allPIXA camera | Manual

CD40067 R04

2018-07-12

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1 General Information

1.1 About Chromasens

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

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

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

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

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

1.1.1 Contact information

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

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

1.1.2 Support

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

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

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

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

1.2 Firmware and software version in this manual

This document refers to the following version:

CST: Version 2.8 (at least)

Camera: Packet 1.70 (at least)

The recent version might have additional functions. Therefore, please 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 enabled 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
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
ZRAM	Line buffer	Memory for RGB line distance (spatial correction)

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.
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 camera

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

The following components are supplied with the allPIXA camera:

- allPIXA camera packaging

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

- allPIXA camera

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

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

- Additionally ordered and supplied accessories

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

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

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

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

We would be pleased to be of assistance to you.

1.6 Information about CST

CST = Camera **S**etup **T**ool

To download the newest version, refer to our website at http://www.chromasens.de.

To be able to log in, a registration is needed.

Before you install and use CST, please check whether there is a recent CST or manual version available. You can find the Software on the Chromasens homepage at **Products → Line Scan Camera allPIXA**.

If you already have an installed version of the CST, you can check the version number using the *Help* menu.

For more information about CST, see chapter 9 “CST program window”**.**

1.7 Design of a line scan camera system

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

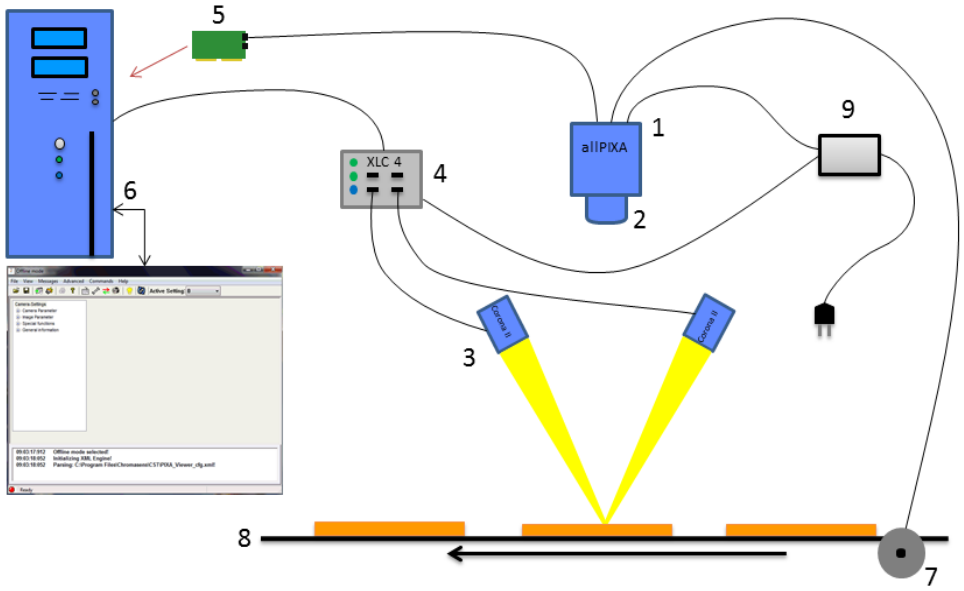


Figure 1: Design of a line scan camera application

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

Component	No.
Line scan camera: An allPIXA 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 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 using 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 means of a frame grabber with a CameraLink 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 means of an optional incremental encoder. The encoder can be connected either to the allPIXA camera or to the frame grabber.	**7**
Conveying unit: The conveying unit moves the scanned object past the allPIXA camera	**8**
Power supply: Both, the allPIXA camera and the illumination system, require a suitable power supply.	**9**

2 allPIXA camera - overview

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

- 2,048 pixels / max. 60,6 kHz
- 4,096 pixels / max. 34,4 kHz
- 7,300 pixels / max. 21.2 kHz

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

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

The allPIXA 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 connected to the CC bits of the CameraLink interface or directly to the allPIXA camera. As a result, images with a consistent quality can be generated even at transport speeds with a high fluctuation rate.

The allPIXA camera parameters can be set with the CST software tool. Equipped with a CameraLink interface (medium), the allPIXA camera achieves a data rate of 170 megapixels per second with 24 bit RGB, which is equal to 510 Mbytes/s.

By using the allPIXA camera, you can also output monochrome / grayscale images.

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

Modularity of the allPIXA camera permits the use of various lenses like C-mount, F-mount, M39x1/26“, M42x1, and M72x0.75 connections. In addition, the modular focus of LINOS / Qioptics is supported, and thus the allPIXA camera can be combined with all commercially available standard lenses.

2.1 allPIXA camera highlights

- Trilinear color line scan camera (trilinear CCD line scan sensor)
- 10 µm pixel size
- High-accuracy sensor alignment
- 24 bit (3x8 bit) color information on the output side
- Maximum data rate of 170 MPx/s (24Bit RGB) – 510 MB/s
- Internal 14-bit A/D conversion per color channel
- RGB spatial compensation in the camera (also sub-pixel correction)
- Shading correction, optionally calculated offline with CST or internally in the camera
- Gamma correction, brightness and contrast controller, separate for each channel
- Color conversion matrix (CCM)
- Continuous white balancing maintains a constant image brightness and color, irrespective of the temperature and service life of the illumination system
- Intelligent camera control by a 16-bit controller
- FPGA-based image processing
- Robust metal housing

- Connection of a wide range of lenses, possible for the use of special lens adapters
- C-mount, F-mount, M39x1/26", M42x1, M72x0.75, modular focus (Qioptics / Germany)
- Other mounts and customized solutions on request
- Incremental encoder port on the camera; this ensures simple handling and less programming work
- Internal test image generator
- Option for area scanning with trigger inputs (light barriers)

2.2 Technical data

Sensor	Trilinear CCD color line sensor
Pixel size	10 µm x 10 µm (10 µm pitch)
Line spacing	40 µm center distance R-G and G-B
Maximum data rate on the Camera Link	170 megapixels/s 24Bit RGB | 510 Mbytes/s
Resolution	1,024 (Only OEM) / 2,048 / 4,096 / 7,300 px Other sensor resolutions are available on request
Maximum line frequency	1,024 pixels: 110 kHz (only in special OEM configurations) 2,048 pixels: 60,7 kHz 4,096 pixels: 34,4 kHz 7,300 pixels: 21.2 kHz
Spectral sensitivity	360 nm to 960 nm
Video signal	3x8 bit on the CameraLink, 3x14 bit ADC
Interface	CameraLink medium with 85 MHz
Line scan operating mode	Free-running / 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, RoHS
Power supply	24 VDC +/- 10 %; 1A; typical 16 W
Operating temperature	0°C to 60°C; 32°F to 140°F (housing temp.)
Housing dimensions	L = 102 mm, H = 126 mm, D = 68 mm
Weight	1.2 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.

2.3 Mechanical dimensions of the allPIXA camera

2.3.1 Mechanical dimensions of the allPIXA camera up to 4,096 pixels

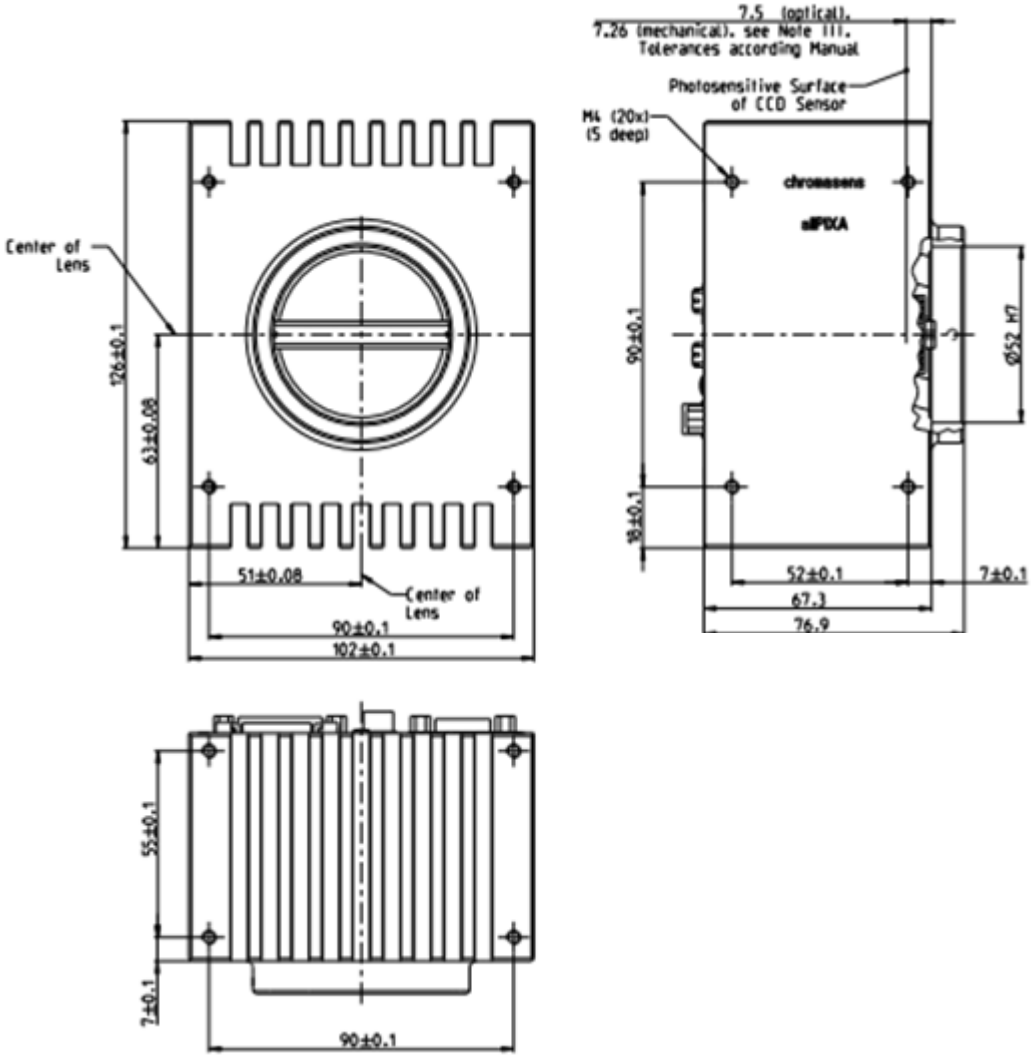


Figure 2: Mechanical dimensions of the allPIXA camer

NOTE I	Drawings and 3D-CAD-models are available on our homepage http://www.chromasens.de/user
NOTE II	For the XYZ coordinate system and for sensor alignment, refer to section 4.2 “Design of the allPIXA camera line scan sensor” and sensor alignment
NOTE III	For the optical path extension, refer to section 4.3

2.3.2 Mechanical dimensions of the 7,300 pixel allPIXA camera

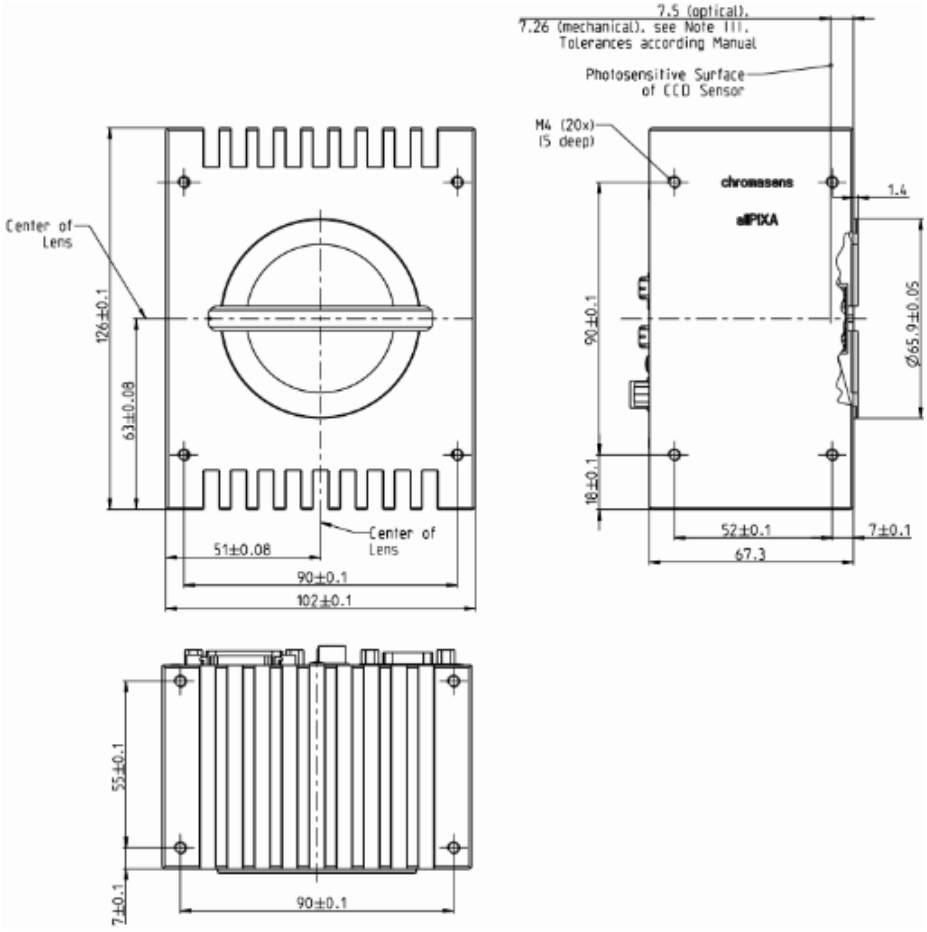


Figure 3: Mechanical dimensions of the allPIXA camera with 7,300 pixels

NOTE I	Drawings and 3D-CAD-models are available on our homepage http://www.chromasens.de/user
NOTE II	For the XYZ coordinate system and for sensor alignment, refer to section 4.2 “Design of the allPIXA camera line scan sensor” and sensor alignment
NOTE III	For the optical path extension, refer to section 4.3

2.4 Ambient conditions

	Value
Ambient temperature during camera operation	0º C to 60 ºC; + 32 °F to 140 °F
Air humidity during camera operation	20% - 85% relative air humidity, non-condensing
Storage / transport temperature	-20 ºC - +85 ºC; -4 °F - +185 °F
Protection category	IP50
General ambient conditions	
Operation	IEC 721-3-3:IE33
Transport	IEC 721-3-2:IE21
Storage	IEC 721-3-1:IE11

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

3.3 Safety instructions on the allPIXA camera

Risks from hot surfaces

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

Observe all precautionary measures for handling electrostatic sensitive equipment.

Make sure that the allPIXA 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 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 camera has been installed is responsible for compliance with relevant safety regulations, standards and directives. Commissioning of the allPIXA camera is only permitted if the machine or system, in which the allPIXA camera is installed, complies with the safety regulations and standards of the country in which the allPIXA camera runs.
- The owner of the machine or system with the installed allPIXA camera has to verify the suitability of allPIXA camera for its intended use.
- Safety regulations of the country in which the device should be used have to be complied with.
- The allPIXA camera may only be connected or used as described in this manual.
- The allPIXA 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 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 person who has undergone the necessary electrotechnical training under the supervision of a qualified electrician, in compliance with applicable electrotechnical regulations.
- Please be aware that only suitably trained and qualified persons are permitted to work with the allPIXA camera. Such persons are qualified to work with the allPIXA 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 have to be clearly defined and specified by the owner of the device in which the allPIXA camera is installed.

3.6 Organisational measurements

- The instruction manual has to be stored safely in the vicinity of the camera in operation.
- Information contained in this manual have to be integrated into the documentation of the device in which the allPIXA camera is installed.
- The allPIXA camera and all connected peripheries have to 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 has to be informed.
- Deadlines and intervals for regular inspections must be complied with.
- Before starting maintenance, the allPIXA camera must be isolated from the power supply.
- Due to the risk of fire, devices such as radiators, heaters, or lighting equipment have to 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 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 may only be transported in its original packaging.

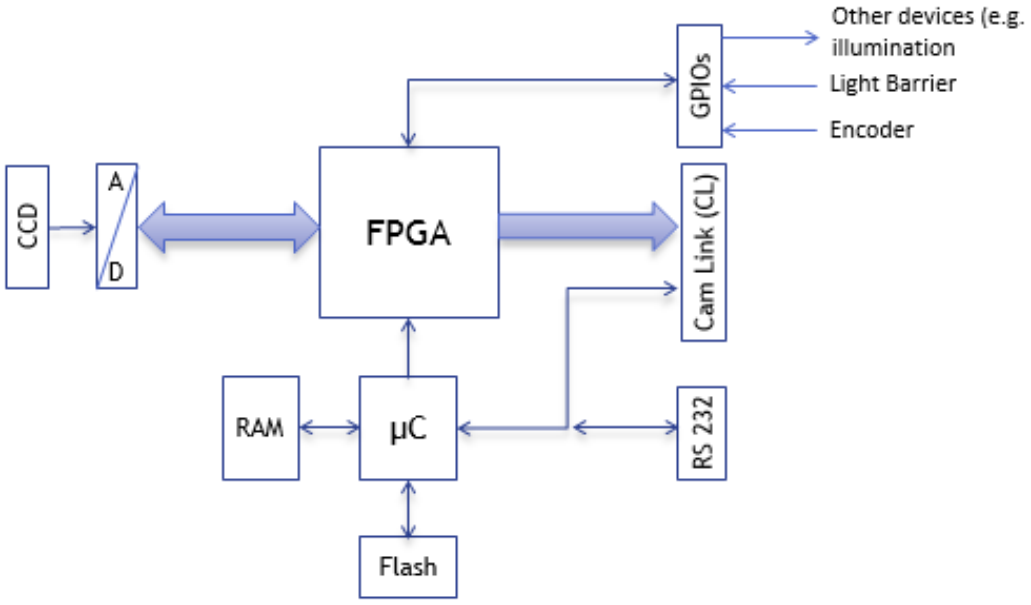
4 allPIXA camera - Design and functions

4.1 Basic design of the allPIXA 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 CameraLink connector.

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

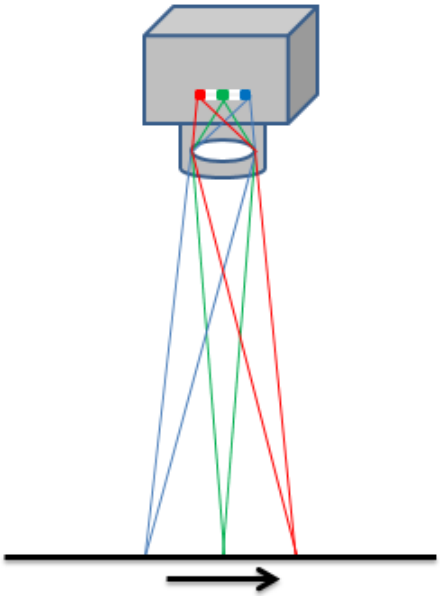
Signals from incremental encoders or light barriers can also be input by the GPIOs (general purpose inputs/outputs).



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 4: Basic design of the allPIXA camera (block diagram)

4.2 Design of the allPIXA camera line scan sensor

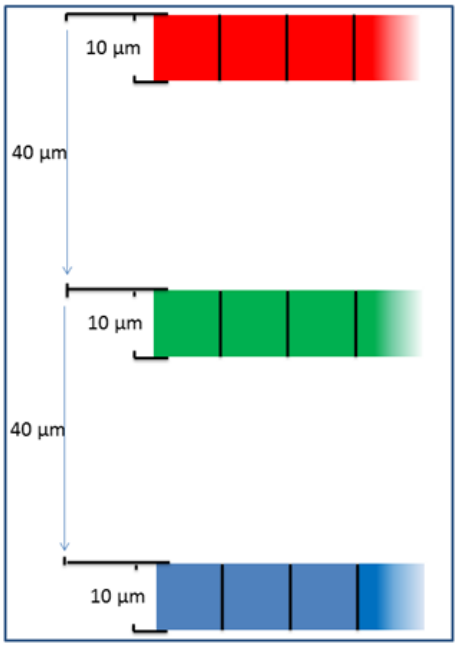


The allPIXA color line scan camera is equipped with a trilinear CCD line scan sensor with 3 spatially separated lines which are sensitive to the colors red, green and blue (RGB).

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

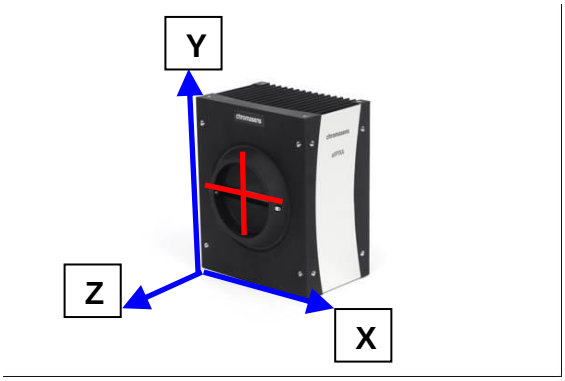
Spatial correction is achieved by the corresponding delay of the individual items of color information. As a result of the object's movement, for example, an object point first reaches the blue sensor line, then the green sensor line and finally the red sensor line.

