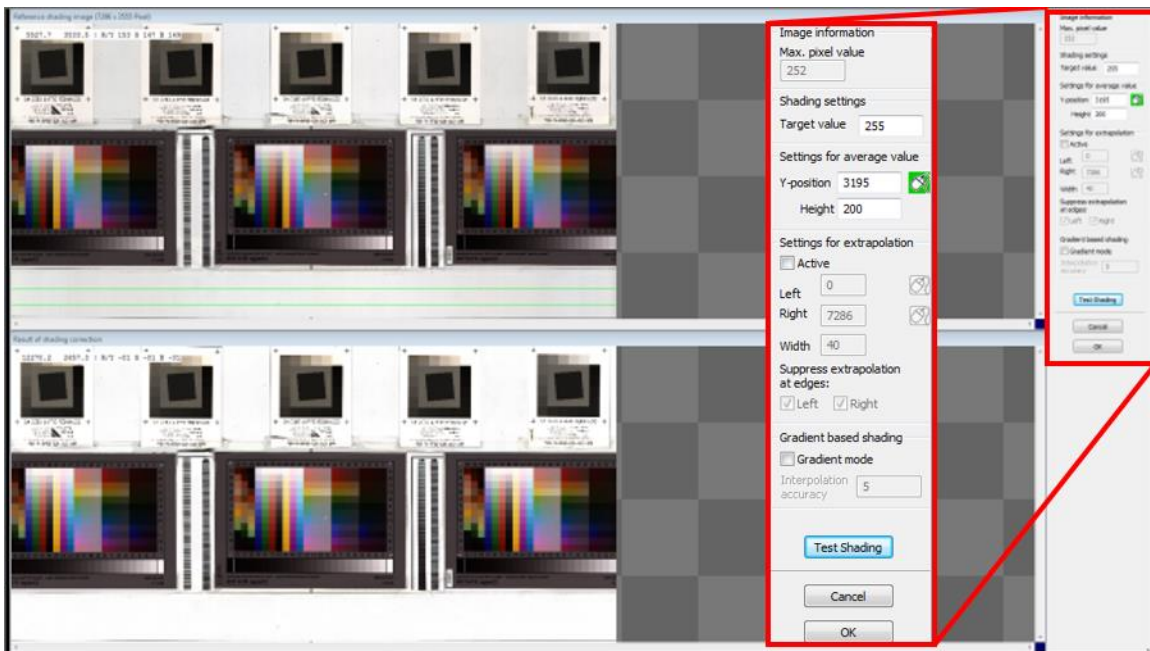
Note: For special applications the three color levels can also originate from various images. In this case select the **Use separate images for the single color channels** check box.

Define the area where the reference values should be calculated (a)

- If it is not possible to cover the full scanning width with a white reference target (for example due to mechanical conditions), the resulting black image borders on the left and right side can also be substituted by extrapolated values. Thus, the bright area is extended outwards.
→ Proceed with **Step 7**.
- Specify the area from which the reference values should be calculated: in the **Y position** box, enter the number of the first line, in the **Height** box the number of lines to be used.

Use at least 100 lines for calculating the reference values to eliminate noise. The values used for the reference are calculated by averaging each column in the selected area.

6



- Click **OK**, and then proceed with **Step 8**.

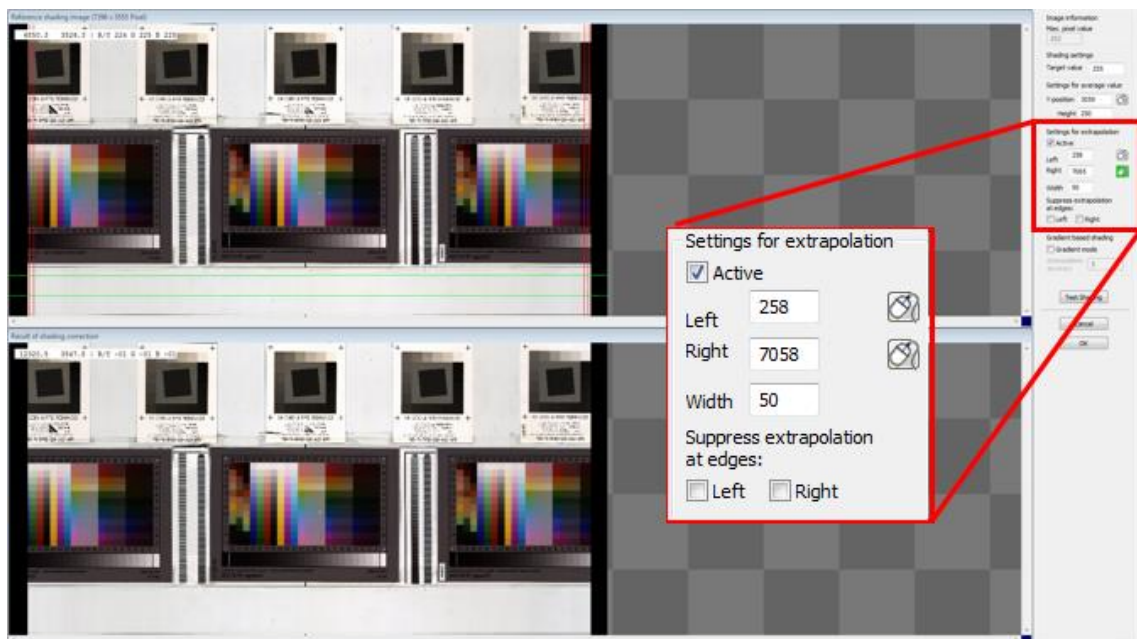
Define the area where the reference values should be calculated (b)

If it is not possible to cover the full scanning width with a white reference target (for example due to mechanical conditions), the resulting black image borders on the left and right side can also be substituted by extrapolated values. Thus, the bright area is extended outward.


- Specify the area from which the reference values should be calculated: in the **Y position** box, enter the number of the first line, in the **Height** box the number of lines to be used.

Use at least 100 lines for calculation of the reference values to eliminate noise. The values used for the reference are calculated by averaging each column in the selected area.

Sample image if the white reference target only partially covers the field of view of the camera:



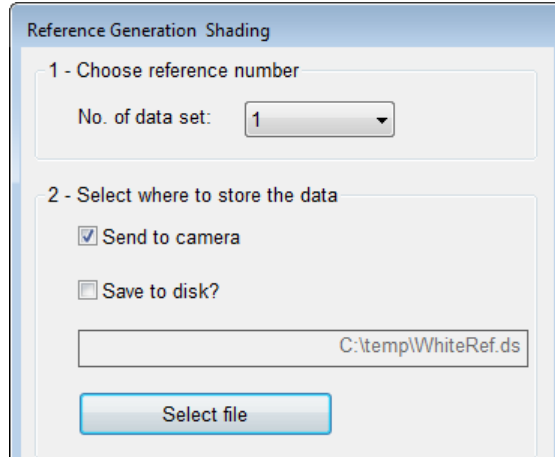
- In the **Settings for extrapolation** area, select the **Active** check box.
- Specify the areas for extrapolation: in the **Left** and **Right** boxes, enter the start positions, and in the **Width** box the width as number of pixels.

Instead of entering values for the start positions, you can click  and then click the respective start position on the image.

- Click **OK**, and then proceed with **Step 8**.

Saving reference data

- In the **No. of data set** list, click the number of the data set in which the reference data should be stored:



- If the reference data should not be sent to the camera, clear the **Send to camera** check box.
- To save the reference data to a file as backup, select the **Save to disk** check box, and then click **Select file** to specify folder and file name.


- Click **Next** .

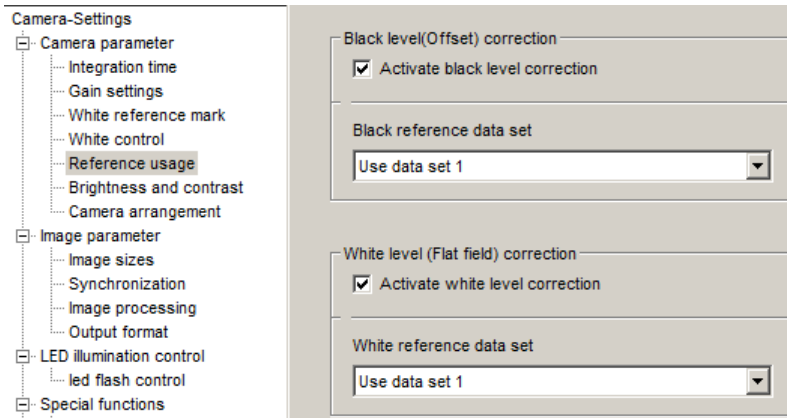
If the reference data are sent to the camera, a progress bar is shown, and the camera is reset afterward to make sure that the initial settings are again active. The last used setting is activated automatically.

- Again click **Next**  to close the wizard.

8

Activate shading correction and check the result on the image.

- On the toolbar, click **Show settings** , and then click **Reference usage**.
- To check white-level correction, select the **Activate white-level correction** check box and check that the just updated data set is used:

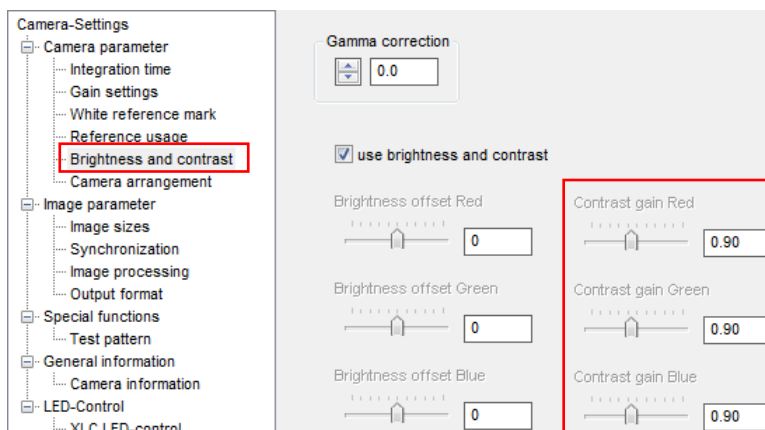


- Click **Transfer setting to camera**  to save the setting to volatile memory.

Brightness of the newly scanned white balancing reference should be exactly at the saturation limit. (255 @8Bit).



Note: At a later point, the image can be "desaturated" to a target value off, for example, 230 for a white paper by use of a contrast adjustment of $230/255=0,90$.



Save the setting

10

- On the toolbar, click **Burn setting permanently** , or press **F10** to save the setting permanently into the camera.



8.4.4 Single color channel reference generation for special illumination situations (Separate lighting for each color channel)

For special tasks a special illumination setup may be necessary. If an inspection task is performed where in each color channel different information is evaluated by use of a special illumination per channel, the balancing procedure must be performed individually per channel.

Creation of a shading reference is only necessary during commissioning or if the gain values are changed considerably.



Make sure that all changes made to your current setting are saved permanently to the camera before you use the Reference wizard. Otherwise, all changes get lost!

1	Get the camera to the desired working point
	<ul style="list-style-type: none"> • Setup the working point and the tap balancing of the camera before grabbing the reference images according to section 8.2.4. Do not use the tap balancing function. • Optional: Activate black-level correction (Do not use with the separate color channels) • Optional: Perform a white balancing (Do not use with the separate color channels) <p>Note: If the white reference target is placed in the best focus plane of the camera, any features on its surface (for example dust, scratches) end up in the calibration profile of the camera. To avoid this if you use a static (non-moving) white reference target, use 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. If this is not possible, you could place the reference target a little bit out of the best focus plane; but take care that the illumination of the target doesn't change too much.</p>
2	Start the reference wizard
	<ul style="list-style-type: none"> • On the toolbar, click Start reference wizard .
3	Select the "Set settings to acquire a white(gain) reference" function
	<ul style="list-style-type: none"> • Click White (flat-field) level reference. • Click Prepare camera to acquire a raw image: <div style="border: 1px solid #ccc; padding: 10px; margin: 10px 0;"> <p>Reference Generation Shading</p> <p>1 - Choose type of reference</p> <p><input type="radio"/> Black(offset) level reference</p> <p><input checked="" type="radio"/> White(flat field) level reference</p> <p>2 - Select image source</p> <p><input type="radio"/> Load reference image from disk</p> <p><input checked="" type="radio"/> Prepare camera to acquire a raw image</p> <p><input type="radio"/> Create reference internally</p> </div> <ul style="list-style-type: none"> • Click Next .

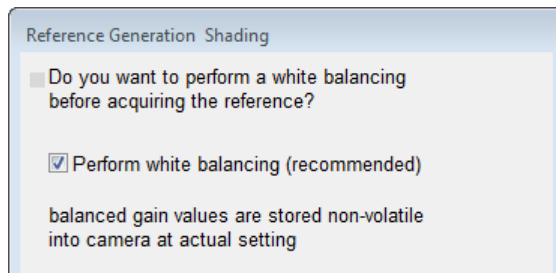
Optional: White balancing

Decide whether you want to perform a white balancing:


The camera must have been balanced before by use of the white and tap balancing functions on the separate color channels (see section 8.2.4).

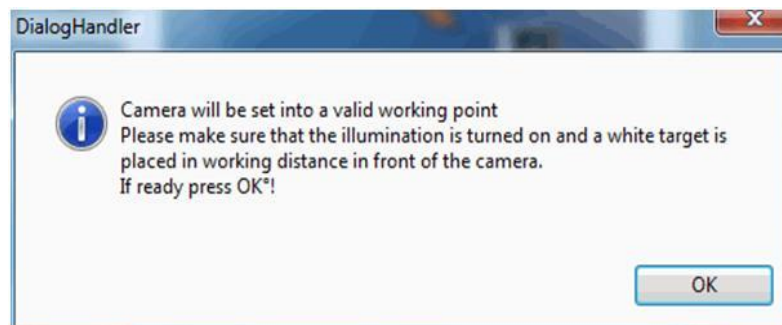
Do not use the white-balancing functions of the reference wizard if you use separate color channels!

- If you don't want to perform white balancing, clear the **Perform white balancing** check box and continue with Step 5.



4

- Click **Next**  . The following dialog box is shown:

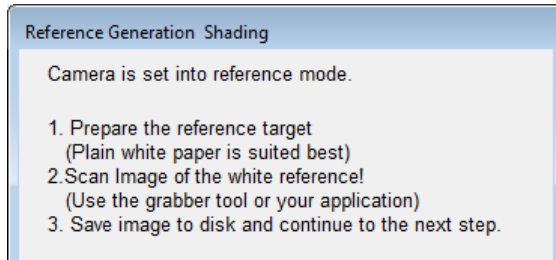


- Follow the instructions in the message box, and then click **OK**.

Note: Changes that have not been saved at this point get lost.

Acquire a shading reference:

- Perform the steps shown on the next page of the wizard:

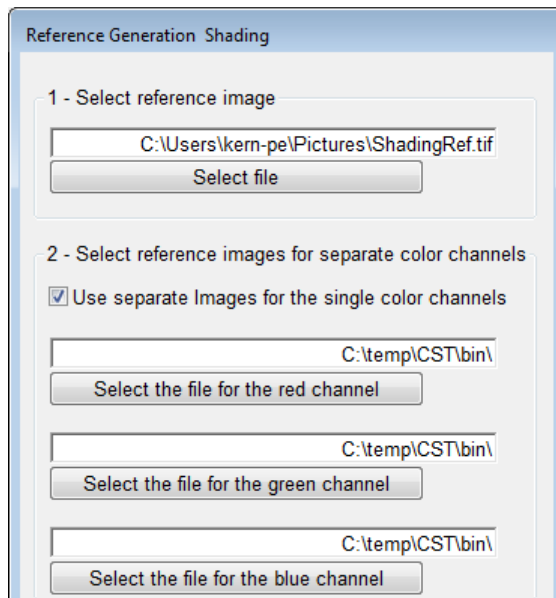


- Prepare the reference target.
- Grab an image of the white reference target for each color channel with the appropriate illumination and save the images to disk.

Preferably use a moving target to avoid wrong data due to dirt.

- Click **Next** .

- On the next page of the wizard, select the **Use separate images** check box. The page is then modified and permits to select three separate files for the three color channels:



- For each color, click the respective **Select** button, select the reference image, and click **Open**.

Note: Uncompressed gray and color images are allowed as input format.

- Click **Next** .

5

Define the area where the reference values should be calculated (a)

- If it is not possible to cover the full scanning width with a white reference target (for example due to mechanical conditions), the resulting black image borders on the left and right side can also be substituted by extrapolated values. So the bright area is extended outwards.
→ Proceed with **Step 7**.

- **The white reference target covers the full scanning range:**

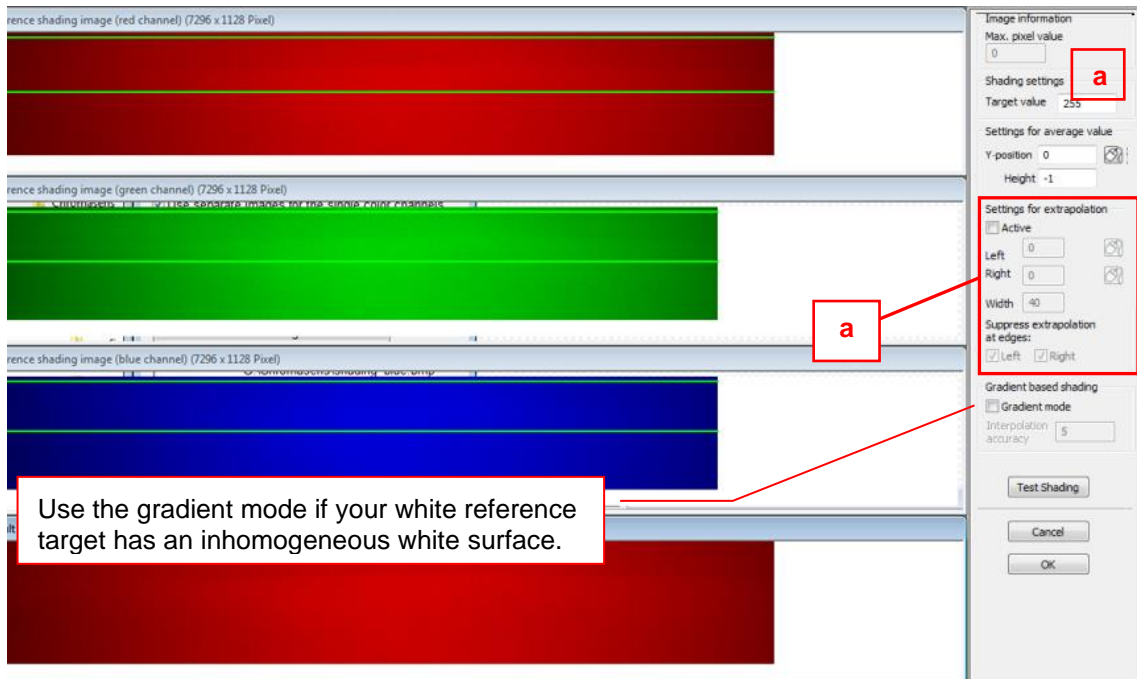
- Specify the area from which the reference values should be calculated: **a**

In the **Y position** box, enter the number of the first line, in the **Height** box the number of lines to be used.

Use at least 100 lines for calculation of the reference values to eliminate noise. The values used for the reference are calculated by averaging each column in the selected area.

It is only possible to define one area for the reference data which is used for every color channel. **Make sure that you set this area to fit all channels!**

6



Use the gradient mode if your white reference target has an inhomogeneous white surface.

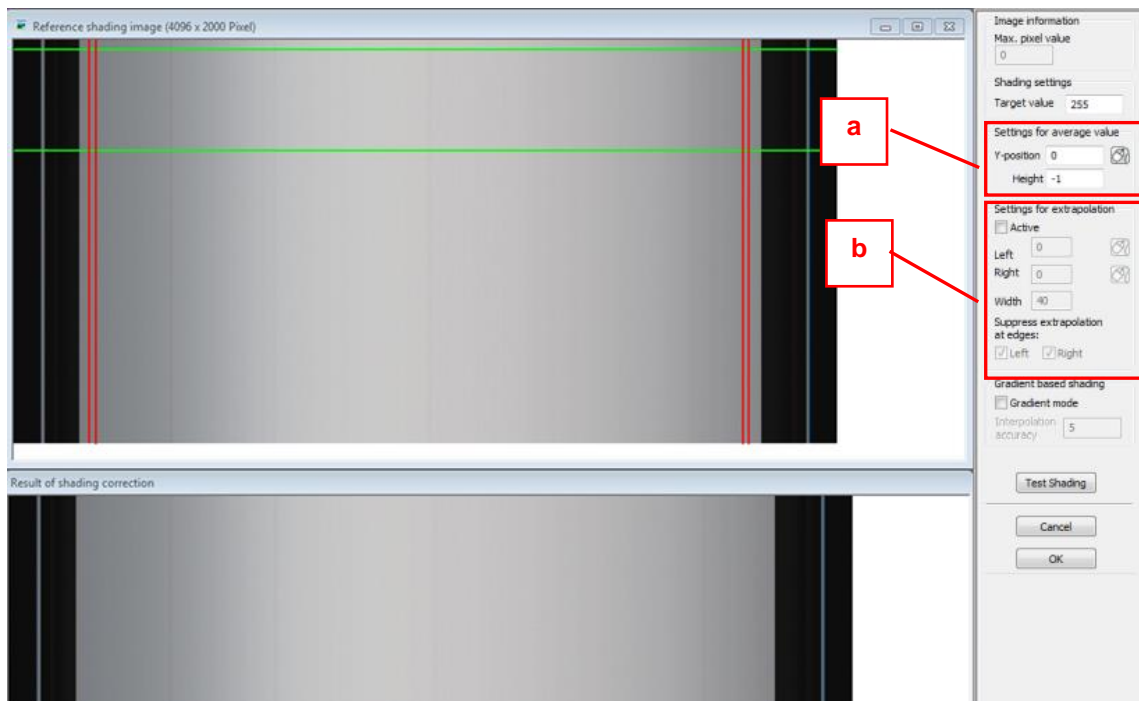
- Click **OK**, and then proceed with **Step 8**.

Define the area where the reference values should be calculated (b)

- If it is not possible to cover the full scanning width with a white reference target (for example due to mechanical conditions), the resulting black image borders on the left and right side can also be substituted by extrapolated values. So the bright area is extended outwards.
- Specify the area from which the reference values should be calculated: in the **Y position** box, enter the number of the first line, in the **Height** box the number of lines to be used. **a**


Use at least 100 lines for calculation of the reference values to eliminate noise. The values used for the reference are calculated by averaging each column in the selected area.

Sample image if the white reference target only partially covers the field of view of the camera:



7

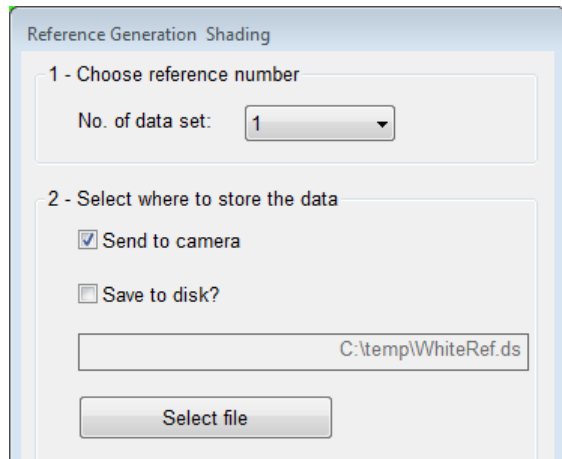
- **Mark the edges of the white reference:** **b**
 - In the **Settings for extrapolation** area, select the **Active** check box.
 - Specify the areas for extrapolation: in the **Left** and **Right** boxes, enter the start positions, and in the **Width** box the width as number of pixels. Place the areas near the left and right edge of the reference target.

Instead of entering values for the start positions, you can click  and then click the respective start position on the image.

- Click **OK** and proceed with **Step 8**.

Saving reference data

- In the **No. of data set** list, click the number of the data set in which the reference data should be stored:




- If the reference data should not be sent to the camera, clear the **Send to camera** check box.
- To save the reference data to a file as backup, select the **Save to disk** check box, and then click **Select file** to specify folder and file name.

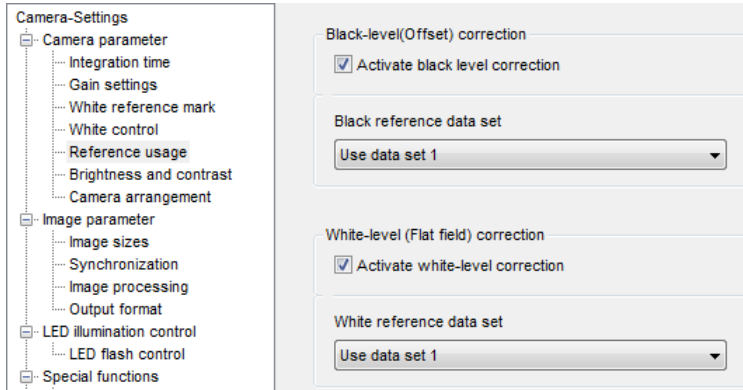
- Click **Next** .

If the reference data are sent to the camera, a progress bar is shown, and the camera is reset afterward to make sure that the initial settings are again active. The last used setting is activated automatically.

- Again click **Next**  to close the wizard.

Activate shading correction and check the result in the image.

- On the toolbar, click **Show settings** , and on the tree view click **Reference usage**.
- To check white-level correction, select the **Activate white-level correction** check box and check that the just updated data set is used:



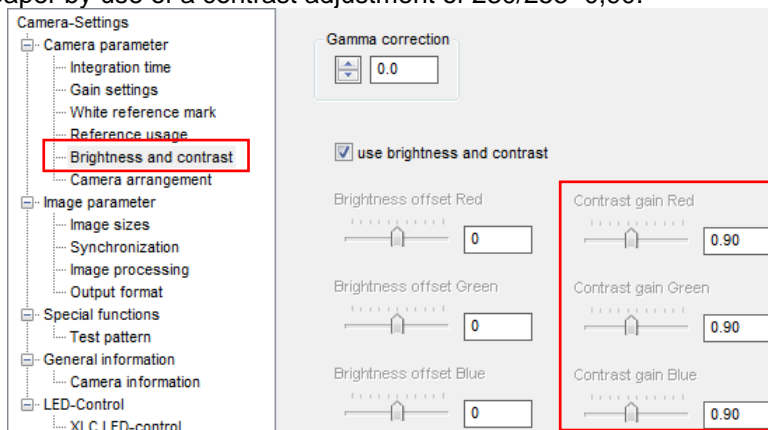
- Click **Transfer setting to camera**  to save the setting to volatile memory.

Brightness of the newly scanned white balancing reference should be exactly at the saturation limit. (255 @8Bit).



9

Note: At a later point, the image can be "desaturated" to a target value off, for example, 230 for a white paper by use of a contrast adjustment of $230/255=0,90$.



Save the setting

10

- On the toolbar, click **Burn setting permanently** , or press **F10** to save the setting permanently into the camera.

8.5 Using continuous white control

8.5.1 Continuous operating point adjustment at the edges

Continuous operating point adjustment at the edges can be used in both - the line scan and the area scan operating modes.

The allPIXA pro camera evaluates the brightness of the respective channels in this range and compares the results with a programmable set value. The amplification values for each color channel are automatically adjusted.

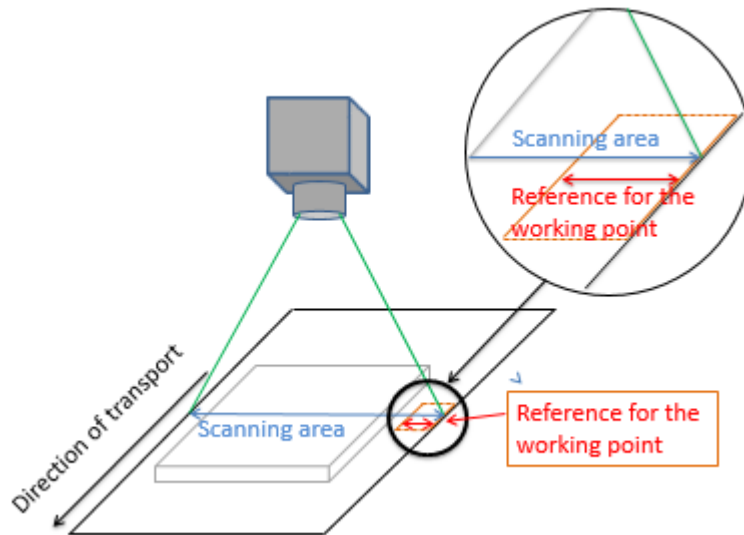
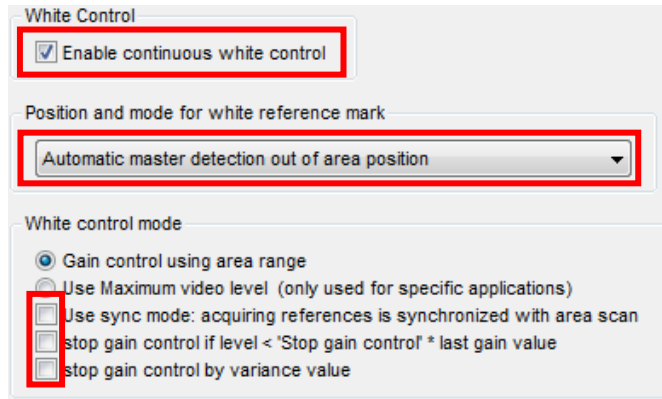


Figure 35: allPIXA camera with continuous automatic white balancing

1	<ul style="list-style-type: none"> • Set up the camera
2	<ul style="list-style-type: none"> • Specify the position of the white reference borders (see section 9.3)
3	<ul style="list-style-type: none"> • Switch on the white reference borders • Set the position of the white reference borders (see also section 9.3)

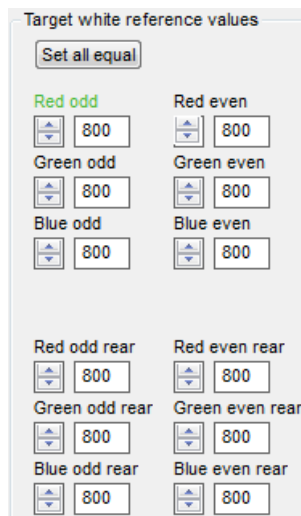
4

- On the toolbar, click **Show settings**, and then click **White control** in the tree view.
- Select the **Enable continuous white control** check box.
- In the **Position and mode for white reference mark** list, select the tap for white control.
- Make sure that the **Use sync mode** check box is cleared:



- Specify target values in the **Target white reference values** area.