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

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

Figure 5: allPIXA camera line scan sensor

4.3 Sensor allignment and orientation



Sensor alignment:

Position:

X:	< +/- 150 µm
Y:	< +/- 150 µm
Z:	< +/- 150 µm

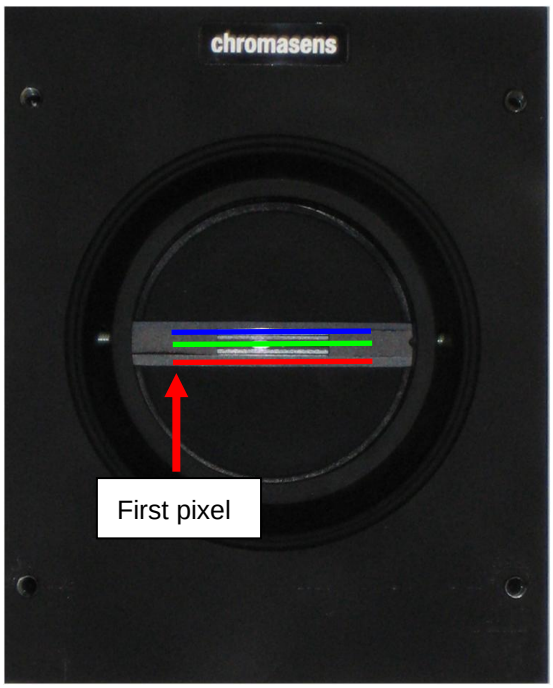
Rotation about:

Y:	< +/- 0.1 °
Z:	< +/- 0.1 °

Planarity of sensor surface:
< +/- 0.50 µm

Sensor window:

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



Sensor orientation:
(view from the front side)

First pixel:
Left side

Color lines:
Blue: top
Green: center
Red: bottom

Sensor alignment is an important issue for:

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

4.4 The allPIXA camera line scan sensor readout principle

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

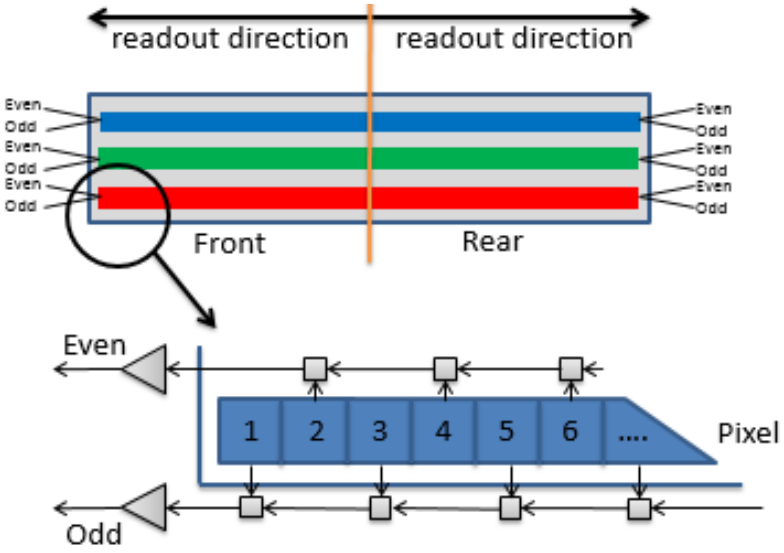


Figure 6: The allPIXA camera line scan sensor readout principle

4.5 Spectral sensitivity of the allPIXA camera line scan sensor

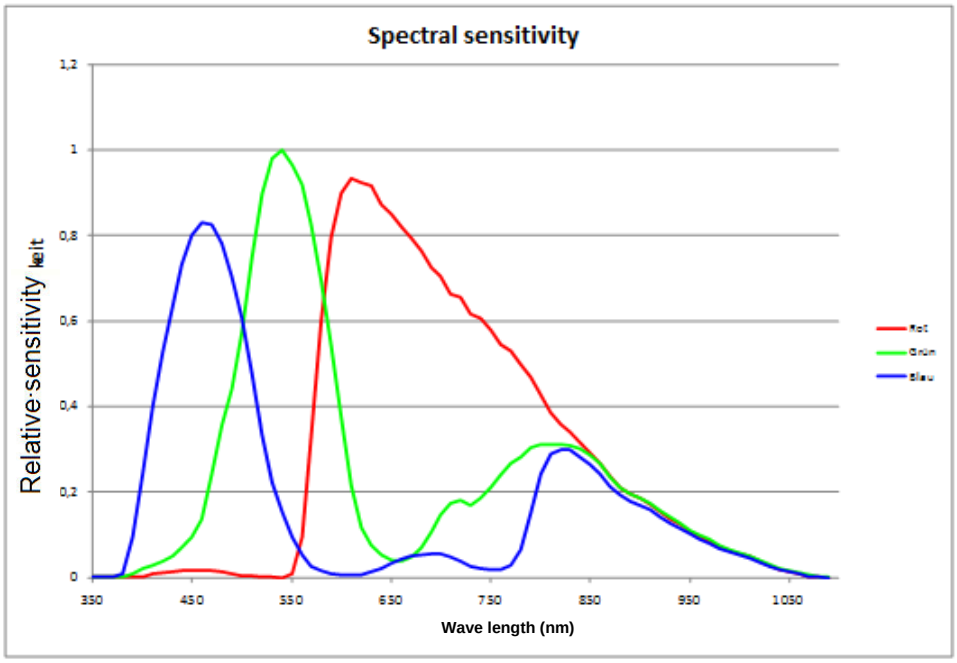


Figure 7: Spectral sensitivity of the line scan sensor

4.6 Image processing

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

4.6.1 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 done in the FPGA.

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

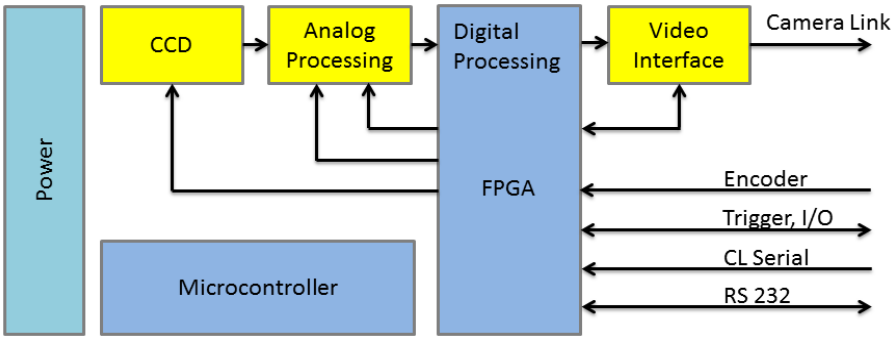


Figure 8: Process of the allPIXA camera image processing (block diagram)

The CCD sensor is read out by using 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.

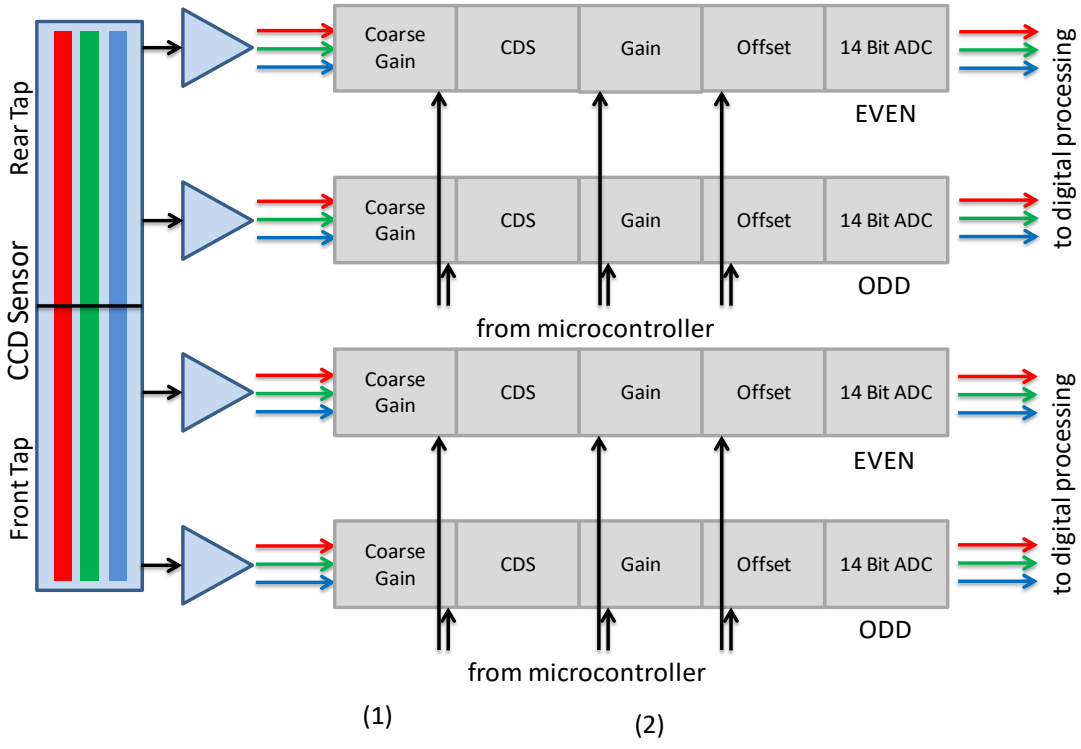


Figure 9: Analog process of the allPIXA camera (block diagram)

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 10***.

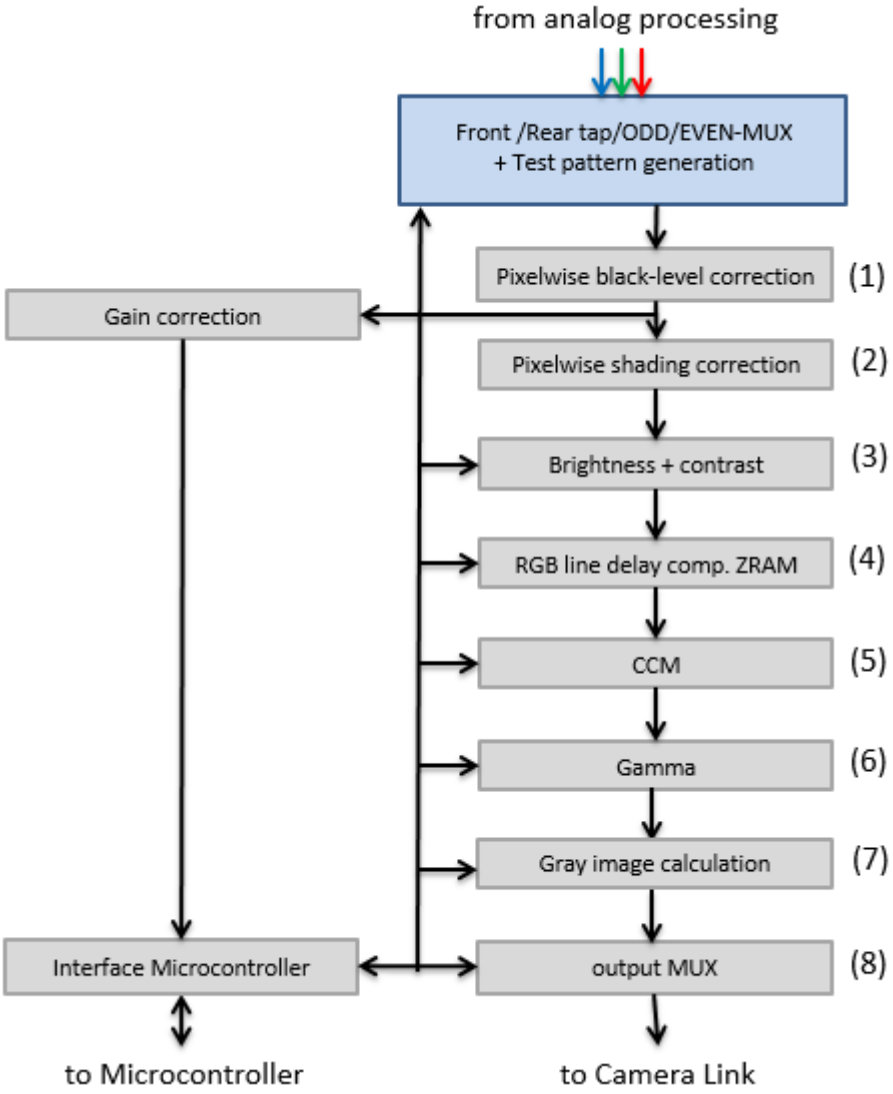


Figure 10: Digital process of the allPIXA camera (block diagram)

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 (ZRAM) (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 CameraLink connection (8).

4.6.2 Image information output on the CameraLink

The sensor is read out in two sections (in front tap and rear tap). The front part is output via CameraLink connector 1 (CL-Con 1), and the rear part is output via CameraLink connector 2 (CL-Con 2).

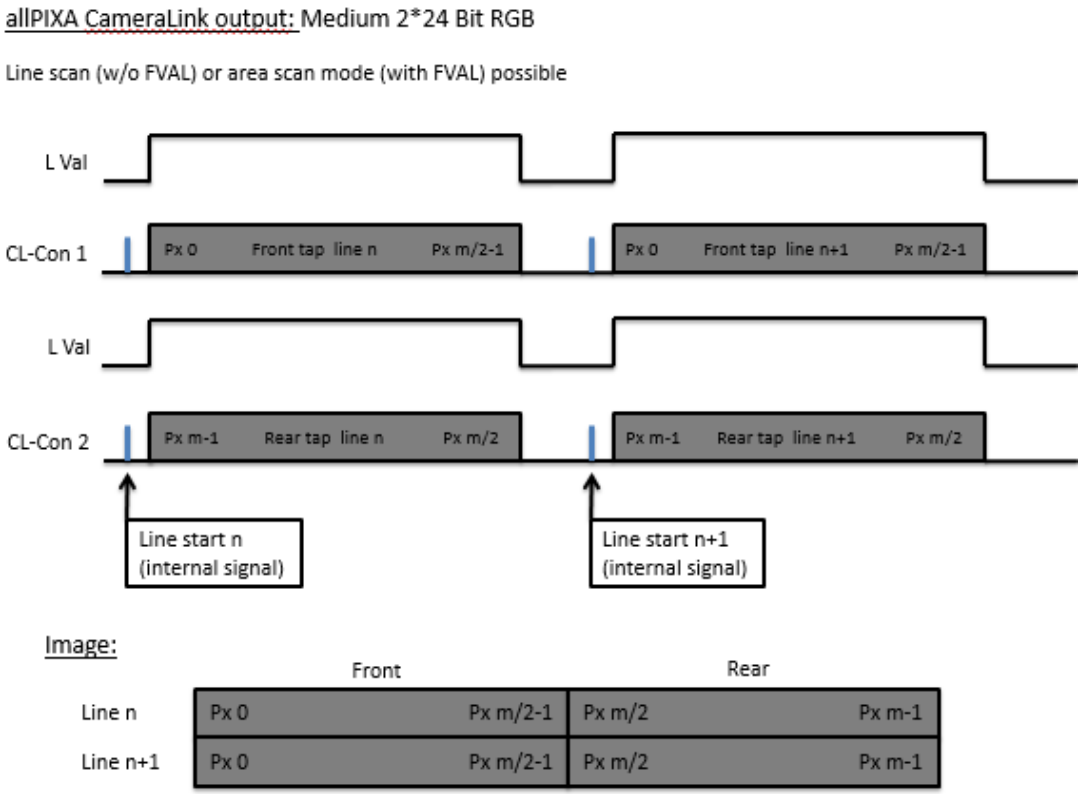


Figure 11: Image information output on the CameraLink

With Regard to the CameraLink draft description for sensors, the read-out system is called "**2XE**".

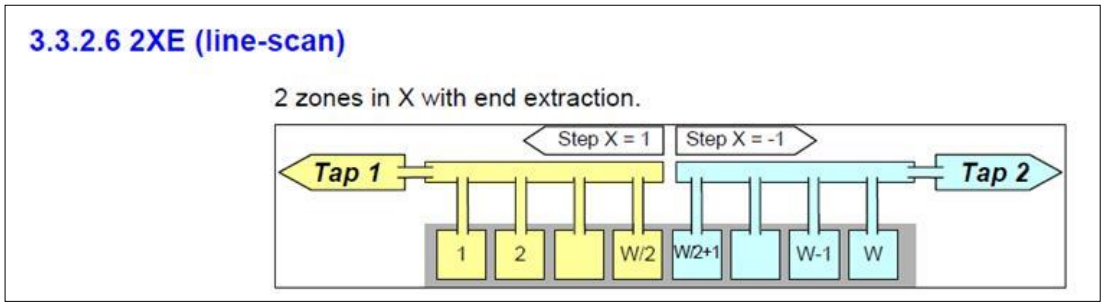


Figure 12

NOTE	Take notice that some frame grabbers use this term and others use terms for "read in", therefore, the direction might be inversed.

In color mode, the CameraLink uses 2XE format with 3x8 bits per pixel transmitted on both CameraLink connectors. If set to gray, 2 pixels with 8 bits are transmitted on the first CameraLink connector.

According to the CameraLink specification, the data are transmitted as displayed in the following table:

Connector 0 (CL1)			Connector1 (CL2)		Conn0/Conn1
Output format “Color” 24Bit RGB	Output format “Grey” 8Bit*2 Grey	Input Name	Output format “Color” 24Bit RGB	Input Name	Trans/Rec Number
PxCLK	PxCLK	Strobe	PxCLK	Strobe	TxClk/RxClkt
LVAL	LVAL	LVAL	LVAL	LVAL	TX24/RX24
FVAL	FVAL	FVAL	FVAL	FVAL	TX25/RX25
Pen	Pen	DVAL	Pen	DVAL	TX26/RX26
Spare	Spare	Spare	Spare	Spare	TX23/RX23
Red Front Bit 0	Front Bit 0	Port A0	Red Rear Bit 0	Port D0	TX0/RX0
Red Front Bit 1	Front Bit 1	Port A1	Red Rear Bit 1	Port D1	TX1/RX1
Red Front Bit 2	Front Bit 2	Port A2	Red Rear Bit 2	Port D2	TX2/RX2
Red Front Bit 3	Front Bit 3	Port A3	Red Rear Bit 3	Port D3	TX3/RX3
Red Front Bit 4	Front Bit 4	Port A4	Red Rear Bit 4	Port D4	TX4/RX4
Red Front Bit 5	Front Bit 5	Port A5	Red Rear Bit 5	Port D5	TX6/RX6
Red Front Bit 6	Front Bit 6	Port A6	Red Rear Bit 6	Port D6	TX27/RX27
Red Front Bit 7	Front Bit 7	Port A7	Red Rear Bit 7	Port D7	TX5/RX5
Green Front Bit 0	Rear Bit 0	Port B0	Green Rear Bit 0	Port E0	TX7/RX7
Green Front Bit 1	Rear Bit 1	Port B1	Green Rear Bit 1	Port E1	TX8/RX8
Green Front Bit 2	Rear Bit 2	Port B2	Green Rear Bit 2	Port E2	TX9/RX9
Green Front Bit 3	Rear Bit 3	Port B3	Green Rear Bit 3	Port E3	TX12/RX12
Green Front Bit 4	Rear Bit 4	Port B4	Green Rear Bit 4	Port E4	TX13/RX13
Green Front Bit 5	Rear Bit 5	Port B5	Green Rear Bit 5	Port E5	TX14/RX14
Green Front Bit 6	Rear Bit 6	Port B6	Green Rear Bit 6	Port E6	TX10/RX10
Green Front Bit 7		Port B7	Green Rear Bit 7	Port E7	TX11/RX11
Blue Front Bit 0		Port C0	Blue Rear Bit 0	Port F0	TX15/RX15
Blue Front Bit 1		Port C1	Blue Rear Bit 1	Port F1	TX18/RX18
Blue Front Bit 2		Port C2	Blue Rear Bit 2	Port F2	TX19/RX19
Blue Front Bit 3		Port C3	Blue Rear Bit 3	Port F3	TX20/RX20
Blue Front Bit 4		Port C4	Blue Rear Bit 4	Port F4	TX21/RX21
Blue Front Bit 5		Port C5	Blue Rear Bit 5	Port F5	TX22/RX22
Blue Front Bit 6		Port C6	Blue Rear Bit 6	Port F6	TX16/RX16
Blue Front Bit 7		Port C7	Blue Rear Bit 7	Port F7	TX17/RX17

Figure 13: Tranmission of data according CameraLink specification CameraLink

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

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

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

- Both operations are based on pixel-by-pixel calculation, and the effects on behavior of single pixels such as PRNU (photo response non uniformity) are eliminated.
- Both operations are carried out separately for each line (red, green, blue).
- The allPIXA camera provides 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 done offline on scanned images. Often, shading data have been calculated internally with a static white reference in front of the camera. In this case, spots of dust on the white reference lead to vertical lines in the image. This effect can be eliminated by slightly defocusing the lens during the generation of the references. The lighting distribution is then seen by the sensor and the lens. Another possibility to avoid this problem is to move the target slightly during the balancing process. Thus, distortions for example caused by dust can be eliminated.
- The allPIXA camera permits to calculate the references offline. You can select a scanned image and define a region of the image, in which shading correction data are calculated. By averaging over a higher number of lines, distortions, for example caused by dust on the target, are eliminated. Therefore, it is possible to use an image with a moving white object.
- The allPIXA camera also permits to generate shading and offset data internally.
- Generated data sets can be stored on the hard disk of the PC. The stored data can be transferred to the camera later on.
- 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)

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

This calculation is done 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

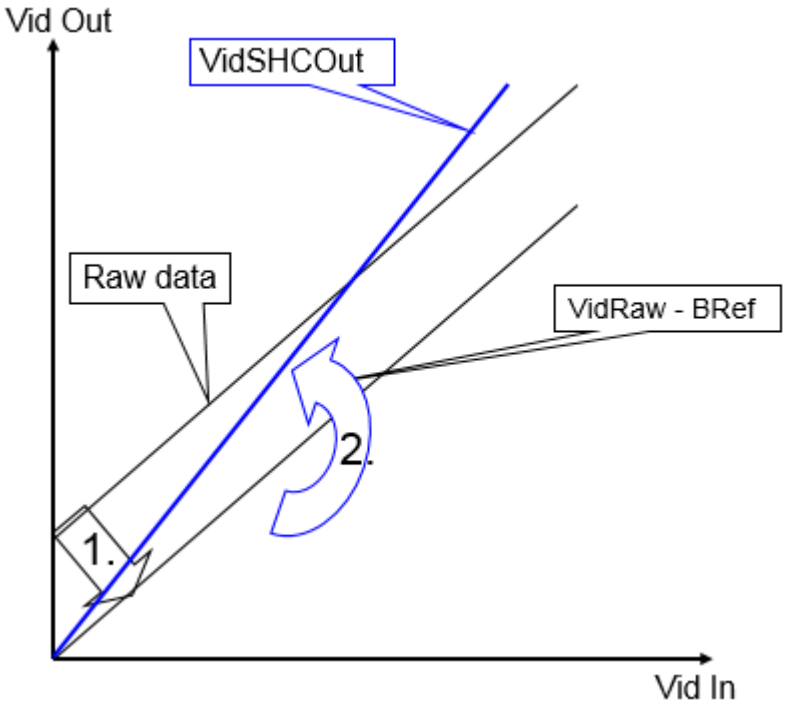


Figure 14: Offset and shading correction

4.8 Image mode

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

The trigger signal can be supplied by the frame grabber either by CC-Bits CC3 or CC4 or with a hardware signal by IO -port. The external signals have to be configured using 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.