If the white target is placed at the borders of the image, the values may be lower than in the center.



5

- Wait for a balanced image
- Check for saturation
- Refresh the data in CST
- Set the initial gaining values
- Burn the setting

6

- Check the function by lowering the light in the control zone, for example by a shadow.

8.5.2 Image-synchronous operating point adjustment on the object (ROI)

The image-synchronous operating point adjustment can only be used in area scan operating mode.

If the object has an area which is suitable as reference for the operating point, this area can be set in the allPIXA pro camera as an ROI (Region of Interest). The allPIXA camera evaluates the brightness of the respective channels in this range and compares the results with a programmable set value. The amplification values for each color channel are automatically adjusted.

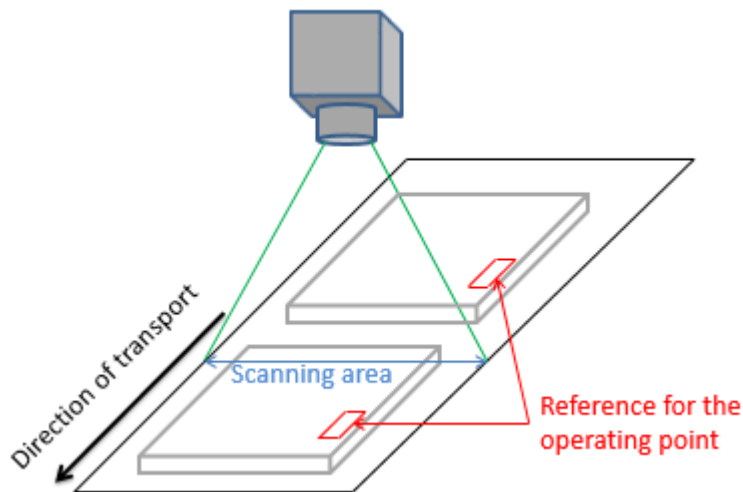


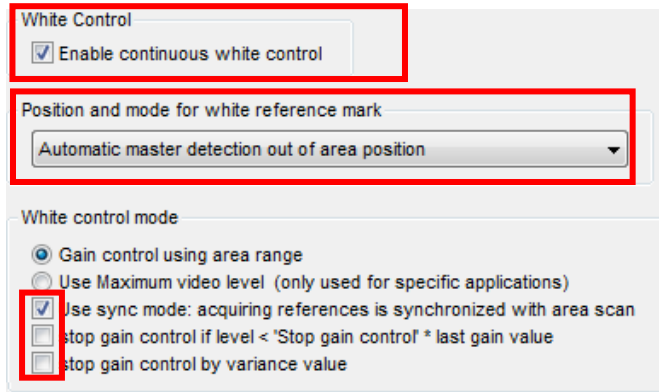
Figure 36: Image-synchronous operating point adjustment on the object (ROI)

NOTE I This mode requires a frame trigger signal at the allPIXA pro camera. The frame trigger can be provided by CC1 through the Camera Link or by the IO port. The allPIXA pro camera must be operated in frame scan mode. Gain control must be set to image-synchronized mode.

NOTE II In image-synchronized mode, the behavior of the closed-loop control is slower than in free-running mode.

1	<ul style="list-style-type: none"> • Set up the camera
2	<ul style="list-style-type: none"> • Start the transport with sample objects
3	<ul style="list-style-type: none"> • Switch on the white reference borders • Specify the position of the white reference borders (see section 9.3)

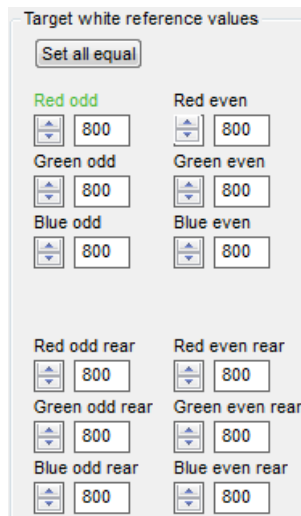
- On the toolbar, click **Show settings**, and then click **White control** in the tree view.
- Select the **Enable continuous white control** check box.
- In the **Position and mode for white reference mark** list, select the tap for white control
- Select the **Use sync mode** check box:



4

- Specify target values in the **Target white reference values** area.

If the white target is placed at the borders of the image, the values may be lower than in the center.



5

- Wait for a balanced image.
- Check for saturation.
- Refresh the data in CST.
- Set the initial gaining values.
- Burn the setting.

6


- Check the function by lowering the light in the control zone, for example by a shadow.

8.6 Frame trigger and line trigger/encoder connection and setup

For detailed function of parameters, see also section 9.17.

8.6.1 Frame trigger and encoder settings

To specify frame trigger mode:

1. On the toolbar click **Show settings** , and then click **Synchronization**.
2. In the **Triggered frame scan** list, click either **Use start condition only** or **Use start and stop condition**.
3. Specify the remaining parameters on the **Synchronization** page as needed.

For more information about the parameters, see section 9.9.


8.6.1.1 Connecting the frame trigger to the camera

There are two different ways to transmit the encoder signals to the camera:

1. Connect the camera using Camera Link CC-bits
 - If the frame trigger is connected to the frame grabber, ensure that the signal is transferred to CC2, CC3 or CC4 bits of the Camera Link cable.
2. Directly connect the frame trigger to the camera:
 - To connect the frame trigger signals directly to the camera you can use the I/O connector (D-Sub15 Pin 1/9 or 2/10).
For a detailed pin assignment, see section 5.1.3
 - Also see the input level definition in section 5.1.4

8.6.2 Line trigger and encoder settings

Settings for line trigger and encoder mode are edited within this view. For more information about the parameters, see section 9.17.

Button	Function key	Menu
		View/Encoder setup

8.6.2.1 Connecting the line trigger / encoder to the camera

There are two different ways to transmit the encoder signals to the camera:

1. Connect the camera using Camera Link CC bits
 - If the line trigger / encoder is connected to the frame grabber, ensure that the signal is transferred to CC1 and CC2 bits of the CameraLink cable.
2. Directly connect the encoder to the camera:
 - To connect the line trigger / encoder signals directly to the camera you can use the I/O connector (D-Sub15 Pin 1/9 and 2/10).
 - For a detailed pin assignment, see section 5.1.3
 - Also see the input level definition in section 5.1.4

For more information about activation of external ports, see section 8.10 IO configuration.

8.6.3 Define the input channel in the camera

After connection of the signals, the camera must be set up to the correct input channel for the encoder signals. Therefore, use the I/O configuration page of CST (see section 8.10)

To show the I/O Configurator, click **Show settings for user-configurable IOs**  on the toolbar.

To define the input channels of the encoder, the inputs can be combined to the following groups:

	Name of IO function	Connector	Internal Function	IO-Standard	Bit Value
01	Encoder Ch 0 / line trigger	CL1-CC1	Encoder0/line trigger	LVDS	<input checked="" type="checkbox"/>
02		X5-4	Encoder0/line trigger	RS422	<input type="checkbox"/>
03		X5-4 (Pull-Down)	Encoder0/line trigger	LVC MOS	<input type="checkbox"/>
04		---	Encoder0/line trigger -> static Low	---	<input type="checkbox"/>
05		---	Encoder0/line trigger -> static High	---	<input type="checkbox"/>
06	Encoder Ch 1	CL1-CC2	Encoder 1	LVDS	<input checked="" type="checkbox"/>
07		X5-12	Encoder 1	RS422	<input type="checkbox"/>
08		X5-12 (Pull-Down)	Encoder 1	LVC MOS	<input type="checkbox"/>
09		---	Encoder 1 -> static Low	---	<input type="checkbox"/>
10		---	Encoder 1 -> static High	---	<input type="checkbox"/>
11		---	Enable Encoder -> static Low/inactive	---	<input type="checkbox"/>
12	Enable Encoder	CL1-CC2	Enable Encoder	---	<input checked="" type="checkbox"/>
13		CL1-CC2	Enable Encoder	LVDS	<input type="checkbox"/>
14		CL1-CC4	Enable Encoder	LVDS	<input type="checkbox"/>
15	SelectScanDir	CL1-CC2	SelectScanDir	LVDS	<input checked="" type="checkbox"/>
16		X5-12	SelectScanDir	RS422	<input type="checkbox"/>
17		X5-12 (Pull-Down)	SelectScanDir	LVC MOS	<input type="checkbox"/>
18	Invert ScanDir from Encoder	---	Inv. ScanDir from Encoder	---	<input checked="" type="checkbox"/>
19	frame trigger / light barrier	CL1-CC3	All debouncing levels	LVDS	<input type="checkbox"/>
20		X5-11	All debouncing levels	LVDS	<input type="checkbox"/>
21		X5-1/9	All debouncing levels	RS422	<input type="checkbox"/>
22		X5-2/10	All debouncing levels	RS422	<input checked="" type="checkbox"/>
23		internal frame trigger	All debouncing levels	---	<input type="checkbox"/>
24		X5-3 (Pull-Up)	All debouncing levels	LVC MOS	<input type="checkbox"/>

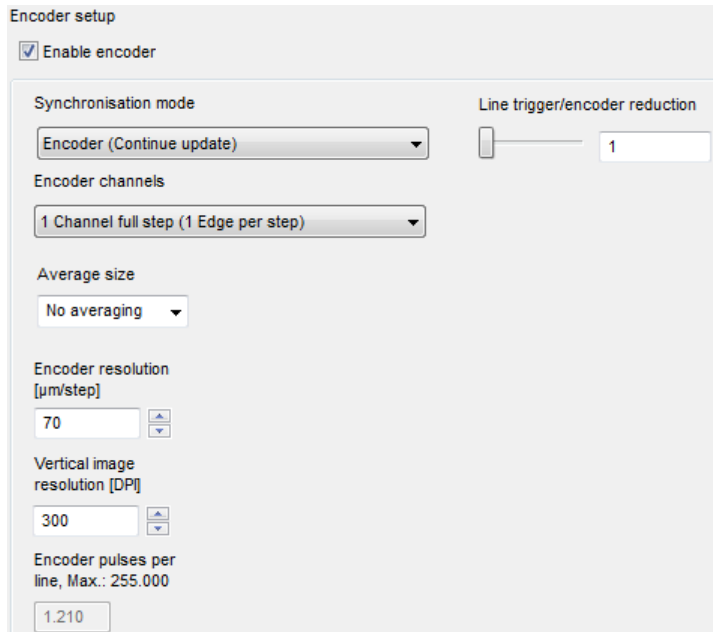
1. Define input encoder channel 1 (line 1-5)
 - In this section the input channel for the line trigger / encoder channel 1 can be selected from different external pins.
 - In this section only one option should be selected.
2. Define input encoder channel 2 (line 6-10)
 - In this section the input channel for the encoder channel 2 can be selected from different external pins.
 - If only a one channel encoder is used, select a defined level on this pin (static low)
 - In this section only a single option should be selected.
3. Define enable signal of encoder (line 11-14)
 - This section allows you to define an external enable signal for the encoder mode. (see also section 9.17.1).
 - If no external enable signal is used, select line 11 (default). The encoder is then controlled with the camera setting.
 - In this section only one option should be selected.
 - With Invert Input (Line 14) you could invert the line trigger / first encoder channel. This could be helpful to match the scan direction forward/backward in free-running mode and triggered mode.
4. Define ScanDir parameter (line 15-18)
 - This section allows you to define the automatic detection of the scan direction.
 - In the first section the input channel for the external ScanDir can be selected from different external pins.
 - Line 18 allows to invert the external ScanDir (see also section 9.7.2)

5. Define frame trigger input (line 19-24)
 - In this section the input channel for the frame trigger can be selected from different CC-bits or external pins.
 - In this section only one option should be selected.

8.6.4 Configuration of the encoder mode and resolution

For configuration, use the **Encoder setup** page of CST to specify all parameters. For more information, see section 9.17.

To open the **Encoder setup** page, click **Encoder setup**  on the toolbar.



To set up the encoder parameters:

1. Select the **Enable encoder** check box.
2. In the **Synchronization mode** list, click the desired mode (for more information, see section 9.17.2):

Line trigger mode (Const. int time): In line trigger mode, the camera sends a single line per pulse. If you specify a value at **Line trigger/ encoder reduction**, the camera sends a single line for the number of specified pulses. The remaining parameters are not available in this mode.

Encoder (Continuous update): The encoder mode uses the internal intelligent encoder functionality. The camera measures the speed of the object and sends lines based on the defined encoder resolution and the vertical image resolution.
3. In the **Encoder channels** list, click the number of recognized edges per step of the encoder signal. Best results are reached with 1 Chanel full step due to tolerances in the duty factor of the pulses.
4. Specify a value for **Line trigger/encoder reduction**:

In line trigger mode: The value defines how many trigger signals are used to trigger a single scanning line.

In encoder mode: This factor can be used to reduce the number of encoder pulses per line. If the number of encoder pulses per line exceeds 255, this factor must be used to reduce the number below 255.
5. In the **Average size** list, specify how many encoder increments are averaged for speed measurements. For more information, see section 9.17.4.

6. In the **Encoder resolution** box, enter the resolution of the encoder in $\mu\text{m}/\text{step}$. For more information, see section 9.17.5.
7. In the **Vertical image resolution** box, specify the physical resolution in transport direction in dpi / line. For more information, see section 9.17.6.

You can calculate as follows: $1 \text{ dpi} = 25,4\text{mm}$, for example ($100\mu\text{m}/\text{line} = 254\text{dpi}$)

With this definition, the camera calculates and displays the encoder pulses per line.

Note: If scanning speed (defined by integration time for one line as well as $\mu\text{m}/\text{step}$ and $\mu\text{m}/\text{line}$) is higher than the maximum camera speed (see section 2.3), the camera goes into free-running mode with maximum speed. The camera goes into normal encoder mode, as soon as the speed drops again below maximum speed.

8. Check the value of **Encoder pulses per line**:

This value is calculated by the camera using the values of the specified parameters. The maximum allowed value is 255.

The minimum value should be at least 0.1, smaller values decrease accuracy.

If this value exceeds 255, change the value of **Line trigger/encoder reduction** to reduce this value below 255.

NOTE Take notice that, if you work with Encoder, the minimum CameraLink transmission time is not checked.

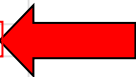
8.6.5 Encoder - enable /disable by external input signal

With the enable increments setting you can enable/disable the encoder input by using an external I/O Port (CC-Bit3 or CC-Bit4 of the Camera Link interface). This feature can be useful to enable the encoder in real time (for example: application with several cameras). The function is configured on the IO Configuration page.

For more information about encoder setup, see section 8.6.

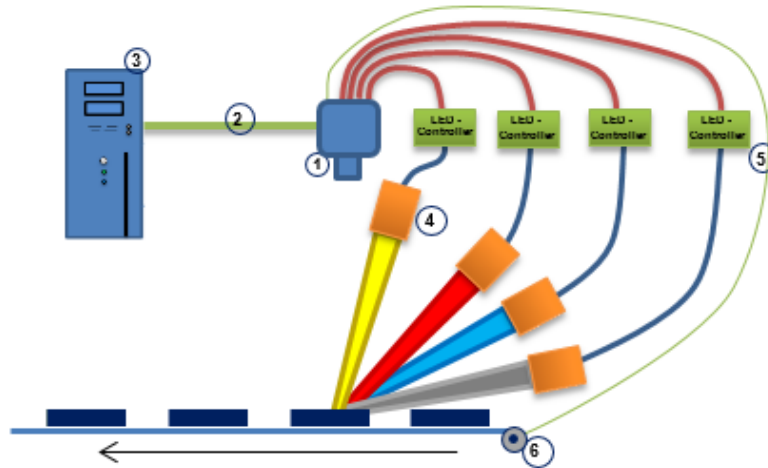
NOTE If this feature is not used, the configuration must be set to default.

	Name of IO function	Connector	Internal Function	IO-Standard	Bit Value
01	Encoder Ch 0 / line trigger	CL 1-CC1	Encoder0/line trigger	LVDS	<input checked="" type="checkbox"/>
02		X5-1/9	Encoder0/line trigger	RS422	<input type="checkbox"/>
03		X5-4 (Pull-Down)	Encoder0/line trigger	LVC MOS	<input type="checkbox"/>
04		---	Encoder0/line trigger -> static Low	---	<input type="checkbox"/>
05		---	Encoder0/line trigger -> static High	---	<input type="checkbox"/>
06	Encoder Ch 1	CL 1-CC2	Encoder 1	LVDS	<input checked="" type="checkbox"/>
07		X5-2/10	Encoder 1	RS422	<input type="checkbox"/>
08		X5-12(Pull-Down)	Encoder 1	LVC MOS	<input type="checkbox"/>
09		---	Encoder 1 -> static Low	---	<input type="checkbox"/>
10		---	Encoder 1 -> static High	---	<input type="checkbox"/>
11		---	Enable Encoder -> static Low/inactive	---	<input type="checkbox"/>
12	Enable Encoder	---	Enable Encoder -> static High/active	---	<input checked="" type="checkbox"/>
13		CL 1-CC2	Enable Encoder	LVDS	<input type="checkbox"/>
14		CL 1-CC4	Enable Encoder	LVDS	<input type="checkbox"/>
15	SelectScanDir	CL 1-CC2	SelectScanDir	LVDS	<input checked="" type="checkbox"/>
16		X5-2/10	SelectScanDir	RS422	<input type="checkbox"/>
17		X5-12 (Pull-Down)	SelectScanDir	LVC MOS	<input type="checkbox"/>
18	Invert ScanDir from Encoder	---	Inv. ScanDir from Encoder	---	<input checked="" type="checkbox"/>



8.7 Multi-channel flash control

With the multi-channel LED control, the camera provides up to four individual flash outputs for illumination controllers. The flash outputs are fully synchronized to the line trigger to permit high speed-synchronous triggering of different illuminations.



1. allPIXA pro camera
2. Camera Link cable
3. Host PC
4. Illumination modules
5. LED driver
6. Encoder / Trigger

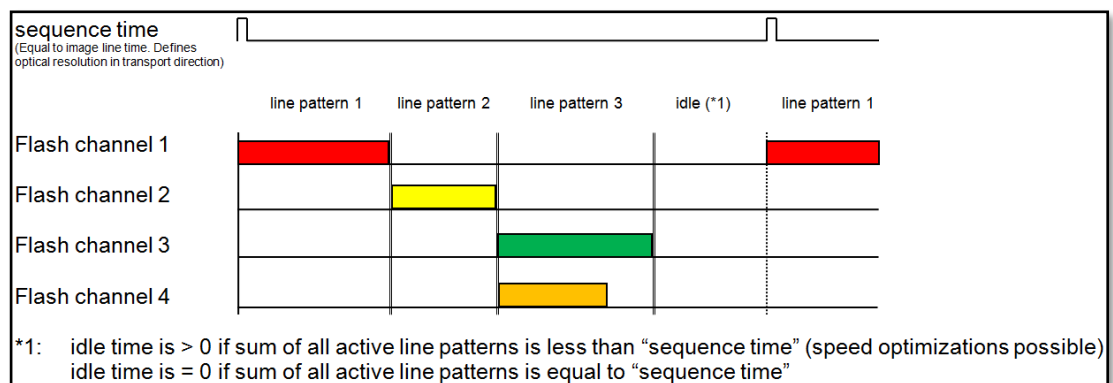
8.7.1 Operation principle

To see the flash control parameters, you must set **User level** to **Guru** in CST!

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

Several outputs can be combined individually 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:



NOTE If flash mode is active, the camera uses the individually defined line pattern times to set up the integration time of each scanning line.
The camera integration time setting value is ignored if the flash mode is used.

Line pattern time

For each output channel (1...4) a time can be defined at which the specific output is active. The resulting time for each line pattern is determined by the largest value.

Example corresponding to the diagram above:

Line pattern 3: -> active time for flash channel 3 = 150 μ s
 -> active time for flash channel 4 = 110 μ s
→ the resulting duration of line pattern 3 = 150 μ s

The minimum time for a line pattern is defined by the following parameters:

1. Minimum integration time of the camera:
The minimum integration time depends on the speed of the camera (minimum possible integration time) and the scan line length. Take notice that the minimum integration is higher if flash mode is used. For more information, see section 9.1.1.
2. Minimum time for output of a scan line via Camera Link interface:
The time for transfer of a scan line via Camera Link depends on the selected Camera Link mode (base, medium, full) and the Camera Link frequency.

A table with the dependencies of the possible scan line speed with different Camera Link modes is shown in section 2.2 „Camera speed for available Camera Link modes and frequency“.

NOTE If the length of a line pattern is shorter than the minimum possible line time (regarding minimal camera integration time and Camera Link speed), the camera automatically increases the specific line pattern time before starting the next line pattern.

 This then also increases the required sequence time.

Sequence time:

Free-running mode:

The camera sequence time is the defined time for one full sequence with up to 4 individual line patterns. During one sequence time cycle, the camera outputs as many number of lines as line patterns are defined.

The sequence time (in combination with the transport speed) defines the transport resolution of the image.

Triggered mode (encoder/line trigger):

One full sequence is executed per trigger signal. Within such a sequence the camera outputs as many lines as line patterns are defined (1 up to 4 line patterns are possible). If four line patterns are used, the camera outputs four lines for each trigger signal.

Make sure that the sum of all line pattern time definitions is short enough to be executed completely at full-speed scanning.

If the allowed value for the sequence time is too short to cover all defined line pattern times, the camera returns an appropriate error code:

0xD7: LED flash mode: sum of all patterns exceeds sequence time

The camera also goes into free-running mode operating with the speed defined by sequence/pattern time.

Flash channel

Signal output channel for control of an illumination controller.

Idle time:

Idle time in free-running mode:

If the sum of all active line patterns is less than “sequence time”, the patterns can be changed without changing the transport resolution of the camera/system.

Idle time in encoder/line trigger mode:

After the last line pattern, the camera waits for the next line trigger to start the next sequence.

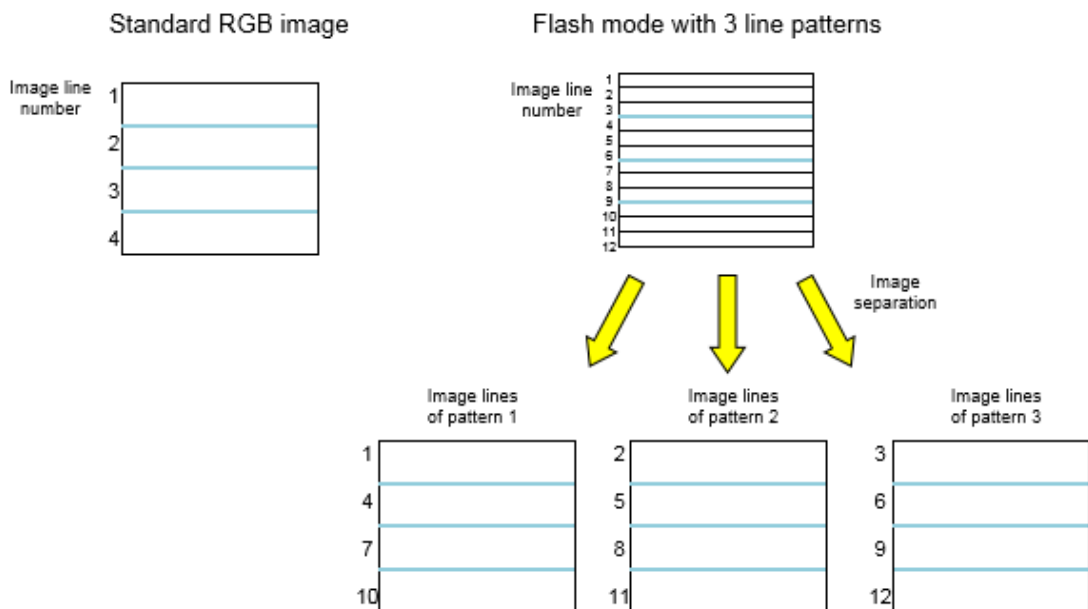
In both cases (free-running/with external line trigger) the camera automatically adapts the subline time (sum of all active line patterns) to the minimum required time. This optimization function permits to use the camera at maximum possible speed of the system in regard to the flash times. For a detailed speed optimization sample, see section 8.7.5.1 Feature: scan speed optimization.

8.7.2 Flash mode – Image size

In standard RGB mode, the camera outputs one line per line trigger. If flash mode is used, the camera provides one full sequence per line trigger. Therefore, the camera outputs as many lines per line trigger as the selected number of line patterns.

This permits to achieve the same image resolution in the separated flash images compared to the standard scanning image without flash mode. Thus, the size (height) of the transmitted raw image increases by the factor of the used pattern (for example; if you use three line patterns, the raw image is three times as long).

In the following diagram, the standard scanning mode and the flash mode using three line patterns are demonstrated:



8.7.3 RGB displacement compensation / RGB line distance for flash mode

If you use the flash mode, image size and scanning speed increase (see section 8.7.2).

In normal scanning operation, a single line is output per sequence. If you use the flash mode, the camera outputs several lines (depending on the number of the used patterns) per sequence. Therefore, the RGB displacement compensation must be adapted.

For compensation of the RGB displacement by the camera, the parameter **Set RGB line distance** on the **Camera arrangement** page can be defined accordingly. For the use of flash mode, the parameter can be adapted according to the following procedure:

No. of used line patterns	RGB line distance value
1	1 x "used line distance without flash mode"
2	2 x "used line distance without flash mode"
3	3 x "used line distance without flash mode"
4	4 x "used line distance without flash mode"

The allPIXA pro camera is capable to internally compensate up to **5 lines** for the 4k, 5k, 6000px, and 7.3k versions (see section 9.7.1).

If the necessary compensation exceeds the capability of the camera, the internal compensation should be set to 0 and the compensation must be done in image post-processing on PC side. The separation of the image lines coming from the different pattern must be done in post-processing generally.

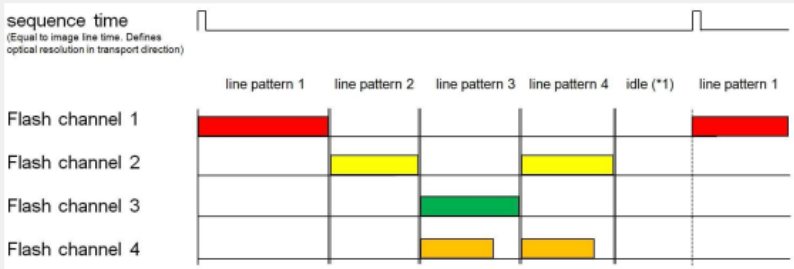
8.7.4 Setting up the multi-channel LED control

The CST software provides an easy setup of the multi-channel flash control:

Set led flash mode

enabled

sequence time
(Equal to image line time. Defines optical resolution in transport direction)



line pattern 1 line pattern 2 line pattern 3 line pattern 4 idle (*1) line pattern 1

Flash channel 1

Flash channel 2

Flash channel 3

Flash channel 4

(*1): idle time is > 0 if sum of all active patterns is less than "sequence time" (speed optimizations possible)
idle time is = 0 if sum of all active pattern is equal to "sequence time"

During the sequence time cycle the camera will output as many number of lines as line patterns are defined.
The camera sequence time definition is only used if the camera is in free run mode (no encoder or line trigger).

number of line pattern
led number line pattern
4

time in μs for repeating all valid pattern
led flash sequence time
350.000


Flash time 1 at channel 1 (μs) 0.000	Flash time 2 at channel 1 (μs) 0.000	Flash time 3 at channel 1 (μs) 0.000	Flash time 4 at channel 1 (μs) 0.000
Flash time 1 at channel 2 (μs) 0.000	Flash time 2 at channel 2 (μs) 0.000	Flash time 3 at channel 2 (μs) 0.000	Flash time 4 at channel 2 (μs) 0.000
Flash time 1 at channel 3 (μs) 0.000	Flash time 2 at channel 3 (μs) 0.000	Flash time 3 at channel 3 (μs) 0.000	Flash time 4 at channel 3 (μs) 0.000
Flash time 1 at channel 4 (μs) 0.000	Flash time 2 at channel 4 (μs) 0.000	Flash time 3 at channel 4 (μs) 0.000	Flash time 4 at channel 4 (μs) 0.000

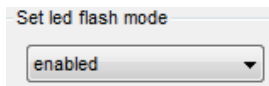
Resulting time pattern 1 0.000	Resulting time pattern 2 0.000	Resulting time pattern 3 0.000	Resulting time pattern 4 0.000
-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

led signal frame control
flash outputs set continuously

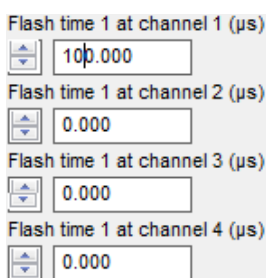
pattern time generation
pattern packed optimal

To set up LED control:

1. On the toolbar, click **Show settings** , and then click **LED flash control**.
2. In the **Set LED flash mode** list, click **enabled**.



3. In the **Number of line patterns** box, enter the number of line patterns you want to use (up to 4).
4. Enter the desired flashing times of the output channel for each line pattern which is used. You can use up to 4 channels. If a channel is not used, enter 0.0:

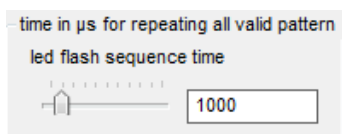


Note:

In general the duration of the flash signals is counted with internal clocks. Therefore, the resulting duration might be rounded down to integer numbers of clocks. The camera needs a certain time gap between two patterns. To keep the distance between pattern start edges the duration of single flash signals might be few shorter than set in CST.

5. Enter a suitable sequence time. This time is used for free-running mode (without external line trigger).

The sequence time defines the time for one full sequence cycle and therefore defines the transport resolution (in combination with the transport speed). For more information see section 8.7.1.