4.9 Monochrome image acquisition

In addition, the allPIXA camera permits to generate monochrome images which have been generated according to the color information. The evaluation of the color channels during generation of a monochrome image can be set individually.

4.10 White balancing with a closed-loop control

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

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

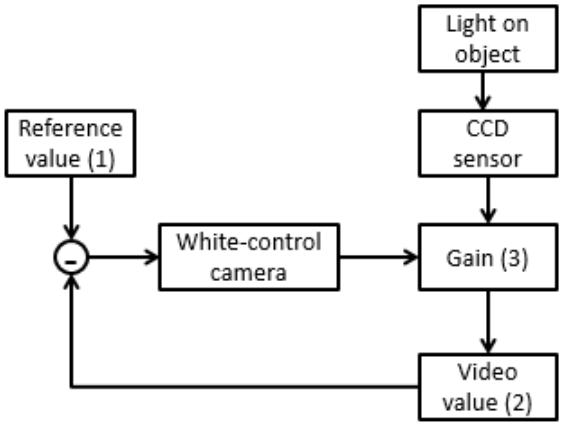


Figure 15: Closed loop control for white balancing

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.

4.11 Setting concept

Furthermore, the allPIXA camera offers a comprehensive setting concept:

You can store up to 18 different settings in the camera. All parameters such as gaining or integration time may be different from setting to setting and are selectable by short commands. Therefore, a fast change of the camera's behavior is possible for different products.

- For the user there are 18 settings available.
- The setting no. 19 is write-protected; the factory's default setting is stored under no. 19 and may be copied to other settings.
- The camera always starts up with setting no. 1

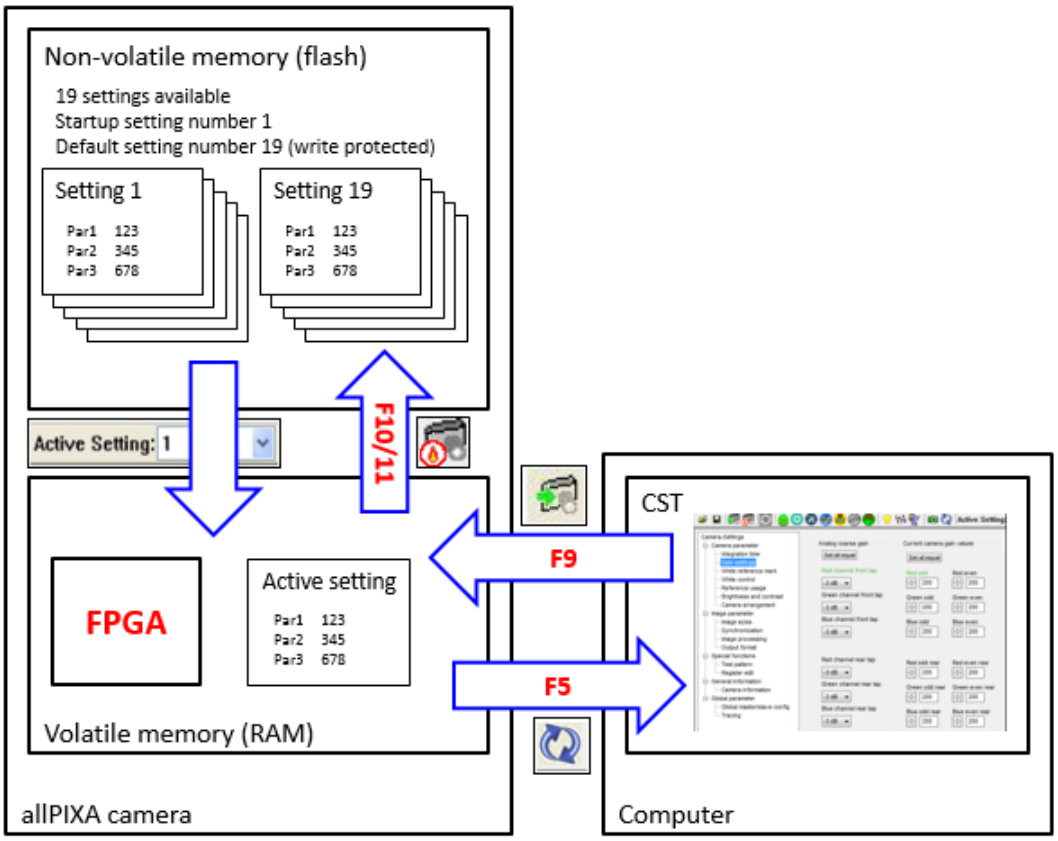


Figure 16: Setting concept

4.11.1 Restore factory default

By loading setting 19 and saving it into the working setting (for example Setting 1), the delivered configuration can be restored.

For information about saving of settings to different setting positions, see section 9.6

5 allPIXA camera - Connections and status LED

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

- Two CameraLink ports (port 1 and 2) for image signalling and for communication between the allPIXA 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 camera and the PC
- A power connection (Hirose HR10A-7R-6P, male) for power supply
- A multi-color LED for indicating the allPIXA camera status

NOTE	If you use a USB to Serial converter for the connection via RS232, use one with an FTDI Chipset (Prolifix chipsets did generate problems while connecting to the camera).

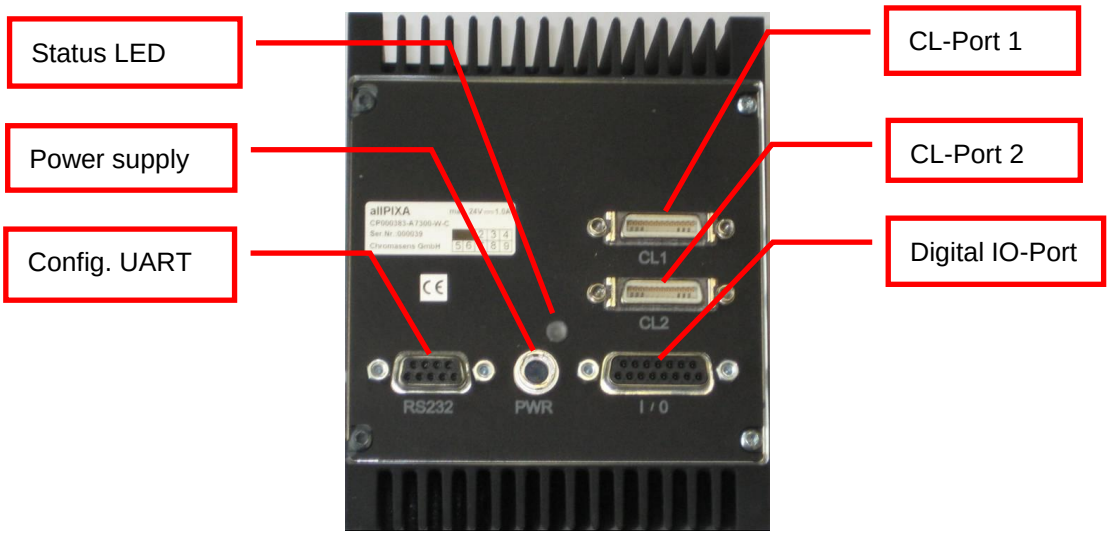


Figure 17: The allPIXA camera connections and status LED

5.1 Status LED

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

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

5.2 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)

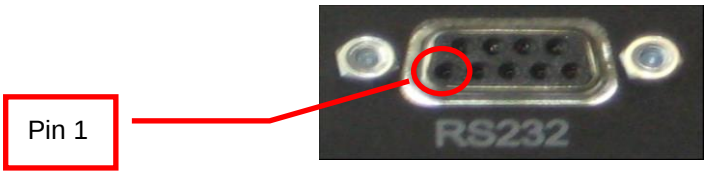
Pin no.	Description	
1	Power +24 V	
2	Power +24 V	
3	Not connected	
4	Not connected	
5	Ground	
6	Ground	

For more information about the input voltage and currents, see section 2.2 “Technical data”.

5.3 Config UART (serial RS 232)

Serial connection to the PC can be established by using 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	Data terminal ready
5	Ground
6	Not connected
7	Request to send
8	Not connected
9	Not connected

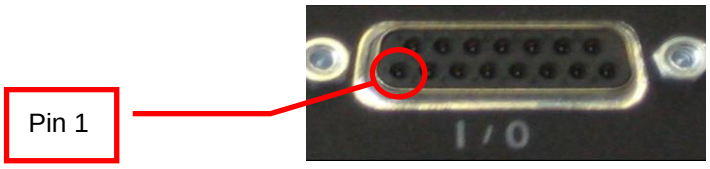


5.4 Digital IO port

You need a 15-pin D-Sub connector (male) to establish a connection to the digital I/O interface of the allPIXA camera. Other functions can be selected at the IO Configurator in CST.

Pin no.	Level	Description	Default
1	RS 422	GPIO_P0 (input)	Incremental encoder (high)
2	RS 422	GPIO_P1 (input)	Light barrier (high)
3	LVCMOS	GPIO_P5 (BDir, PullUp)	Can be used for light barriers or nSelMaster (Bridge to 0 V). Only pin 3: V_{in} 5,0 V max. .
4	LVCMOS	GPIO_P6 (BDir, PullDown)	Selectable with IO Configurator
5	3.3 V over 100 Ohm	Power	Output
6	LVCMOS	GPIO_P8 (BiDir, PullDown)	Master/Slave interface
7	0 V	Ground	-
8	LVCMOS	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	LVCMOS	GPIO_7 (BiDir, PullDown)	Selectable with IO Configurator
13	0 V	Ground	-
14	LVCMOS	GPIO_9 (BiDir, PullDown)	Selectable with IO Configurator
15	5 V over 100 Ohm	Power supply	Output

NOTE	Power supply with a 100 Ohm series resistor; RS422 to RS422 standard LVCMOS with 10 Ohm series resistor



Some requirements for using the RS422 interfaces:

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

b) The allPIXA 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.

5.4.1 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!
Use a level converter, if necessary (for example 74 LVC14).
Non-compliance can result in irreparable damages to the allPIXA camera!

5.5 Video CameraLink port 1

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

Cable designation	Camera connector: CL 1	Frame grabber connector	Channel link signal: Base
Inner shield	1	1	Inner shield
Inner shield	14	14	Inner shield
PAIR1-	2	25	X0-
PAIR1+	15	12	X0+
PAIR2-	3	24	X1-
PAIR2+	16	11	X1+
PAIR3-	4	23	X2-
PAIR3+	17	10	X2+
PAIR4-	5	22	Xclk-
PAIR4+	18	9	Xclk+
PAIR5-	6	21	X3-
PAIR5+	19	8	X3+
PAIR6+	7	20	SerTC+
PAIR6-	20	7	SerTC-
PAIR7-	8	19	SerTFG-
PAIR7+	21	6	SerTFG+
PAIR8-	9	18	CC1-
PAIR8+	22	5	CC1+
PAIR9+	10	17	CC2+
PAIR9-	23	4	CC2-
PAIR10-	11	16	CC3-
PAIR10+	24	3	CC3+
PAIR11+	12	15	CC4+
PAIR11-	25	2	CC4-
Inner shield	13	13	Inner shield
Inner shield	26	26	Inner shield

NOTICE

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

5.6 Video CameraLink port 2

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

Cable designation	Camera connector: CL 2	Frame grabber connector	Channel link signal: Medium
Inner shield	1	1	Inner shield
Inner shield	14	14	Inner shield
PAIR1-	2	25	X0-
PAIR1+	15	12	X0+
PAIR2-	3	24	X1-
PAIR2+	16	11	X1+
PAIR3-	4	23	X2-
PAIR3+	17	10	X2+
PAIR4-	5	22	Xclk-
PAIR4+	18	9	Xclk+
PAIR5-	6	21	X3-
PAIR5+	19	8	X3+
PAIR6+	7	20	100 Ohm
PAIR6-	20	7	Terminated
PAIR7-	8	19	
PAIR7+	21	6	
PAIR8-	9	18	CC1-
PAIR8+	22	5	CC1+
PAIR9+	10	17	CC2+
PAIR9-	23	4	CC2-
PAIR10-	11	16	CC3-
PAIR10+	24	3	CC3+
PAIR11+	12	15	CC4+
PAIR11-	25	2	CC4-
Inner shield	13	13	Inner shield
Inner shield	26	26	Inner shield

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

5.7 Optical accessories

5.7.1 Lenses and mounts

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

You can find the complete list of all accessories including descriptions and detailed drawings on our Website https://www.chromasens.de/en

In the following figure you can see a conventional range of adapters and lenses for the allPIXA camera devices up to 7,300 pixels (left) and 4,096 pixels (right):

Figure 18: Selection of optical accessories

Item	Description	Chromasens part no.
01	allPIXA camera with line scan sensor with camera housing type “W”	7,300 pixels: CP000383-A-7300-W-C
02	allPIXA camera with line scan sensor with camera housing type “S”	2,096 pixels: CP000383-A-2048-S-C 4,096 pixels: CP000383-A-4096-S-C
03	Retrofit adapter for allPIXA camera with 7,300 pixels	CP000388
04	Adapter for M72 x 0.75-RF	CP000457
05	Adapter for modular focus for allPIXA camera with 7,300 pixels	CP000428
06	Lens for modular focus	Commercial lens
07	Modular focus by Qioptics	CP000418
08	Adapter for modular focus for allPIXA camera with 4,096 pixels	CP000386
09	Adapter for modular focus	Customized adapters
10	Lens	Customized lens
11	F-mount lens	Commercial lens
12	F-mount adapter	CP000385
13	Adapter for modular focus	Customized adapters
14	Lens	Customized lens

NOTE Cameras equipped with housing type W need the Retrofit adapter (CP000388) to be adapted to the extension tubes (section 5.7.4) and lens mounts.

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

NOTE For further information on accessories please refer to the corresponding accessories catalogue or the configuration sheet at our website https://www.chromasens.de/en

5.7.2 Accessories for 7,300 camera W-Series:

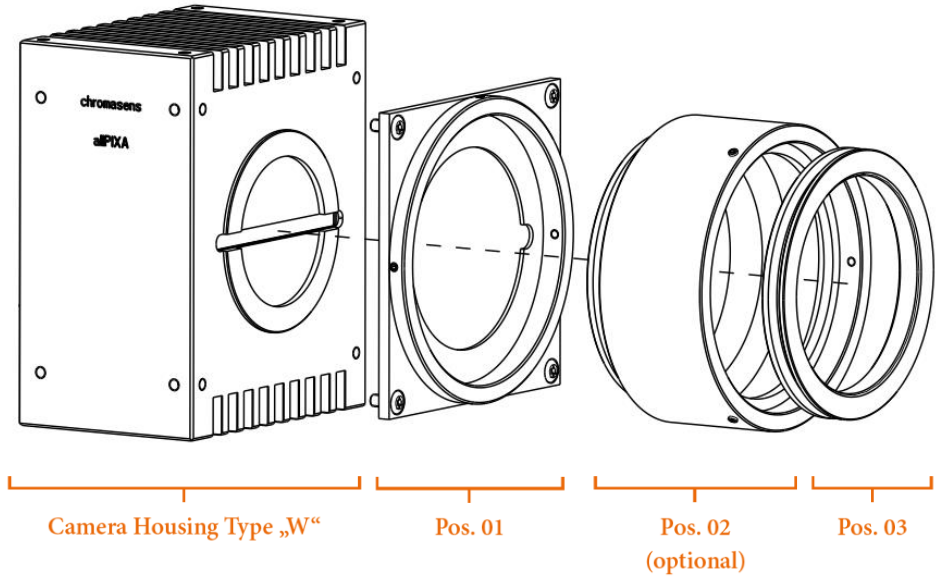


Figure 19: configuration sheme (housing type W)

allPIXA camera	Identification No.	POS.
allPIXA camera-170MPx/s-7300Pixel	CP000383-A-7300-W-C	
Retrofit Adapter allPIXA camera (from camera to tube or adapters)	CP000388	01

allPIXA camera Tubes 7k	Identification No.	POS.
allPIXA camera-Tubus-7k 20 mm	CP000423	02
allPIXA camera-Tubus-7k 40 mm	CP000424	02
allPIXA camera-Tubus-7k 60 mm	CP000425	02
allPIXA camera-Tubus-7k 80 mm	CP000426	02
allPIXA camera-Tubus-7k 100 mm	CP000427	02

allPIXA camera 7k mount Adapters	Identification No.	POS.
Adapter - Modular Focus	CP000428	03
Adapter M72x0,75-RF	CP000457	03
allPIXA camera Adapter-M58x0,75 (to Schneider Unifoc 76)	CP000463	03

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

5.7.3 Accessories for 2,048 & 4,096 camera S-Series:

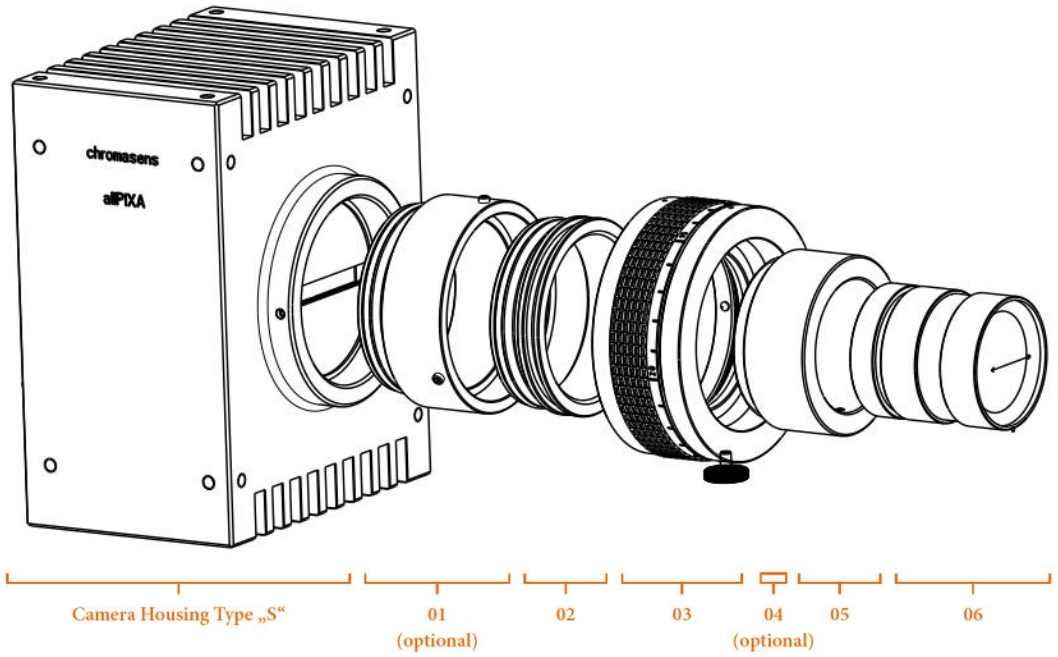


Figure 20: configuration sheme (housing type S)

Description	ID & Code
allPIXA-170 MPx/s-2048 Pixel - NH	CP000383-A-2048-C-C
allPIXA-170 MPx/s-2048 Pixel	CP000383-A-2048-S-C (on request)

allPIXA-170 MPx/s-4096 Pixel - NH	CP000383-A-4096-C-C
allPIXA-170 MPx/s-4096 Pixel - SNH (Height 95mm, compact design)	CP000383-A-4096-D-C
allPIXA-170 MPx/s-4096 Pixel	CP000383-A-4096-S-C (on request)

allPIXA-170 MPx/s-7300 Pixel - NH	CP000383-A-7300-C-C
allPIXA-170 MPx/s-7300 Pixel - SNH (Height 100mm, compact design)	CP000383-A-7300-E-C
allPIXA-170 MPx/s-7300 Pixel	CP000383-A-7300-W-C (on request)

Cameras with lens adapters	ID & Code
allPIXA-170 MPx/s-4096 Pixel - NH - F-Mount	CP000460-0016
allPIXA-170 MPx/s-4096 Pixel - F-Mount	CP000431 (on request)

allPIXA 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 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 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/en

5.7.4 Mounting of the extension tube systems

The extension tubes are used for extending the image distance between the allPIXA camera (lens reference area) and the lens adapter, and the optical image can be varied with this system. Individual extension tubes are available in 20 mm stages and can be interconnected.

Figure 21: allPIXA camera 7300 (W-housing and Retrofit adapter) with extension tubes

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

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

Figure 22: Securing the extension tubes with grub screws

Figure 23: Mounting the lens adapter plate

5.7.5 Mounting of a lens adapter ring

Lens adapter ring is mounted on the retrofit adapter (**Figure 24)**.

Figure 24: Mounting the lens adapter ring on the retrofit adapter

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

Figure 25: Securing the lens adapter ring to the retrofit adapter

6 Getting started

6.1 Pre-setup

1	**Prepare the general setup:**
	Get the right magnification and calculate the object-to-sensor distance You can find an instruction for calculation in the appendix in section 12.1.1.
2	**Have the lens and mounts installed correctly on the camera** For detailed description of the lens and mount installation, see section 5.7.
3	**Prepare the right cabling for your application** CameraLink cable: The allPIXA provides MDR connectors. Check the plugs of your frame grabber to decide whether you need MDR-MDR or MDR-SDR CameraLink cables. Power supply: Hirose 6-pin plug (HR10A-7P-6S). The allPIXA connecting interfaces are described in chapter 5 - allPIXA camera - Connections and status LED.

6.2 Application Setup

Before acquiring an image and operating the camera, make sure that you have a correct design of a line scan camera application (see section 1.7).