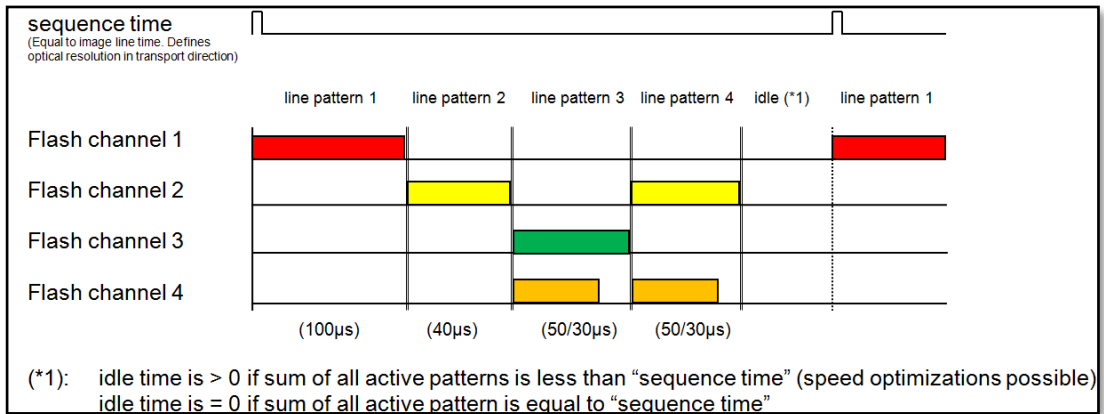


8.7.5 Sample setup for four different illumination units (free-running)

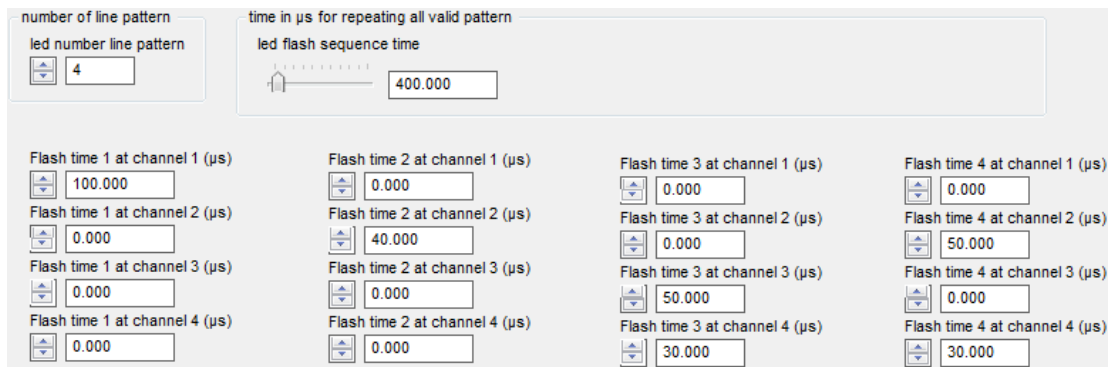
Operation sample for a flash control setup with 4 individual illuminations and 4 patterns:

- Operation mode: free-running
- Camera integration time: not used
(The line time is defined individually by the definition of each line pattern. The parameter **Integration time** in the camera is ignored if flash mode is used).
- Used LED channels: 4
- Line patterns: 4
- Sequence time: 400 μ s

Timing diagram:



Camera setup with CST:



The screenshot shows the camera setup interface with the following parameters:

- number of line pattern: 4
- time in µs for repeating all valid pattern: 400.000
- Flash time 1 at channel 1 (µs): 100.000
- Flash time 2 at channel 1 (µs): 0.000
- Flash time 3 at channel 1 (µs): 0.000
- Flash time 4 at channel 1 (µs): 0.000
- Flash time 1 at channel 2 (µs): 0.000
- Flash time 2 at channel 2 (µs): 40.000
- Flash time 3 at channel 2 (µs): 0.000
- Flash time 4 at channel 2 (µs): 50.000
- Flash time 1 at channel 3 (µs): 0.000
- Flash time 2 at channel 3 (µs): 0.000
- Flash time 3 at channel 3 (µs): 50.000
- Flash time 4 at channel 3 (µs): 0.000
- Flash time 1 at channel 4 (µs): 0.000
- Flash time 2 at channel 4 (µs): 0.000
- Flash time 3 at channel 4 (µs): 30.000
- Flash time 4 at channel 4 (µs): 30.000

8.7.5.1 Feature: scan speed optimization

If the sum of all line patterns is shorter than the sequence time, the scanning speed can be optimized as follows:

Based on the sample data from above, the total active time (sum of all line pattern times) for all of the 4 line patterns is 240 µs (minimum sequence time).

The sequence time is set to 400µs. This results in an idle time for this setup of about 160µs.

This permits to reduce the sequence time and thus to speed up the total scanning speed.

Conventional camera setup:

- 4 individual flash scenarios
- Integration time 100µs
- Required time for one full sequence = 400µs

allPIXA pro - optimized camera setup by use of the flash function:

- 4 individual flash scenarios
- Parameter **Pattern time generation** is set to **Pattern packed optimal**
- Using the real individual line pattern times for scanning:
 resulting sequence time = 240µs (100µs+40µs+50µs+50µs)
- Required time for one full sequence = 240µs
- Depends also on minimum integration time and camera link mode.

The optimized flash scenarios lead to a much faster sequence time of 240µs instead of 400µs. By use of the allPIXA pro flash function the next flash sequence can be started right after 240µs. This in total saves 160µs of scanning time per sequence.

⇒ Scanning speed increase of about 66% by using the allPIXA pro flash function

8.7.6 Sample setup for two different illumination units (triggered mode)

Operation sample for triggered mode with two individual illuminations and three patterns:

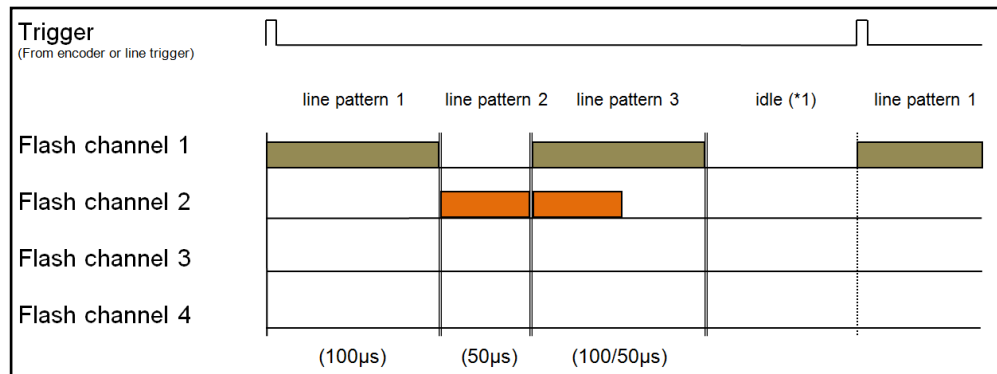
Operation mode: encoder, line trigger
 Camera integration time: not used (The line time is defined individually by the definition of each line pattern. The parameter **Integration time** in the camera is ignored if flash mode is used.)
 Used LED channels: 2
 Line patterns: 3
 Sequence time: not used in encoder mode. The sequence time must be set larger than the sum of the individual line patterns.

NOTE One full sequence is executed per trigger signal. Within such a sequence the camera outputs the same number of lines as line patterns are defined. In this example the camera outputs three lines for each trigger signal.

Make sure that the sum of the used line patterns times is short enough to be completely executed at full-speed scanning.

If the trigger speed is faster than the sequence time, the camera automatically switches to free-running mode operating with defined speed of the sequence / pattern times.

Timing diagram:



Camera setup with CST:

number of line pattern: 3
 led number line pattern: 3
 time in µs for repeating all valid pattern: 300.000
 led flash sequence time: 300.000

Flash time 1 at channel 1 (µs): 100.000	Flash time 2 at channel 1 (µs): 0.000	Flash time 3 at channel 1 (µs): 100.000	Flash time 4 at channel 1 (µs): 0.000
Flash time 1 at channel 2 (µs): 0.000	Flash time 2 at channel 2 (µs): 50.000	Flash time 3 at channel 2 (µs): 50.000	Flash time 4 at channel 2 (µs): 50.000
Flash time 1 at channel 3 (µs): 0.000	Flash time 2 at channel 3 (µs): 0.000	Flash time 3 at channel 3 (µs): 0.000	Flash time 4 at channel 3 (µs): 0.000
Flash time 1 at channel 4 (µs): 0.000	Flash time 2 at channel 4 (µs): 0.000	Flash time 3 at channel 4 (µs): 0.000	Flash time 4 at channel 4 (µs): 30.000
Resulting time pattern 1: 0.000	Resulting time pattern 2: 0.000	Resulting time pattern 3: 0.000	Resulting time pattern 4: 0.000

8.7.7 Electrical interface (pin assignment)

For information about voltage levels (LVCMOS) of input (e.g. trigger) signals, see section: 5.1.4

NOTICE

You should check for correct input voltage levels.
Non-compliance can result in irreparable damages to the allPIXA pro camera!

Cabling requirements:

- The connection cable from camera to LED controller has to be fully shielded.
- Use the **same** ground potential for all devices (cameras, LED-Drivers, shielding for all cables, ...). Also use 0V ground pins for ground potential at the controller.
- *** TBD- The max length of the cable between camera and LED controllers is 5m. ***

Pin no.	Level	Description	LED-Flash
1	RS 422	GPIO_P0 (input)	---
2	RS 422	GPIO_P1 (input)	---
3	LVCMOS	GPIO_P4	Out4; over 1 KOhm + Pull-Up
4	LVCMOS	GPIO_P2	Out1; over 680 Ohm + Pull-Down
5	3.3 V over 100 Ohm	Power	---
6	LVCMOS	GPIO_P3	Out3; over 10 Ohm + Pull-down
7	0 V	Ground	0V
8	LVCMOS	GPIO_N4	Out4; over 10 Ohm + Pull-Down
9	RS 422	GPIO_N0 (input)	---
10	RS 422	GPIO_N1 (input)	---
11	0 V	Ground	0V
12	LVCMOS	GPIO_N2	Out2; over 10 Ohm + Pull-Down
13	0 V	Ground	0V
14	LVCMOS	GPIO_N3	LEDDRV_CLK + Pull-Down
15	5 V over 100 Ohm	Power supply	---

Out 1 – Out 4:

LED trigger output signal for channel 1 – 4

0V:
controller

0V signal ground potential for use with Out 1-4 at the LED

NOTE I

Always use 0V ground signal level of the camera in addition to the OUT channels for the signal levels at the LED controller.

8.7.8 I/O port configuration

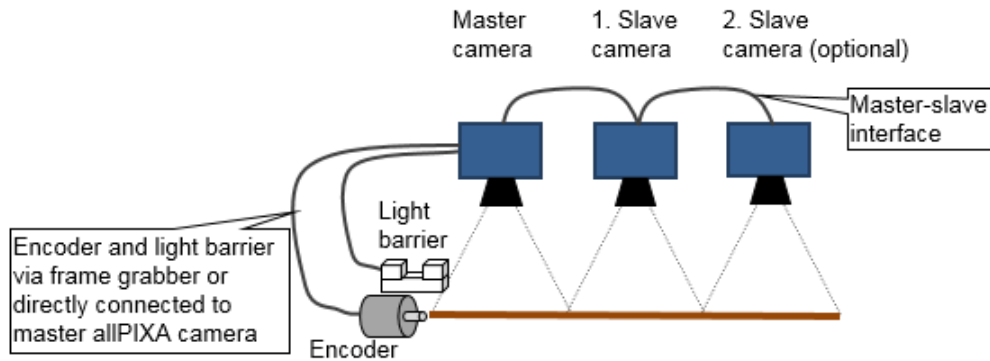
For the operation of flash control, the selected output ports (Out 1...4) are allocated automatically if flash control is activated.

Make sure that the ports are not in use for other functionality. Any definitions for this output channels in the I/O Configurator (see section 8.10) are ignored as soon as flash control is activated.

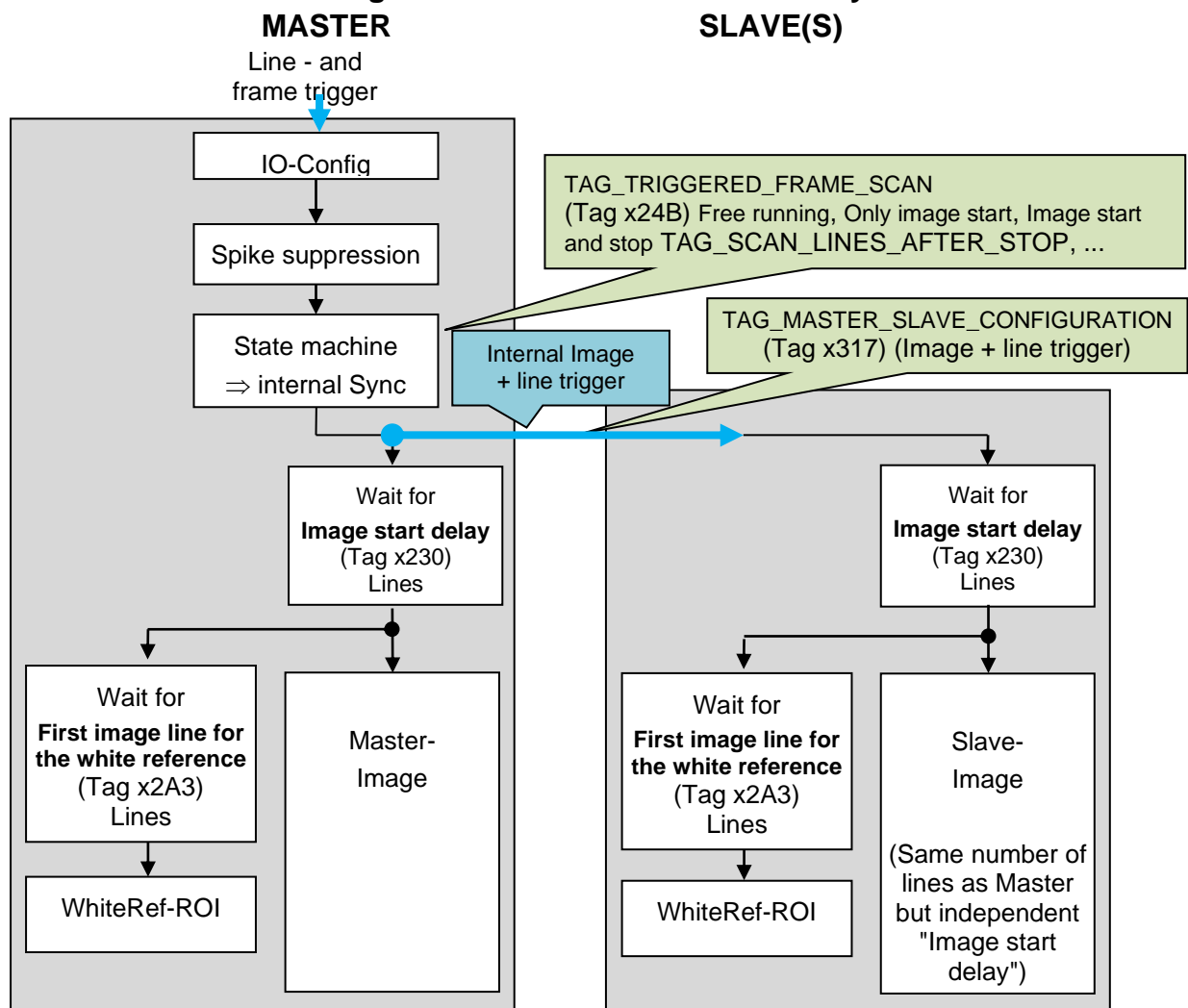
8.8 Principle of master-slave synchronization

The trigger signals from light barrier (frame trigger) and/or encoder (line trigger) are connected to the master camera only.

This could be achieved with the CC-bits via the frame grabber or by directly connecting to the master allPIXA pro camera. This trigger information is transferred via the master-slave interface to the slave camera(s). Due to this synchronization interface all cameras run with exactly the same timing for lines and optional frames.



8.8.1 Parameters and region of interest of master-slave synchronization



To ensure synchronous operation, the master camera provides an internal image and line trigger.

Image start delay can be specified separately for master and slave cameras. This permits to correct small deviations due to incorrect mechanical adjustment.

Also, the position of the white reference mark can be specified separately because the mark may be at different positions for the different cameras.

*) Available modes for state machine (internal sync): (Note: All modes should be set to the same value for all cameras.)

line trigger modes:

- Free-running
- Line trigger
- Encoder mode

frame trigger modes:

- Free-running
- Use start condition
- Use start/stop condition

NOTE

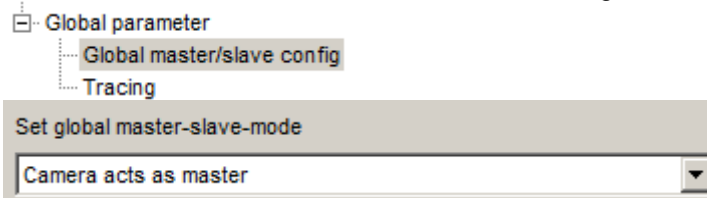
- The position of the image in transport direction (Y) of each camera can be set separately (start and length)
- Also, the position (X + Y) and the size of the white reference could be set separately in each camera
- The connection between master and slave must be specified by the I/O configuration!
- For OEM versions of the allPIXA pro also internal connections could be chosen.

8.8.2 Set up the cameras for master-slave synchronization

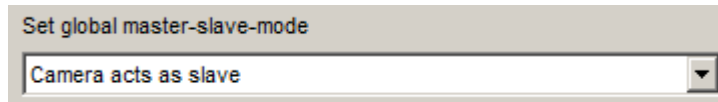
There are three options to set the cameras either to master or slave:

(a) Global:

The cameras can be set to master or slave via the global master-slave mode:



or



I/O definition



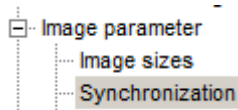
If the master/slave definition is set by software setting as above, the configuration of nSelMaster input is ignored. Therefore, no selection for nSelMaster has to be made.

(b) By Setting:

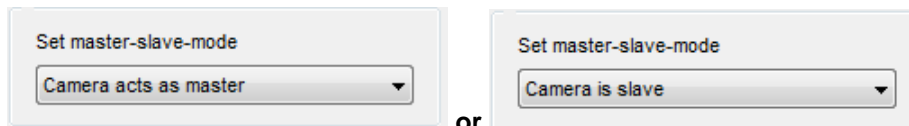
If the global master-slave mode is



the setting decides whether the camera acts as a master or a slave:



The cameras have dedicated settings, or the PC sets the camera to master or slave via the TAG_MASTER_SLAVE_CONFIGURATION



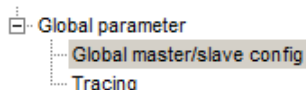
I/O definition

If the master/slave definition is set by software setting as above, the configuration of nSelMaster input is ignored. Therefore, no selection for nSelMaster has to be made.

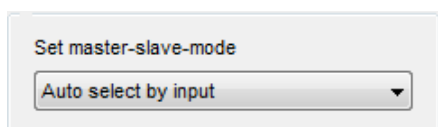
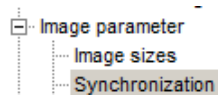
(c) Hardware (external input signal for master definition):

To set the camera for master/slave detection with external pin assignments by the I/O connector or CC bit 4 from the Camera Link interface, select the option **Auto-select by input**:

This can be done globally with



or from each setting:



The automatic master-slave detection uses the input pin assignment on the 15 pin I/O connector or the CC4 bit via Camera Link. The definition has to be as follows:

Background information: The signal nSelMaster is low active. A logic 0 on this input switches the camera to master, a logic 1 (or open on I/O Interface) sets the camera as slave. The input pin 3 of the I/O connector is held high by an internal Pull-Up.

- Master camera definition:

1. By using pin assignment: external master definition by applying a low voltage level (ground) to pin 3 (nSelMaster). Therefore, an electrical connection from pin 3 to pin 11(GND) on the D-Sub 15 connector can be used. (see following section "8.8.3. Connecting the master/slave cameras (cabling)")
2. By using the CC4 bit: apply a low signal on this bit via the frame grabber.

- Slave camera definition:

1. By using pin assignment of pin 3 on the D-Sub 15: no pin assignment is needed
2. By using the CC4 bit: apply a high signal on this bit via the frame grabber

I/O definition

If the master camera definition is defined externally, check the desired input for nSelMaster. For example, for defining master/slave by hardware, check the IO Interface-3 as shown. If you want to use the CC4 bit signal to define master slave, check the line below.

25	Select master camera	X5-3	nSelMaster	LVC MOS	<input checked="" type="checkbox"/>
26		CL1-CC4	nSelMaster	LVDS	<input type="checkbox"/>

8.8.3 Connecting the master-slave cameras (cabling)

The master/slave interface consists of two timing signals for standard setup (pin 6 and 8). These two signals have to be connected 1:1 between the master and all slave camera(s). In addition, the ground signal has to be connected between master and slave cameras. Therefore pin 7 and 13 can be used for a 1:1 connection between master and slave camera(s). It is recommended to have a 1:1 connection at least at pin 6; 7 and 8 (optionally pin 13) of all master and slave cameras.

NOTE: At least one ground signal must be connected in addition to the two timing signals (pin 6 and 8).

I/O definition

To enable the I/O input for master-slave communication, select the appropriate input in the I/O configurator as shown below.

25	Select master camera	X5-3 (Pull-Up)	nSelMaster	LVC MOS	<input checked="" type="checkbox"/>
26		CL1-CC4	nSelMaster	LVDS	<input type="checkbox"/>
27	Master / Slave interface	X5-6/8	MS_Interface	LVC MOS	<input checked="" type="checkbox"/>
28		X9-1/8	MS_Interface internal A	LVC MOS	<input type="checkbox"/>
29		X12-2/4	MS_Interface internal B	LVC MOS	<input type="checkbox"/>
30		X5-6/8-4/12	MS_Interface + Hub	LVC MOS	<input type="checkbox"/>

Cabling between master-slave cameras

Make sure that at least pin 6, 7 (GND), 8 (and 13, GND) are 1:1 connections between all master and slave cameras. For master definition using pin assignment, additionally connect pin 3 and 11 at the master camera.

Pin no.	Level	Connection at master camera	Connection at slave camera(s)
1	RS 422	Incremental encoder (high, Optional)	open
2	RS 422	Light barrier (high, Optional)	open
3	LVC MOS	nSelMaster (Bridge to 0 V)	Open, internal PullUp
4	LVC MOS	-	-
5	3.3 V over 100 Ohm	open	open
6	LVC MOS	Master/Slave-interface ↔	Master/Slave-interface
7	0 V	0 V ↔	0 V
8	LVC MOS	Master/Slave-interface ↔	Master/Slave-interface
9	RS 422	Incremental encoder (low, Optional)	open
10	RS 422	Light barrier (low, Optional)	open
11	0 V	0 V (Bridge to nSelMaster)	-
12	LVC MOS	-	-
13	0 V	0 V ↔	-0 V
14	LVC MOS	-	-
15	5 V over 100 Ohm	open	open

Only at Master!
(only if master selection by hardware is used)

1:1 connections

Internal Master/Slave interface (OEM-Versions only):

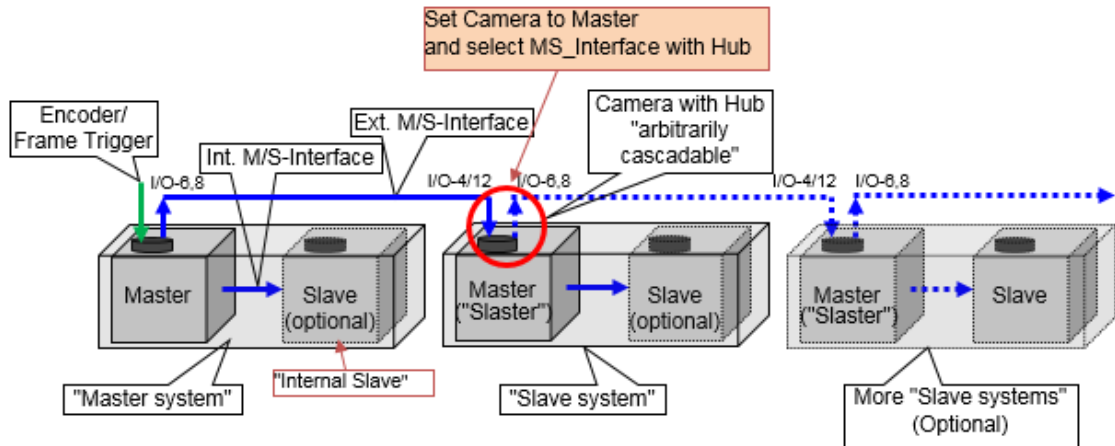
For OEM versions of the allPIXA pro (for example Dual-3D-PIX A), internal master/Slave connections are used.

27	Master / Slave interface	X5-6/8	MS_Interface	LVC MOS	<input type="checkbox"/>
28		X9-1/8	MS_Interface internal A	LVC MOS	<input checked="" type="checkbox"/>
29		X12-2/4	MS_Interface internal B	LVC MOS	<input type="checkbox"/>
30		X5-6/8-4/12	MS_Interface + Hub	LVC MOS	<input type="checkbox"/>

NOTE: These internal connections are set by factory and must not be changed!

Master/Slave interface with hub:

If more than one slave camera is used, there is an additional option to connect further slaves by use of the allPIXA pro as a hub for the Master/Slave interface:



Pin 6 and 8 of the 15-pin connector are used for output and pins 4 and 12 are used for input of the master slave interface.

NOTE: At least one ground signal (pin 7 or 13) must be connected in addition to the two timing signals.

I/O definition

To enable the Master/Slave interface with hub, choose the appropriate input interface:

27	Master / Slave interface	X5-6/8	MS_Interface	LVC MOS	<input type="checkbox"/>
28		X9-1/8	MS_Interface internal A	LVC MOS	<input type="checkbox"/>
29		X12-2/4	MS_Interface internal B	LVC MOS	<input type="checkbox"/>
30		X5-6/8-4/12	MS_Interface + Hub	LVC MOS	<input checked="" type="checkbox"/>

Wiring for "Master/Slave interface with hub"

Two outputs from the Master are connected to two inputs of the next slave. This slave acts as a master for the next slave. (In = Slave, Out = Master ⇒ "Slaster")

From master to slave: Pin 6⇒Pin 4 and Pin 8 ⇒ Pin 12

Additionally 2 wires for 0V (1:1) plus shielding.

At the first master, frame trigger and line trigger/encoder can be connected optionally.

D-Sub15	Signal name Master	Wire	Signal name Slaster_1	Wire	Signal name Slaster_2	Wire	Signal name Slaster_3 etc.
Pin							
1	IncrInP (Opt)		---		---		---
2	LBIInP (Opt)		---		---		---
3	LBIIn (Opt)		GP-I/O		GP-I/O		GP-I/O
4	GP-I/O		M/S-Int(0)-In		M/S-Int(0)-In		M/S-Int(0)-In
5	(3,3V)		(3,3V)		(3,3V)		(3,3V)
6	M/S-Int(0)-Out		M/S-Int(0)-Out		M/S-Int(0)-Out		M/S-Int(0)-Out
7	0V		0V		0V		0V
8	M/S-Int(1)-Out		M/S-Int(1)-Out		M/S-Int(1)-Out		M/S-Int(1)-Out
9	IncrInN (Opt)		---		---		---
10	LBIInN (Opt)		---		---		---
11	0V		0V		0V		0V
12	GP-I/O		M/S-Int(1)-In		M/S-Int(1)-In		M/S-Int(1)-In
13	0V		0V		0V		0V
14	GP-I/O		GP-I/O		GP-I/O		GP-I/O
15	(5V)		(5V)		(5V)		(5V)
Shield							

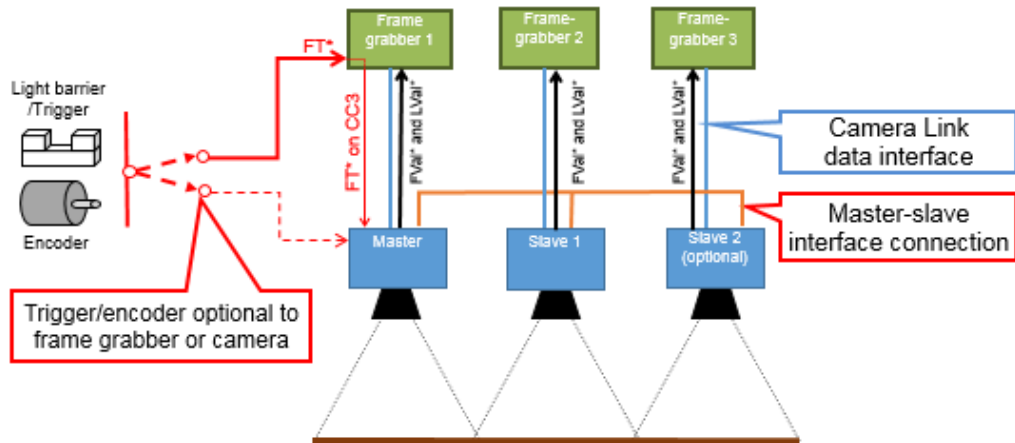
8.8.4 Frame grabber setup information for Master/Slave operation

There are two basic strategies for camera/frame grabber configurations to set up the system for master / slave mode.

Option 1 (Frame grabber in frame/area mode, preferred):

- Frame Signal: Frame trigger signal is provided only to the master camera (for example directly to the camera or via CC3 on Camera Link)
- Frame grabber mode: Frame/area mode
- Master Camera operation: Line: free-running mode or line trigger/encoder mode
Frame: free-running mode or frame trigger mode
- Slave camera synchronization: Cameras are synchronizing each line and also provide FrameValid signal to the frame grabbers
- Operation: The frame trigger signal is only sent to the master camera, for example by the use of CC3 bit. Each frame grabber is set to frame/area mode. The cameras run fully synchronized. The cameras provide the frame grabber with the LineValid and FrameValid signals.

IMPORTANT: If Multi-channel flash control (see section 8.7) is used, the frame grabber must be used in area mode.