1	**Setup your illumination:**
	Adjust the focusing point of your illumination unit and position it correctly Refer to the manual of the illumination manufacturer for proper installation of the illumination.
2	**Install your frame grabber:**
	Install the frame grabber on your PC by following the manufacturer's description Set the configuration of the frame grabber to adjust it to the configuration of the allPIXA camera. For more information about image information output on the CameraLink, see section 4.6.2.
3	**Install the camera to the application:**
	• **Make sure that the camera 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 7. • **Make sure that you have the correct object-to-sensor distance** The sensor line lays 7.5 mm (mechanical)/ 7.26 mm (optical) behind the front surface of the allPIXA camera. You can find the detailed sensor position description in section 2.3 „Mechanical dimensions of the allPIXA camera".

6.3 Setting the system into operational state

1	**Connect to the camera:**
	• Connect the allPIXA camera to the frame grabber (section 0) • Connect the allPIXA camera to a suitable power supply (24 VDC +/- 10 %; 1A; typical 16 W)
2	**Set into operational state:**
	Parameters of the camera are edited and set by using the CST. • Turn on the illumination and the camera. • Install CST (Camera setup tool) (see chapter 8). • Run CST and select the correct port to connect with the camera. (see section 8.3). • On the toolbar, click **Show settings** and then click **Output format**. • Set the correct CameraLink configuration and the connection speed. • Click **Transfer setting to camera** to save the setting into volatile memory. Now, you should see an image in your frame grabber tool and may focus the camera. Proceed to section 6.4 to calibrate the camera and to adjust the camera settings to your operating condition. (You may select the **User level** in the system settings in section 9.14)

NOTE	If 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! Other buttons of the toolbar are described in section 9.1.

6.4 Adjusting the camera settings to your operating condition

Set the camera to free-running mode (Disable encoder and/or frame trigger).

Place a white reference that covers the whole scanning range in front of the camera.

NOTE	The white reference target has to be placed into the best focus plane of the camera. Therefore any features on its surface (for example dust or 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.

You can find the most important parameters and functions on the simple setup page (see section 10.1).

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

1	**Check your line scan system application:** • **Illumination setting:** Switch on the lighting and ensure that the adjustment of the lighting provides best illumination on the target. • **Frame grabber setting:** Check your frame grabber setting. Make sure that the grabber configuration matches the allPIXA 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. • **Optical resolution:** Check the optical resolution with a specified test target.
2	**Set integration time:** • 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 12.1.3). Make sure that the integration time is supported by your camera and Camera Link-configuration (see table in section 0). • Click **Transfer setting to camera** , or press **F9** to save the setting to volatile memory.
3	**Set the operating point (white balancing, section 10.2):** 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 10.2.2 for manual white balancing. This step has to be done again, for example after changing the light or the f-stop. Refer to section 10.2 for detailed description on how to set the operating point.
4	**Perform a tap balancing (section 10.3):** 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 balance can only be performed correctly if continuous white control is disabled. Refer to section 10.3 for detailed description how to perform tap balancing.

5	**Generate black-level reference (section 10.4):** • 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**  , to save the setting to volatile memory. For information about creation of a black-level reference, see section 10.4.
6	**Generate the shading reference / flat-field correction (section 10.5):** • On the toolbar, click **Start reference wizard**  , and follow the description in section 10.5. • On the toolbar, click **Show simple setup view**  , and then select the **Activate white-level (flat-field) correction** check box**.** For information about creation of a shading reference, see section 10.5.
7	**Save the settings:** • 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 9.6), or by saving the settings to disk (section 9.9).

NOTE	By selecting another setting, changes that have not been saved permanently  into the camera are lost

6.5 Digital processing and digital line trigger

1	**Add image processing functions:** • You can add digital image processing functions. Study the section 11.10 onward to find out which image processing functions are offered by the allPIXA.
2	**Set the line trigger or encoder functions:** • 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. • Define the correct input signal port for the signals. • Click **Show encoder setup**  to open the **Encoder setup** page (see section11.16). • Set the parameters in CST for the encoder or line trigger mode.

7 Installing the allPIXA camera

7.1 Mechanical installation

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

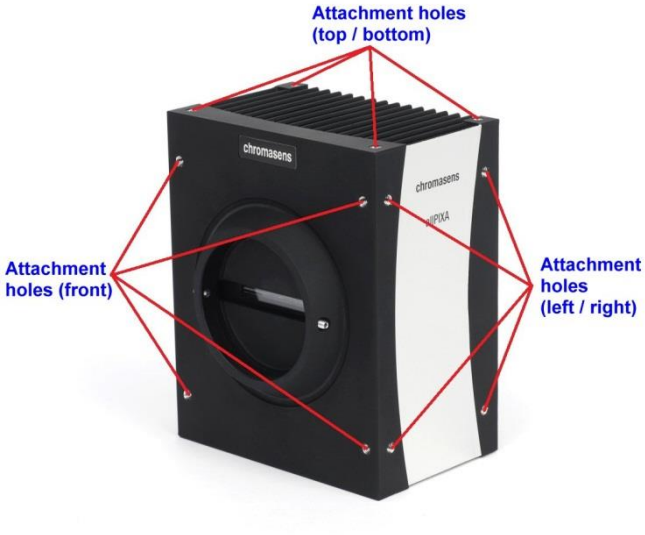


Figure 26: Mechanical connection points of the allPIXA camera

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

For more information about the exact dimensions, see section 2.3 “Technical Data”.

7.2 Thermal links / cooling

The camera works within the defined temperature range (see section 2.4). To this purpose, it has to be mounted 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 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 camera with passive heat sinks (cooling fins) or by active fan which should be directed at a large surface area of the allPIXA camera.

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

7.3 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.

7.3.1 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 27*** you can see the optimum tracking of the conveyor belt, that means the conveyor belt runs completely straight. The enlarged view shows that each of the 3 pixels highlighted in black acquires the same point on the object.

In the right-hand section of ***Figure 27*** you can see a situation in which the conveyor belt runs untrue and oscillates in a lateral direction to the transport position and then each line acquires a different area of the passing object. As a consequence, the image generated by the three color lines is not aligned, resulting in chromatic aberration which occurs laterally to the transport position.

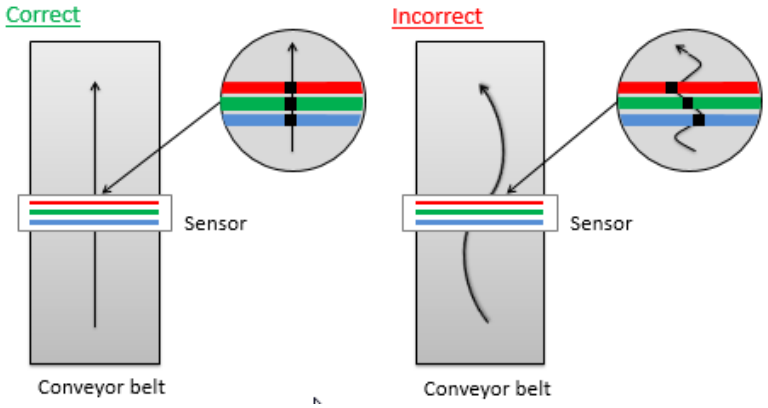


Figure 27: Optimum conveying belt tracking

7.3.2 Perpendicularity of the sensor to the direction of transport

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

In the left-hand section of ***Figure 28*** you can see the optimum alignment of the camera, that means it is aligned perpendicularly to the direction of transport. The enlarged view shows that each of the three pixels highlighted in black acquires the same point on the object.

In the right-hand section of ***Figure 28*** the camera is not aligned perpendicularly to the transport position and therefore the same point on the object is imaged at different positions on the quad/trilinear sensor. Thus the image generated by the three color lines is not aligned, resulting in chromatic aberration on the image:

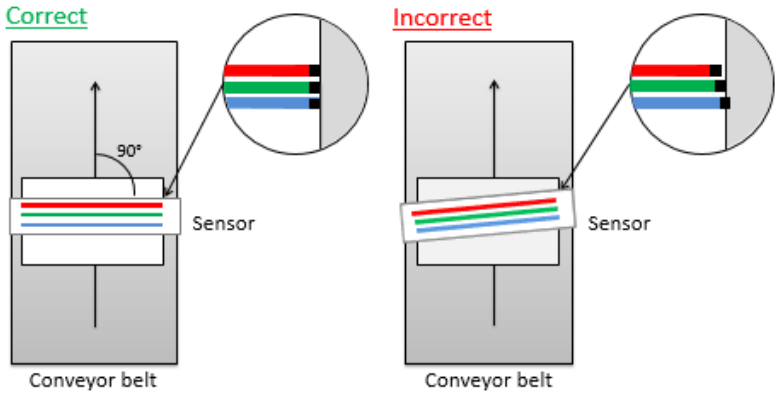


Figure 28: Rectangularity of the sensor to the object

7.3.3 Rotation around the longitudinal axis of the line scan sensor

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

The center section of ***Figure 29*** shows the optimum alignment of the camera, that means it is aligned parallel to the direction of transport.

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

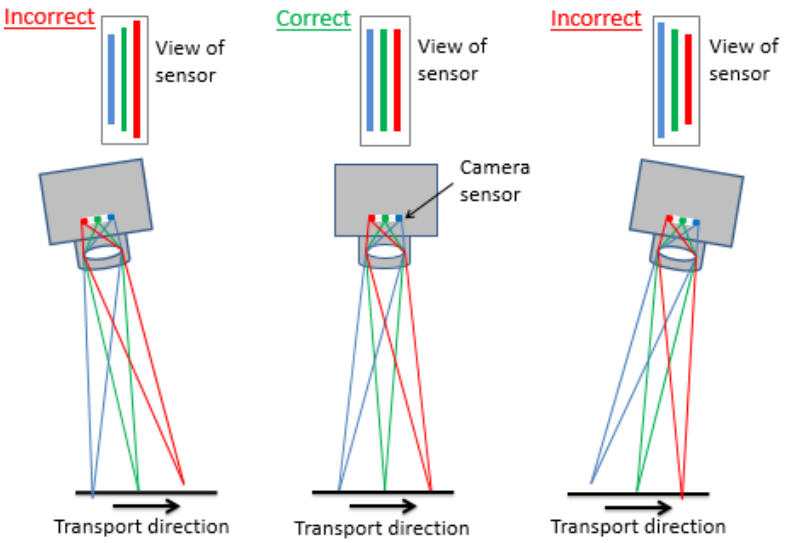


Figure 29: Rotation around the longitudinal axis of the line sensor

To obtain the best results, 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 camera offers the "Keystone correction" function. If you use the **Keystone correction** function, the allPIXA camera is able to correct this error. For more information about keystone correction, see section 11.10.6**.**

7.3.4 Rotation around the transverse axis of the line sensor

Make sure that the transverse axis of the allPIXA wave camera runs parallel to the transport level. In the center section of *Figure 30* you can see the optimum alignment of the camera, that means it is aligned parallel to the direction of transport.

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

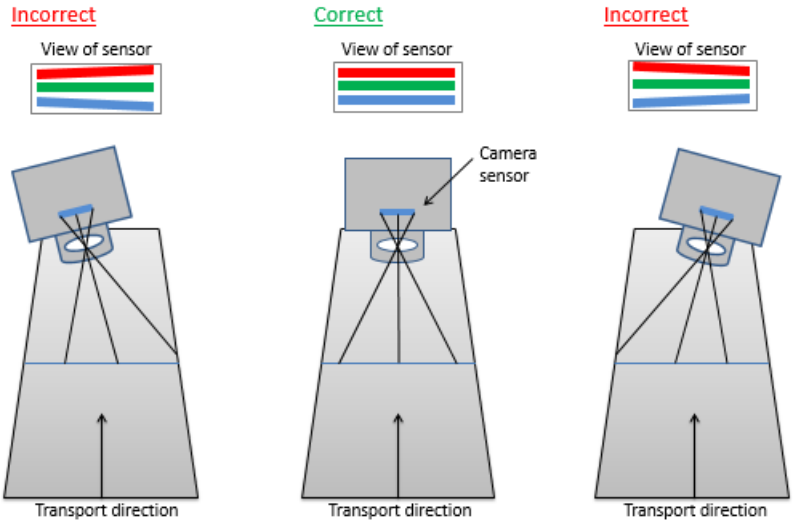


Figure 30: Rotation around the transverse axis of the line scan sensor

7.3.5 Alignment of the allPIXA camera

Exact alignment of the allPIXA camera is necessary for many applications, for example, if you use several allPIXA cameras in parallel.

The following section describes a simple method for exact alignment of the allPIXA camera.

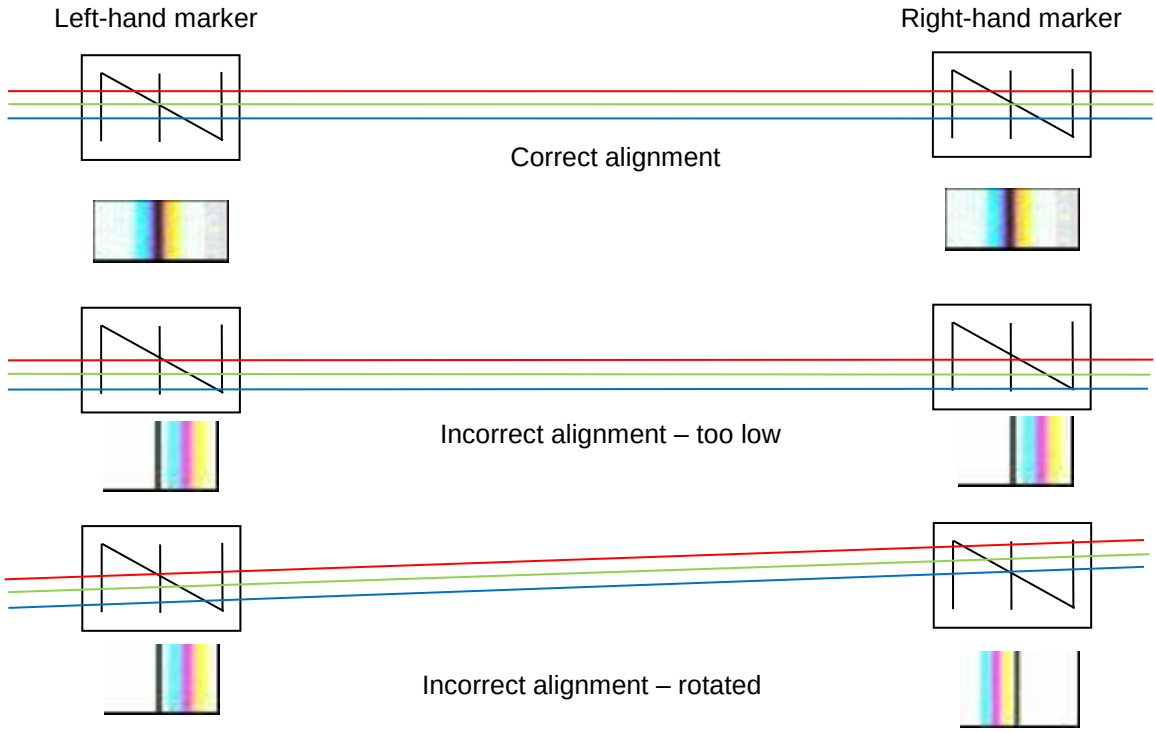


Figure 31: Alignment of the allPIXA camera

In that case the static reference is the scanned object of which the camera is to be aligned including one vertical and one steadily rising straight line. These two straight lines intersect in the set position of the green color channel; prerequisite is that the lines are continually acquired (free-running mode) and the reference should no longer be moved.

Each line then achieves the same position and the angled line is acquired as a result of spacing the sensor lines of the color lines in different positions which results in colored lines in the image. The vertical center line produces a black line in the image, therefore, the center of the colored lines and the black line have to be aligned.

7.4 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 camera or to its connected components.

NOTICE

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

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

NOTE

Grounding the housing and the outer cable shield:

Due to an environment with electromagnetic contamination it might be necessary to establish contact between the housing and / or the outer shield of the CameraLink 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 0.

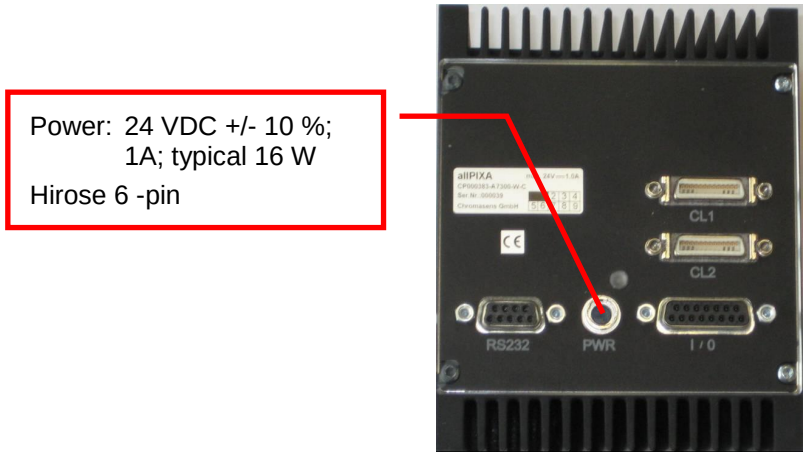


Figure 32: Connecting the allPIXA camera to the power supply

7.5 Connecting the camera to the PC

The camera is connected to the PC by a CameraLink cable to the PC.

NOTE	CameraLink cables are supplied ready-for-use in different lengths varying from 1 m to 10 m. You require a 26-pin MDR mini-D ribbon (male) connector for connection to the allPIXA camera. Camera Link specification limits cable length to at most 6 m for a pixel clock of 85 MHz. The setup of camera, cable and frame grabber have to be tested in advance.

1. Connect the Camera Link cable:

- Camera Link Port 1 or 1+2 of the allPIXA wave camera (Port 1+2 support 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 this might cause a switch between front and rear tap, some frame grabbers only offer the serial connection through the first port.

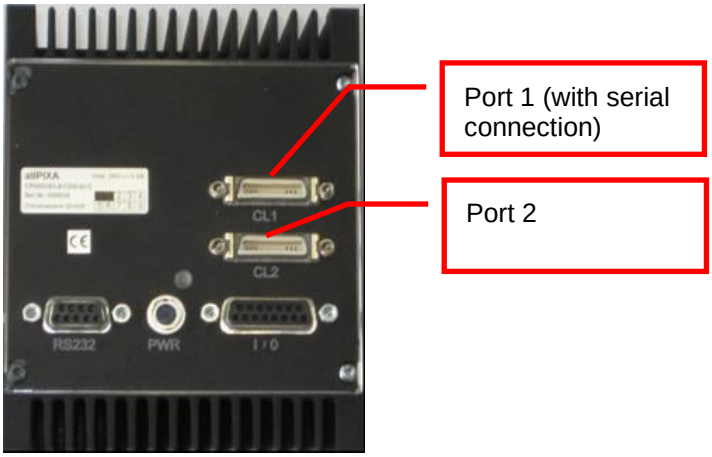


Figure 1: Connecting the allPIXA camera to a PC

8 Installing the Camera Setup Tool (CST)

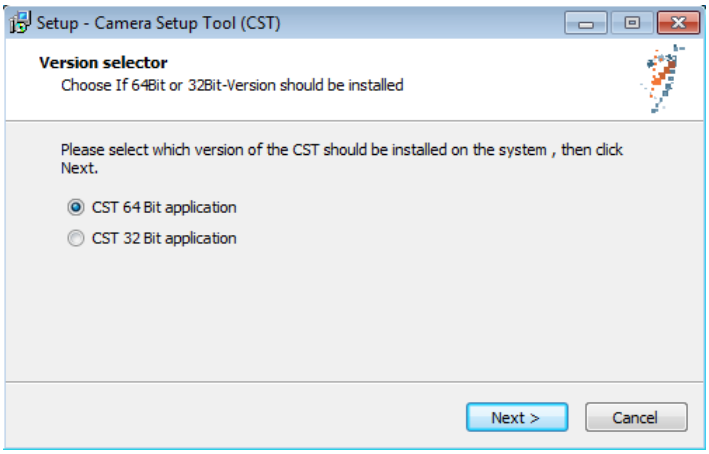
8.1 System Requirements

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

8.2 Installing the CST Software

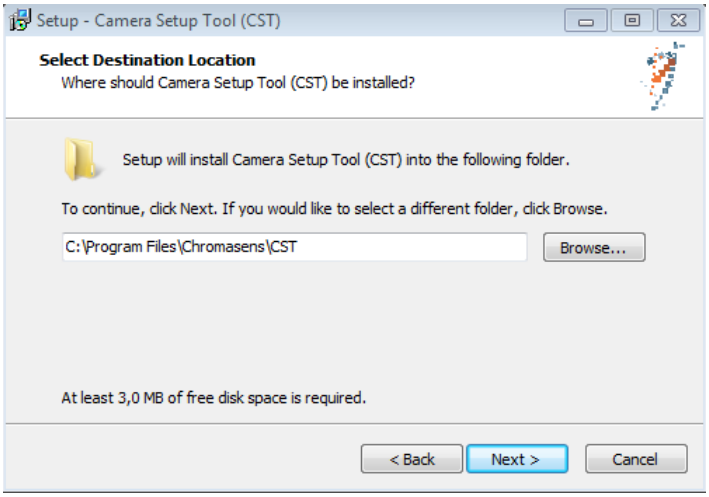
To install the CST software on your PC:

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



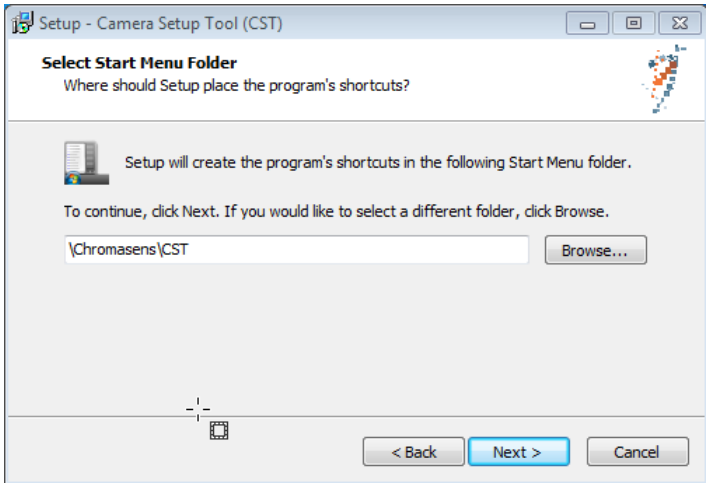
In this case, select the version that should be installed, and then click **Next**.

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



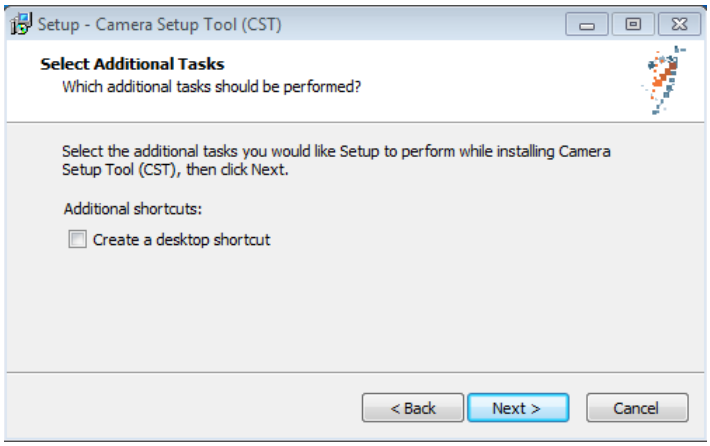
3. Select the folder in which the CST software should be installed and then click **Next**.

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



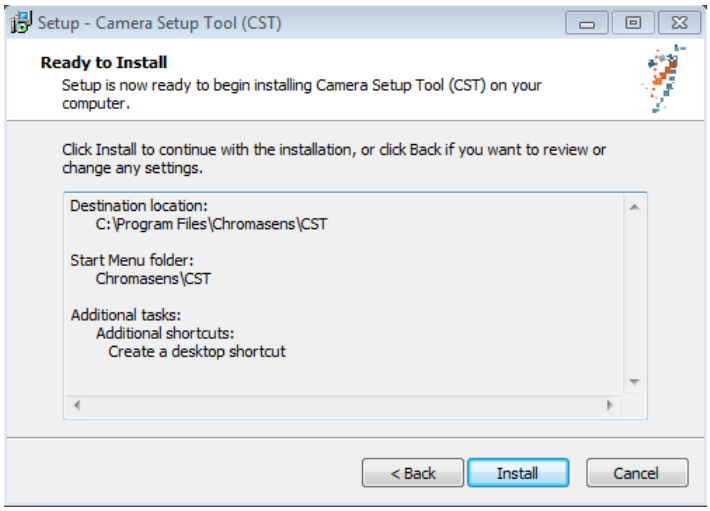
4. Select the start menu folder in which the shortcut to the CST software should be created, and then click **Next**.

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



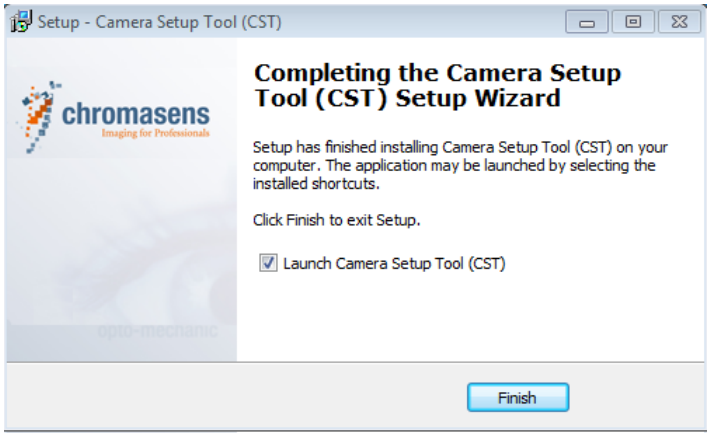
5. If an icon should be created on the desktop, select the check box, and then click **Next**.

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



6. 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.

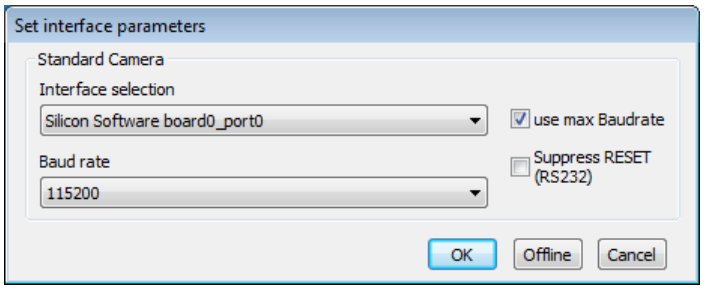
8.3 Establishing communication between camera and PC

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:

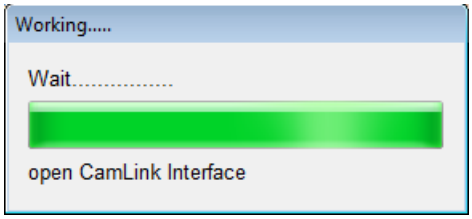


2. Select the PC interface for the communication either via Camera Link or external serial port.
3. In the **Baud rate** list, click the desired baud rate for communication.

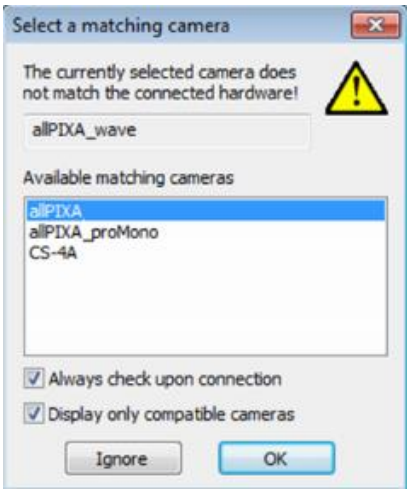
   Alternatively, select the **Use max. Baud rate** check box to start automatic setup of the baud rate. CST and the allPIXA camera then determine the fastest possible baud rate up to 115 kBaud. If the frame grabber/interface does not support 115 kBaud, clear the **Use max. Baud rate** check box.

   The default baud rate is 19.2 kBaud.
4. Click **OK**.

   The CST software now establishes communication to the camera:



5. 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:

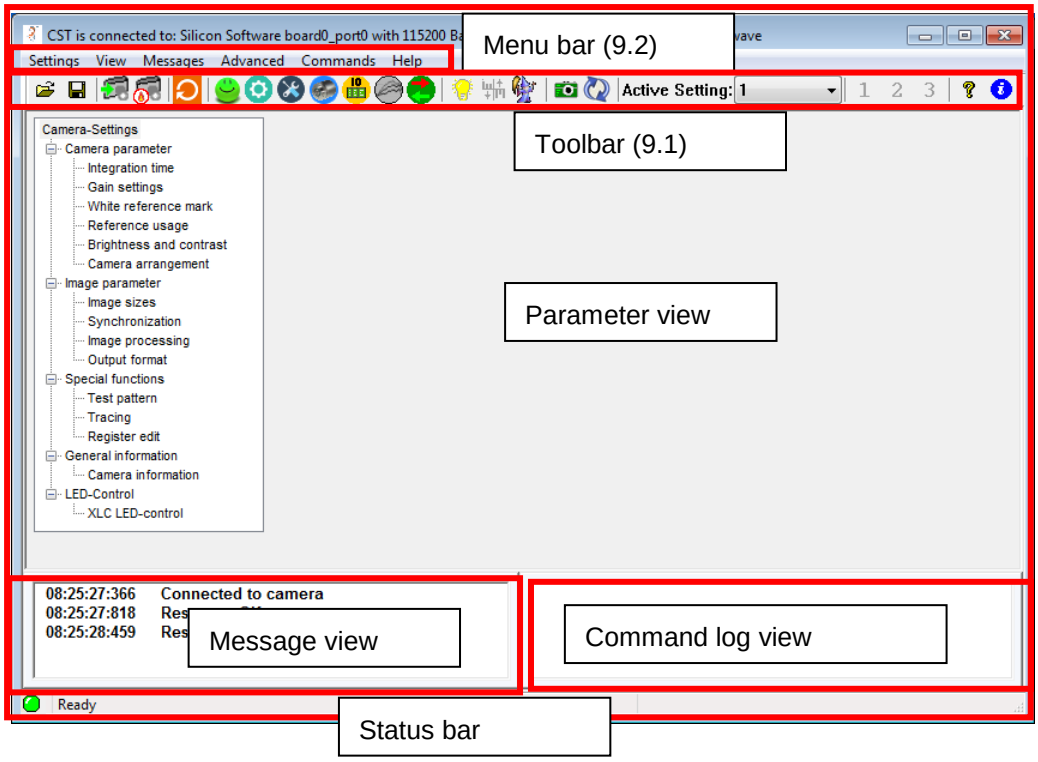


Check that **allPIXA** is selected in the **Available matching cameras** list, and then click **OK**.

9 CST program window

The CST program window comprises 5 areas:

Toolbar:	Direct access to functions and data (section.9.1)
Menu bar:	Access to all functions (section. 9.2)
Parameter view:	Displaying the data
Status bar:	Displaying the status of the connection
Message view	



9.1 Toolbar

The toolbar for the CST provides the following functions:

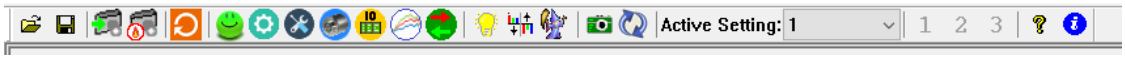
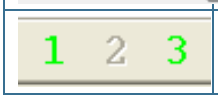


Figure 2: CST Toolbar

Button	Function
	Load setting from file
	Save setting to file
 **F9**	Transfer setting to camera
 **F10**	Burn setting permanently
	Reset camera. **Take notice that the parts for signal and image processing are not restarted with this button!**

Button	Function
	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.
	Show system configuration: • Transfer setting data to and from the camera • Firmware update • Reset the camera • Open new “Camera Connection” • Set the user level for the 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 Send a command to balance the 2 taps against each other
	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**)
	Select and display the currently used setting
	Buttons for user-defined functions (three 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.

9.2 CST menu bar

The menu bar provides the following menus:

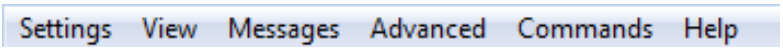


Figure 3: CST Menu

Settings	Open setting from disk	Open a setting file 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 “Transfer setting to volatile camera memory” 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 are 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	Show/hide the toolbar
	Status bar	Show/hide 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-related and line-trigger-related settings
	System configuration	Set system settings: • 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

View	Current camera values	Display current camera values such as voltages temperatures, gain values or similar. This function permits to monitor the current values of important parameters of the allPIXA wave camera in live mode (for example the temperature or the current values of the reference for the operating point or the statuses of the inputs etc.)
	Show line profile	
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 views	Save the message view 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 dialog box 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. Might 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 this can be detected by the camera.
	Create HIS checksum	For development purposes only. If a value in an HSI-file changes, the checksum is longer valid. This function recalculates the checksum and updates the file.
	Edit color conversion matrix	Opens a dialog box, which permits to edit the 4 color conversion matrixes 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	Opens a message box showing the camera state.
	Restore factory setting	Restore factory settings from internal camera memory.

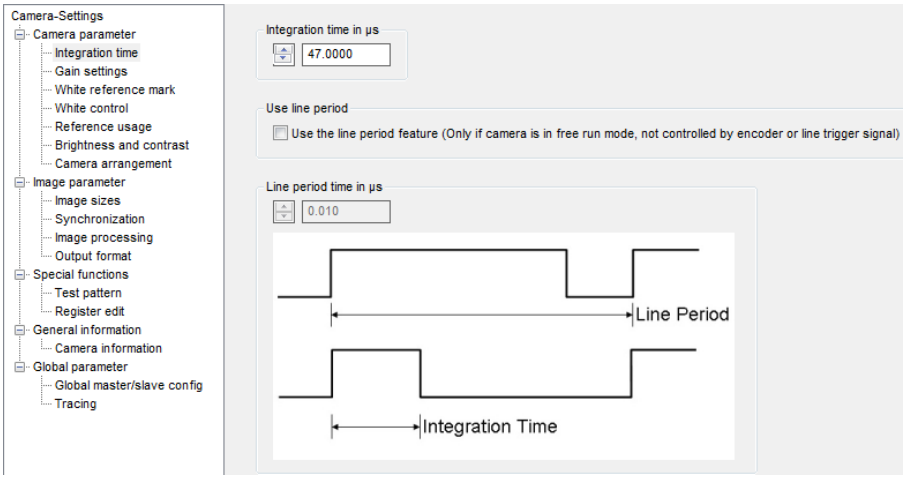
Commands	Reset camera	Triggers a camera reset
	Process white balancing	Perform an automated white-balancing on the camera
	Initiate tap balancing	Perform a balancing procedure between the two camera taps to eliminate the differences at the tap border.
	Generate references (wizard)	Open the reference wizard. The wizard guides 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	Shows a message box with version information
	Show system information	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.

9.3 Basic camera parameter settings (overview)

Basic parameters of the camera are split into different groups:

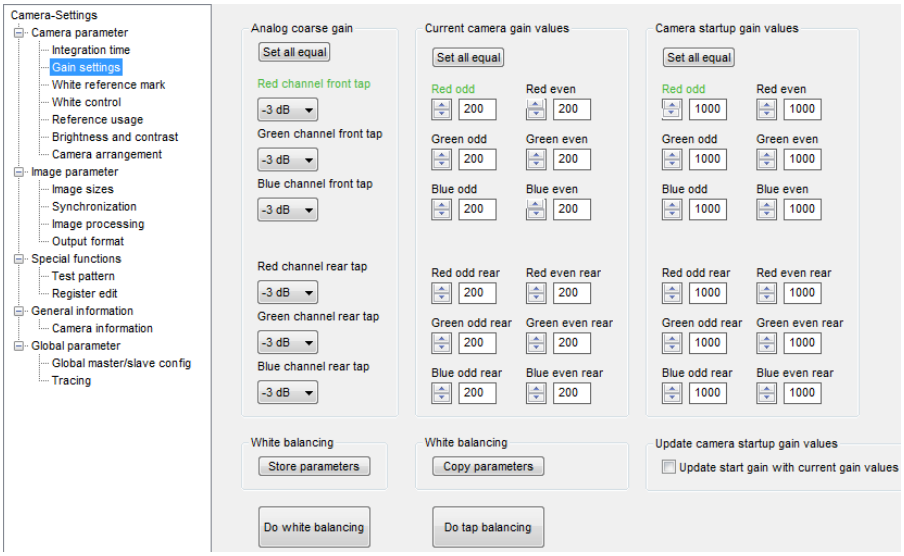
9.3.1 Camera parameters

This part contains the parameters related to the following:

Page	Function
Camera settings – Camera Parameter – Integration time	
	**Integration time:** • Set the integration time • Set the line period mode • Set the line period time **Section: 11.1**

Page	Function

Camera settings – Camera Parameter – Gain settings

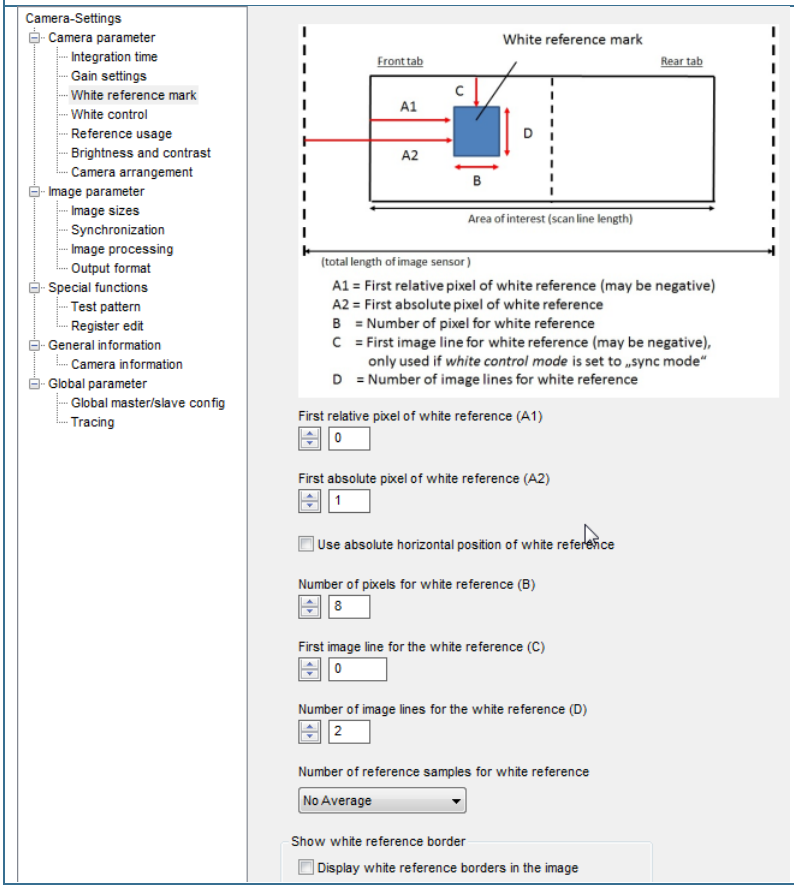


Camera Gain Settings:

- Analog Coarse Gain
- Analog Gain
- Closed-loop control for white balancing

Section: 11.2

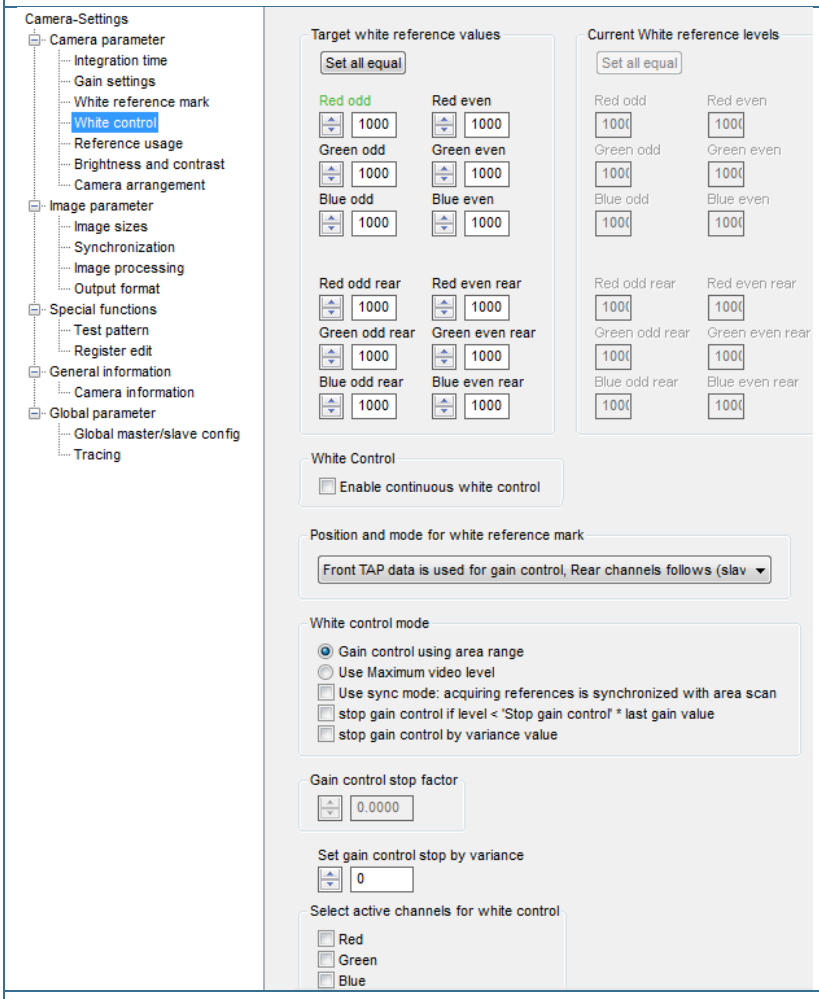
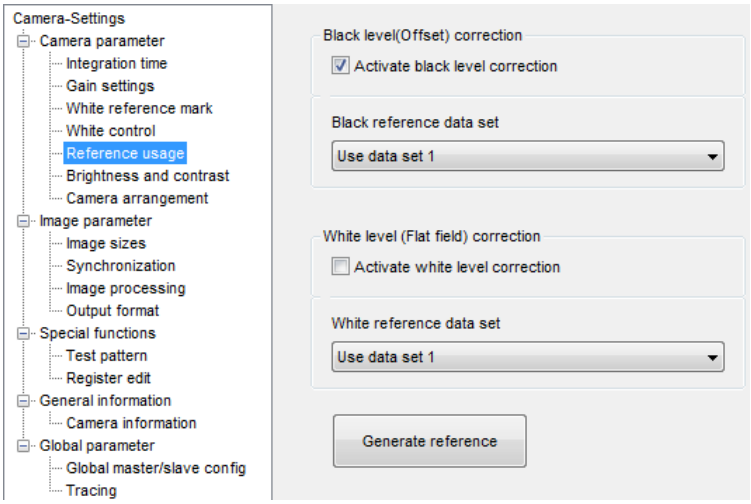
Camera settings – Camera Parameter – White reference mark