- *FT – Frame trigger (optional)
- *LT – Line trigger/Encoder (optional)
- *FVAL – FrameValid (from each camera to the corresponding frame grabber)
- *LVAL – LineValid (from each camera to the corresponding frame grabber)
- *Light barrier / Trigger and Encoder can be connected independently to the frame grabber or to the camera IO, e.g. Encoder -> Frame grabber IO -> CC1; Light barrier / Trigger -> Camera IO -> X5-1/9

Option 2 (Frame grabber in line mode):

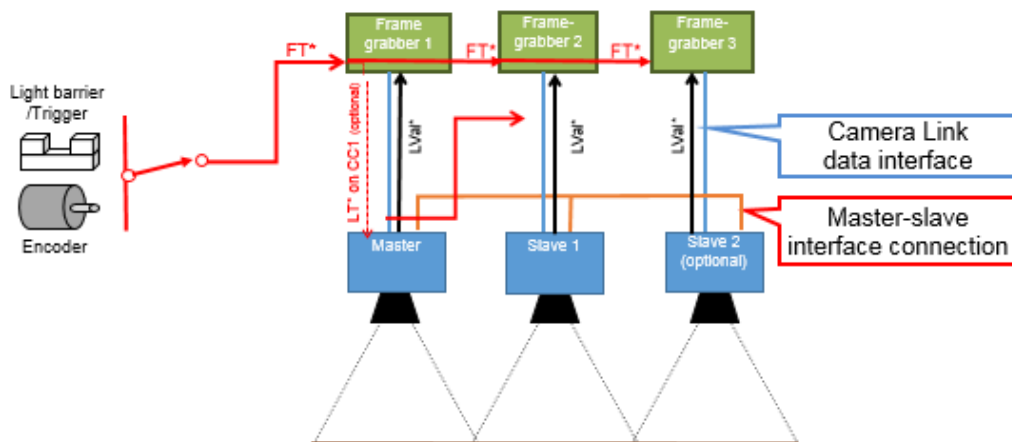
- Frame Signal: Frame trigger signal is provided to each frame grabber
- Framegrabber mode: Line mode
- Camera synchronization: Cameras are synchronizing each line
- Camera operation: Free-running mode/ encoder mode

Operation: The frame trigger signal is sent to each frame grabber, for example by the use of a dedicated connection cable. So each frame grabber has the same FrameValid signal available.
The cameras synchronize each line to each other. Each camera is outputting lines continuously.

Special feature: use FVal to also trigger the frame grabbers in line mode.

If the master camera is triggered by frame trigger, all cameras also provide an FVal signal to the frame grabber. Depending on the functionality of the used frame grabber in line mode, the frame grabber is able to process the FVal signal for image start or not.

If the frame grabber is restricted in functionality and cannot process the FVal signal, it must be provided to each frame grabber (as shown below).



- *FT – Frame trigger
- *LT – Line trigger
- *FVAL – FrameValid
- *LVAL – LineValid

For more information about the detailed setup of the frame grabber, refer to your frame grabber manual or contact support of your frame grabber dealer.

NOTE: With Option 2, the frame grabbers receive the frame trigger signal not exactly at the same time. Therefore, it may sometimes happen that a frame grabber misses the first line so that the images of the different frame grabbers are not synchronous.

8.9 Edit color conversion (correction) matrix

For color conversion, four color conversion matrix tables are available in the camera.

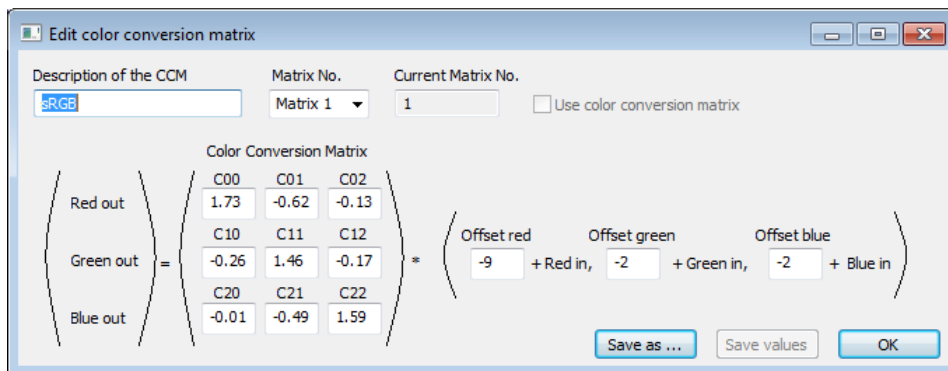
$$\begin{pmatrix} R_{out} \\ G_{out} \\ B_{out} \end{pmatrix} = \begin{pmatrix} C00, C01, C02 \\ C10, C11, C12 \\ C20, C21, C22 \end{pmatrix} * \begin{pmatrix} R_{in} + Offset_R \\ G_{in} + Offset_G \\ B_{in} + Offset_B \end{pmatrix}$$

With:

Offset: Additional Offset in 10Bit range, from -511 to +511 corresponding -0,5 to +0,5

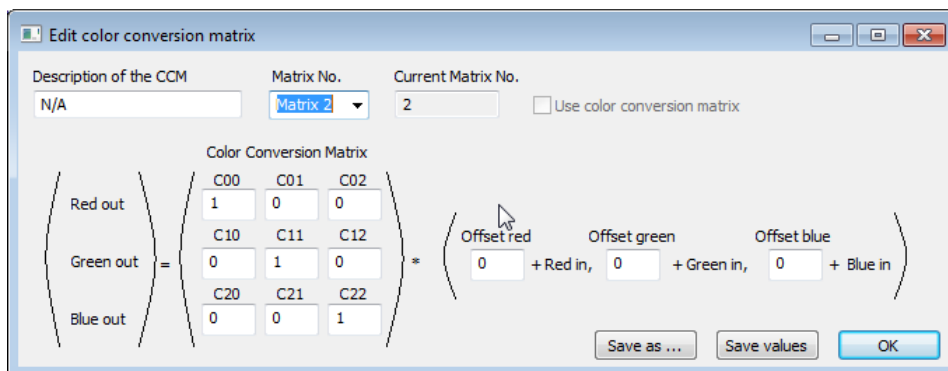
Cxy Gain factor from -2,0 to +2,0.

Matrix 1 is a preconfigured color conversion matrix for sRGB conversion. It is write-protected and cannot be modified:



NOTE To use the sRGB conversion, additionally set **Gamma correction** to 0.1 on the **Brightness and contrast** page of the Camera Settings. With gamma 0.1 a special sRGB table is activated. With gamma 0.2 a special table for multi-spectral applications is activated.

Matrix 2 to Matrix 4 are preconfigured as transparent color conversion matrix:



Matrix 2 to Matrix 4 can be modified.

To modify a matrix:

1. On the **Advanced** menu, click **Edit color conversion matrix**.
 The **Edit color conversion matrix** dialog box opens and shows the values of Matrix 1.
2. In the **Matrix No** list, select the matrix whose values you want to modify.
3. Modify values, click **Save as** and select one of the matrixes **Matrix 2** to **Matrix 4**.
4. If the currently selected matrix is not **Matrix 1**, you can alternatively click **Save values** to save the values to the currently selected matrix.

NOTE The command **Edit color conversion matrix** is only available in CST user mode **Guru**.

8.10 IO configuration


The allPIXA camera offers different ports for synchronizing image data. Its functions are as follows:

- Line trigger or encoder
- Frame trigger

Two ways are available to transfer the signals to the camera:

- CC bits on the Camera Link cable
- IO-port (D-Sub-15) on the allPIXA camera

External ports must be connected to the internal functions by use of the IO Configurator. For more information about encoder setup, see section 8.6.

Button	Function key	Menu
		View/IO Configurator

	Name of IO function	Connector	Internal Function	IO-Standard	Bit Value
01	Encoder Ch 0 / line trigger	CL1-CC1	Encoder0/line trigger	LVDS	<input checked="" type="checkbox"/>
02		X5-1/9	Encoder0/line trigger	RS422	<input type="checkbox"/>
03		X5-4 (Pull-Down)	Encoder0/line trigger	LVC MOS	<input type="checkbox"/>
04		---	Encoder0/line trigger -> static Low	---	<input type="checkbox"/>
05		---	Encoder0/line trigger -> static High	---	<input type="checkbox"/>
06	Encoder Ch 1	CL1-CC2	Encoder 1	LVDS	<input type="checkbox"/>
07		X5-2/10	Encoder 1	RS422	<input type="checkbox"/>
08		X5-12(Pull-Down)	Encoder 1	LVC MOS	<input type="checkbox"/>
09		---	Encoder 1 -> static Low	---	<input checked="" type="checkbox"/>
10		---	Encoder 1 -> static High	---	<input type="checkbox"/>
11	Enable Encoder	---	Enable Encoder -> static Low/inactive	---	<input type="checkbox"/>
12		---	Enable Encoder -> static High/active	---	<input checked="" type="checkbox"/>
13		CL1-CC2	Enable Encoder	LVDS	<input type="checkbox"/>
14		CL1-CC4	Enable Encoder	LVDS	<input type="checkbox"/>
15	SelectScanDir	CL1-CC2	SelectScanDir	LVDS	<input checked="" type="checkbox"/>
16		X5-2/10	SelectScanDir	RS422	<input type="checkbox"/>
17		X5-12 (Pull-Down)	SelectScanDir	LVC MOS	<input type="checkbox"/>
18	Invert ScanDir from Encoder	---	Inv. ScanDir from Encoder	---	<input type="checkbox"/>
19	frame trigger / light barrier	CL1-CC3	All debouncing levels	LVDS	<input checked="" type="checkbox"/>
20		CL1-CC4	All debouncing levels	LVDS	<input type="checkbox"/>
21		X5-1/9	All debouncing levels	RS422	<input type="checkbox"/>
22		X5-2/10	All debouncing levels	RS422	<input type="checkbox"/>
23		internal frame trigger	All debouncing levels	---	<input type="checkbox"/>
24		X5-3 (Pull-Up)	All debouncing levels	LVC MOS	<input type="checkbox"/>
25	Select master camera	X5-3 (Pull-Up)	nSelMaster	LVC MOS	<input type="checkbox"/>
26		CL1-CC4	nSelMaster	LVDS	<input type="checkbox"/>
27	Master / Slave interface	X5-6/8	MS_Interface	LVC MOS	<input type="checkbox"/>
28		X9-1/8	MS_Interface internal A	LVC MOS	<input type="checkbox"/>
29		X12-2/4	MS_Interface internal B	LVC MOS	<input type="checkbox"/>
30		X5-6/8-4/12	MS_Interface + Hub	LVC MOS	<input type="checkbox"/>
31	Test signals	X5-4	VSYNC / FVAL	LVC MOS	<input type="checkbox"/>
32		X5-12	HSYNC / LVAL	LVC MOS	<input type="checkbox"/>
33	FVAL while flashing	X5-14	FVAL while flashing	LVC MOS	<input type="checkbox"/>
34		CL1-CC4	ScanCancel	LVDS	<input type="checkbox"/>



Line trigger / encoder inputs. See 8.6.2.1

Enable Line trigger inputs See 8.6.5

ScanDir for RGB line compensation. See 9.7.2

Frame trigger inputs See 8.6.1

Master/Slave configuration See 8.8.2

- Avoid double use of internal functions (for example only select one input for line trigger or frame trigger)
- To transfer the selection to the camera, click **Transfer setting to camera**  on the toolbar, or press **F9**.
- To save changes on the camera permanently, click **Burn setting permanently**  on the toolbar, or click **F10**.

8.11 Cancelling scanning

If you activate **ScanCancel** in the IO Configuration (see section 8.10), you can use this signal to cancel the scan operation for the current image. This can, for example, be used to terminate image acquisition if the transport stops.

If **ScanCancel** is set to High, the current image is aborted and FVAL becomes Low. When **ScanCancel** returns to Low afterwards, the camera is ready to receive a new frame trigger immediately.

9 Camera parameters

The camera parameters are arranged in the same order as they are listed in the CST software. In this part of the manual the parameters are described “as they are”. For a description how to setup the camera, see section 8 “Camera operation”.

The visibility of the parameters is defined by the specified **User level** in CST. For more information about which user level is required to modify certain parameters, see section 9.19.

For an overview of the camera parameters and their general functions on the CST user interface, see section 6.2.

9.1 Integration time parameters

9.1.1 Integration time

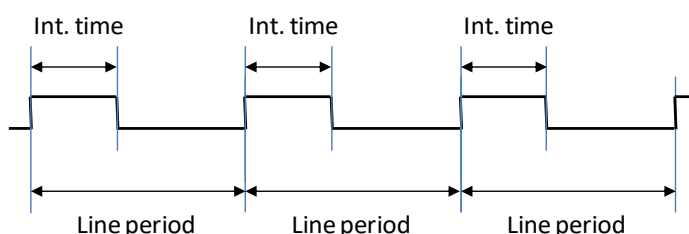
Name			
Name	Integration time		
Function	Sets the integration time in microseconds to the camera		
Unit	Float	Step:	0.001
	Linear		
Dependency	None		
Notes	<p>These are the minimum integration times for the camera. The speed could additionally be throttled by Camera Link parameters!</p> <p>For more information, see section 9.11.4.</p> <p>If Multi-channel flash control is used (see section 8.7), the minimum integration time is higher. In this case, the values in Flash mode column take effect.</p>		
	Camera:	Value CST:	Flash mode
Lower limit	4k	19,68 μ s	28,94 μ s
	5K	24,48 μ s	32,12 μ s
	6000	29,14 μ s	38,26 μ s
	7.3k	33,65 μ s	45,88 μ s
Upper limit	All	9.25 msec	9,25 msec

9.1.2 Use line period

Name	
Name	Use Line Period
Function	Activates the function for independent control of integration time and line period time.
Channels	All
Unit	Bool
Dependency	Camera must be in free-running mode; the Enable encoder check box must be cleared.
Notes	
	Camera: Value CST
Lower limit	All Off
Upper limit	All On

9.1.3 Line period time

Name			
Name	Line period time		
Function	Sets the value for line period in microseconds to the camera.		
Unit	Float	Step:	0,001
	Linear		
Dependency	Only available if the Use line period check box is selected.		
Notes	Value must be greater than that of Integration time.		
Camera:		Value CST	
Lower limit	4k	>19,68 μ s	
	5K	>24,48 μ s	
	6000	>29,14 μ s	
	7.3k	>33,65 μ s	
Upper limit	All	9.25 msec	



9.2 Gain settings

9.2.1 Analog coarse gain

This parameter describes the coarse gain parameter of the camera, which takes effect in step (1) of analog image processing (section 4.5.1 Analog / digital image processing; *Figure 16*).

Name		
Name	Analog Coarse Gain	
Function	Pre-amplification after CCD and before analog gaining.	
Channels	Red, Green, Blue Front; Rear	
Unit	-3 dB; 0 dB; +3 dB; +6 dB	
	Log.	
Dependency	None	
Notes	Use this parameter for a rough adjustment of gaining at the first step.	
Camera:		Value CST:
Lower limit	all	-3 dB
		0 dB
		3 dB
Upper limit	All	6 dB

Analog Coarse Gain is a pre-amplification factor (basically to adapt the output signal of the CCD to the input of the main analog amplifier). The output range of the CCD is greater than the input range of the AFE (analog front end). Therefore, with this factor the possible output range can be adjusted. With this “adjustable two-step amplification” it is possible to adjust the allPIXA pro for a wide range of applications.

Usage: If the current gain values are higher than about 300, the Analog Coarse Gain-amplifier may be used (set to a higher amplification factor) to decrease gain values. Otherwise, the image pixel noise increases.

It is recommended to operate the camera with current gain values in a range from 150 – 300 for best image quality by using the **Analog Coarse Gain** function to pre-adjust the actual gain range.

Note: If “saturation” is detected within the image (clipped areas) this may have different reasons. One reason may be that the output signal of the CCD is higher than the possible input signal of the AFE.

Therefore, analog coarse gain has to be set to – 3 dB.

9.2.2 Current camera gain values

This parameter describes the analog gaining parameter of the camera which takes effect in step (2) of analog image processing (section 4.5.1; *Figure 16: Analog process of the allPIXA pro camera (block diagram)*).

With active white control, this parameter refers to the gain values labeled with (3) in the diagram of section 4.9.

Name		
Name	Current camera gain values	
Function	Gaining values for the analog gaining of the camera.	
Channels	Red, Green, Blue Odd; Even Front; Rear	
Unit	Integer	
	Log.	
Dependency	None	
Notes	One step of this parameter refers to 0.0359 dB, 27.85 steps refer to 1 dB. An increase of up to 168 steps doubles the signal.	
Camera:		
Value:		
Lower limit	all	0
Upper limit	all	700

9.2.3 Startup gain values

Name		
Name	Camera startup gain values	
Function	According to these values the gaining values are updated at startup of the camera or by loading a setting for faster startup behavior of the closed-loop control for white balancing.	
Channels	Red, Green, Blue Odd; Even Front; Rear	
Unit	Integer	
	Linear	
Dependency	None	
Notes		
Camera: Value:		
Lower limit	All	0
Upper limit	All	700

9.2.4 Update start gain values

Name		
Name	Update start gain with current gain values	
Function	By setting and transmitting this value to the camera, it updates the value Camera start gain values with the values defined by Current camera gain values .	
Channels	all	
Unit	Bool	
Dependency	None	
Notes	Take notice that the result may differ due to the fact that this function takes values of the camera and not of CST. To make sure to read the current values, click Refresh or press F5 before you perform this operation.	
Camera: Value:		
Lower limit	All	0
Upper limit	All	1

9.3 White reference mark

9.3.1 Position and size in CCD direction

NOTE **Attention:**
The white reference area must not cover the tap border.

For the position in CCD direction of the white reference control zone you have two alternatives:

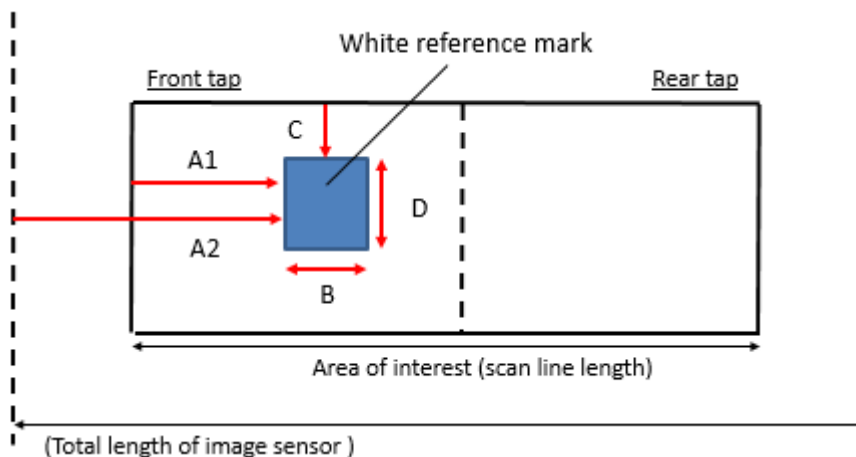
“Relative” x position

The x position of the white reference mark can be defined “relative” to the current image window (ROI).

If defined *relative*, the reference position **moves** if the scan line length of the current scan Window is changed.

“Absolute” x position

The x position of the white reference mark can be defined “absolute” within the maximum scan window (for example 4K with a 4K allPIXA pro). If defined *absolute*, the reference position **does not** move if the width of the current scan window is changed.



A1= First relative pixel of white reference (may be negative); see section 9.3.3

A2= First absolute pixel of white reference (see section 9.3.4)

B = Number of pixel for white reference (see section 9.3.6)

C = First image line of white reference (may be negative),
only used if *white control mode is set to “sync mode”* (see section 9.3.7)

D = Number of image lines for white reference (see section 9.3.8)

The **Use absolute horizontal position of white reference** check box determines whether relative or absolute white reference mode is used.

NOTE If you use **Horizontal Binning** (see section 9.8.4), A1 and B refer to the unreduced image.
If you use **Vertical scan line reduction** (see section 9.8.5), C refers to the unreduced image, while D specifies the length of the white reference mark within the reduced image.

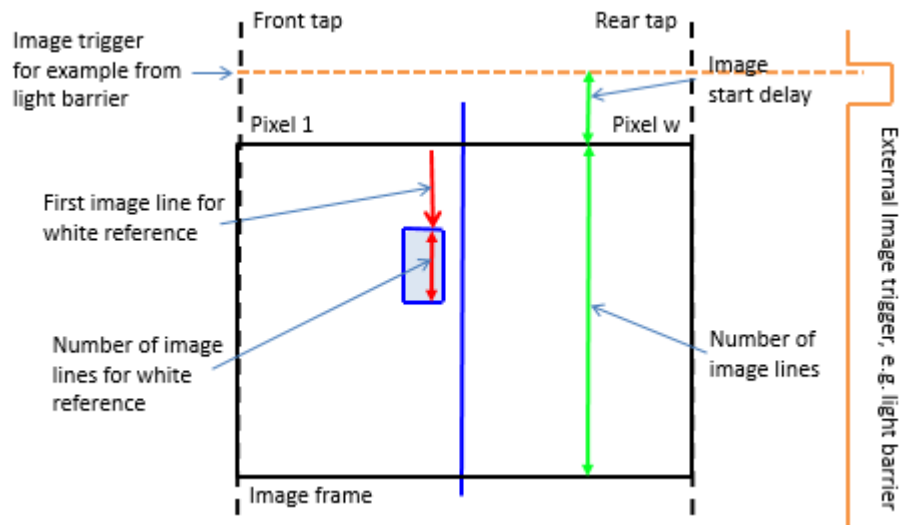
9.3.2 Position and size in transport direction (sync. mode)

By default, the reference area is not synchronized to image frame acquisition. Measurement of white reference values is done continuously, no matter whether the image frame is active or not.

If **Use sync mode** is selected at the **White control mode** area of the **White control** page (see section 9.4.5), the reference area is defined as ROI to the captured image frame.

The y position of the white reference ROI is defined “relative” to the image window.

NOTE **Attention:**
 Vertical reference white position **moves** with changing **Image start delay** of the current scan window.



The height of the white reference area is defined by **Number of image lines for the white reference**.

9.3.3 First relative pixel of white reference

Name	
Name	First relative pixel of white reference
Function	Describes the start of the control zone for the white balancing in the line/image (relative to the currently captured image)
Channels	All
Unit	Integer
Dependency	None
Notes	If Horizontal Binning is used, the value refers to the unreduced image.
Camera:	Value:
Lower limit	All 0
Upper limit	4k 4.092 – Number of pixels of white reference
	5k 5.116 – Number of pixels of white reference
	6000 5.996 – Number of pixels of white reference
	7.3k 7.292 – Number of pixels of white reference

9.3.4 First absolute pixel of white reference

Name		
Name	First absolute pixel of white reference	
Function	Describes the start of the control zone for white balancing in the line / image (beginning from first visible pixel of the camera)	
Channels	All	
Unit	Integer	
Dependency	None	
Notes		
Camera:		Value:
Lower limit	All	0
Upper limit	4k	4.092 – Number of pixels of white reference
	5k	5.116 – Number of pixels of white reference
	6000	5.996 – Number of pixels of white reference
	7.3k	7.,292 – Number of pixels of white reference

9.3.5 Use absolute horizontal position of white reference

Name			
Name	Use absolute horizontal position of white reference		
Function	If the check box is selected, absolute horizontal position of white reference is used (9.3.3), otherwise, relative position is used (0)		
Channels	All		
Unit	Bool		
Dependency	None		
Notes			
Camera:		Value:	Function:
Lower limit	All	0	Off
Upper limit	All	1	On

9.3.6 Number of pixels for white reference

Name		
Name	Number of pixels for white reference	
Function	Describes the width of the control zone for the white balancing in the line/image	
Channels	All	
Unit	Integer	
Dependency	None	
Notes	If Horizontal Binning is used, the value refers to the unreduced image.	
Camera:		Value:
Lower limit	All	2
Upper limit	All	1.024

9.3.7 First image line for the white reference

Name		
Name	First image line for the white reference	
Function	Starts pixel of control zone in transport direction	
Channels	All	
Unit		
Dependency	Only if the image synchronized mode is used for white balancing.	
Notes	If Vertical scan line reduction is used, value refers to the unreduced image.	
Camera:		Value:
Lower limit	All	1
Upper limit	All	Image size – "Number of Number of image lines for the white reference"

9.3.8 Number of image lines for the white reference

Name		
Name	Number of image lines for the white reference	
Function	Length of control zone in transport direction	
Channels	All	
Unit	Integer	
Dependency		
Notes	If Vertical scan line reduction is used, value refers to the reduced image.	
Camera:		Value:
Lower limit	All	0
Upper limit	All	1.024

9.3.9 Number of reference samples (Average)

Name		
Name	Number of reference samples	
Function	Number of ROIs needed for averaging of current video values for closed-loop control, either with synchronization or free-running.	
Channels	All	
Unit	Integer	
	None; 2; 4; 8; 16; 32	
Dependency	None	
Notes	With a higher average number, the speed of the closed loop control is slower but the noise suppression becomes higher.	
Camera:		Value CST:
Lower limit	All	None
		2 samples
		4 samples
		8 samples
		16 samples
Upper limit	All	32 samples

9.3.10 Show white reference border

Name			
Name	Show white reference border		
Function	Displays the border of the control zone with blue lines in the image.		
Channels	All (Blue: 255; Red and Green: 0)		
Unit	Bool		
Dependency	None		
Notes	Function must be switched off for taking reference images regarding to black and white correction. With encoder/line trigger mode: If the maximum speed is exceeded, the vertical position of the control area can't be guaranteed. The gain control is skipped until the speed has reached the nominal range and the reference borders are marked red.		
Camera:	Value:	Function:	
Lower limit	All	0	Off
Upper limit	All	1	On

9.4 White control

9.4.1 Target white reference values

Name		
Name	Target white reference values	
Function	Video value for the desired value of the closed-loop control for white balancing	
Channels	Red, Green, Blue Odd; Even Front; Rear	
Unit	Integer in 10 Bit	
	Linear	
Dependency	Only takes effect if the Enable continuous white control check box is selected, or during a white reference operation if you click Perform white reference on the toolbar.	
Notes	<ul style="list-style-type: none"> Refers to the white control mark. Inside this area the closed-loop control tries to adjust gain to reach these desired values. Internal value is a 14-bit video, GUI values are 10-bit video value (0 to 1023); output range of the image at the Camera Link port is usually 8-bit range 	
Camera:	Value:	
Lower limit	all	0
Upper limit	all	1023 – dark reference value

This parameter refers to the reference values labeled with (1) in the diagram of section 4.9.

NOTE I The maximum reachable value for the target values is **Target values = 1023 - max dark reference value** (with active black-level correction). The typical dark reference values are about 4 ... 16 (in 8 bit) in the raw image data.

NOTE II The level of the target value must be adapted to the position of the white reference control zone (see Figure 35 below). For zone 1 the values must be set to a lower value than for zone 2. If the target values for zone 1 are too high, this results in saturation in the image's center.

A good compromise for centered control zone is a value of about 800.

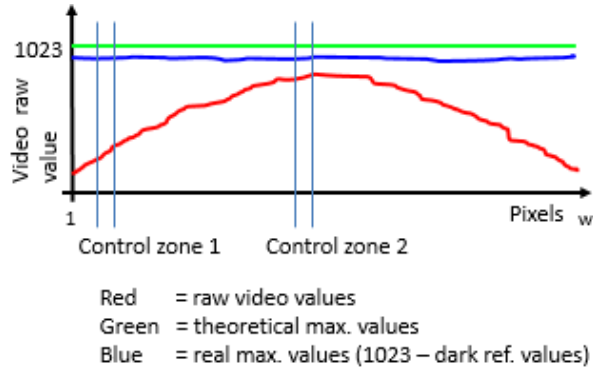


Figure 37: Sample of raw and theoretical video and dark reference values (with 10-bit GUI value range)

9.4.2 Current white reference values

Name		
Name	Current white reference levels	Read only
Function	Video value measured by the camera inside the white control mark, mean value over the defined area and the number of ROI defined for averaging	
Channels	Red, Green, Blue Odd; Even Front; Rear	
Unit	Integer	
	Linear	
Dependency	None	
Notes	<ul style="list-style-type: none"> Refers to the white control mark. Inside this area the closed-loop control tries to adjust gain to reach current values to the desired values. 10-bit video output value. Output range of the image at the Camera Link port is usually in the 8-bit range 	
Camera:		Value:
Lower limit	all	0
Upper limit	all	1023

This parameter refers to the video values labeled with (2) in the diagram of section 4.9.

9.4.3 Enable continuous white control

Name			
Name	Enable continuous white control		
Function	Enables the closed-loop control for white balancing		
Channels	all		
Unit	Bool		
Dependency	None		
Notes			
	Camera:	Value:	Function:
Lower limit	all	0	Off
Upper limit	all	1	On

9.4.4 Position and mode for white reference mark

Name		
Name	Position and mode for white reference mark	
Function	<p>It is possible to set the reference zone either to front tap, rear tap, to both taps independently or to automatic detection.</p> <p>It is strongly recommended to use automatic detection. In this case, the camera chooses automatically which tap is used as master.</p> <p>Changing this default behavior should only be done by experienced users.</p>	
Channels	All	
Unit	Integer	
Dependency	Only takes effect if the Enable continuous white control check box is selected, or during a white reference operation if you click Perform white reference on the toolbar.	
Notes	<p>For more information about the exact size and position, see section 9.3</p> <p>This function is only available, if User level is set to Guru.</p>	
	Camera:	Function:
Lower limit	All	Front TAP data are used for gain control. Rear channels follow (slave rear)
	All	Rear TAP data are used for gain control. Front (slave front)
	All	Front and Rear TAP data are controlled independently
Upper limit	All	Automatic master tap detection out of area position (recommended!)

9.4.5 White control mode

Name	
Name	White control mode
Function	Set the mode of the white control function
Channels	All
Unit	
Dependency	It is only available if the Enable continuous white control has been selected.
Notes	Function is only available if User level has been set to Guru .
Camera:	Functions:
All	Use sync mode: acquiring references is synchronized with area scan
All	Stop gain control if level <"Stop gain control" * last gain value
All	Stop gain control by variance value

Two modes for white control are available:

Gain control using area mode:

Gain control uses the video levels within the specified white reference mark.

Use maximum video level:

Gain control uses the maximum video level independently of the position of the white reference mark.

Three options are available:

Use sync mode: ...