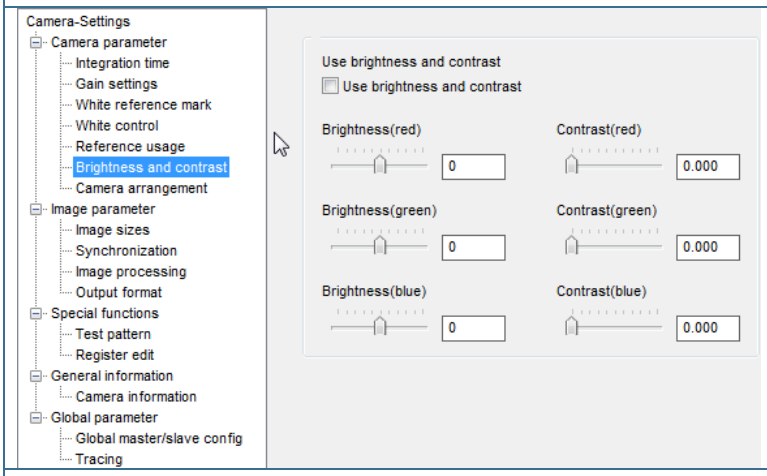
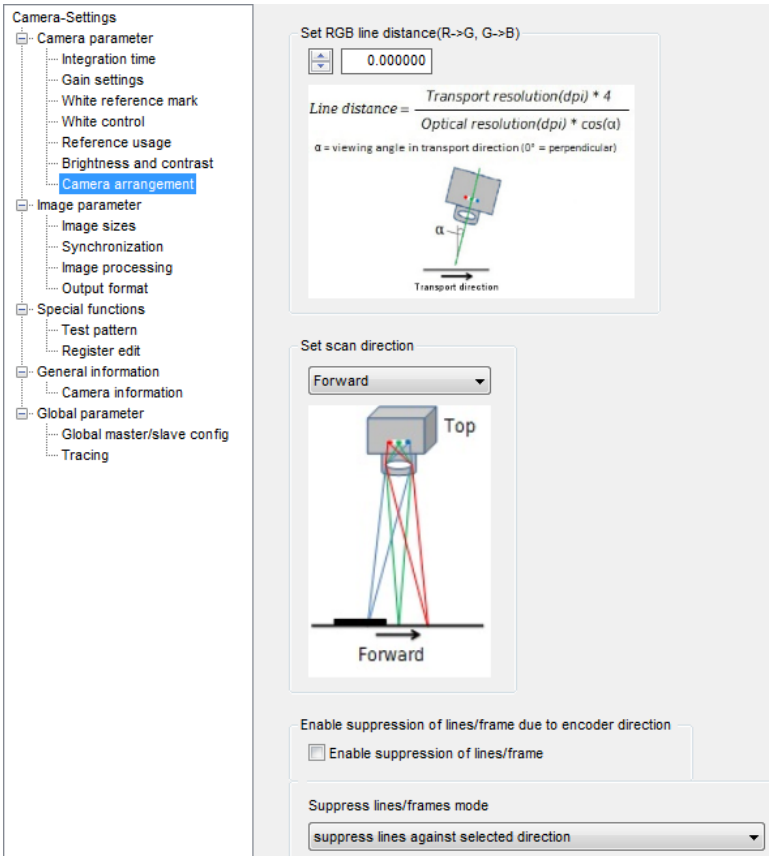


White reference mark:

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

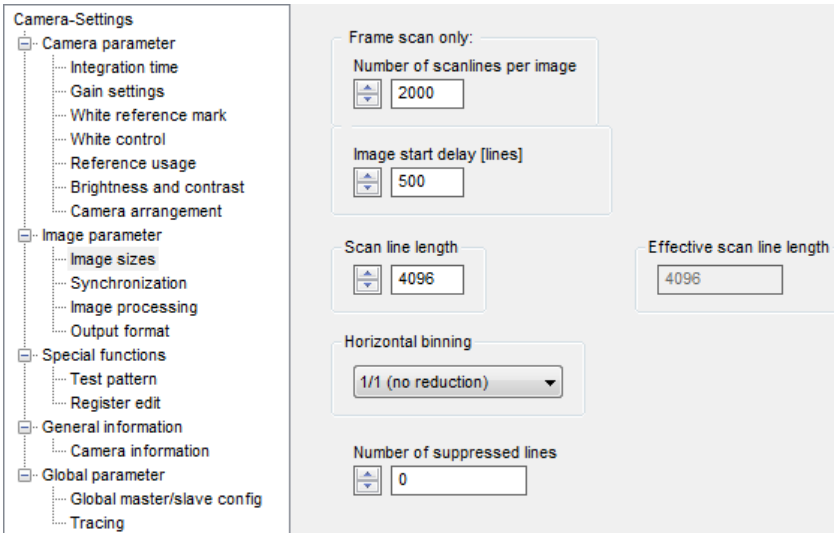
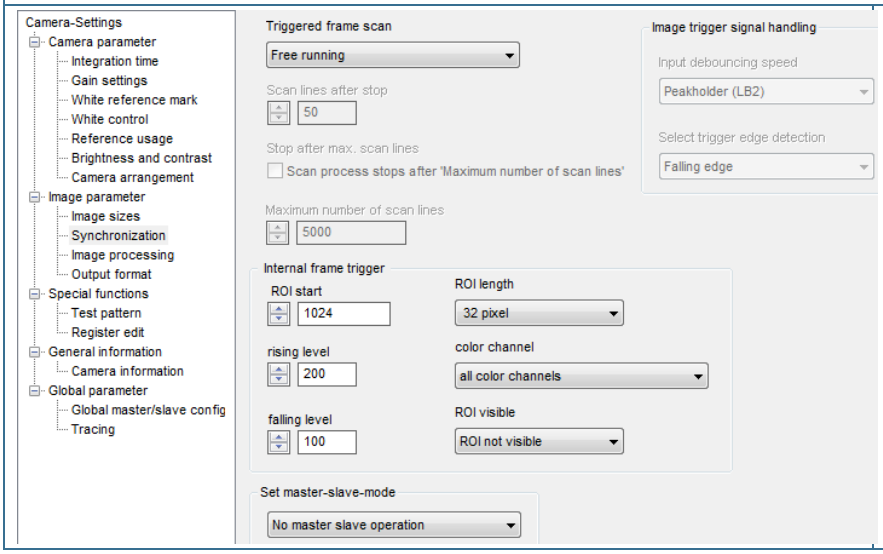
Section:11.3

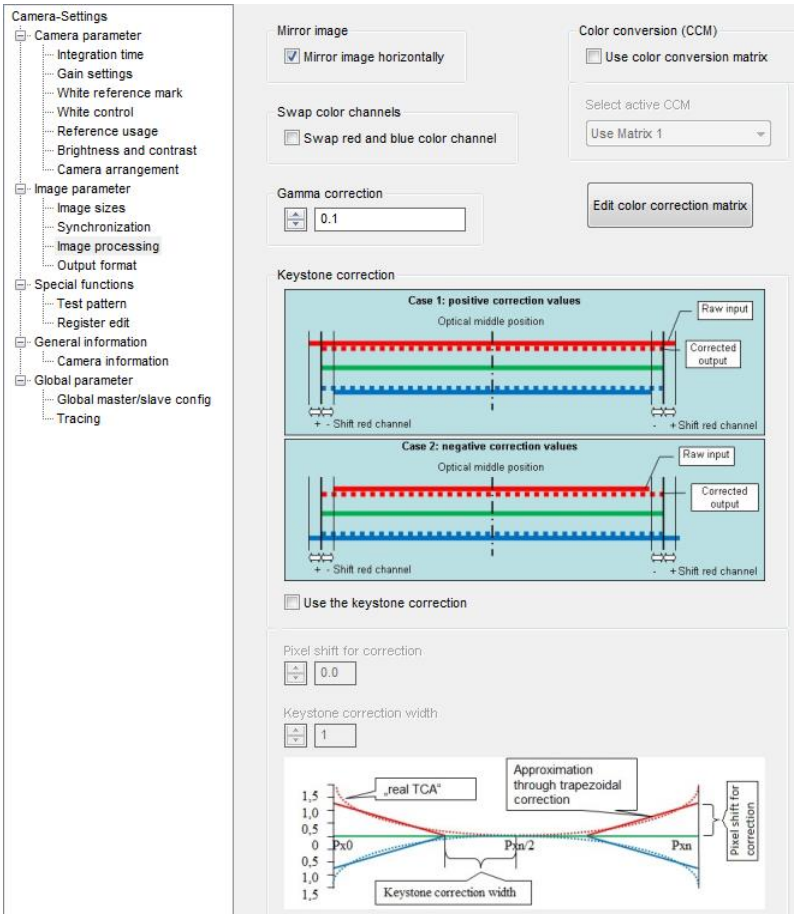
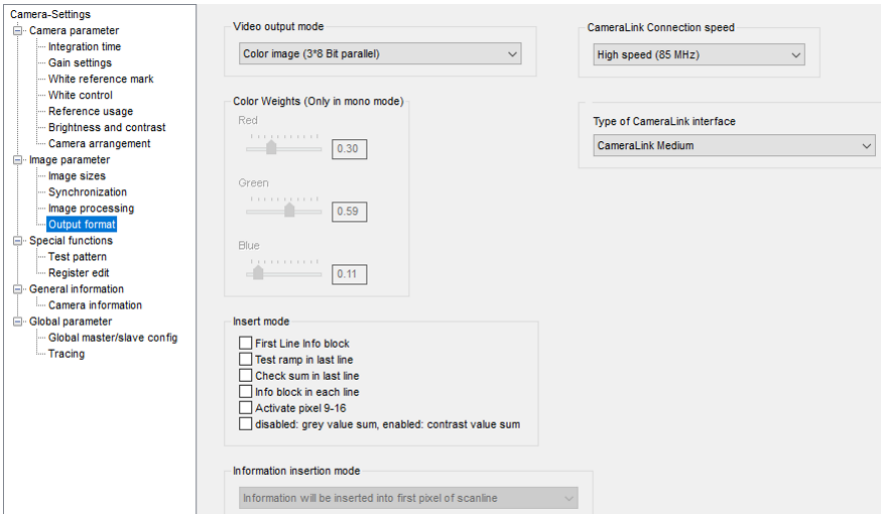
Page	Function
Camera settings – Camera Parameter – White control	
	**White control** • Set parameters such as target values for the closed-loop gain control **Section: 11.4**
Camera settings – Camera Parameter – Reference usage	
	**Reference usage:** • Activate black/white level correction • Select the data set for offset and white level correction **Section:0**

Page	Function
Camera settings – Camera Parameter – Brightness and Contrast	
	**Brightness and Contrast:** • Digital gain • Digital offset • Gamma correction **Section: 11.6**
Camera settings – Camera Parameter – Camera arrangement	
	**Camera arrangement:** • Set the line shift/spatial correction • Set the scan direction **Section: 0**

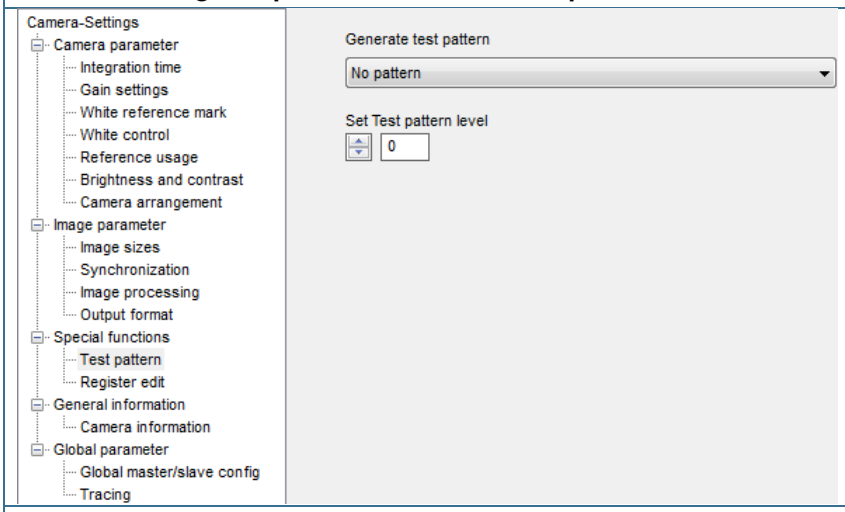
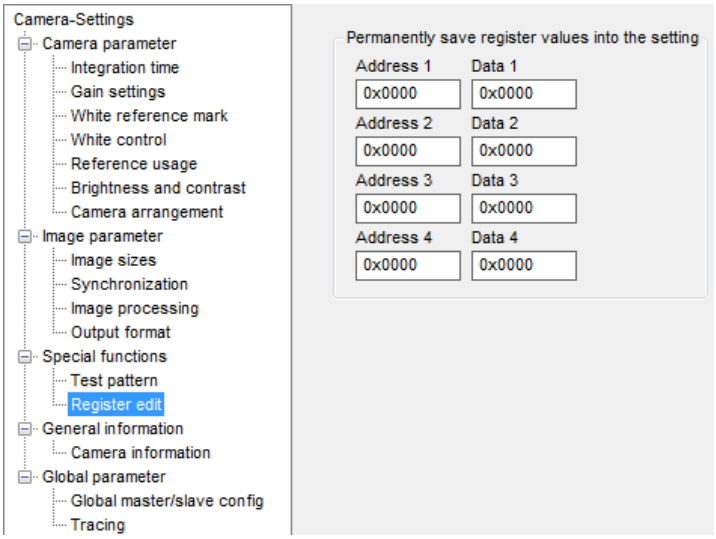
9.3.2 Image parameters

This part contains parameters related to the image.

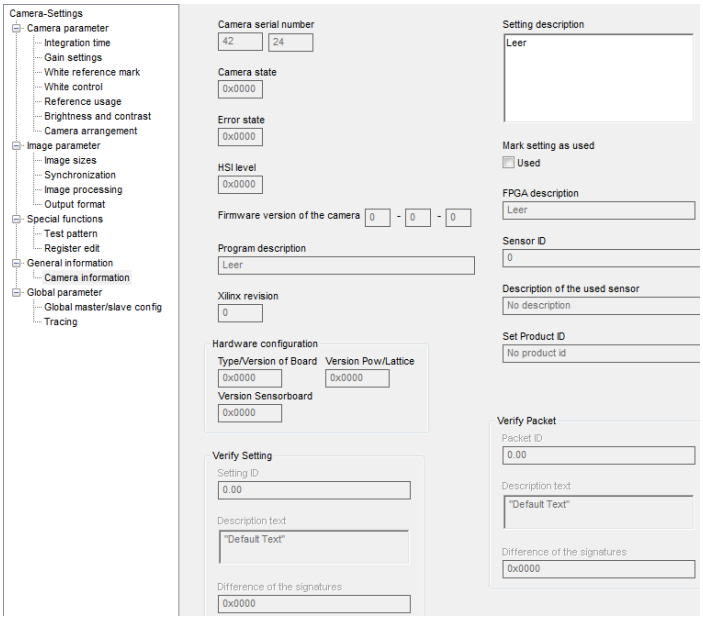
Page	Function
Camera settings – Image Parameter – Image sizes	
	**Image size:** • Set the parameters related to the image size **Section: 0**
Camera settings – Image Parameter – Synchronization	
	**Synchronization:** • Set the parameters for triggering the frame scan modes • Select the synchronization with other cameras (Master/slave mode) **Section:11.8.5**

Page	Function
Camera settings – Image Parameter – Image processing	
	**Image processing:** • Activate image mirroring • Activate color correction • Activate and set parameters for the keystone functions **Section: 11.10**
Camera settings – Image Parameter – Output format	
	**Output format:** • Set the pixel clock on CameraLink • Select the port type medium or base • Different parameters for data transfer on CameraLink • Insert information into image data **Section: 11.11**

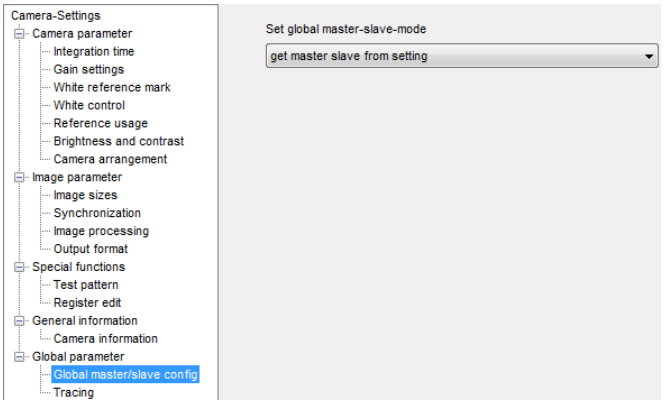
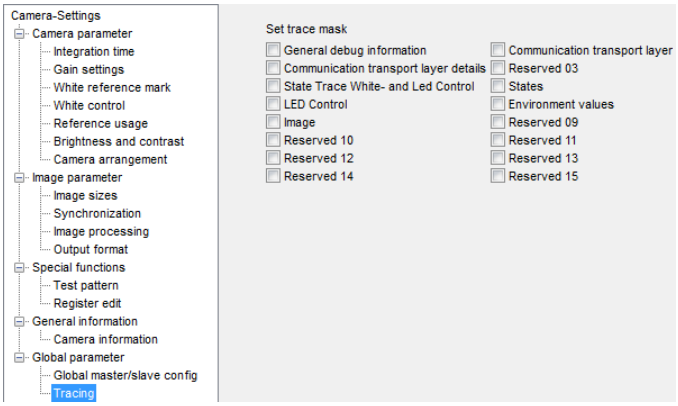
9.3.3 Special functions

Page	Function
Camera settings – Special functions – Test pattern	
	**Test pattern:** • Test images can be generated inside the camera **Section: 0**
Camera settings – Special functions – Register edit	
	**Register edit:** • You can directly edit registers. • These data are saved on the camera when settings are burnt. • Be careful if you use this function. It can cause damage of the firmware or cause malfunction of the camera. **Section: 0**

9.3.4 General information

Page	Function
Camera settings – General information – Camera information	
	**Camera information:** • Information about firmware on the camera • Please attach a screen shot of this page for all support questions. **Section: 11.14.1**

9.3.5 Global parameters

Page	Function
Camera settings – Special functions – Global master/slave config	
	**Global master/slave config:** **Section: 11.15.1**
Camera settings – Special functions – Tracing	
	**Tracing:** • Debugging functions **Section: 0**

9.4 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 baud rate **115200**, 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 baud rate of the camera is 115200.

9.5 Transfering data to the camera

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

Changes in the setting must be transferred to the camera.

NOTE	• Data edited in CST are not transferred to the camera automatically • Data edited in CST are not transferred to the camera when you press **Enter**. • Data are lost during a restart or a reset 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

9.6 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:

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

Button	Function key	Menu
	**F10**	**Settings/Burn current setting permanently**

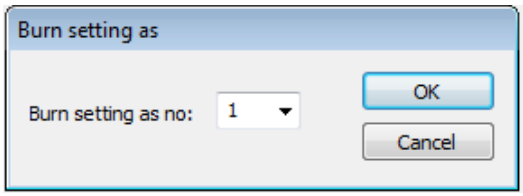
To save the data to different setting in the camera, use the following:

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:



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.

9.7 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**	

9.8 Selecting a setting on the camera

The **Active Setting** list permits to activate a previously saved setting on the camera.

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

9.9 Saving settings to the PC

There are two different file types are available for saving settings from the camera to the PC:

***.mk-Files:**

Binary file of the setting from the camera. This data can be transferred to the camera directly.

***.set-Files:**

This file type is based on XML. You can edit such a file manually but this is only recommended for advanced users. You should use CST for editing the files safely. The file can also be downloaded to the camera, but CST translates it first.

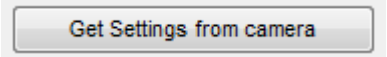
9.9.1 Saving settings from CST to hard disk:

Button	Function key	Menu
		**Settings/Save setting to disk**

With this function you can save data from **CST** to a *.set file.

NOTE	Changes at the camera, for example caused by the automatic white control, are not saved in the files. Therefore, click **Refresh current camera parameters**  on the toolbar, before you save the data on hard disk.

9.9.2 Saving settings from the camera to hard disk:

Button	Function key	Menu
		**View/System configuration**
		

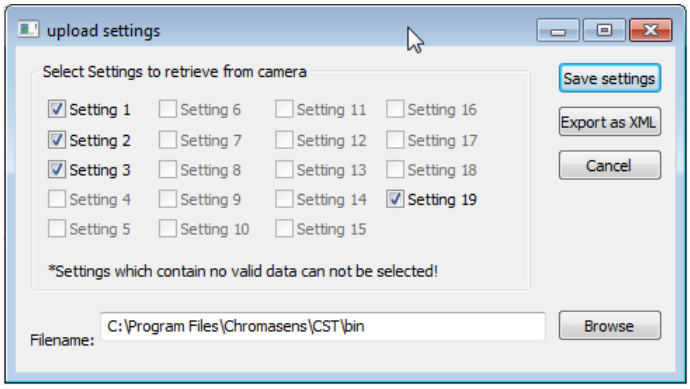
With this function, you can save permanently saved camera settings to a *.mk file in binary format or to an *.set file in XML format.

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.

9.10 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 ways 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**
Send files to camera		

2. Transferring settings using 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.

9.11 Deleting settings on the camera

You can delete burned settings on the camera.

Button	Function key	Menu
		Settings/Clear settings

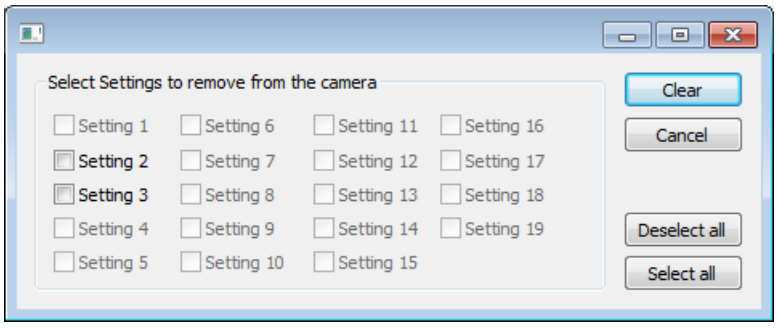
NOTE I	It is **not allowed** to delete setting 1. If setting 1 has been changed erroneously, you can download the initial setting 1 to the camera. The required file is included in the software package, which is available for download. The file is called *PIXAwaveXXXX_InitSetting1_FreeRun_Rnnn.mk* . where XXXX is related to the allPIXA camera model and nnn is the revision of the firmware package. Alternatively, 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.

NOTE II	This function is only available if the **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:

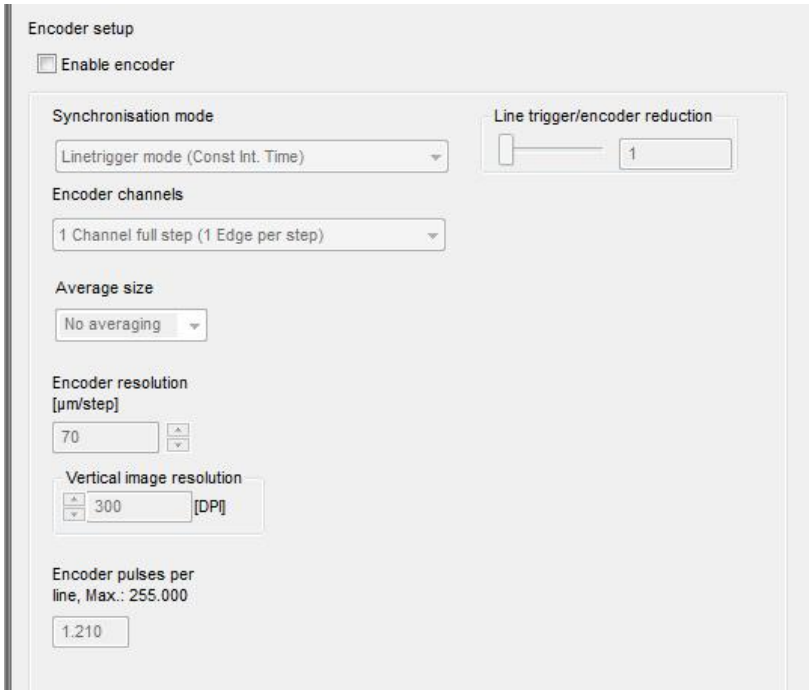


3. To delete the specified settings, click **Clear**.

9.12 Line trigger and encoder settings

For more information about the parameters, see section 11.16.

Button	Function key	Menu
		**View/Encoder setup**



9.13 IO configuration

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

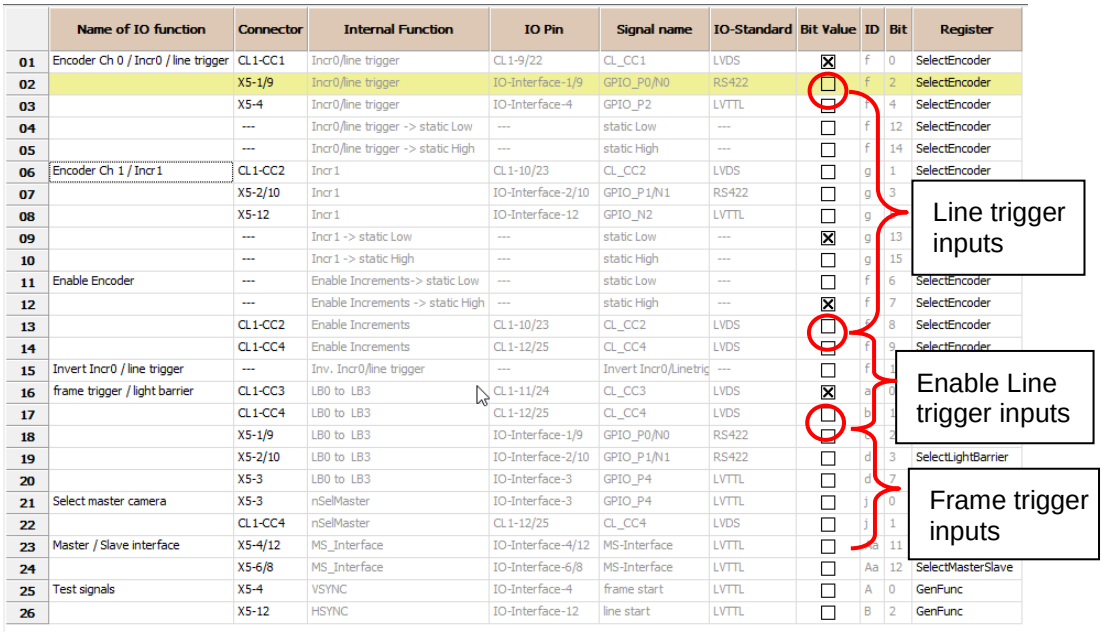
- Line trigger or encoder
- Frame trigger

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

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

External ports have to be connected to the internal functions by using the IO Configurator.

Button	Function key	Menu
		**View/IO Configurator**



	Name of IO function	Connector	Internal Function	IO Pin	Signal name	IO-Standard	Bit Value	ID	Bit	Register
01	Encoder Ch 0 / Incr0 / line trigger	CL1-CC1	Incr0/line trigger	CL1-9/22	CL_CC1	LVDS	☒	f	0	SelectEncoder
02		X5-1/9	Incr0/line trigger	IO-Interface-1/9	GPIO_P0/N0	RS422	☐	f	2	SelectEncoder
03		X5-4	Incr0/line trigger	IO-Interface-4	GPIO_P2	LVTTL	☐	f	4	SelectEncoder
04		---	Incr0/line trigger -> static Low	---	static Low	---	☐	f	12	SelectEncoder
05		---	Incr0/line trigger -> static High	---	static High	---	☐	f	14	SelectEncoder
06	Encoder Ch 1 / Incr1	CL1-CC2	Incr1	CL1-10/23	CL_CC2	LVDS	☐	g	1	SelectEncoder
07		X5-2/10	Incr1	IO-Interface-2/10	GPIO_P1/N1	RS422	☐	g	3	
08		X5-12	Incr1	IO-Interface-12	GPIO_N2	LVTTL	☐	g		
09		---	Incr1 -> static Low	---	static Low	---	☒	g	13	
10		---	Incr1 -> static High	---	static High	---	☐	g	15	
11	Enable Encoder	---	Enable Increments-> static Low	---	static Low	---	☐	f	6	SelectEncoder
12		---	Enable Increments -> static High	---	static High	---	☒	f	7	SelectEncoder
13		CL1-CC2	Enable Increments	CL1-10/23	CL_CC2	LVDS	☐		8	SelectEncoder
14		CL1-CC4	Enable Increments	CL1-12/25	CL_CC4	LVDS	☐		9	SelectEncoder
15	Invert Incr0 / line trigger	---	Inv. Incr0/line trigger	---	Invert Incr0/Linetrig	---	☐	f	11	
16	frame trigger / light barrier	CL1-CC3	LB0 to LB3	CL1-11/24	CL_CC3	LVDS	☒	a	0	
17		CL1-CC4	LB0 to LB3	CL1-12/25	CL_CC4	LVDS	☐	b	1	
18		X5-1/9	LB0 to LB3	IO-Interface-1/9	GPIO_P0/N0	RS422	☐	c	2	
19		X5-2/10	LB0 to LB3	IO-Interface-2/10	GPIO_P1/N1	RS422	☐	d	3	SelectLightBarrier
20		X5-3	LB0 to LB3	IO-Interface-3	GPIO_P4	LVTTL	☐	d	7	
21	Select master camera	X5-3	nSelMaster	IO-Interface-3	GPIO_P4	LVTTL	☐	j	0	
22		CL1-CC4	nSelMaster	CL1-12/25	CL_CC4	LVDS	☐	j	1	
23	Master / Slave interface	X5-4/12	MS_Interface	IO-Interface-4/12	MS-Interface	LVTTL	☐	Aa	11	
24		X5-6/8	MS_Interface	IO-Interface-6/8	MS-Interface	LVTTL	☐	Aa	12	SelectMasterSlave
25	Test signals	X5-4	VSYNC	IO-Interface-4	frame start	LVTTL	☐	A	0	GenFunc
26		X5-12	HSYNC	IO-Interface-12	line start	LVTTL	☐	B	2	GenFunc

- Avoid double use of internal functions (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** p**ermanently** on the toolbar, or click **F10**.

9.13.1 Encoder - enable increments setting

With the enable increments setting you can enable/disable the encoder input by using an external I/O Port (CC2 or CC4 of the CameraLink interface). This feature can be useful to enable the encoder in real time (for example applications with several cameras). The function is configured with the IO Configuration menu. If this feature is not used, the configuration must be set to default.

	Name of IO function	Connector	Internal Function	IO Pin	Signal name	IO-Standard	Bit Value	ID	Bit	Register
01	Encoder Ch 0 / Incr0 / line trigger	CL1-CC1	Incr0/line trigger	CL1-9/22	CL_CC1	LVDS	☒	f	0	SelectEncoder
02		X5-1/9	Incr0/line trigger	IO-Interface-1/9	GPIO_P0/N0	RS422	☐	f	2	SelectEncoder
03		X5-4	Incr0/line trigger	IO-Interface-4	GPIO_P2	LVTTL	☐	f	4	SelectEncoder
04		---	Incr0/line trigger -> static Low	---	static Low	---	☐	f	12	SelectEncoder
05		---	Incr0/line trigger -> static High	---	static High	---	☐	f	14	SelectEncoder
06	Encoder Ch 1 / Incr1	CL1-CC2	Incr1	CL1-10/23	CL_CC2	LVDS	☐	g	1	SelectEncoder
07		X5-2/10	Incr1	IO-Interface-2/10	GPIO_P1/N1	RS422	☐	g	3	SelectEncoder
08		X5-12	Incr1	IO-Interface-12	GPIO_N2	LVTTL	☐	g	5	SelectEncoder
09		---	Incr1 -> static Low	---	static Low	---	☒	g	13	SelectEncoder
10		---	Incr1 -> static High	---	static High	---	☐	g	15	SelectEncoder
11	Enable Encoder	---	Enable Increments-> static Low	---	static Low	---	☐	f	6	SelectEncoder
12		---	Enable Increments -> static High	---	static High	---	☒	f	7	SelectEncoder
13		CL1-CC2	Enable Increments	CL1-10/23	CL_CC2	LVDS	☐		8	SelectEncoder
14		CL1-CC4	Enable Increments	CL1-12/25	CL_CC4	LVDS	☐	f	9	SelectEncoder
15	Invert Incr0 / line trigger	---	Inv. Incr0/line trigger	---	Invert Incr0/Linetrig	---	☐	f	11	SelectEncoder
16	frame trigger / light barrier	CL1-CC3	LB0 to LB3	CL1-11/24	CL_CC3	LVDS	☒	a	0	SelectLightBarrier
17		CL1-CC4	LB0 to LB3	CL1-12/25	CL_CC4	LVDS	☐	b	1	SelectLightBarrier
18		X5-1/9	LB0 to LB3	IO-Interface-1/9	GPIO_P0/N0	RS422	☐	c	2	SelectLightBarrier
19		X5-2/10	LB0 to LB3	IO-Interface-2/10	GPIO_P1/N1	RS422	☐	d	3	SelectLightBarrier
20		X5-3	LB0 to LB3	IO-Interface-3	GPIO_P4	LVTTL	☐	d	7	SelectLightBarrier
21	Select master camera	X5-3	nSelMaster	IO-Interface-3	GPIO_P4	LVTTL	☐	j	0	SelectMasterSlave
22		CL1-CC4	nSelMaster	CL1-12/25	CL_CC4	LVDS	☐	j	1	SelectMasterSlave
23	Master / Slave interface	X5-4/12	MS_Interface	IO-Interface-4/12	MS-Interface	LVTTL	☐	Aa	11	SelectMasterSlave
24		X5-6/8	MS_Interface	IO-Interface-6/8	MS-Interface	LVTTL	☐	Aa	12	SelectMasterSlave
25	Test signals	X5-4	VSYNC	IO-Interface-4	frame start	LVTTL	☐	A	0	GenFunc
26		X5-12	HSYNC	IO-Interface-12	line start	LVTTL	☐	B	2	GenFunc

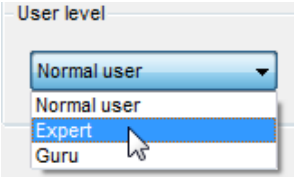
9.14 Setting the user level in CST

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
		**View/System configuration**

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:



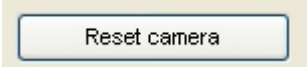
NOTE	We recommend to work with **Normal user** level as much as possible to avoid erroneous settings.

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
IO-Configurator	X	X	(X)
Get Camera Trace		X	X
Verify Packet/Setting			X
Clear Settings			X
Edit Color Correction Matrix			X
Get current camera state	X	X	X

9.15 Resetting the camera

You can reset the camera from CST:

Button	Function key	Menu
		**View/System configuration**
		

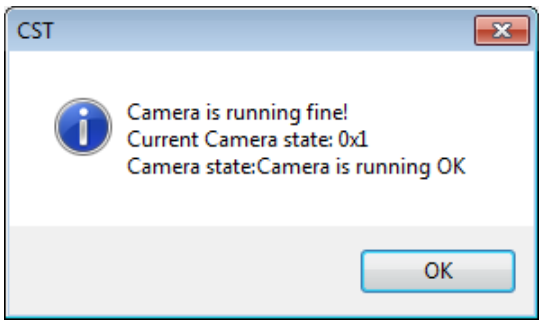
On the camera a reset is performed, and afterward CST is automatically re-connected to the camera.

9.16 Checking the camera state

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:



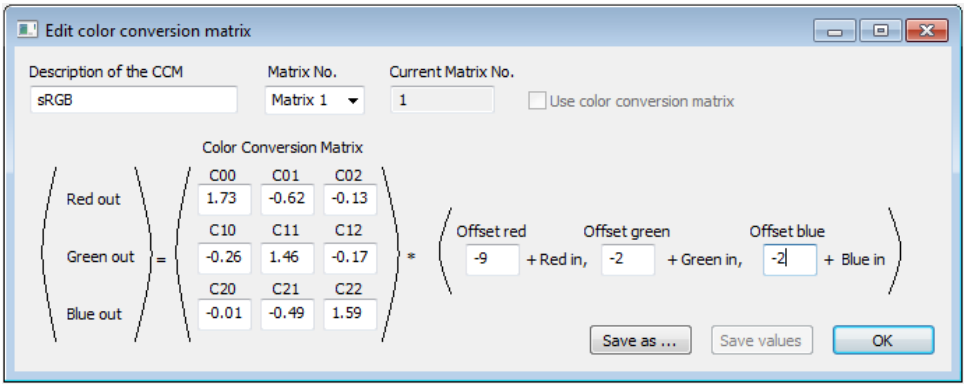
9.17 Edit color conversion (correction) matrix

For color conversion 4 color conversion matrix tables are available in the camera.

$$\begin{pmatrix} Rout \\ Gout \\ Bout \end{pmatrix} = \begin{pmatrix} C00, C01, C02 \\ C10, C11, C12 \\ C20, C21, C22 \end{pmatrix} * \begin{pmatrix} Rin + Offset_R \\ Gin + Offset_G \\ Bin + Offset_B \end{pmatrix}$$

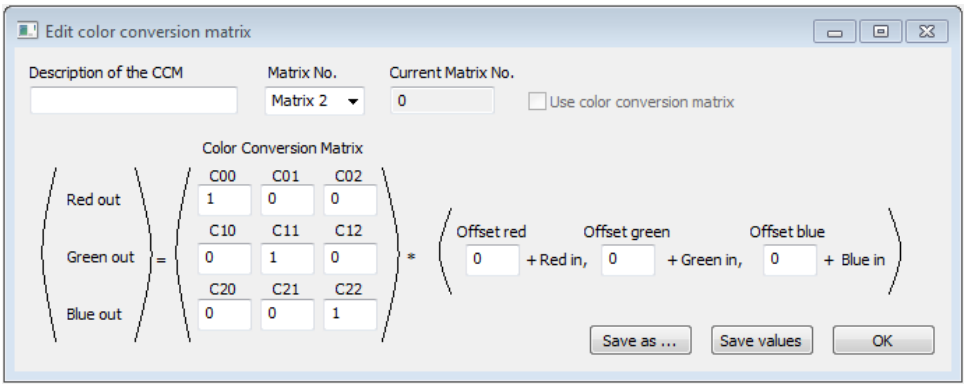
With:
Offset: Additional Offset in 10Bit range, from -511 to +511 corresponding -0,5 to +0,5
Cxy Gain factor from -2,0 to +2,0.

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.

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 user mode **Guru**.

9.18 Choosing a different configuration file for the parameter display

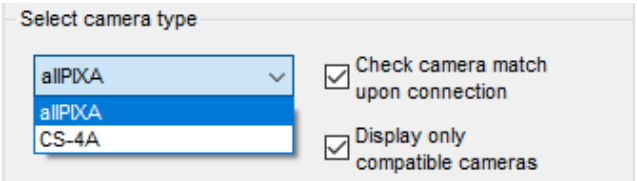
You can modify the **Parameter** view of CST according to the camera type.

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 wave camera is allPIXA_wave.



   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.

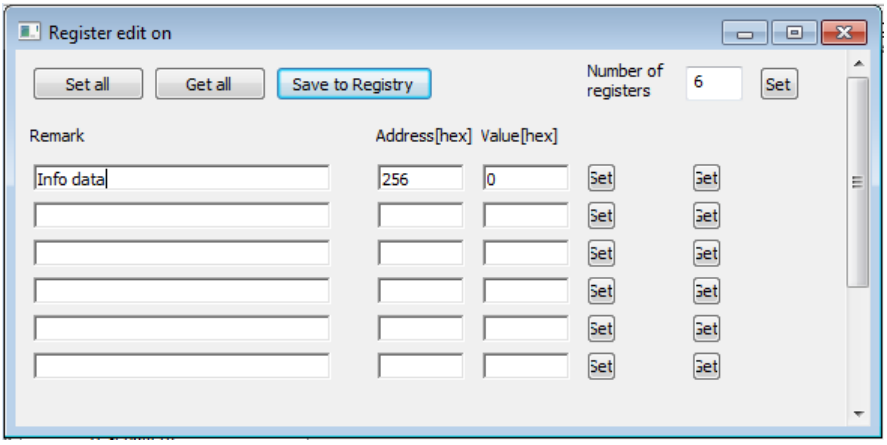
9.19 Register Edit

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 0 “

Special functions"), 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.

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**.

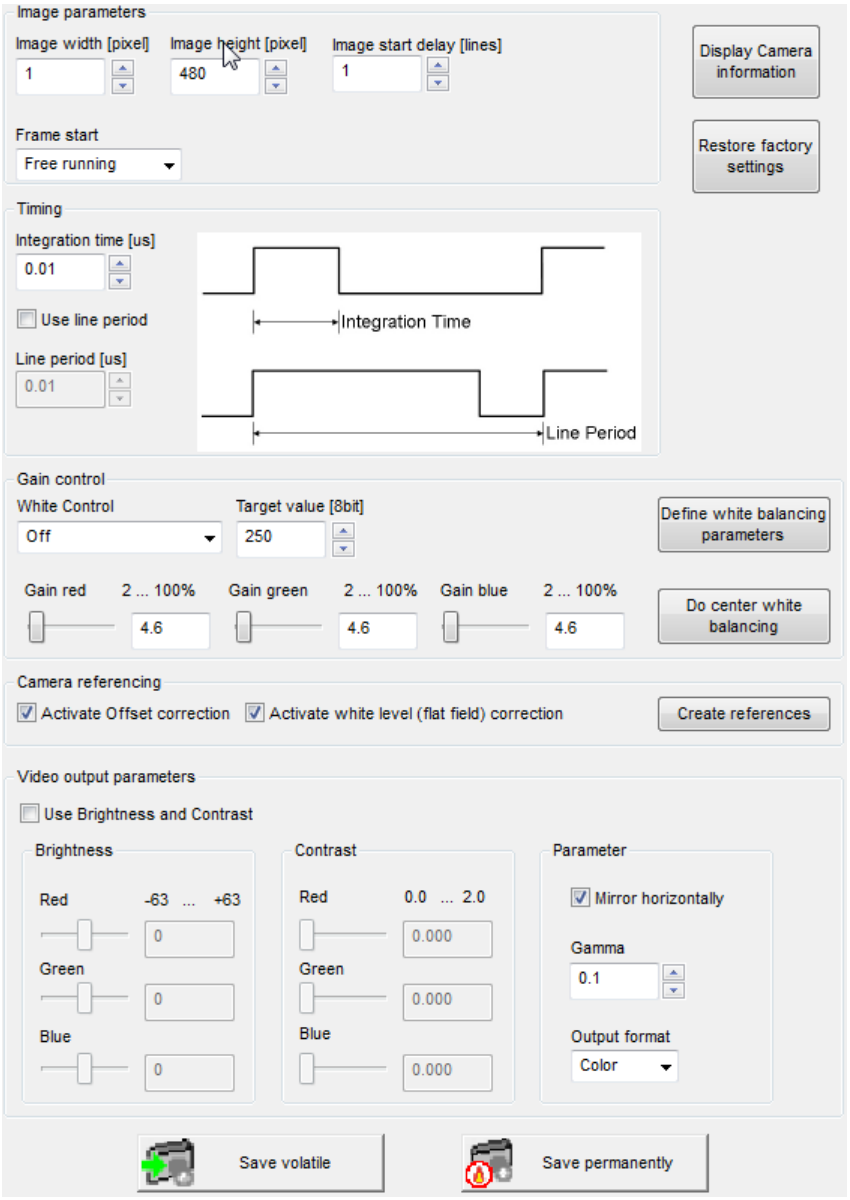
NOTE	This function is only for trained users.

10 allPIXA setup

To set up the allPIXA camera for an application, several parameter must be adapted. For example scan line period must fit transport speed of the scanned target. Or camera gain must be adapted to brightness of illumination. For all these parameters, a simple setup process is described here to get quick start of the camera in customer surrounding.

10.1 Simple setup for a fast ready-to-operate state

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.

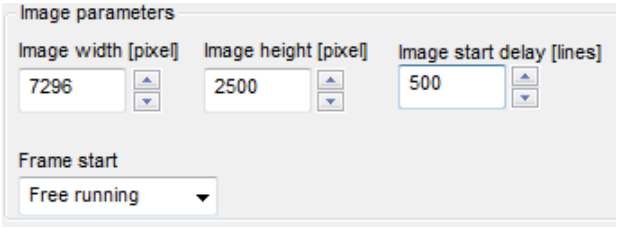


The parameters are placed in a functional order to give you an orientation which parameters should be set first. Start with the topmost parameter.