If you use this option, white control sets the white reference into the image regarding to the necessary frame trigger.

Stop gain control if level < 'Stop gain control' * last gain value

If the value of the white reference video level is lower than the specified value of **Gain control stop factor**, the closed-loop control for the white balancing could be paused by using this option (for example if the light on the white reference is lowered without any present document (stray-light from the document)).

Stop gain control by variance value

If the medium variance of the white reference video level is higher than the specified value of **Set gain control stop by variance**, the closed-loop control for the white balancing can be paused by use of this option. For experienced users only.

9.4.6 Gain control stop factor

Name		
Name	Gain control stop factor	
Function	Sets the pause condition for the white control.	
Channels	All	
Unit	Float	
Dependency	It is only available if the Stop gain control if... check box is selected in the White control mode area.	
Notes	White control pauses if the following condition is fulfilled: Average of all values of Current white reference levels < value * Average of the last valid Current white reference levels .	
Camera:		Value CST:
Lower limit	All	0
Upper limit	All	1

1. Description of paper (object) detection function:

During scanning, the camera is set to automatically control the image brightness using the implemented function "Automatic white control". The control mechanism of the camera uses the reference area on the object to adapt the camera gain values as defined within the camera parameters.

In certain situations during the scanning process it can occur that an object is missing on the transport. If no object is on the transport, the reference area for the brightness control appears darker than the normal paper white. Therefore, a missing object can irritate and misguide the automatic gain process. With the paper detection functionality, the existence of a sheet is detected, and the automatic gain control stops if no object (certain degree of brightness) is found on the transport.

2. Basic functionality description:

The camera reads the white values of the reference area. If the brightness of the reference area is below the suppress condition, automatic white control is disabled only for the currently scanned image. The procedure is applied separately to each acquired image.

3. Suppress condition:

Mean of value of current reference area < (mean value of desired values of all channels * threshold factor).

4. Feedback camera signal:

While gain control is disabled, the image is scanned with the last valid gain values. The camera sets a flag if the values in the reference area are too low (-> no paper) and the "automatic gain control" function is disabled.

Example:

All desired values for the white reference target value are set to 800, stop gain control factor is set to 0.5.
If sum of all current white references drops below $0.5 * 800 = 400$, then automatic gain control is disabled.

9.4.7 Set gain control stop by variance

Name		
Name	Set gain control stop by variance	
Function	Sets the pause condition for the white control.	
Channels	All	
Unit	Integer	
Dependency	Takes only effect if the Stop gain control by variance value check box is selected in the White control mode area.	
Notes	White control pauses if medium variance of the values of the pixels in the white reference area is higher than the specified value.	
Camera:		Value:
Lower limit	All	0
Upper limit	All	65535

During the scan, the camera is set to automatically control the image brightness using the implemented function “Automatic white control”. The control mechanism of the camera uses the reference area on the object to adapt the camera gain values as defined within the camera parameters.

In rare situations, the **Gain control stop factor** parameter cannot be used successfully, because medium brightness is similar to that of the expected object if no object is on the transport. But in these cases often brightness variance of the pixels is much higher if no object is present.

9.4.8 Set active channels for white control

Name		
Name	Set active channels for white control	
Function	Determines which channels are active during automatic white and tap balancing	
Channels	All	
Unit	Bool	
Dependency	Applies only to the automatic gain control functions such as white balancing and tap balancing.	
Notes	<p>If you work with “white” illumination, leave all channels set to “Enabled” (Standard use of the allPIXA pro).</p> <p>This function is useful if you work with different lighting conditions. If you are for example working with three different light setups for the different color channels, you could turn on the lights for one channel, disable the other “Active channels” and perform white and tap balancing. After this you run through the same procedure for the other channels. If you disable the channel, the old values for the white or tap balancing are not overwritten.</p>	
Camera:		Value CST:
Lower limit	All	0
Upper limit	All	1

For more details, see section 8.2.4.

9.5 Reference usage

9.5.1 Black-level correction (offset correction)

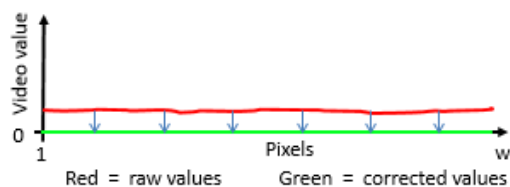
Name			
Name	Activate black-level correction		
Function	This function enables the pixel-wise black-level correction inside the camera.		
Channels	All		
Unit	Bool		
Dependency	None		
Notes			
Camera:	Value:	Function:	
Lower limit	All	0	Off
Upper limit	All	1	On

Black-value correction is made pixel-by-pixel and corrects the different behavior of the individual pixels (**DSNU = Dark Signal Non-Uniformity**) in dark images. Black-value correction is carried out with a non-exposed sensor (for example if the lens is closed, the illumination is switched off, or a black reference is scanned).

Black-value correction is carried out individually on each allPIXA pro camera during factory calibration.

If the gain of the camera changes it is recommended to take a new black-level reference.

Four reference sets for the black-level correction are supported by the allPIXA pro camera as well as four reference sets for the shading correction. Reference position number can be entered if a reference is created using the CST Reference Wizard and if it is selected in the allPIXA pro camera setting. All reference sets can be used for different setups, for example different f-stops or different illuminations.



This parameter refers to the video values labeled with **(1)** in the diagram in section 4.5.1 figure 16.

9.5.2 Black-reference data set

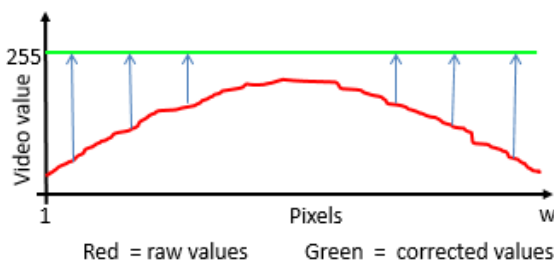
Name		
Name	Black reference data set	
Function	Select the data set for black-level correction.	
Channels	All	
Unit	Integer	
Dependency	None	
Notes	Four data sets for black-level reference can be stored inside of the camera. The number for the storage space must be selected in CST when a new reference is created with the Reference wizard.	
Camera:	Value:	
Lower limit	All	Use data set 1
Upper limit	All	Use data set 4

9.5.3 Shading correction (flat-field correction)

Name			
Name	Activate white-level correction		
Function	This function enables the pixel-wise shading correction inside the camera.		
Channels	All		
Unit	Bool		
Dependency	None		
Notes			
Camera:	Value:	Function:	
Lower limit	All	0	Off
Upper limit	All	1	On

Shading correction is made pixel-by-pixel and corrects the different behavior of the individual pixels in the images (**PRNU = Photo Response Non-Uniformity**). In addition, it compensates any illumination non-homogeneities.

Four reference sets for the shading correction are supported by the allPIXA pro camera, as well as four reference sets for the black-level correction. The reference position number can be entered if a reference is created using the CST Reference Wizard and if it is selected in the allPIXA pro camera setting. All reference sets can be used for different setups, for example for different f-stops or different illuminations.



This parameter refers to the video values labeled with **(2)** in the diagram in section 4.9.

The internal processing is not limited up to 255@8bit. This means that after shading correction it is possible to additionally process higher values such as 300, which can be taken without loss into the visible area by using the brightness and contrast control afterward.

Internal value is a 14-bit video, diagram range is 8-bit range because the image at the Camera Link port is usually 8-bit range.

9.5.4 White reference data set

Name		
Name	White reference data set	
Function	Select the data set for shading correction.	
Channels	All	
Unit	Integer	
Dependency	None	
Notes	Four data sets for white reference can be stored inside the camera. The number for the storage space must be selected in CST when a new reference is created using the Reference wizard.	
Camera:	Value:	
Lower limit	All	Use data set 1
Upper limit	All	Use data set 4

9.6 Brightness and contrast

These parameters describe the digital offset and gaining parameters for the camera. This operation takes place in step (3) of the digital image processing pipeline (*section 4.5.1; Figure 17: Digital process of the allPIXA pro camera (block diagram)*).

NOTE Using these parameters to adjust image brightness in a wide range to get brighter images may degrade image quality.

First, use the analog gaining to adjust brightness of the image (see sections 9.2.1 and 9.2.2). For instance, after adjusting analog gain and performing a shading correction (it sets the values for white to 255), you can get the white slightly out of the area of the image saturation from 255 to 245.

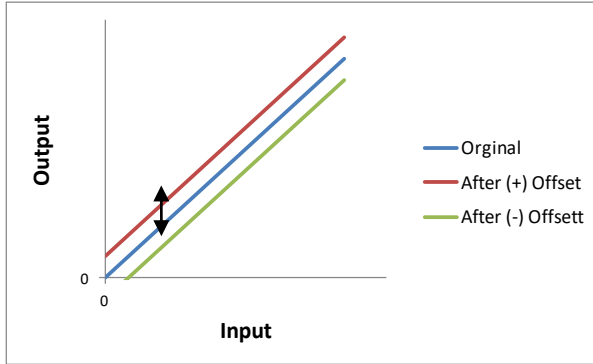
The internal processing is not limited up to 255@8bit. This means that after the shading correction it is possible to additionally process higher values such as 300, which can be taken without loss into the visible area by using the brightness and contrast control afterward.

9.6.1 Use brightness and contrast

Name			
Name	Use brightness and contrast		
Function	Enables the digital gaining and contrast function in the camera.		
Channels	All		
Unit	Bool		
Dependency	None		
Notes			
	Camera:	Value:	Function:
Lower limit	all	0	Off
Upper limit	all	1	On

9.6.2 Brightness

Name			
Name	Brightness		
Function	Digital offset		
Channels	Red; Green; Blue		
Unit	Integer		
	Linear		
Dependency	Only available if the Use Brightness and Contrast check box has been selected.		
Notes	This value refers to 10-bit image data, in output image there are usually 8-bit image data. This results in a relative range of -0.25...+0.25.		
	Camera:	Value:	Output image:
Lower limit	all	-255	-64
Upper limit	all	255	64



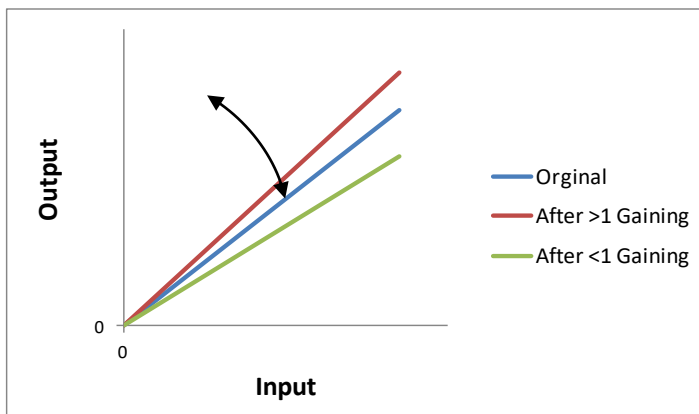
Take notice that using “Brightness” causes a digital offset in the image data:

$$Vid\ Brightness\ Out(x,y) = (VidIn(x,y) + Offset)$$

- VidIn(x,y) Pixel-normalized image after the shading correction (0...2047 in 10Bit area = 0... 2,0 relative)
- Offset Additional adjustable “Brightness” for this color (-255... 0 +255 in 10Bit area = -0,25...0...+0,25 relative)
- (x, y) Number of pixels within a line or column
- Vid Brightness Out(x,y) Output of this step (area 0...1023)

9.6.3 Contrast

Name			
Name	Contrast		
Function	Digital gaining		
Channels	Red; Green; Blue		
Unit	Float	Step	0.001
	Linear		
Dependency	It is only available if the Use Brightness and Contrast check box has been selected.		
Notes			
Camera:		Value:	
Lower limit	all		0.0
Upper limit	all		2.0



Take notice that using „Contrast“causes digital increase or decrease of sensitivity.

$$VidContrastOut(x,y) = Vid\ BrightnessOut(x,y) * Gain$$

- Vid BrightnessOut (x,y) Pixel-normalized image after the Vid Brightness correction (0...2047 in 10Bit area)
- Gain separation Additionally adjustable “Contrast” for this color (0...1...2.0)
- (x, y) Number of pixels within a line or column
- VidContrastOut (x,y) Output of this step (area 0 ... 1023)

NOTE Calculation is performed in the following order (section 4.5.1; *Figure 17: Digital process of the allPIXA pro camera (block diagram)*) :

1. Brightness
2. Contrast

9.7 Camera arrangement

9.7.1 RGB line distance

Name			
Name	Set RGB line distance		
Function	Delays the line output for the two other lines to match the shift by different positions on the sensor which is also called “Spatial correction”.		
Channels	All		
Unit	Float	Step	1/1024
	Linear		
Dependency	None		
Notes	The value “0” switches this function off. Line delay can be set up to 5 lines. With square pixel the viewing angle in transport direction could be up to 36,8° for 5 lines		
Camera:		Value CST	
Unit		In 1/1 lines	
Lower limit	All	0.0	
Upper limit	All	5.0	

The trilinear lines of the allPIXA pro camera signify that the camera disposes of 3 individual color lines (RGB) which means that for each image point the accurate information is obtained. The three line sensors are physically arranged in different locations, resulting in the acquirement of the individual color channels to an image of a moving object at different points. Refer to section 4.2 “Design of the allPIXA camera line scan sensor” / sensor alignment.

For spatial correction, the lines are buffered, and the respective lines are re-aligned with a corresponding correction. The color lines have been delayed by a specific number of lines and, therefore, the values of R, G and B match each corresponding object point. The allPIXA pro camera enables this compensation with up to 5+5 lines spacing. Correct color images are only generated correctly if the ratio of the optical resolution is the same as the resolution of transport direction.

If you observe according to the standard conditions, the line resolution is the same as the transport resolution; the value “4” must be applied. In some applications it can be helpful if the camera displays correct images even if the transport resolution differs from the resolution in CCD line direction which is useful for example if transport resolution is lower than optical resolution.

If the user prefers to receive pixels in a non-square shape (transport resolution is not the same as the resolution in CCD direction), the value of the line resolution may be lowered to the transport resolution which means that the camera internally applies a subpixel-based correction. The result is that the images do not have any colored edges, even if the transport resolution does not match the resolution in CCD direction (=optical resolution).

For calculation of the setting value, use one of the following formulas:

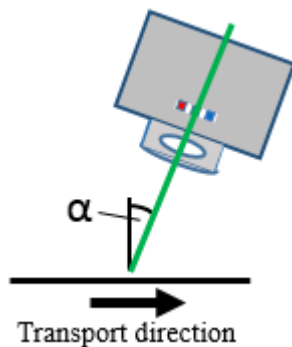
Either

$$Line\ distance = \frac{TransportResolution(dpi) * 4}{OpticalResolution(dpi) * \cos(\alpha)}$$

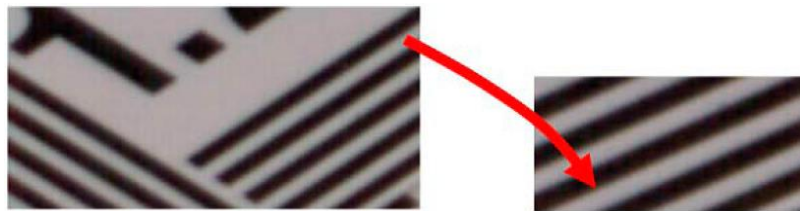
or

$$Line\ distance = \frac{OpticalPixelSize\left(\frac{mm}{pixel}\right) * 4}{TransportPixelSize\left(\frac{mm}{pixel}\right) * \cos(\alpha)}$$

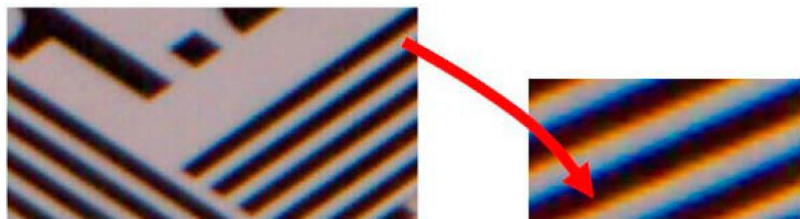
- α viewing angle in transport direction (0° = perpendicular)



Function of the subpixel line shift:



With subpixel compensation



Without patented subpixel compensation

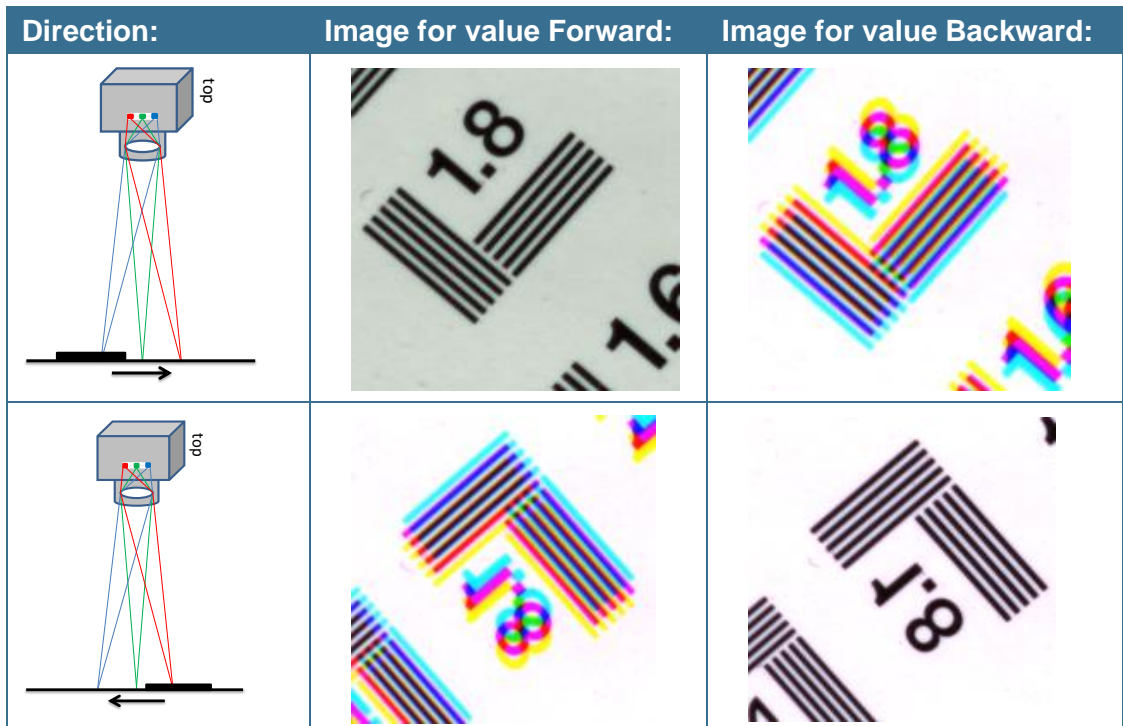
9.7.2 Scan direction

Name	
Name	Set scan direction
Function	Changes the sequence from forward to backward (for example from R-G-B to B-G-R), to adapt to the movement direction of a conveyor regarding to the orientation of the camera.
Channels	All
Unit	Bool
Dependency	None
Notes	
Camera:	Value:
All	Forward
All	Backward
All	Set by ext. pin
All	Set by encoder direction

Direction of the spatial correction depends on the direction of transport regarding to the orientation of the camera, i.e. the sequence of the lines in the direction of transport can be either red-green-blue (RGB) or blue-green-red (BGR) but the sequence can be changed, if necessary. Then the color offset is being corrected, irrespective of the installation position of the camera.

If the encoder is activated, the transport direction can be determined in the encoder controller. If the determined scan direction from the encoder doesn't match the scan direction in free-run mode, the scan direction from the encoder could be inverted with the I/O configurator (Invert scan direction from encoder)

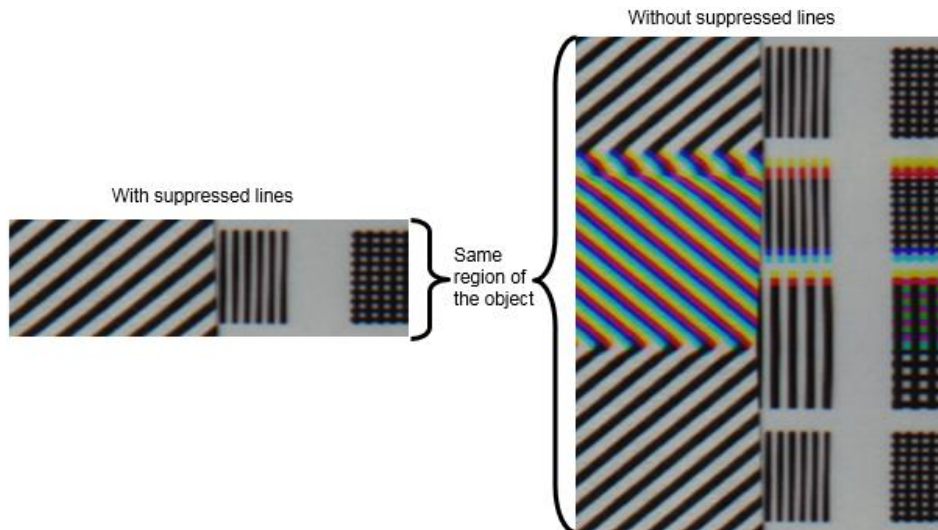
In addition, the scan direction could also be set with an external pin by e.g. the motor control of the system.

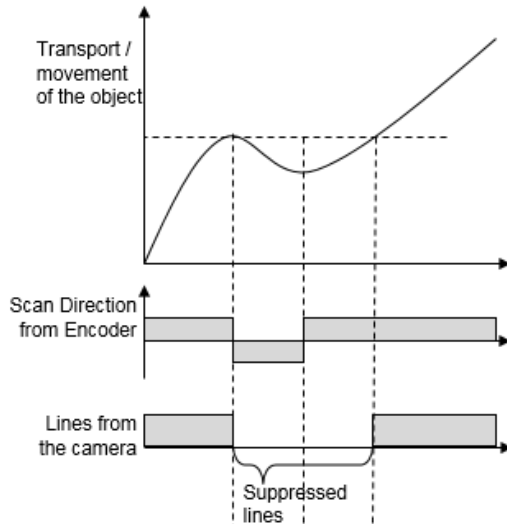


9.7.3 Enable suppression of lines/frame due to encoder direction

Name		
Name	Enable suppression of lines/frame	
Function	Enables the suppression of lines / frames	
Channels	All	
Unit	Bool	
Dependency	Only available if the scan direction could be detected by two-channel encoder or input.	
Notes	<p>On the Camera arrangement page, Set scan direction must be set to Forward or to Backward.</p> <p>The second encoder input or the direction input is specified using the IO Configurator in the same way as for Set by ext. pin or Set by encoder direction.</p>	
Camera: Value:		
Lower limit	all	Off
Upper limit	all	On

If during scanning transport stops and moves backwards for a short time, a part of the object is scanned twice with color distortions. If a two-channel encoder is used, or if a motor direction bit is connected by use of the IO Configurator, the camera can correct this by suppressing up to 64K lines until the object is again at the position at which transport changed direction beforehand:



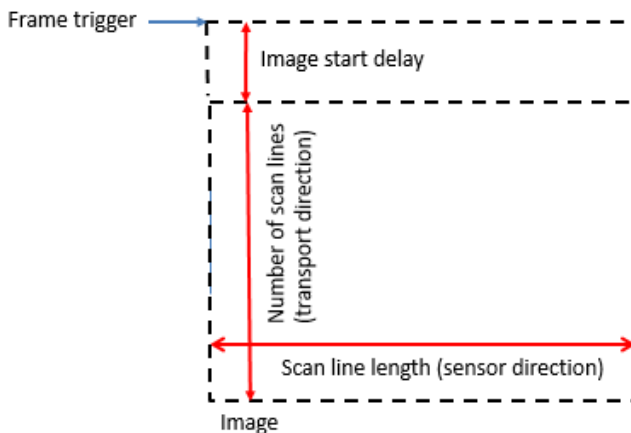


9.7.4 Suppress lines/frames mode

Name	
Name	Suppress lines/frames mode
Function	Defines the direction for suppression
Channels	All
Unit	Bool
Dependency	Only available if the Enable suppression of lines/frame check box is selected.
Notes	
Camera:	Value:
Lower limit	all Suppress lines against selected direction
Upper limit	all Suppress lines in selected direction

9.8 Image sizes

If the camera is supplied with information about the frame start at CC2, CC3 or CC4 (via Camera Link) or at the IO Port, it is able to generate FVAL (VSync) and frame-valid signal. The external signals must be connected with the IO Configurator to the internal functions with CST. Without these signals, the camera is able to send images in free-run mode.

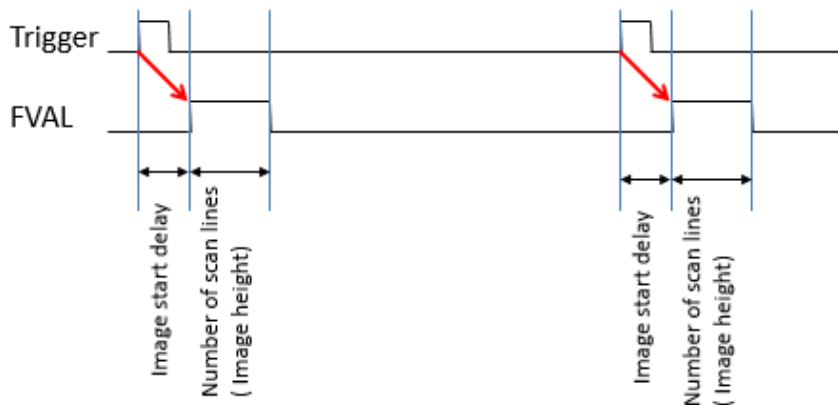


9.8.1 Number of scan lines per image (frame mode)

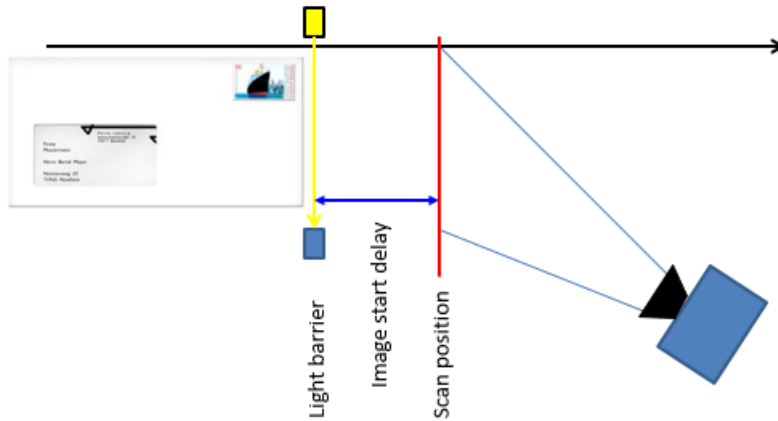
Name		
Name	Number of scan lines per image	
Function	Image size in transport direction	
Channels	All	
Unit	Integer	
Dependency	Only in frame scan mode	
Notes		
Camera:		Value:
Lower limit	All	1
Upper limit	All	1 Meg for fixed object length (use start condition only) 64K for mixed object lengths (use start and stop condition)

9.8.2 Image start delay

Name		
Name	Image start delay	
Function	Delay of image start after frame trigger in lines; the frame trigger could be taken internally or externally.	
Channels	All	
Unit	Integer	
Dependency	Only in frame scan mode	
Notes		
Camera:		Value:
Lower limit	All	0
Upper limit	All	32767



Sample for use of Image start delay:



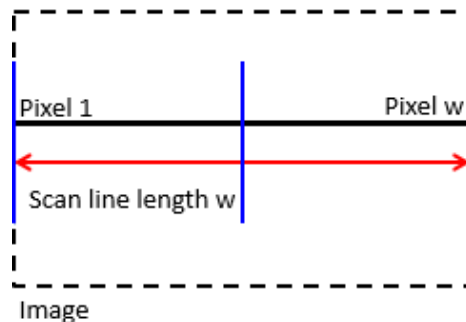
Refer to section 9.9 Synchronization.

9.8.3 Scan line length

Name		
Name	Scan line length	
Function	Image width	
Channels	All	
Unit	Integer	
Dependency	None	
Notes	The numbers of pixels are centered to the visible area of the camera. The image width depends on the used video output mode (for example a multiple of 2, or for some frame grabbers 8 or 16 may be needed). See section 9.11.4.	
Camera:	Value:	
Lower limit	All	2
Upper limit	4k	4.096
	5k	5120
	6000 px	6.000
	7.3k	7.300 (7.296 as default)

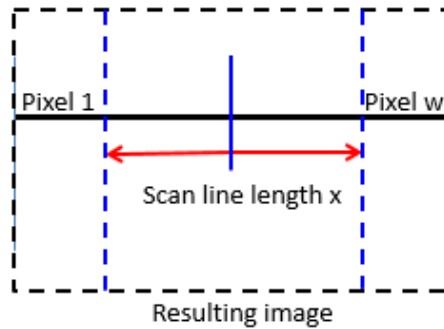
There are two different cases for scan line length:

- **Original: Scan line length equal to sensor length:**



Scan line length is set to the sensor length of the camera, for example 4096 at a 4K allPIXA pro.

- **Cropping: Scan line length shorter than sensor length:**



The camera captures an image from a ROI which is centered in the sensor.

9.8.4 Horizontal binning

Name	
Name	Horizontal binning
Function	Enables horizontal pixel reduction. Several neighbored pixels are averaged to a single pixel which is output.
Channels	All
Unit	Integer
Dependency	Due to the restrictions of some frame grabbers, only special module numbers of pixels are possible. For most grabbers the number of camera link clock cycles and the number of pixels must be an integer value, sometimes with an additional modulo of for example 8. You must test the number of pixels for your application, especially for the camera full modes in RGB.
Notes	Only the amount of output data per line is affected. With 2/3 reduction, a line length modulo 3 is needed for most frame grabbers If you use Horizontal Binning , the values of First relative pixel of white reference and Number of pixels for white reference refer to the unreduced image.
Camera: Value:	
	All 1/1 (no reduction)
	All 1/2 reduction
	All 1/4 reduction
	All 1/8 reduction
	All 1/16 reduction
	All 2/3 reduction

9.8.5 Vertical scan line reduction

9.8.5.1 Vertical scan line reduction pattern length

Name	
Name	Vertical scan line reduction pattern length
Function	Set the length of the frame-synchronous line reduction register.
Channels	All
Unit	Integer
Dependency	Works only with Vertical scan line reduction pattern
Notes	This function can be used to suppress dark lines if LED flashing is used. With this function the camera runs "with a lower speed" at the output. If you activate Vertical scan line reduction , the value of First image line of white reference refers to the unreduced image, while the value of Number of image lines for white reference refers to the reduced image.
Camera	Value
Lower limit	All 0 (without reduction)
Upper limit	All 8

9.8.5.2 Vertical scan line reduction pattern

Name	
Name	Vertical scan line reduction pattern
Function	Defines the pattern of the frame synchronous line reduction register.
Channels	All
Unit	Integer
Dependency	Works only with Vertical scan line reduction pattern length .
Notes	This function can be used to suppress dark lines if LED flashing is used. With this function the camera runs "with a lower speed" at the output.
Camera	Value
Lower limit	All 0
Upper limit	All 7

Example:

Vertical scan line reduction pattern length = 6

Vertical scan line reduction pattern = 0x25 (100101b)

The pattern is evaluated from right to left. Thus the first, the third and the sixth line of every six lines are output.

NOTE

- Number of scan lines per image refers to the original image before scan line reduction takes place.
- Scan line reduction also takes effect outside the image.

9.9 Synchronization (frame synchronization)

The allPIXA pro camera is able to generate frame information.

Some settings are necessary if you want to use this mode.

NOTE I First, the hardware ports must be connected to the internal functions of the camera. Therefore, use the IO Configurator in CST and refer to section 8.10 “IO Configurator”.

NOTE II If the camera is used in “Triggered Frame Scan” mode with active LineTrigger or Encoder, the linesync (Encoder or LineTrigger) must fit some pulses before light barrier input.

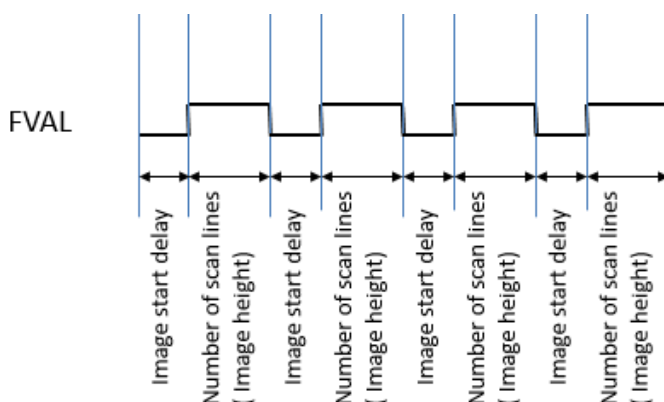
9.9.1 Triggered frame scan

Name	
Name	Triggered frame scan
Function	Enables the triggered frame scan modes
Channels	All
Unit	Integer
Dependency	None
Notes	
Camera	Value
All	Free-running
All	Use start condition only
All	Reserved
All	Use start and stop condition

There are 4 different modes:

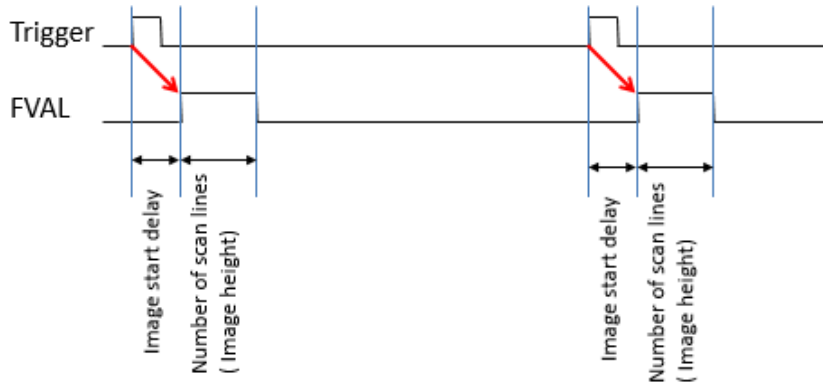
a) (0) Free-running:

FVAL is generated continuously, depending on **Number of scan lines** (Image height) and **Image start delay**.

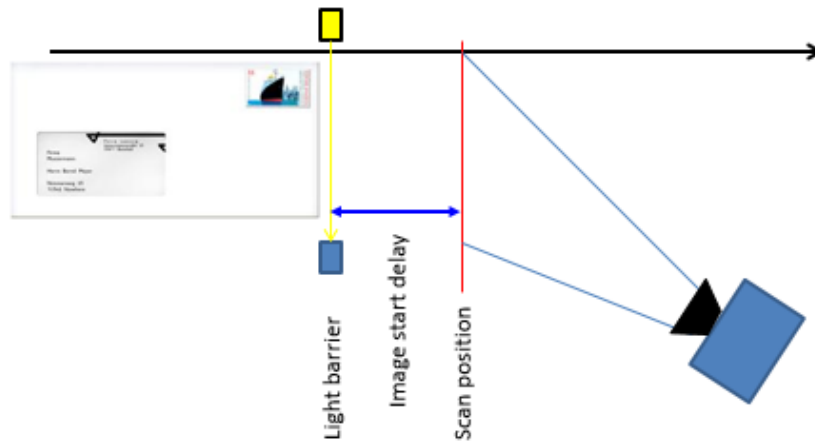


b) (1) Use start condition only:

FVAL (Frame valid) is generated after receiving a frame trigger signal. The frame is delayed by the value of **Image start delay** and image length is defined by **Number of scan lines** (Image height).



Sample: Image acquisition is started automatically. It is also possible to specify a delay if the scanning position is behind the light barrier:

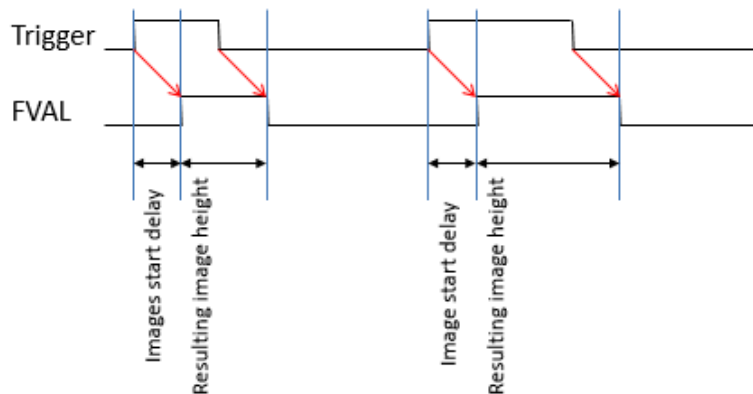


c) (2) Reserved:

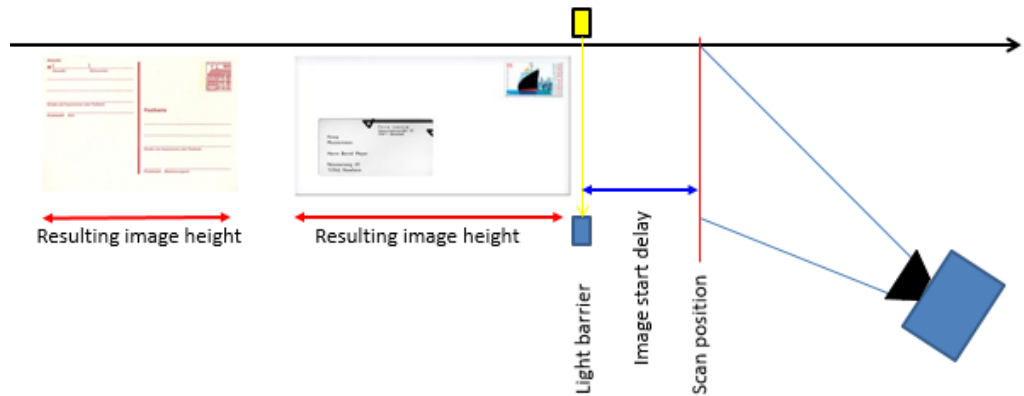
Reserved for OEMs and future use.

d) (3) Use start and stop condition:

FVAL is generated after receiving a frame trigger signal. The frame is delayed by the value of **Image start delay**. Image length depends on the length of the pulse from the frame trigger port.



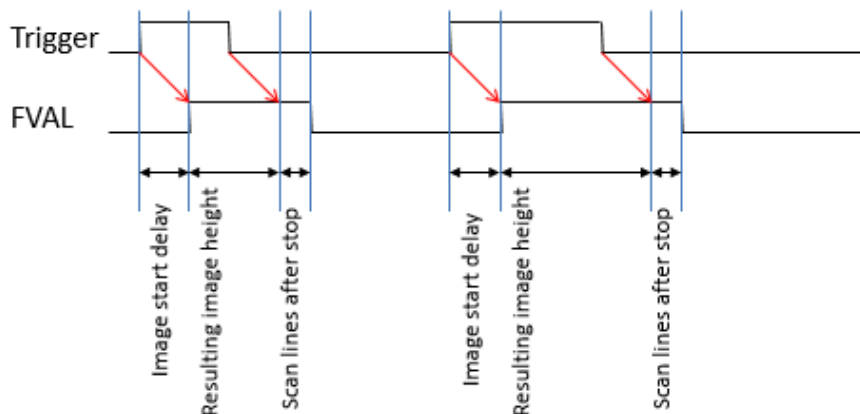
Sample: This function is useful for automatic detection of different object sizes; the camera sends a correctly sized image.



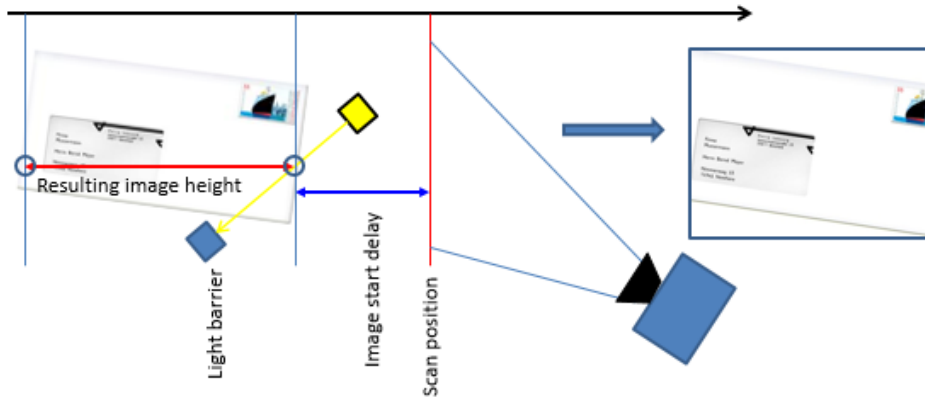
For information about **Number of scan lines** and **Image start delay**, see section 9.8.

9.9.2 Scan lines after stop

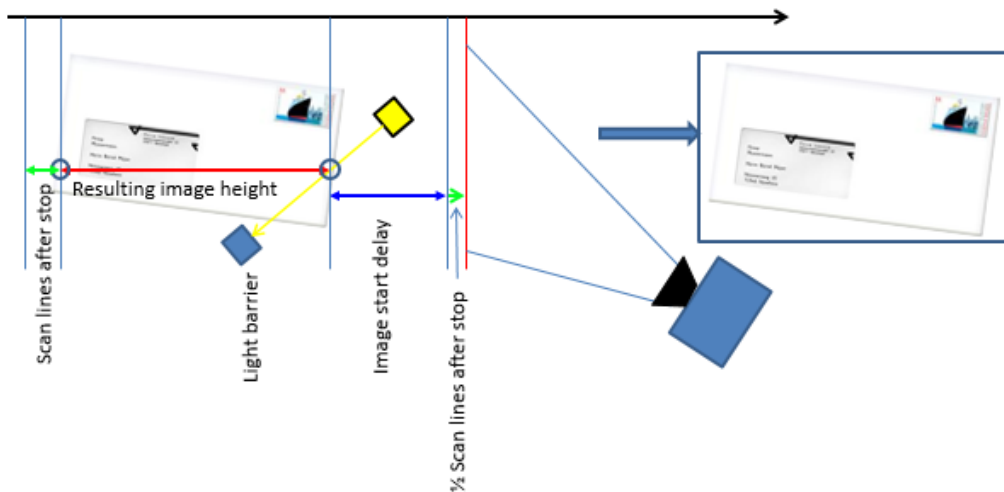
Name	
Name	Scan lines after stop
Function	Sets the number of lines added to the image after the stop condition.
Channels	All
Unit	Integer
Dependency	Only available if Use start and stop condition is selected at Triggered frame scan
Notes	
Camera	Value
Lower limit	All 0
Upper limit	All 65535



Sample: If the transported object is not rotated, the result with **Use start and stop condition** is not satisfactory.



If you use the parameter “Scan line after stop”, the setup deals with this issue:



- Set a suitable value for the parameter **Scan line after stop**, for example 300 lines
- Reduce the value of **Image start delay** by half of the value of **Scan lines after stop**, for example original value of 1000 lines – (300 lines / 2) = 850 lines

9.9.3 Stop after maximum number of lines

Name	
Name	Stop after max. scan lines
Function	Stops the image if no ending edge or signal of the frame trigger is detected after the given “maximum number of lines”.
Channels	All
Unit	Bool
Dependency	Only available if Use start and stop condition is selected at Triggered frame scan
Notes	Maximum numbers of scan lines must be set to a reasonable value.
Camera	
Value	
Lower limit	All 0 Off
Upper limit	All 1 On

9.9.4 Maximum number of scan lines

Name	
Name	Maximum number of lines
Function	Stops the image after getting the maximum number of lines if no falling edge of the frame trigger is detected.
Channels	All
Unit	Integer
Dependency	Only available if Use start and stop condition is specified at Triggered frame scan and Stop after max. scan lines has been activated.
Notes	
Camera	Value
Lower limit	All 1
Upper limit	All 65530

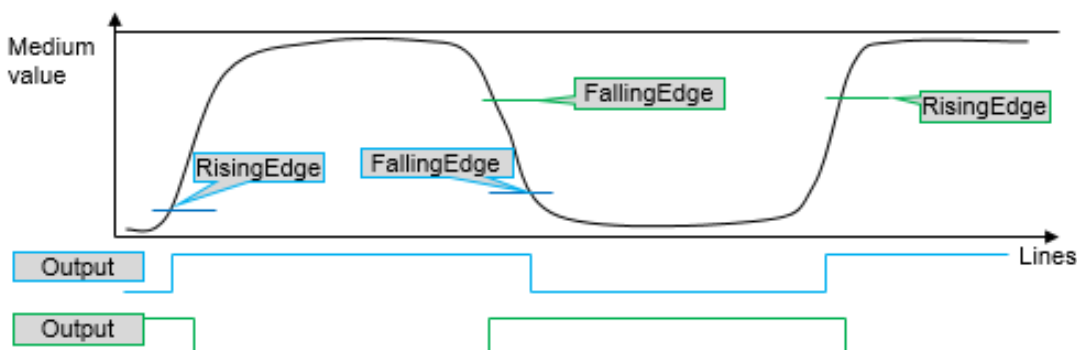
9.9.5 Internal frame trigger

This function permits to use a brightness change as frame trigger instead of an external light barrier. The camera starts or stops image acquisition if the medium brightness of pixels in a specified ROI crosses a specified threshold. To activate the function, use the IO Configurator to select the respective connector in the **Frame trigger / light barrier** section (see section 8.10):

frame trigger / light barrier	CL1-CC3	All debouncing levels	LVDS	<input type="checkbox"/>
	CL1-CC4	All debouncing levels	LVDS	<input type="checkbox"/>
	X5-1/9	All debouncing levels	RS422	<input type="checkbox"/>
	X5-2/10	All debouncing levels	RS422	<input type="checkbox"/>
	internal frame trigger	All debouncing levels	---	<input checked="" type="checkbox"/>
	X5-3	All debouncing levels	LVC MOS	<input type="checkbox"/>

To control behavior of the internal frame trigger, set the parameters **Triggered frame scan** and **Select trigger edge detection** accordingly.

The following graphic shows examples for threshold values for bright objects (in blue color) and for dark objects (in green color):



9.9.5.1 ROI start

Name	
Name	Internal LB ROI start
Function	Specified at which pixel the ROI starts
Channels	All
Unit	Integer
Dependency	Takes effect only if the internal frame trigger has been activated using the IO Configurator.
Notes	The ROI, specified by ROI start and ROI length , must be completely within the front or the rear tap. It must not cross the tap border.
Camera	Value
Lower limit	All 1
Upper limit	All ###

9.9.5.2 ROI length

Name	
Name	Internal LB ROI length
Function	Specifies the ROI length
Channels	All
Unit	
Dependency	Takes effect only if the internal frame trigger has been activated using the IO Configurator.
Notes	The ROI, specified by ROI start and ROI length , must be completely within the front or the rear tap. It must not cross the tap border.
Camera	Value
Lower limit	All 32 pixel
	64 pixel
	128 pixel
Upper limit	All 256 pixel

9.9.5.3 Rising level

Name	
Name	Rising level
Function	Specifies the threshold for a rising edge.
Channels	All
Unit	Integer
Dependency	Takes effect only if the internal frame trigger has been activated using the IO Configurator.
Notes	
Camera	Value
Lower limit	All 1
Upper limit	All 254

9.9.5.4 Falling level

Name	
Name	Falling level
Function	Specifies the threshold for a falling edge.
Channels	All
Unit	Integer
Dependency	Takes effect only if the internal frame trigger has been activated using the IO Configurator.
Notes	
Camera	Value
Lower limit	All 1
Upper limit	All 254

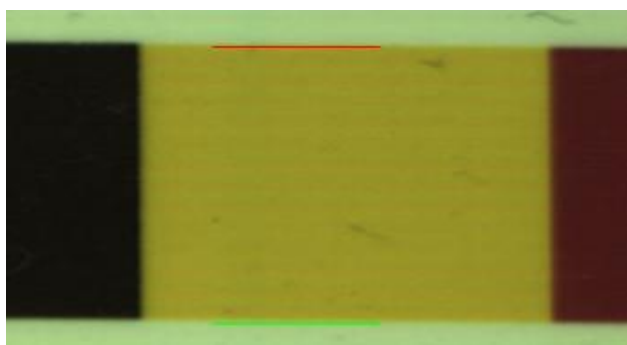
9.9.5.5 Color channel

Name	
Name	Color channel
Function	If All color channels is selected, the medium values for all three colors must fulfill the condition. For example, if image acquisition should start a rising edge, it starts as soon as the medium values for all three colors are above the specified threshold.
Channels	All
Unit	Integer
Dependency	Takes effect only if the internal frame trigger has been activated using the IO Configurator.
Notes	
Camera	Value
	All All color channels
	All Red color channel
	All Green color channel
	All Blue color channel

9.9.5.6 ROI visible

Name	
Name	Internal LB ROI visible
Function	If ROI visible is selected, the ROI is shown in the image in green color at the line at which the threshold is crossed for a rising edge, in red color for a falling edge.
Channels	All
Unit	Integer
Dependency	Takes effect only if the internal frame trigger has been activated using the IO Configurator.
Notes	
Camera	Value
Lower limit	All ROI not visible
Upper limit	All ROI visible

The following image shows an example of an inserted ROI:



9.9.6 Input debouncing speed (Frame trigger)

To trigger images from an external source, the signal of the frame trigger, for example from a light barrier, must be connected to the hardware ports of the camera; this could be done by means of the frame grabber using CC-bits, the D-Sub 15 IO port on the camera, or internal frame trigger. For more information about an internal frame trigger, see section 9.9.5.

This external signal must be connected to the internal function (frame trigger) with the IO configuration. See 8.10.

The single inputs have different properties regarding the debouncing speed.

Name	
Name	Input debouncing speed for the frame trigger
Function	Selects the different debouncing speeds to be used for the frame trigger input
Channels	All
Unit	Time, see below
Dependency	Only active if Use start condition only or Use start and stop condition is selected. The external frame trigger input must be selected with the IO configuration.
Notes	The frame trigger for the camera needs to be, depending on the parameter, at least 6 to 10 lines stable.
Camera	Value
All	Peakholder (LB2)
All	50 ns (LB1)
All	4 image lines (LB3)
All	60 image lines (LB0)

By using this option you can select the debouncing speed of the frame trigger.

There are different methods for debouncing the signal:

- Peakholder: no debouncing, peak holder
- Fast: 4 clock pulses ~ 50 ns
- Middle: 4 output lines
- Very long: 60 output lines

Examples:

- If you use the zero output of an encoder, which is usually 1/4 of an encoder step, you must lengthen this pulse to enable the camera to use it as a frame trigger. Therefore you must set the debouncing to **Peakholder**. In this case every short "peak" is held for 10 camera lines.

- If you scan punched papers and the light barrier could hit punches, you must set the debouncing to 60 lines. In this case the camera "overlooks" the holes and creates a single image of the paper. Otherwise the camera creates two images, one from paper start to the hole and one from the hole to paper end.

9.9.7 Select trigger edge detection

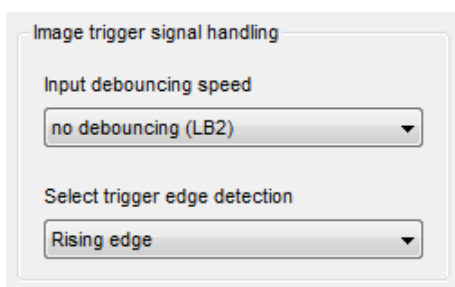
Name	
Name	Select trigger edge detection
Function	This determines whether the frame trigger is evaluated at the rising or at the falling edge.
Channels	All
Unit	
Dependency	Only active if Use start condition or Use start and stop condition is selected.
Notes	
Camera	Value
All	(Start) Falling edge
All	(Start) Rising edge

This function determines whether the image starts at rising or falling edge of the signal. Setting differs for **Use start condition only** and for **Start and stop condition**.

The state of the ports is checked synchronized with the line frequency clock. At each rising edge of the line frequency clock, the status is checked and the debouncing condition must be complied with. See section 9.9.6.

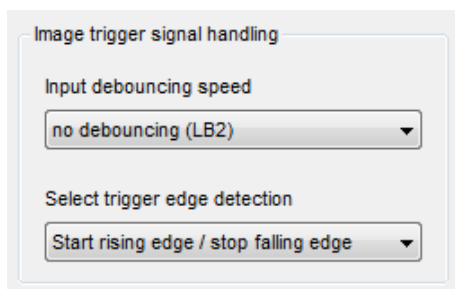
The following tables show suitable sequences and their function (screen shots from CST):

If **Use start condition only** is selected as triggered frame scan parameter:



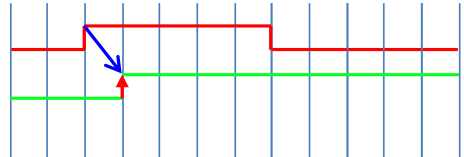
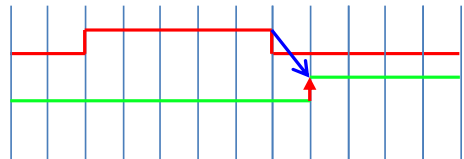
This means that the image starts with rising edge of the frame trigger input (with a delay of **Image start delay** lines, see section 9.8.2, the length of the image is **Scan line length** lines, see section 9.8.3)

If **Start and stop condition** is selected as triggered frame scan parameter:

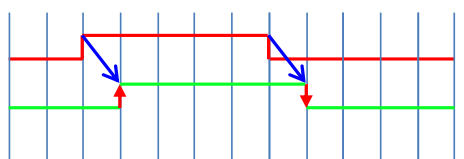
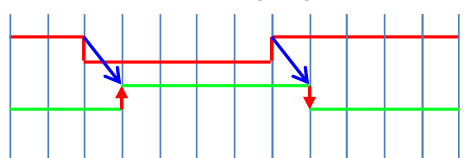


This means that the image starts with rising edge of the frame trigger input (with a delay of **Image start delay** lines, section see 9.8.2, the length of the image corresponds to the length of the frame trigger). Optionally **Stop after max. scan lines** (see section 9.9.3), or **Scan lines after stop** (see section 9.9.2) could be used.

1. Use start condition only

Select trigger edge detection	Function
Select trigger edge detection <input type="text" value="Rising edge"/>	These sequences cause a frame start at a rising edge: Trigger  Image
Select trigger edge detection <input type="text" value="Falling edge"/>	These sequences cause a frame start at a falling edge: Trigger  Image

2. Use start and stop condition

Select trigger edge detection	Function
Select trigger edge detection <input type="text" value="Start rising edge / stop falling edge"/>	These sequences cause a frame start at a rising edge and the frame stop at a falling edge. Trigger  Image
Select trigger edge detection <input type="text" value="Start falling edge / stop rising edge"/>	These sequences cause a frame start at a falling edge and the frame stop at a rising edge. Trigger  Image

9.9.8 Master-slave setup

Name	
Name	Set master-slave mode
Function	Synchronization of several allPIXA pro cameras
Channels	All
Unit	
Dependency	Set this parameter in all slave cameras similarly. Use only one camera as a master
Notes	<ul style="list-style-type: none"> The position of the image in transport direction (Y) of each camera can be set separately. The image length is defined by the master. Also, the position (X + Y) and the size of the white reference can be set separately. This parameter only takes effect if Global master/slave mode is set to Get master/slave from setting.
Camera	Value
All	No master slave operation
All	Camera acts as master
All	Camera is slave
All	Auto-select by input

If more than one camera is used, for example in print inspection, these cameras must be synchronized accurately to achieve the best system performance.

Connect line trigger / frame trigger to the master camera.

Connect master and slave camera(s)

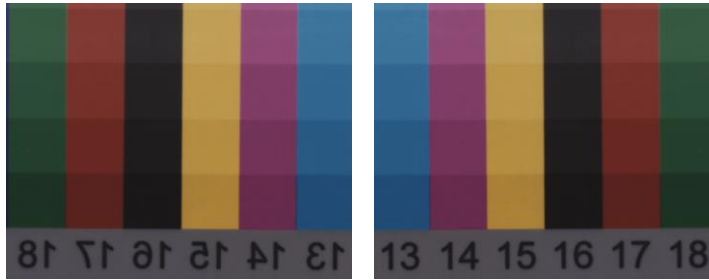
For more information, see section 8.8.

9.10 Image processing

9.10.1 Mirror image horizontally

Name			
Name	Mirror image horizontally		
Function	Mirrors the lines inside the camera.		
Channels	All		
Unit	Bool		
Dependency	None		
Notes	Function must be switched off for the acquisition of the black-value and shading reference (white balancing).		
Camera:	Value:	Function:	
Lower limit	All	0	Off
Upper limit	All	1	On

This function changes the sequence of the pixels within the line, i.e. the left pixels are replaced by the right ones. As a result, the alignment of the line with the direction of transport is possible, irrespective of the camera's installation position (pixel 1 left or right).



With mirroring

Without mirroring

9.10.2 Swap red and blue color channel

Name			
Name	Swap red and blue color channel		
Function	On video output, the red and the blue channel are swapped		
Channels	Red, blue		
Unit	Bool		
Dependency	None		
Notes	Some frame grabbers first expect the blue channel, instead of the red channel and this may cause wrong colors in the resulting image. This task can be performed in real time inside of the camera; this is usually faster than doing with the frame grabber.		
Camera:	Value:	Function:	
Lower limit	All	0	Off
Upper limit	All	1	On

9.10.3 Color conversion

Name	
Name	Color conversion mode
Function	Permits to enable color conversion by a 3x3 matrix, for example from RGB to sRGB. For the chromaPIXA camera, it permits to enable color conversion using data generated with the Chromasens program ChromaCalc .
Channels	All
Unit	
Dependency	None
Notes	The color conversion matrix has to be generated offline and must be transferred to the camera.
Camera:	Value:
All	Color conversion disabled
All	Use 3x3 matrix method
chromaPIXA	Use ChromaCalc-generated data

For more information about how to modify a color conversion matrix, see section 8.9.

9.10.4 Select active CCM

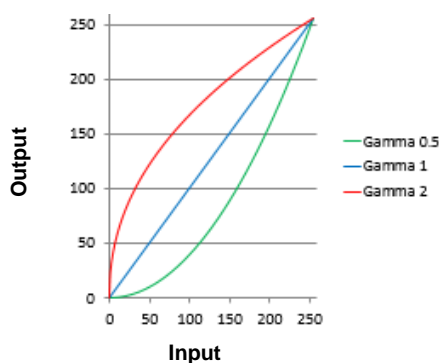
Name	
Name	Select active CCM
Function	Selects the number of the used color conversion matrix. Four matrix tables are available.
Channels	All
Unit	Integer
Dependency	It is only available if Use color conversion matrix has been selected.
Notes	Matrix 1 is the default table and it cannot be modified.
Camera: Values:	
	All Use Matrix 1 ... Use Matrix 4

9.10.5 Gamma correction

Name	
Name	Gamma correction
Function	Performs a LUT operation for gamma correction with image data
Channels	All
Unit	Float Step 0.1
	Log.
Dependency	None
Notes	<ul style="list-style-type: none"> The value "0" causes the camera to ignore the mentioned image processing step with the LUT; value "1" causes a linear LUT (output=input) which may be used. For the value 0.1, a special gamma table for sRGB conversion is used! See also section 8.9. For the value 0.2, a special gamma table for multi-spectral applications is used! This function must be switched off for the acquisition of the black-value and shading reference (white balancing).
Camera: Value CST:	
Lower limit	all 0
Upper limit	all 2.5

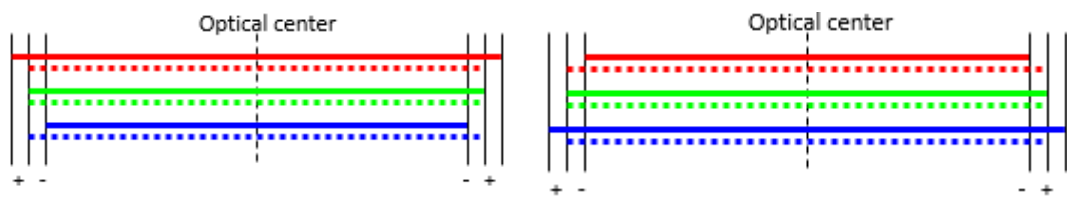
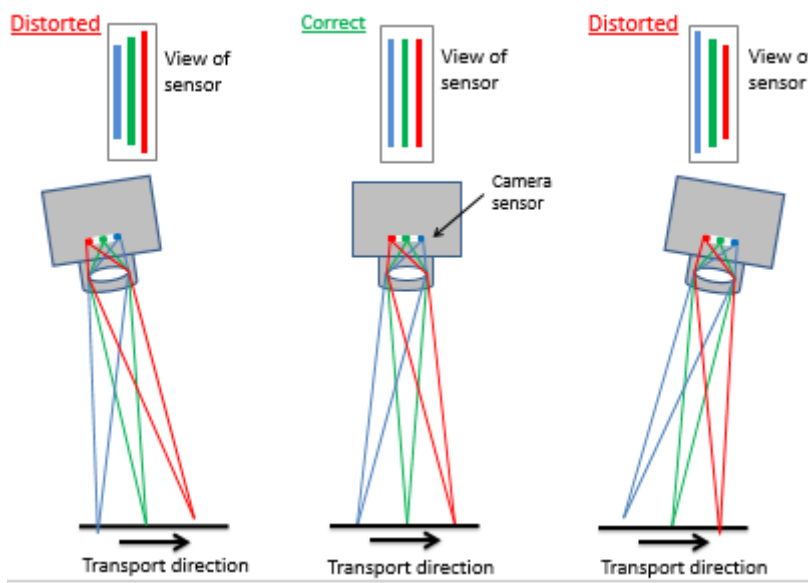
A CCD sensor has a linear sensitivity (the brightness sensitivity of the humans is non-linear). Gamma correction serves to adapt the linear sensitivity curve of a camera to the human eye. As a result, the brightness in certain areas of the image is increased and lowered in others.

With a gamma value of 1, the curve is linear. If the gamma value is lower than 1, the images are darker, and images with a gamma value above 1 are brighter.



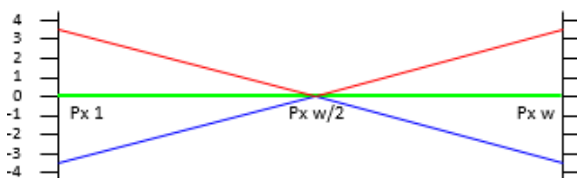
9.10.6 Use keystone correction

Name			
Name	Use keystone correction		
Function	Enables the function keystone correction.		
Channels	Red, Blue		
Unit	Bool		
Dependency	None		
Notes			
Lower limit	Camera:	Value:	Function:
	All	0	Off
Upper limit	All	1	On



Sign: negative refers to red channel

Sign: positive refers to red channel



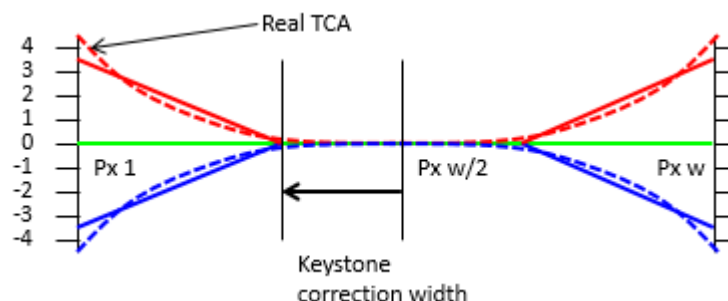
Sample with correction value of +3.5

9.10.7 Pixel shift for correction

Name			
Name	Pixel shift for correction		
Function	Sets the pixel shift up to +/- 4 pixels for the first and the last pixel. Between the center and the first and last pixels they are linearly interpolated between 0 and the specified value.		
Channels	Red, Blue		
Unit	Float	Step	0.1
Dependency	Only available if the option Use keystone correction has been activated.		
Notes	The start value for the first and last pixels relates to the nominal length of the camera (4K with a 4K allPIXA pro)		
Camera:		Value CST:	
Lower limit	All		- 4
Upper limit	All		+ 4

9.10.8 Keystone correction width

Name		
Name	Keystone correction width	
Function	Start value from the center for keystone/TCA correction	
Channels	Red, Blue	
Unit	Integer	
Dependency	Only available if the option Use keystone correction has been activated.	
Notes	Set to 1 to use as a standard keystone correction.	
Camera:		Value:
Lower limit	All	1 = default
Upper limit	4k	2,048
Upper limit	5k	5,060
Upper limit	6000k	3000
Upper limit	7.3k	3,648



TCA (= Transversal Chromatic Aberration) is an objective-caused displacement of 3 colors increasing at the edge.

9.11 Output format

9.11.1 Video output mode

Name			
Name	Video output mode		
Function	Sets the output on the Camera Link port to different modes, for example RGB as standard or to gray-level output.		
Channels	All		
Unit	Integer		
Dependency			
Notes	<p>If Color image is selected, 6 different output formats are available at Type of CameraLink interface, ranging from Base up to Full80_10Tx8Bit 1X Raw. For mono images, only Base mode is available, for Mono image (8 Bit on CL-port 1) in addition Base 3T8bit 1X3 Raw. For the gray-image calculation, the values of Color weights are used.</p>		
	Camera:	Value:	Function:
Lower limit	All	0	Color image (3*8 Bit parallel)
	All	1	Mono image (8 Bit on CL-port 1)
	All	2	Mono image (10 Bit on CL-port 1)
Upper limit	All	3	Mono image (12 Bit on CL-Port 1)
	OEM versions		Special modes are available

9.11.2 Color weights

Name			
Name	Color weights		
Function	Calculates the mono-value for the pixel using data from RGB, weighted with this factor.		
Channels	Red; Green; Blue		
Unit	Float	Step:	0,01
	Linear		
Dependency	Only active if output mode on Camera Link is set to Mono mode .		
Notes	<p>The sum of these 3 parameters should be 1.0. A higher sum causes a “brighter” image, and a lower sum causes a “darker” image. Standard values by NTSC and the default values in the camera are the following:</p> <p>Red: 0.299 Green: 0.587 Blue: 0.114</p>		
	Camera:	Value CST:	
Lower limit	All	0	
Upper limit	All	1	

9.11.3 Camera Link connection speed

Name	
Name	Camera Link connection speed
Function	Sets the pixel clock on the Camera Link port to 85, 75.56 MHz or 61.82 MHz
Channels	All
Unit	Integer
Dependency	None
Notes	<ul style="list-style-type: none"> • This function reduces only the pixel clock at the output, the internal clock is not changed. • The minimum integration / line time may be limited by this function. Please see the limitations in the table mentioned below. • For some applications it would be helpful to increase the Camera Link data width and reduce the speed, for example to be able to use the camera with longer cables.
Camera: Value:	
	All Standard (75.5 MHz)
	All High speed (85 MHz)
	All Reduced speed (61.8 MHz)

For information about minimum integration time for different camera types at different output pixel clocks, see the following section 9.11.4:

9.11.4 Camera Link interface type and minimum line time (integration time)

Name		
Name	Type of Camera Link interface	
Function	Sets the output to Base, Medium, Full64 or Full80 mode	
Channels	All	
Unit	Integer	
Dependency	None	
Notes	<ul style="list-style-type: none"> For some modes, the line rates and integration time are limited. For details, refer to the table below. For some modes, the scan line length must be a multiple of x. For details, refer to the table below. For Base mode the Camera Link connector 1 must be used. allPIXA pro-Mono supports only the first two modes. 	
Camera	Value	Function
Lower limit	All	Base 1Tx24b (1X1), for color output 2Tx8b, 2Tx10b or 2Tx12b (2XE for mono output with the color camera) Scan line length must be a multiple of 2.
	All	Base 3Tx8Bit 1X3 Raw Scan line length must be a multiple of 2.
	All	Medium 2XE 2Tx24b (2XE RGB) Scan line length must be a multiple of 2
	All	Medium 1X2 (RGB, RAW) 2Tx24b (1X2, Raw) Scan line length must be a multiple of 2.
	All	Full64_8Tx8Bit 1X Raw, RGB with 8 color planes per Camera Link clock. Scan line length must be a multiple of 16.
	All	Full80_8Tx10Bit 1X Raw RGB with 8 color planes per Camera Link clock. Scan line length must be a multiple of 16.
Upper limit	All	Full80_10Tx8Bit 1X Raw RGB with 10 color planes per Camera Link clock Scan line length must be a multiple of 2.

NOTE

If you work with Encoder and with low CameraLink speed, e.g. with Base mode, make sure that the time between Encoder pulses is always longer than line transmission time. Otherwise the images are erroneous and the camera indicates this error at the **Speed2High** bit if **Info block in each line** has been activated on the **Output format** page (see section 9.11.6.2).

Minimum line time (integration time) for different camera types at different Camera Link modes and frequencies:

All output in regard with >16 clocks cycles gap between the camera link lines.

allPIXA pro 4k (4096 pixel):

CL-Definition	Base Mode	Medium mode	Full64 mode	Full80_8Tap_10Bit	Full80_10Tap_8Bit	Mono output 2XE*	Mono output 1X3*
85.00 MHz	48.471µs	24.328µs	19.669µs	19,669µs	19,685 µs	24.328µs	19,685µs
75.56 MHz	54.542µs	27.434µs	20.657µs	20.657µs	19.685 µs	27.434µs	19,685µs
61.82 MHz	66.542µs	33.505µs	25.175µs	25.175µs	20.234µs	33.505 µs	22,523µs

*) mono output available in Camera Link Base mode (at 8; 10 or 12 bits per pixel)

allPIXA pro 5k (5120 pixel):

CL-Definition	Base Mode	Medium mode	Full64 mode	Full80_8Tap_10Bit	Full80_10Tap_8Bit	Mono output 2XE*	Mono output 1X3*
85.00 MHz	60.55µs	30.44µs	24.48µs	24.48µs	24.48µs	30.48µs	24.48µs
75.56 MHz	68.12µs	34.24µs	25.77µs	25.77µs	24.48µs	34.24µs	24.48µs
61.82 MHz	83.26µs	41.85µs	31.50µs	31.50µs	25.28µs	41.85µs	28.04µs

*) mono output available in Camera Link Base mode (at 8; 10 or 12 bits per pixel)

allPIXA pro 6000px (6000 pixel):

CL-Definition	Base Mode	Medium mode	Full64 mode	Full80_8Tap_10Bit	Full80_10Tap_8Bit	Mono output 2XE*	Mono output 1X3*
85.00 MHz	70.92µs	35.48µs	29.14µs	29.14µs	29.14µs	35.48µs	29,14µs
75.56 MHz	79.62µs	39,92µs	29,99µs	29,99µs	29,99µs	39,92µs	29,14µs
61.82 MHz	97.32µs	48.79µs	36.66µs	36.66µs	36.66µs	48.79µs	32,79µs

*) mono output available in Camera Link Base mode (at 8; 10 or 12 bits per pixel)

allPIXA pro 7.3k (7300 pixel):

CL-Definition	Base Mode	Medium mode	Full64 mode	Full80_8Tap_10Bit	Full80_10Tap_8Bit	Mono output 2XE *	Mono output 1X3 *
85.00 MHz	86.20µs	43.26µs	33.65µs	33.65µs	33.65µs	43.26µs	33,65µs
75.56 MHz	96.98µs	48.67µs	36.59µs	36.594µs	33.65µs	48.67µs	33,65µs
61.82 MHz	118.53µs	59.48µs	44.72µs	44.72µs	35.86µs	59.48µs	39,80µs

*) mono output available in Camera Link Base mode (at 8; 10 or 12 bits per pixel)

9.11.5 Information insertion mode

Name	
Name	Information insertion mode
Function	Enables the function for displaying additional information in the image and selects the tap in which the information is displayed.
Channels	All
Unit	Byte
Dependency	None
Notes	
Camera	Function
All	First pixels
All	Last pixels
All	First and last pixels

9.11.6 Insert mode

Name	
Name	Insert mode
Function	Permits to display different camera data in the image (for example image counter or line counter)
Channels	All
Unit	Byte
Dependency	None
Notes	The parameter inside the camera is measured in bytes. In CST the single bits can be specified by the check boxes.
Camera	Function
All	First line info block
All	Test ramp last line
All	Check sum last line
All	Info block in each line
All	Activate pixel 9-16
All	Gray-value sum <-> Contrast value sum

Single information is displayed in the image as shown below:

- „FirstLine InfoBlock“:
Image-related information is shown in the first 22 pixels of the first image line. The image functionality is required.
- „EachLine InfoBlock“:
Line-related information is shown in the first 10 or 17 pixels of each line, depending on the selections for **Insert Mode**.
- Last line information:
There are two options for the last image line:
 - A test ramp is inserted into the last line. Image functionality is required. It starts with 128 from outside, increments with 1 and overruns with 255.
 - The check sum for the image data is inserted into the last transmitted pixels of each tap. In the resulting image they are located centrally on both sides of the tap border. Image functionality is required.

9.11.6.1 First line information

Overview on the info block „First line info block“:

Pixel	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Line 0		Serial no.					Image count		Integration time			Line time			Encoder clocks			Error reg. Temperature		Time stamp			

Information	Pixel	Description
Serial number	1–2–3–4	Displays the serial number of the camera as 16+16 bit value: Px 1 MSByte SerialNumber_FirstPart, Px 2 LSByte SerialNumber_FirstPart, Px 3 MSByte SerialNumber_SecondPart, Px 4 LSByte SerialNumber_SecondPart, Each with the same value for RGB. Sample:1000-1234 = allPIXA camera with serial number 1234
Image Count	6 – 7	16-bit image counter starts at power-on with 0 and could be preset with software by use of TAG_IMAGECOUNTER (291 H). Px 6 MSByte, Px 7 LSByte, Each with the same value for RGB.
Integration time	8–9	16-bit value of the current integration time for the CCD in clocks at 100 MHz. Integration times, which are measured in μ s, are IntTime/100. (Up to P3.00: /113,33) Px 8: MSByte, Px 9 LSByte, Each with the same value for RGB.
Line time	11–12–13	20-bit value of the current line time for the CCD in clocks at 100 MHz. Integration times, which are measured in μ s, are IntTime/100. (Up to P3.00: /113,33) Line time, measured in μ s, is LineTime. Px 11: MSByte Px 12 MidByte Px 13 LSByte Each with the same value for RGB.
Encoder clocks	14–15–16–17	32-bit counter starts with power-on with 0 and has an overflow at 2^{32} . Line trigger pulses (line trigger active) and encoder pulses (encoder active) counts depending on the selected mode; can be used as position information by a sequence of documents. Can be reset with software by use of TAG_CLEAR_ENCODER (947 H). Px 14: MSByte Px 15 higher MidByte Px 16 lower MidByte Px 17 LSByte Each with the same value for RGB.
Error register/ Board temperatures	18	Red: In case of any error, it is inserted here. Green: Temperature of power board Blue: Temperature of sensor board

Information	Pixel	Description
Time stamp	19–20–21	<p>„Real time clock“</p> <p>Output is in a 16.8b seconds value. TimeStamp (23:8) states the seconds when the power is on or in case of reset. TimeStamp (7:0) issues the decimal places in a multiple of 4 milliseconds. (0...249)</p> <p>Sample: TimeStamp = 0x123456</p> <p>→ 0x1234 = 4660 seconds since start = 1h, 17min, 40 seconds</p> <p>→ 0x56 = 86 * 4 = 344 ms.</p> <p>Px 19 MSByte Px 20 MidByte Px 21 LSByte</p> <p>Each with the same value for RGB.</p>
Markers	0–5–10–22	<p>It is used for marking the info block with red pixels.</p> <p>Red xFF Blue x00 Green x00</p>

9.11.6.2 Each line information

Overview at the info block „Each line info block“:

Pixel	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Value	Info block										GrayValSum or ContrastValue							
Red	xFF	Error register	Speed2High Line time (19:16)	Encoder clock (23:16)	Next line pos. (15:8)	Time stamp (15:8)	MaxVal. Front R (7:0)	MaxVal. Rear R (7:0)	State of ext. Inputs (23:16)	xFF	Red Front (23:16)	Green Front (23:16)	Blue Front (23:16)	Red Rear (23:16)	Blue Rear (23:16)	Green Rear (23:16)	xFF	
Green	x00 Cont Line CNT 15:8	Line count (15:8)	Line time (15:8)	Encoder clock (15:8)	Next line pos. (7:0)	Time stamp (7:0)	MaxVal. Front G (7:0)	MaxVal. Rear G (7:0)	State of ext. Inputs (15:8)	x00	Red Front (15:8)	Green Front (15:8)	Blue Front (15:8)	Red Rear (15:8)	Blue Rear (15:8)	Green Rear (15:8)	x00	
Blue	x00 Cont Line CNT 7:0	Line count (7:0)	Line time (7:0)	Encoder clock (7:0)	Next line pos. Frac.(7:0)	Time stamp (7:0)	MaxVal. Front B (7:0)	MaxVal. Rear B (7:0)	State of ext. Inputs (7:0)	x00	Red Front (7:0)	Green Front (7:0)	Blue Front (7:0)	Red Rear (7:0)	Blue Rear (7:0)	Green Rear (7:0)	x00	

Information	Pixel	Channel	Description
ContLineCNT	0	G/B	If Image start delay has the value 0, a line count is inserted as 16-bit value in the green and blue channel. The lines are counted continuously, i.e. the count is not reset at the start of a new image. Can be used to check whether lines are missing between adjacent images.
Error register	1	R	In case of any error, it is inserted here.
Line Count	1	G/B	16-bit line count since image start
Speed too high	2	R (7)	The highest bit has the value of "Speed2High" (the line time decreases the specified integration time). Now the camera is in free-running line mode (only in Encoder/Line trigger mode if the speed becomes too high).
Line time	2	R/G/B	20-bit value of the current line time for the CCD in pixel clocks. The line time, measured in μ s, is LineTime. Resolution 10ns Red MSByte (3:0), Bits (6:4) are zero Green MidByte Blue LSByte
Encoder clock	3	R/G/B	24-bit counter starts at power-on with 0 and overflows at 2^{24} . At a slave camera, the value is always zero. Line trigger pulses (line trigger active) and encoder pulses (encoder active) are counted depending on the selected mode and can be used as position information by a sequence of documents. It can be reset by. Red MSByte Green MidByte Blue LSByte
Next line trigger position	4	R/G/B	Information of the next line trigger position in encoder pulses (only at encoder mode). The calculated position is shown in a 16.8b value. If encoder averaging is used, the value is divided by the average size. At a slave camera, this field has the value zero. Red MSByte integer part Green LSByte integer part Blue decimal place
Time stamp	5	R/G/B	„Real time clock“ Output is a 16.8b seconds value. TimeStamp (23:8) states the seconds when the power is on or in case of reset. TimeStamp (7:0) issues the decimal places in a multiple of 4 milliseconds. (0...249) Sample: TimeStamp = 0x123456 → 0x1234 = 4660 seconds since start = 1 h, 17 min, 40 seconds → 0x56 = 86 * 4 = 344ms. Red MSByte Green MidByte Blue LSByte
Max video value	6/7	R/G/B	Maximum (raw-) video value (8Bit) for each color of the last whole line. Pixel 6 FrontTap Pixel 7 RearTap
State of ext. inputs	8	R/G/B	The state of several input ports is indicated by bits of this pixel. For more information, see the table below.

Information	Pixel	Channel	Description
Gray value sum	10 - 15	R/G/B	<p>24-bit gray value sum of front and rear tap raw video inside the set line length of the last line as a value for the image brightness.</p> <p>Pixel 10 Red front Pixel 11 Green front Pixel 12 Blue front Pixel 13 Red rear Pixel 14 Green rear Pixel 15 Blue rear</p> <p>For each pixel, values are shown in this order: Red MSByte Blue MidByte Green LSByte</p> <p>It can be shown optionally with Contrast value sum.</p>
Contrast value sum	10-15	R/G/B	<p>Contrast sums of front and rear tap raw video inside the set line length of the last line. It is a value of the image's sharpness.</p> <p>Note: e.g. with 2048 pixels there are only 2047 difference values.</p> <p>For ordering refer to the "Contrast value sum" as follows:</p> $LineContrast = \sum_{i=first\ pixel\ in\ line}^{last\ pixel\ in\ line-1} Pixel\ value_{i+1} - Pixel\ value_i $ <p>It can be shown optionally with Gray value sum.</p>
Markers	0,9,16	R/G/B	<p>It is used for marking the info blocks with red pixels.</p> <p>Red xFF Blue x00 or ContLineCNT first byte Green x00 or ContLineCNT second byte (see above)</p>

Bit assignments for **State of external inputs**:

Color bit	Output bit	Pin
R0	16	CL-CC1
R1	17	CL-CC2
R2	18	CL-CC3
R3	19	CL-CC4
R4-R7	20-23	-
G0	8	X5-1/9 (RS422 in)
G1	9	X5-2/10 (RS422 in)
G2	10	X5-3
G3	11	X5-4
G4	12	X5-6
G5	13	X5-8
G6	14	X5-12
G7	15	X5-14
B0	0	Internal light barrier
B1-B6	1-6	-
B7	7	ScanDir

For more information about the pins of the digital IO port, see section 5.1.3.

9.11.6.3 Last line information

Overview of LastLine IMGChk Sum:

Pixel line	1	..	W/2-2	W2-1	W/2	W/2+1	W/2+2	W/2+3	..	W
...	Vid	..	Vid					Vid	..	Vid
LastLine R	Vid	..	Vid	ChkSumRed Front(15:8)	ChkSumRed Front(7:0)	ChkSumRed Rear(7:0)	ChkSumRed Rear(15:8)	Vid	..	Vid
LastLine G	Vid	..	Vid	ChkSumGreen Front(15:8)	ChkSumGreen Front(7:0)	ChkSumGreen Rear(7:0)	ChkSumGreen Rear(15:8)	Vid	..	Vid
LastLine B	Vid	..	Vid	ChkSumBlue Front(15:8)	ChkSumBlue Front(7:0)	ChkSumBlue Rear(7:0)	ChkSumBlue Rear(15:8)	Vid	..	Vid

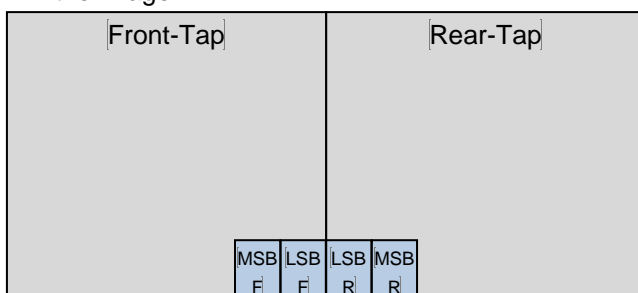
LastLine IMGChk Sum is in the last line and in the last two pixels of each tap.

The number of pixels of the camera n is 4096 if you use a 4K-PIXA.

CHK sum overwrites the LastLine test ramp on the last 2 pixels of the tap and it consists of the last 16 bits of the sum of pixels (8 MSBits), from Pixel 0:0 until H:W/2-2 (with W pixels per tap and H lines within the image). This means that the CHK sum is naturally not included in the sum.

Note: with 10 bits per pixel the CHK Sum is not applicable!

Position in the image:



In addition, a test ramp starting with the value 128 can be inserted into the last line. The test ramp can be used to determine the last line of an image.

If both IMGChkSum and test ramp have been activated, the four bytes containing the check sum overwrite the respective pixels of the test ramp.

9.12 LED flash control

For a detailed description of the functionality, see section 8.7.

9.12.1 LED flash control

Name			
Name	Set LED flash mode		
Function	If set to enabled , the functionality of LED flash control is active		
Channels	All		
Unit	Bool		
Dependency	None		
Notes	For more information, see section 8.7 "Multi-channel flash control".		
Camera:	Value:	Function:	
Lower limit	All	disabled	Off
Upper limit	All	enabled	On

9.12.2 LED number line pattern

Parameter sets the number of patterns to be used in the LED flash control sequence. The sequence starts with pattern 1.

Name		
Name	Number of line patterns	
Function	Sets the number of patterns	
Channels	All	
Unit	Integer	
Dependency	Only available if LED flash control has been enabled	
Notes	If LED number of line pattern is set to 0, LED flash control is disabled internally. For more information, see section 8.7 "Multi-channel flash control".	
Camera	Value	
Lower limit	All	0
Upper limit	All	5

9.12.3 LED flash sequence time

Name			
Name	LED flash sequence time		
Function	Gives the time for the sequence of all valid patterns in microseconds.		
Unit	Float	Step:	0.001
	Linear		
Dependency	If encoder / line trigger mode is active, LED flash sequence time is ignored		
Notes	If all 4 patterns are used, the maximum sequence time is $4 * 2,3 \text{ msec} = 9,2 \text{ msec}$ The sum of all valid patterns may not exceed sequence time. If the camera is triggered by external input (LineTrigger or Encoder), the frequency of the trigger signal may not be faster than the sum all active patterns. For more information, see section 8.7 "Multi-channel flash control".		
Camera	Value		
Lower limit	All	0	
Upper limit	All	9.200.000	

9.12.4 LED line pattern

Name			
Name	Flash time # at channel #		
Function	LED line pattern sets the active time for 1 of 4 available patterns and of 1 of 4 available output channels in microseconds		
Unit	Float	Step:	0.001
	Linear		
Dependency	If all line patterns for an output channel are set to 0, the output channel is disabled		
Notes	For more information, see section 8.7 “Multi-channel flash control”.		
Camera		Value	
Lower limit	All	0	
Upper limit	All	2.300.000	

9.12.5 LED signal frame control

Name		
Name	LED signal frame control	
Function	Controls whether flash sequence is active continuously or only within image frames.	
Unit	Bool	
Dependency	None	
Notes	For more information, see section 8.7 “Multi-channel flash control”.	
Camera	Value	
Lower limit	All	Flash outputs set continuously
Upper limit	All	Flash outputs controlled by image frame

9.12.6 Pattern time generation

Name		
Name	Pattern time generation	
Function	If set to Pattern packed optimally , the individual line pattern times are used for scanning, minimizing the sequence time if different pattern times are used.	
Unit		
Dependency	Depends on minimum integration time and camera link mode.	
Notes	For more information, see section 8.7 “Multi-channel flash control”.	
Camera	Value	
Lower limit	All	Pattern packed optimally
Upper limit	All	Pattern enlarged to sequence time

9.13 Special functions

9.13.1 Test pattern

To be able to check the system setup, it is helpful to generate exactly defined test images inside the camera.

This explicitly helps to check:

1. Frame grabber connection
2. Frame grabber setting
3. Transmission quality over the Camera Link cable

Name	
Name	Generate test pattern
Function	Enables different test images in the camera.
Channels	All
Unit	Integer
Dependency	None
Notes	The data are generated directly after analog image processing. It passes all digital image processing steps. (Test patterns 6-15 only for internal use)
Camera	Value
Lower limit	All 0
Upper limit	All 5

The following different test images are available:

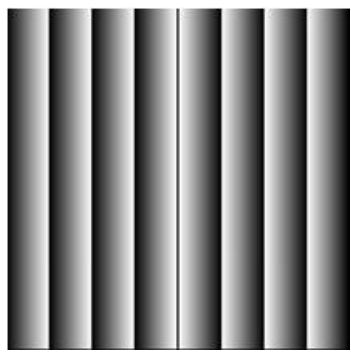
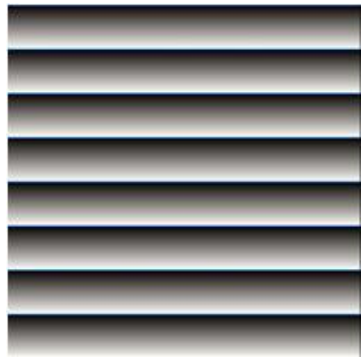
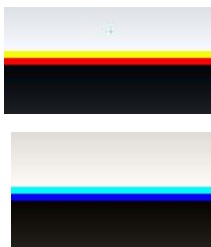
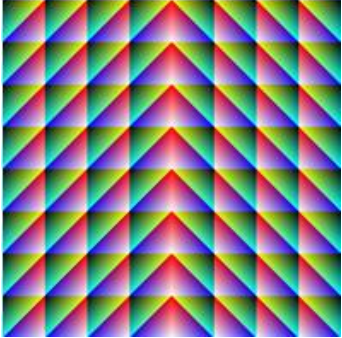
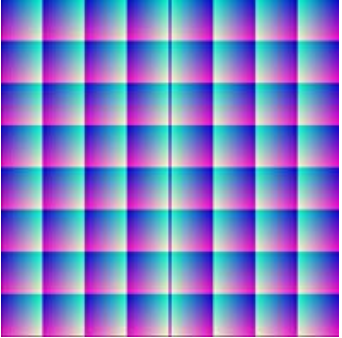
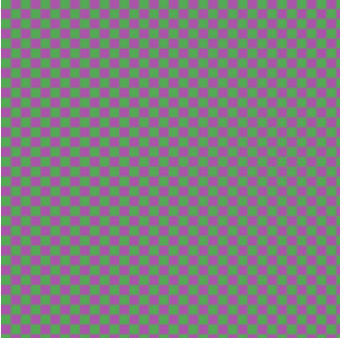
Image	Name
	Test pattern 1: Gray ramp in CCD direction
	Test pattern 2: Gray ramp in transport direction Scan direction:  forward backward

Image	Name
	<p>Test pattern 3: Red: X-Ramp Green: XY-Ramp Blue: Y-Ramp</p>
	<p>Test pattern 4: Sequence of 4 toggling images; 3 test patterns with parameter Test pattern level and one live image</p>
	<p>Test pattern 5: Gray value with parameter Test pattern level</p>
	<p>Test pattern 6-15: Internal use only</p>

9.13.2 Test pattern level

Name		
Name	Set test pattern level	
Function	Sets the video level for some test images	
Channels	All	
Unit	Integer	
	Linear	
Dependency	Only with test image 4 and 5	
Notes	Refers to 10-bit image data	
	Camera	Value
Lower limit	All	0
Upper limit	All	1023

9.14 Register edit

All registers can be written directly on the camera.

There are two different possibilities to directly manipulate the register:

- **Permanent modification:**

Changes are stored in the setting and are available if the camera is restarted or a setting is reloaded.

You can find this function in CST at **Camera settings > Special functions > Register edit**. There are four places for saving register edits directly to a setting.

- **Non-permanent modification:**

Changes are transferred to the camera, but they are not stored permanently. If the camera is restarted or a setting is reloaded, the changes get lost. You can find this function in CST at the command **Register edit** of the **Advanced** menu.

NOTICE

It is possible to damage the function of the camera by use of this function.

Therefore, this function is only available if **User level** has been set to **Guru**.

For more information, see section 6.15 "Setting the user level in CST".

9.15 Camera information

9.15.1 Camera serial number

Note All allPIXA pro cameras have an individual serial number. For any support, provide the serial number of the camera.

Name			
Name	Camera serial number	Read only	
Function	Returns type and serial number of the camera		
Channels	All		
Unit	Two integers		
Dependency	None		
Notes	The first value is the camera type (10020 for the allPIXA pro camera). The second value is the serial number.		
	Camera	Value camera type	Value serial number
Lower limit	All	10020	0
Upper limit	All	10020	65535

9.15.2 Setting description

Name	
Name	Setting description
Function	You can write a small description for each setting of the camera.
Channels	All
Unit	String of up to 40 characters
Dependency	None
Notes	Take notice that a carriage return counts as two characters! This may result in descriptions that seem to be cut by the camera.
Camera	Value
All	

9.16 Tracing

Function for debugging the system.

Default: All options unchecked!

For more information, ask the Chromasens support.

E-Mail: support@chromasens.de

9.17 Line trigger and encoder setup (line synchronization)

NOTE I Due to internal timing limitations, there is a small delay in the start of the integration time after the line trigger and this delay may jitter. Therefore, a pulsed illumination which is synchronous to the trigger signal may cause problems with image quality.

NOTE II If the camera is used in the “Triggered Frame Scan” mode with active LineTrigger or encoder, the linesync (Encoder or LineTrigger) must fit some pulses before light barrier input.

For detailed information about encoder setup, see section 8.6.

9.17.1 Enable encoder

Name			
Name	Enable encoder		
Function	Enables the line trigger or encoder mode in the camera and the main selection between internal and external line trigger.		
Channels	All		
Unit	Bool		
Dependency	None		
Notes	If you want to use this mode, you must connect the external ports with the internal function using the IO Configurator of CST.		
Camera	Value	Function	
Lower limit	All	0	Off / internal
Upper limit	All	1	On / external

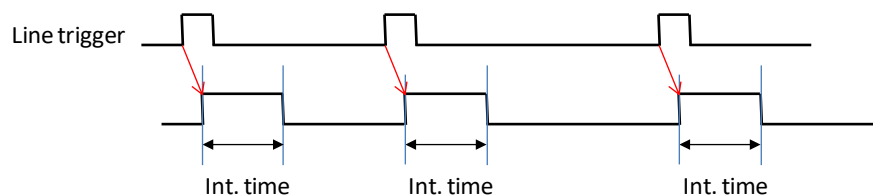
9.17.2 Synchronization mode

Name	
Name	Synchronization mode
Function	Select the mode Line trigger mode or Encoder .
Channels	All
Unit	Integer
Dependency	Only available if the Enable encoder check box is selected.
Notes	If you want to use this mode, you must connect the external ports with the internal function using the IO Configurator of CST.
Camera:	Value:
All	Encoder (Continue update)
All	Line trigger mode (Const int. time)

The following two modes are available:

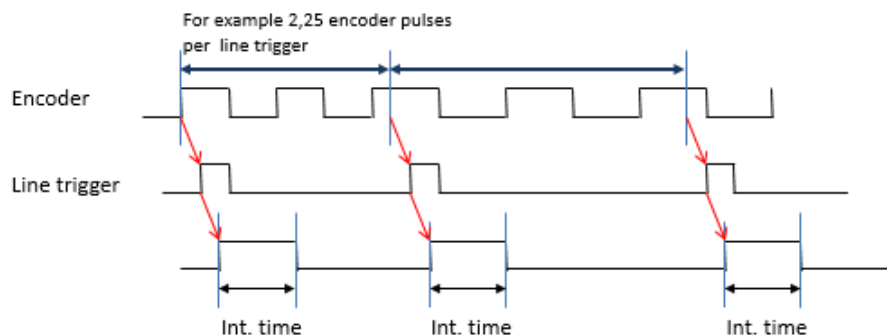
- **Line trigger:**

With the line trigger the camera sends one line per pulse.



- **Encoder mode:**

The camera measures the distance of the signals and sends lines with the requested resolution. An internal line trigger is generated. The desired transport and encoder resolution must be specified in CST.



For detailed encoder setup, see section 8.6

NOTE Minimum pulse duration is 45ns. Shorter pulses are ignored.
 Minimum speed with encoder mode is:

$$V, \text{min} = \frac{\text{mm/Encoder pulse}}{0,59\text{s}}$$

Example for the required minimum speed with encoder mode:

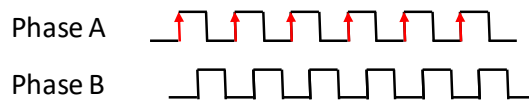
Encoder has 12,5 pulses per mm
 1 Encoder pulse is $1/12,5\text{mm} = 0,08\text{mm}$
 $\Rightarrow V, \text{min} = 0,08\text{mm}/0,59\text{s} = 0,135\text{mm/s}$

9.17.3 Encoder channels

Name	
Name	Encoder channels
Function	Sets the mode according to the edges if the encoder is taken for speed measurement.
Channels	All
Unit	Integer
Dependency	Only available if Encoder (Continue update) is selected at Synchronization mode .
Notes	If you want to use this mode, you must connect the external ports with the internal function using the IO Configurator of CST.
Camera	Value
All	1-Channel full step (1 edge per step)
All	1-Channel encoder (2 edges per step)
All	2-Channel encoder (4 edges per step)

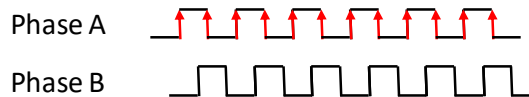
The following three modes are available:

1. One Channel full step (1 edge per step):



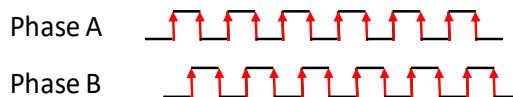
(Phase B is ignored for speed detection, but could be used for scan direction)

2. One Channel encoder (2 edges per step):



(Phase B is ignored for speed detection, but could be used for scan direction)

3. Two Channel encoder (4 edges per step):



NOTE Best results are reached with encoder mode 1 (**1 Channel full step**) and without encoder averaging. This mode avoids errors due to tolerances in the duty factor of the pulses.

9.17.4 Average size for the encoder

Name	
Name	Average size
Function	Sets the number of increments taken for distance measurement to average the speed measurement
Channels	All
Unit	Integer
	None; 2x; 4x; 8x; 16x
Dependency	Only available if Encoder (Continue update) is selected at Synchronization mode .
Notes	Best results are reached with encoder mode 0 and without encoder averaging. This mode avoids errors due to tolerances in the duty factor of the pulses
Camera	Value
Lower limit	All
	No averaging
	2
	4
	8
Upper limit	All
	16

9.17.5 Encoder resolution

Name	
Name	Encoder resolution
Function	Sets the distance of which the transport might be moved by one increment of the encoder.
Channels	
Unit	Float
	Step: 0.001
	µm per full increment
Dependency	Only available if Encoder (Continue update) is selected at Synchronization mode .
Notes	Refers to a full increment of the encoder.
Camera	Value CST
Lower limit	All
	0 µm
Upper limit	All
	100,000 µm

NOTE The value **Encoder pulses per line** is calculated internally by the camera and may not exceed 255. Recommended values are between 0.5 and 255. Take notice that values less than 0.5 cause a decrease in transport resolution accuracy. For information about calculation, see section 9.17.6

9.17.6 Vertical image resolution

Name			
Name	Vertical image resolution		
Function	Define the desired transport (vertical) resolution for the encoder mode.		
Channels	All		
Unit	Float	Step:	0.01
	DPI (dots per inch)		
Dependency	Only available if Encoder (Continue update) is selected at Synchronization mode .		
Notes	This parameter is needed for the calculation of internal parameters for the encoder mode.		
Camera		Value CST	
Lower limit	All	0	
Default	All	4,000 (*0,01dpi)	

NOTE The value **Encoder pulses per line** is calculated internally by the camera and may not exceed 255. Recommended values are between 0.5 and 255. Take notice that values less than 0.5 cause a decrease in transport resolution accuracy.

This value is automatically calculated with one of the following formulas by the user-defined values in CST:

$$EncoderPulsesPerLine = \frac{EncoderChannel \left(\frac{Edges}{Step} \right) * 25,4 \left(\frac{mm}{inch} \right) * 1000}{EncoderResolution \left(\frac{\mu m}{Step} \right) * VerticalImageResolution \left(\frac{Dots}{inch} \right)}$$

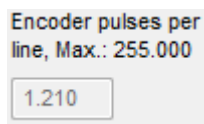
By using dots per inch (dpi) for this calculation, you must use the following formula:

$$EncoderPulsesPerLine = FullIncrementResolution(dpi) * \frac{Edges/step}{TransportResolution(dpi)}$$

The value for encoder pulses per line can also be calculated with the following formula:

$$EncoderPulsesPerLine = TransportResolution \left(\frac{\mu m}{pixel} \right) * \frac{Edges/step}{FullIncrementResolution \left(\frac{\mu m}{incr} \right)}$$

Afterward, the result is shown:



NOTE The resulting scanning speed should not exceed the max speed of the camera. The setup of the **Vertical image resolution** and **Integration time** must match to the speed of the transport. The time for one line (Speed divided by resolution) should be longer than the shortest possible integration time (scanning speed is within the max. camera speed). If the encoder setup requires higher speed than the max camera speed, the camera switches to free-running line mode with maximum possible speed.

For more information about encoder setup, see section 8.6

9.17.7 Line trigger / encoder reduction

Name	
Name	Line trigger/encoder reduction
Function	Internal pre-counter for the line trigger or encoder signal; outputs an internal line trigger after the set value of signals from external line trigger source.
Channels	All
Unit	Integer
Dependency	Only available if the Enable encoder check box is selected.
Notes	
Camera	Value
Lower limit	All 1
Upper limit	All 256

By use of line trigger reduction, the vertical image resolution is reduced by factor:

$$TransportResolution, reduced [dpi] = \frac{TransportResolution [dpi]}{\text{Line trigger reduction factor}}$$

$$TransportResolution, reduced [\mu m] = \text{Line trigger reduction factor} * TransportResolution [\mu m]$$

For more information about encoder setup, see section 8.6.

9.18 Default parameters

The camera is delivered with the following default parameters. (Setting 1)

Sect.	Name	4096	5120	6000	7300	
9.1.1	Integration time	19.68µs	30.40 µs	35.48 µs	43,25 µs	
9.1.2	Use line period	Off	Off	Off	Off	
9.1.3	Line period time	100 µs	100 µs	100 µs	100 µs	
9.2.1	Analog coarse gain	-3 dB	-3 dB	-3 dB	-3 dB	
9.2.2	Current camera gain values	*)	*)	*)	*)	
9.2.3	Startup gain values	*)	*)	*)	*)	
9.2.4	Update start gain values	Off	Off	Off	Off	
9.3.3	First relative pixel of white reference	1800	2300	2800	3500	
9.3.6	Number of pixels for white reference	100	100	100	100	
9.3.7	First image line for the white reference	200	200	200	200	
9.3.8	Number of image lines for the white reference	100	100	100	100	
9.3.9	Number of reference samples (Average)	No average	No average	No average	No average	
9.3.10	Show white reference border	Off	Off	Off	Off	
9.4.1	Target white reference values	800	800	800	800	
9.4.3	Enable continuous white control	Off	Off	Off	Off	
9.4.4	Position and mode for white reference mark	Automatic	Automatic	Automatic	Automatic	
9.4.5	White control mode	Use sync mode	Off	Off	Off	Off
		Stop gain control if level...	Off	Off	Off	Off
		Stop gain control by variance	Off	Off	Off	Off
9.4.6	Gain control stop factor	0.8	0.8	0.8	0.8	
9.4.7	Set gain control stop by variance	0	0	0	0	
9.4.8	Set active channels for white control	On	On	On	On	
9.5.1	Black-level correction (offset correction)	On	On	On	On	
9.5.2	Black-reference data set	1	1	1	1	
9.5.3	Shading correction (flat-field correction)	Off	Off	Off	Off	
9.5.4	White reference data set	1	1	1	1	
9.6.1	Use brightness and contrast	Off	Off	Off	Off	
9.6.2	Brightness	0	0	0	0	
9.6.3	Contrast	0.9	0.9	0.9	0.9	
9.7.1	RGB line distance	4	4	4	4	
9.7.2	Scan direction	Forward	Forward	Forward	Forward	
9.7.3	Enable suppression of lines/frame due to encoder direction	Off	Off	Off	Off	
9.7.4	Suppress lines/frames mode	Suppress ... against ...	Suppress ... against ...	Suppress ... against ...	Suppress ... against ...	
9.8.1	Number of scan lines per image (frame mode)	2000	2000	2000	2500	
9.8.2	Image start delay	10	10	500	10	
9.8.3	Scan line length	4096	5120	6000	7296	
9.8.4	Horizontal binning	1/1 (no reduction)	1/1 (no reduction)	1/1 (no reduction)	1/1 (no reduction)	
9.8.5	Vertical scan line reduction	0 / 0	0 / 0	0 / 0	0 / 0	

Sect.	Name	4096	5120	6000	7300
9.9.1	Triggered frame scan	Free-running	Free-running	Free-running	Free-running
9.9.2	Scan lines after stop	50	50	50	50
9.9.3	Stop after maximum number of lines	Off	Off	Off	Off
9.9.4	Maximum number of scan lines	5000	5000	5000	5000
9.9.5.1	ROI start	500	500	500	500
9.9.5.2	ROI length	32 pixels	32 pixels	32 pixels	32 pixels
9.9.5.3	Rising level	100	100	100	100
9.9.5.4	Falling level	99	99	99	99
9.9.5.5	Color channel	All	All	All	All
9.9.5.6	ROI visible	not visible	not visible	not visible	not visible
9.9.6	Input debouncing speed	LB2: fast	LB2: fast	LB2 fast	LB2: fast
9.9.7	Select trigger edge detection	Falling edge	Falling edge	Falling edge	Falling edge
9.9.8	Master-slave setup	Off	Off	Off	Off
9.10.1	Mirror image horizontally	Off	Off	Off	Off
9.10.2	Swap red and blue color channel	Off	Off	Off	Off
9.10.3	Color conversion	Off	Off	Off	Off
9.10.4	Select active CCM	1	1	1	1
9.10.5	Gamma correction	0	0	0	0
9.10.6	Use keystone correction	Off	Off	Off	Off
9.10.7	Pixel shift for correction	0	0	0	0
9.10.8	Keystone correction width	1	1	1	1
9.11.1	Video output mode	3x8 Bit	3x8 Bit	3x8 Bit	3x8 Bit
9.11.2	Color weights	0.3/0.59/0.11	0.3/0.59/0.11	0.3/0.59/0.11	0.3/0.59/0.11
9.11.3	Camera Link connection speed	High speed	High speed	High speed	High speed
9.11.4	Camera Link interface type	Medium 1X2	Medium 1X2	High speed	Medium 1X2
9.11.6	Insert mode	Off	Off	Off	Off
9.12	LED flash control	Disabled	Disabled	Disabled	Disabled
9.13.1	Test pattern	Off	Off	Off	Off
9.13.2	Test pattern level	0	0	1023	1023
9.14	Register edit	None	None	None	None
9.15.1	Camera serial number	*)	*)	*)	*)
9.15.2	Setting description				
9.16	Tracing	None	None	None	None
9.17.1	Enable encoder	Off	Off	Off	Off
9.17.2	Synchronization mode	Line trigger	Line trigger	Line trigger	Line trigger
9.17.3	Encoder channels	1 channel full step	1 channel full step	1 channel full step	1 channel full step
9.17.4	Average size for the encoder	Off	Off	Off	Off
9.17.5	Encoder resolution	70 µm	70 µm	70 µm	70 µm
9.17.6	Vertical image resolution	300 dpi	300 dpi	300 dpi	300 dpi
9.17.7	Line trigger / encoder reduction	1	1	1	1

*) Settings differ from camera to camera. Serial numbers are individual for each camera. Some settings result from final test of the camera.

9.19 User levels of parameters

The visibility (and as a result the accessibility) of parameters is defined by the specified **User level** in CST. For more information, see section 6.15.

The following table shows the user level for single parameters:

Section	Name	Normal User	Expert	Guru	
9.1.1	Integration time	X	X	X	
9.1.2	Use line period	X	X	X	
9.1.3	Line period time	X	X	X	
9.2.1	Analog coarse gain	X	X	X	
9.2.2	Current camera gain values	X	X	X	
9.2.3	Startup gain values	X	X	X	
9.2.4	Update start gain values	X	X	X	
9.3.3	First relative pixel of white reference	X	X	X	
9.3.4	First absolute pixel of white reference	X	X	X	
9.3.5	Use absolute horizontal position of white reference	X	X	X	
9.3.6	Number of pixels for white reference	X	X	X	
9.3.7	First image line for the white reference	X	X	X	
9.3.8	Number of image lines for the white reference	X	X	X	
9.3.9	Number of reference samples (Average)	X	X	X	
9.3.10	Show white reference border	X	X	X	
9.4.1	Target white reference values	X	X	X	
9.4.2	Current white reference values	X	X	X	
9.4.3	Enable continuous white control	X	X	X	
9.4.4	Position and mode for white reference mark			X	
9.4.5	White control mode	Use sync mode	X	X	X
		Stop gain control			X
		Stop ... by variance ...			X
9.4.6	Gain control stop factor			X	
9.4.8	Set active channels for white control			X	
9.5.1	Black-level correction (offset correction)	X	X	X	
9.5.2	Black-reference data set	X	X	X	
9.5.3	Shading correction (flat-field correction)	X	X	X	
9.5.4	White reference data set	X	X	X	
9.6.1	Use brightness and contrast	X	X	X	
9.6.2	Brightness	X	X	X	
9.6.3	Contrast	X	X	X	
9.7.1	RGB line distance	X	X	X	
9.7.2	Scan direction	X	X	X	
9.7.3	Enable suppression of lines/frame due to encoder direction	X	X	X	
9.7.4	Suppress lines/frames mode	X	X	X	

Section	Name	Normal User	Expert	Guru
9.8.1	Number of scan lines per image	X	X	X
9.8.2	Image start delay	X	X	X
9.8.3	Scan line length	X	X	X
9.8.4	Horizontal binning	X	X	X
9.8.5	Vertical scan line reduction	X	X	X
9.9.1	Triggered frame scan	X	X	X
9.9.2	Scan lines after stop	X	X	X
9.9.3	Stop after maximum number of lines	X	X	X
9.9.4	Maximum number of scan lines	X	X	X
9.9.5	Internal frame trigger	X	X	X
9.9.6	Input debouncing speed	X	X	X
9.9.7	Select trigger edge detection	X	X	X
9.9.8	Master-slave setup			X
9.10.1	Mirror image horizontally	X	X	X
9.10.2	Swap red and blue color channel	X	X	X
9.10.3	Color conversion	X	X	X
9.10.4	Select active CCM	X	X	X
9.10.5	Gamma correction	X	X	X
9.10.6	Use keystone correction	X	X	X
9.10.7	Pixel shift for correction	X	X	X
9.10.8	Keystone correction width			X
9.11.1	Video output mode	X	X	X
9.11.2	Color weights	X	X	X
9.11.3	Camera Link connection speed	X	X	X
9.11.4	Camera Link interface type	X	X	X
9.11.6	Insert mode	X	X	X
9.12	LED flash control			X
9.13.1	Test pattern	X	X	X
9.13.2	Test pattern level	X	X	X
9.14	Register edit			X
9.15.1	Camera serial number	X	X	X
9.15.2	Setting description	X	X	X
9.16	Tracing	X	X	X
9.17.1	Enable encoder	X	X	X
9.17.2	Synchronization mode	X	X	X
9.17.3	Encoder channels	X	X	X
9.17.4	Average size for the encoder	X	X	X
9.17.5	Encoder resolution	X	X	X
9.17.6	Vertical image resolution	X	X	X
9.17.7	Line trigger / encoder reduction	X	X	X

10 Troubleshooting and Support

The troubleshooting information in this chapter helps 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 10.5) 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.

10.1 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: <https://www.chromasens.de/>

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

10.2 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 continuously self-checks. If an error is detected, the camera indicates this by changing the LEDs color.

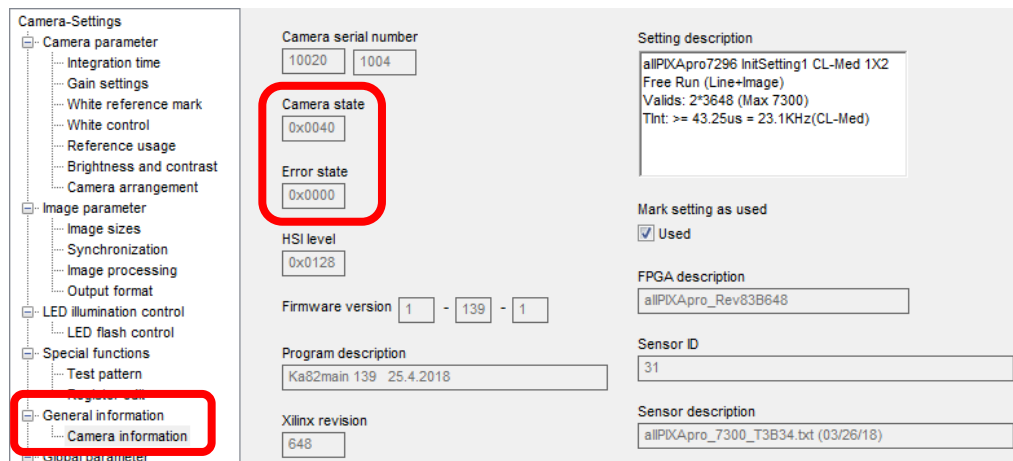
LED color	Description
off	No power is present at the camera or the input voltage is out of the limits. (see also section 2.3 for power rating and section 5.1.1 for pin layout)
Green	Camera has power and is OK (FVAL inactive)
Red	The camera is in error condition. You can check the detailed camera status using CST (see section 10.3)
Blue	Camera is OK and outputs image data (FVAL active)
LED alternates green/blue	The camera is OK and outputs frequently image data based on a trigger signal
Sequence of long green, short orange, green	This is the normal power-up sequence. After this sequence, the camera continues operation according to the definitions which have been made in setting 1.

10.3 Identifying the camera status using CST

If you want to get more detailed information on the current camera condition, you can check the camera status using CST.

To get a quick camera state feedback, do one of the following:

- On the **Advanced** menu, click **Get current camera state**, or on the toolbar, click **Show camera state and reset errors**  (see section 6.17).
- On the toolbar click **Show settings** , and then click **Camera information** in the tree view:



If an error occurs, the camera shows an error message and resets **Error state** afterward. Therefore, **Error state** is >0 only in case of a permanent error, for example if the temperature is above the allowed maximum value.

Camera state is subdivided into four groups of four bits with the following meaning:

Bits 15..12	Bits 11..8	Bits 7..4	Bits 3..0
If continuous white control is enabled, this value is >0 if white control is temporarily disabled due to a specified condition.	Always 0	State of internal white control.	State of internal process control

10.4 Camera overheating protection

For safety reasons the camera is equipped with an internal three-step overheating protection.

Step 1: high-temperature warning:

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

- Status LED of the camera turns red
- The camera returns error state 0x3d or 0x3e

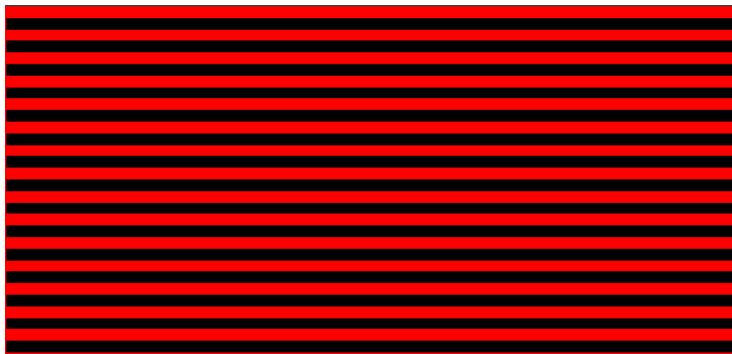
Let the camera cool down and check the environment. Improve cooling conditions of the camera if necessary.

Step 2: warning level 2:

If the temperature is still increasing, 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
- The camera returns error state 0x40
- The camera outputs the following image:



Step 3: final safety shutdown:

If the temperature is still increasing above the critical internal temperature, the camera hardware is shut down to protect and prevent damage to the camera. In this condition the camera:

- Does not send images anymore
- Status LED of the camera turns red
- The camera returns error state 0x40

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

1. Let the camera cool down.
2. Check the environment and improve cooling if necessary.
3. Restart the camera (power off/on)

For information about temperature level definitions, see sections 2.3 and 5.3.

10.5 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 staff.

To collect the most important information about 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/de/support/support>

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	<input type="checkbox"/> allPIXA <input type="checkbox"/> allPIXA pro <input type="checkbox"/> 4k <input type="checkbox"/> 5k <input type="checkbox"/> 6000px <input type="checkbox"/> 7.3k
Camera serial number	
CST version used	
Operating system	
Frame grabber	Type + Manufacturer
CameraLink cable length + type	m

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

Image and Parameter Files	
Camera parameter settings	<input type="checkbox"/> (It is very important to provide a copy of the exact camera settings when the problem occurred)
Live images	<input type="checkbox"/> (Live or test images showing the problem. Save images in BMP format)
Computer System Information	<input type="checkbox"/> (Press the  -button in the CST-toolbar and copy the output into a file or the support mail)

11 Appendix

11.1 EC conformity declaration

 <p>chromasens Imaging for Professionals</p>	<p><u>EU Declaration of Conformity</u></p>	<p>DCE_CP000476 R01</p>
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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 CCD line scan camera with Camera Link Interface
 Series: Chromasens allPIXA pro
 Types: **CP000476**-nnnn-h (all derivations)

Manufacturer authorized representative: **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: No. 19PBI109408-00, dated 05-11-2019.

Konstanz, November 15, 2019



.....
Martin Hund, CEO

11.2 Camera system design / lens selections

11.2.1 Calculating the object-to-image distance

To be able to calculate the optical setup, you need the following parameters:

- 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:

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

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

Calculate the image distance:

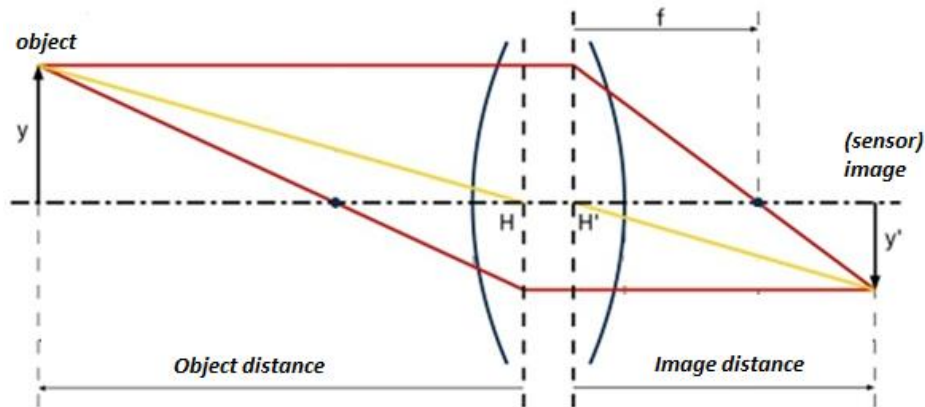
$$\text{ImageDistance} = \text{FocalLength} * (m + 1)$$

Calculate the object distance:

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

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

$$\text{ObjectImageDistance} = \text{ImageSize} + \text{ObjectSize} + \text{Main plain distance}$$



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

Example:

Camera: allPIXA pro camera 7300 73 mm (10um/pixel * 7300 pixels)
 Object width/size: 450 mm

Lens: 90.1 mm real focal length

-2.5 mm

principal main plain distance

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

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

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

$$ObjectImageDistance = ImageSize + ObjectSize + Main \text{ plain distance} = 747.73$$

(w/o glass plates in the optical path)

11.2.2 Calculating the distance rings (tubes) for the allPIXA pro camera

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

To calculate the needed distance rings, you must 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

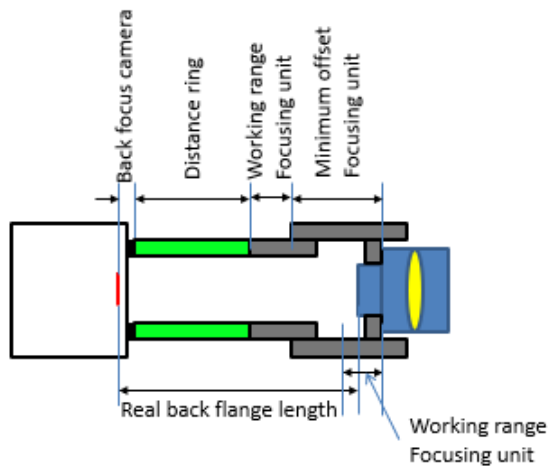


Figure 38

Example:

Camera:	allPIXA pro camera 7300	
Lens:	Linios 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 pro 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.

11.2.3 Determining line period time and integration time

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

$$LinePeriodTime/sec. = \frac{1}{LineFrequency/Hz}$$

For the calculation of the line period time the following parameters are necessary:

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

Calculate the line period time with the formula as follows:

$$LinePeriodTime = \frac{TransportResolution \left(\frac{mm}{pixel}\right)}{NominalSpeed \left(\frac{mm}{s}\right)}$$

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).

$$MinimumLinePeriodTime = Max(MinimumIntegrationTime, MinCameraLinkTime)$$

MinimumIntegrationTime depends on the sensor length (see section 9.1.1).

MinCameraLinkTime depends on the sensor length, the specified **CameraLink connection speed** (see section 9.11.3), and the specified **Type of CameraLink interface** (see section 9.11.4).

The Integration time must then be in the range:

$$MinimumLinePeriodTime \leq Integration\ time \leq Actual\ Line\ period\ time$$

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