NOTE If 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 0).

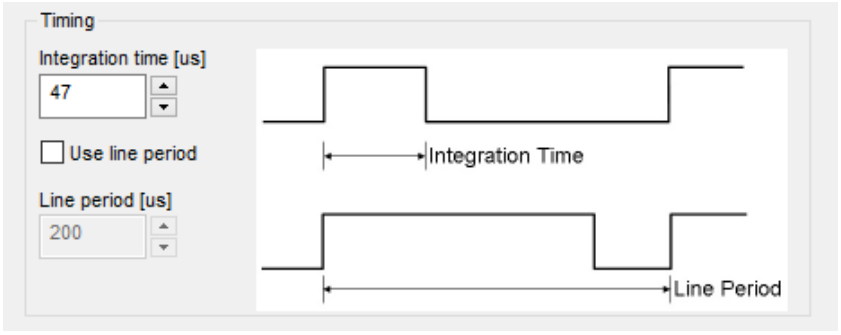
   If you reduce the image width, the resulting image is located in the middle of the sensor area. Asymmetric reduction is not supported.

   The defined image width is also the number of pixels that is output to the frame grabber via CameraLink.

2. If you use a frame scan mode, enter values at **Image height** and **Image start delay** (see sections 11.8.1 and 11.8.2).

3. In the **Frame start** list, specify image output by selecting **Free-running** or **Triggered**. In triggered mode, image capturing is started by an external signal (see section 11.9.1.).

Timing:



You can specify the integration time (see section 11.1.1).

If you need the line period feature, select the **Use line period** check box (see section 11.1.3).

In triggered frame scan mode, the camera waits for an 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.

In the **Target value** box, 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 (see section 11.2.1) by adjusting the analog camera gain values.

You can specify the camera gain values manually (see section 11.2.2).

Alternatively you can set the camera gain values automatically by clicking **Do center white-balancing**. The white control field is moved into 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 10.2.2.

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

Camera referencing:

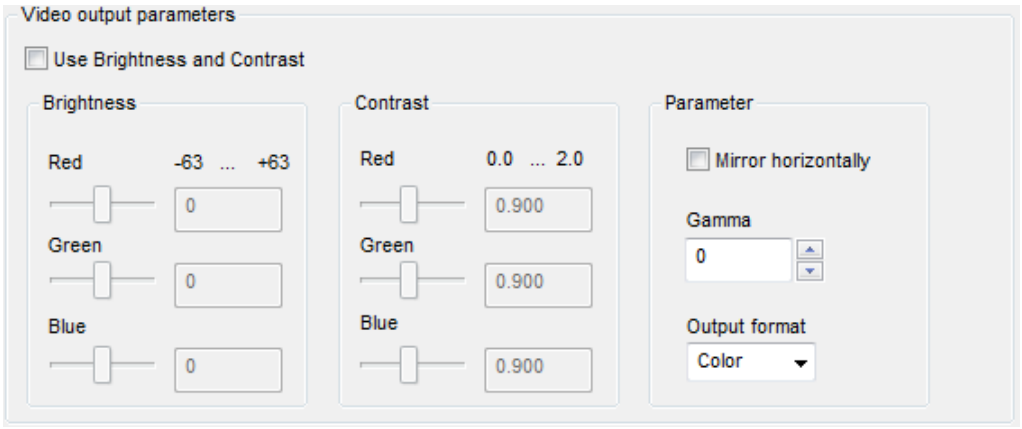
Specify whether offset and the white-level (flat-field) correction should be used:

If the references for black level and flat field correction were already generated, simply activate/deactivate them by selecting the checkboxes.

Click **Create references**, to start the reference wizard, and follow the instructions of the wizard to generate a black-level reference (section 10.4) or a white-level (shading) reference (section 10.5).

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 11.6.

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.
video_out_level = video_in_level $^{1/Gamma}$
This is valid for values > 0.4. If 0.1 is selected for the gamma value a special table for sRGB conversion is used.

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.

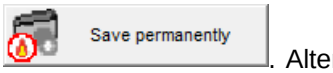
For a detailed description of the transmission of data according Camera Link specification, see section 4.6.2.

Transfer and burn setting:

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

. Alternatively, you can click **Transfer setting to camera**  on the toolbar, or press **F9**.

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 

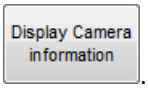
. Alternatively, you can transfer the setting to the camera and then click **Burn setting permanently**  on the toolbar, or press **F10**.

Restoring the default factory setting:

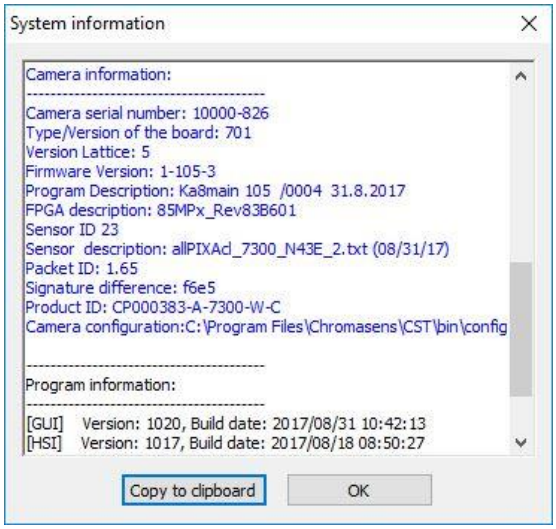
By clicking 

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:

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.

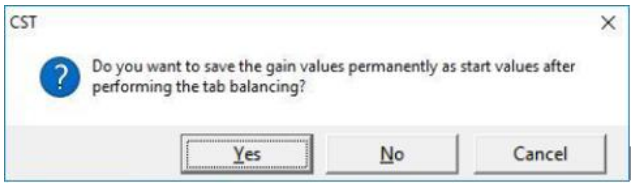
10.2 Performing a white balancing on the camera

You can perform white balancing automatically (see section 10.2.1) or manually (see section 10.2.2)

10.2.1 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 saved in the setting.
- This operation only takes place in the currently selected setting.
- This function has to 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.** • Stop the transport • Place a white reference target in front of the camera • Set the camera to free-running mode (disable encoder and/or frame trigger) • Enable the black-level correction Optional: • Start an image acquisition with the frame grabber to control the result.
2	• On the toolbar, click **Perform white balancing**  .
3	• In the appearing dialog box, click **Yes**. If process succeeds, **White balancing succeeded** appears in the message box. Possible errors: **White balancing error occurred. Error code No: 0x10D: no reference data** → Camera is not in free-running mode, 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 exceed internal limit. ⇨ Increase analog coarse gain or increase illumination intensity. **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.
4	• On the toolbar, click **Perform tap balancing** .
5	• In the appearing dialog box, click **Yes** to save the gain values permanently as start values after performing tap balancing: 
6	• On the toolbar, click **Refresh** . Optional: • Check the values of **Current camera gain values**, if necessary. It is recommended to keep the gaining values in the range of 80 to 200 for best image quality. • If the current gaining values are above 200, you can please increase **Analog coarse gain** and repeat from step 2. (For more information about analog coarse gain, see section 11.2.1).
7	• On the toolbar, click **Burn setting permanently** .

10.2.2 Setting the operation point manually

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

The pattern below describes the principle of analog image processing.

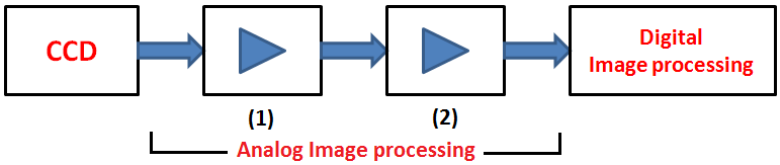


Figure 33 Analog image processing comprises of two levels.

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 11.2.

NOTE	Manual operating point setting is carried out during commission by using a shading reference for the operating point.

1

Setup

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

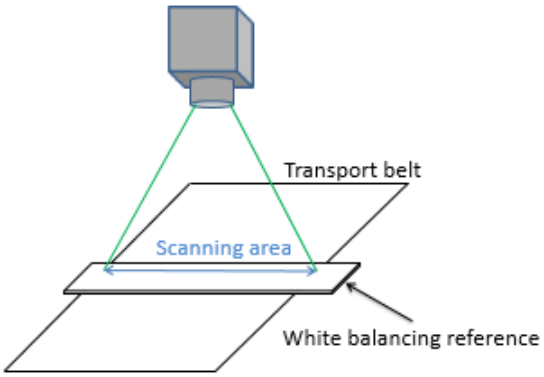


Figure 32: allPIXA camera with a white balancing reference

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

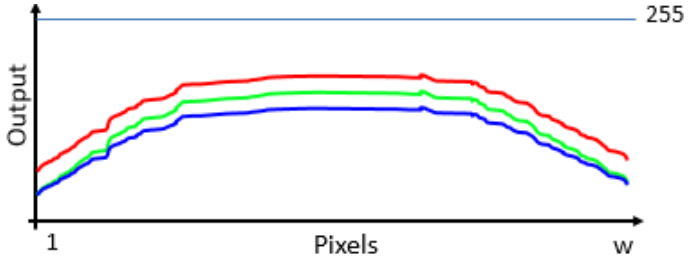
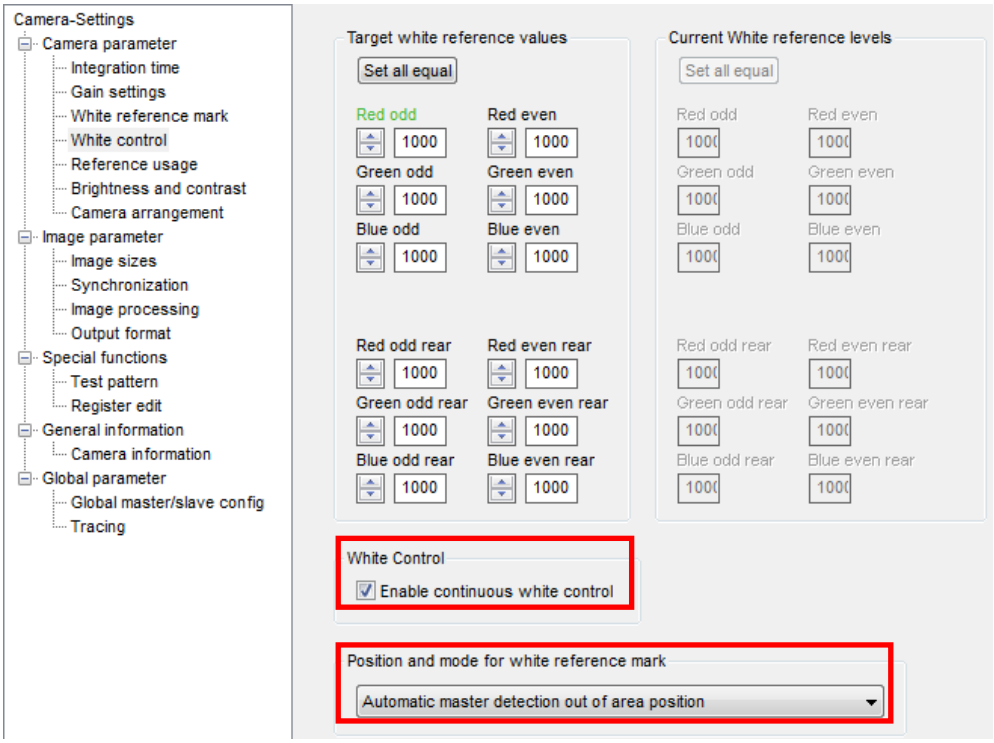


Figure 32: Line plot display

2

Gain and reference settings

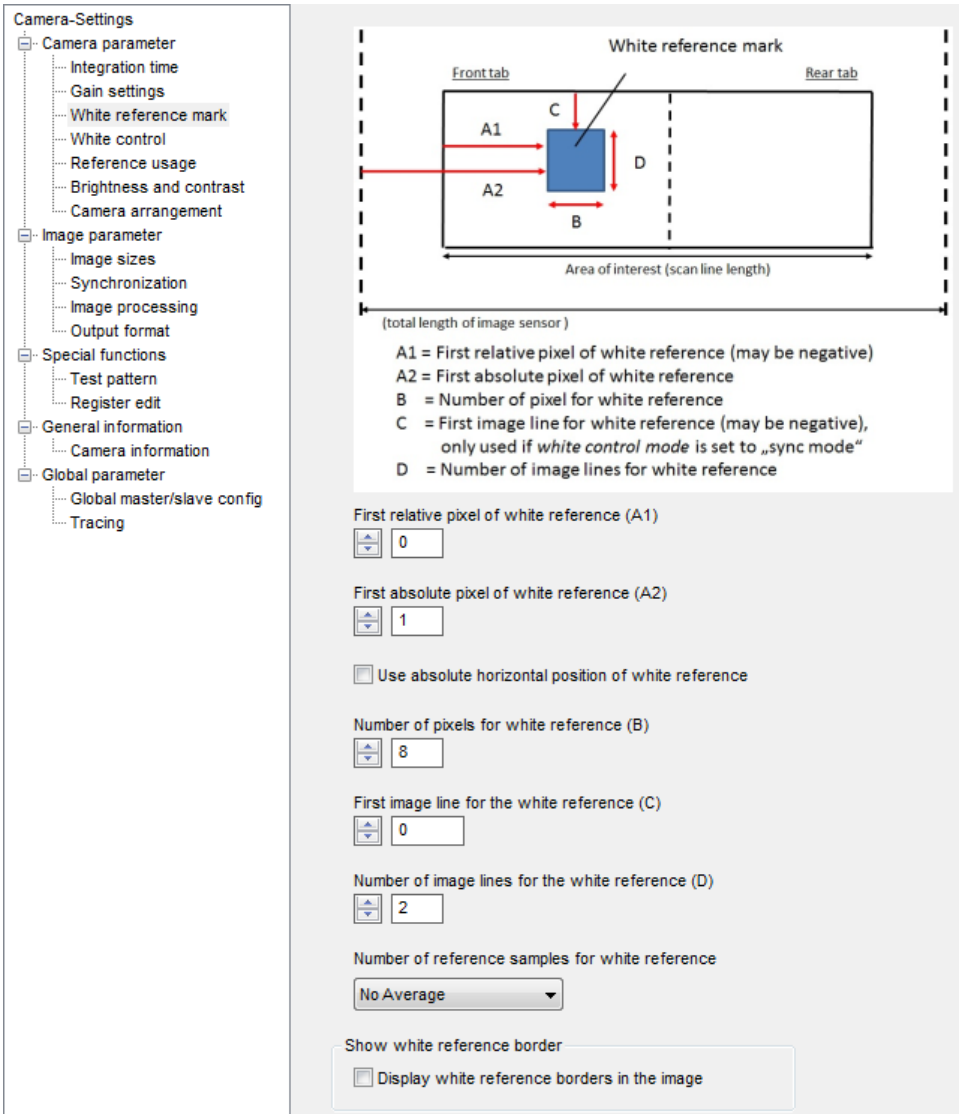
- On the toolbar, click **Show settings**  , and then click **White control**.
- Select the **Enable continuous with control** check box.
- In the **Position and mode for white reference mark** list, click **Automatic master detection out of area position**:



Note: The **Position and mode for white reference mark** list is not shown if **User level** is set to **Normal user** or **Expert**. But in this case, automatic detection is already selected by default.

3

Selection and adjustment of the white reference mark on the white reference



- Set the “White reference mark” to the brightest region in the image. In most cases, this is the center of the image.

Note:

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

4

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

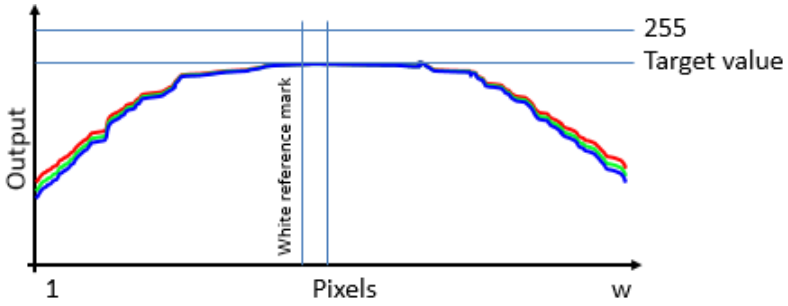
  Current camera parameters are saved non-permanently in the camera.

5

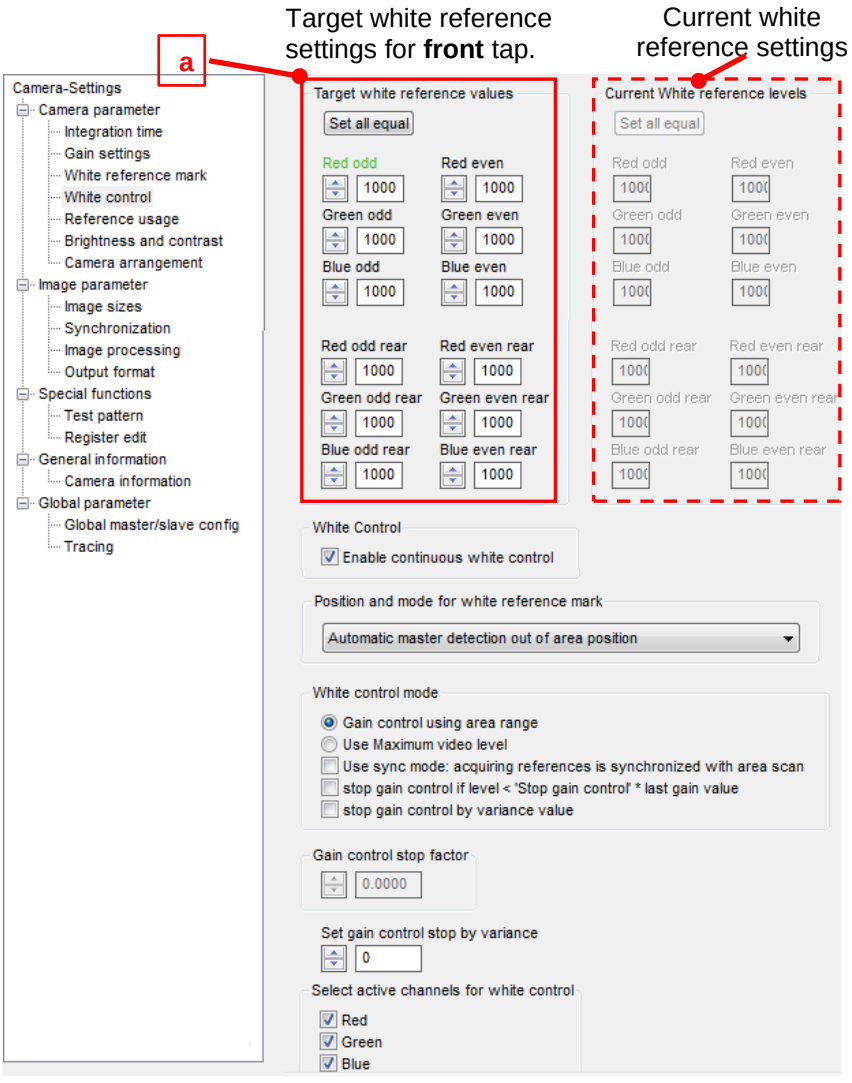
Setting of Target White Reference Values (Video Levels)

- Set the target white reference values (a)
- On the toolbar, click **Transfer setting to camera**  , or press **F9** to save the target white reference value. The range is from 0 – (1023 - the max dark value).

  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).



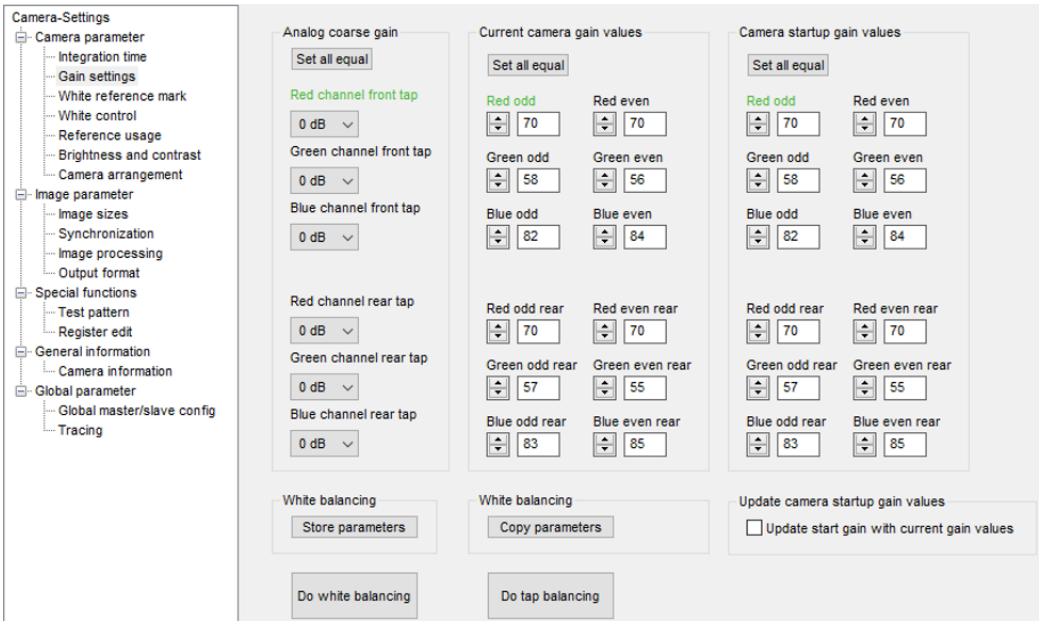
Use the “current white reference values" displayed on the right as a starting point.



6

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 80 and 200:



- If a current gain value exceed 200, you could increase the corresponding value at **Analog coarse gain**. If a current gain value is below 80, 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 6.
- If you do not achieve a satisfying result, you can also adjust the **Target white reference values** on the **White control** page (see step 5)
- On the toolbar, click **Transfer setting to camera**, or press **F9** to save the settings non-permanently on the camera.

7

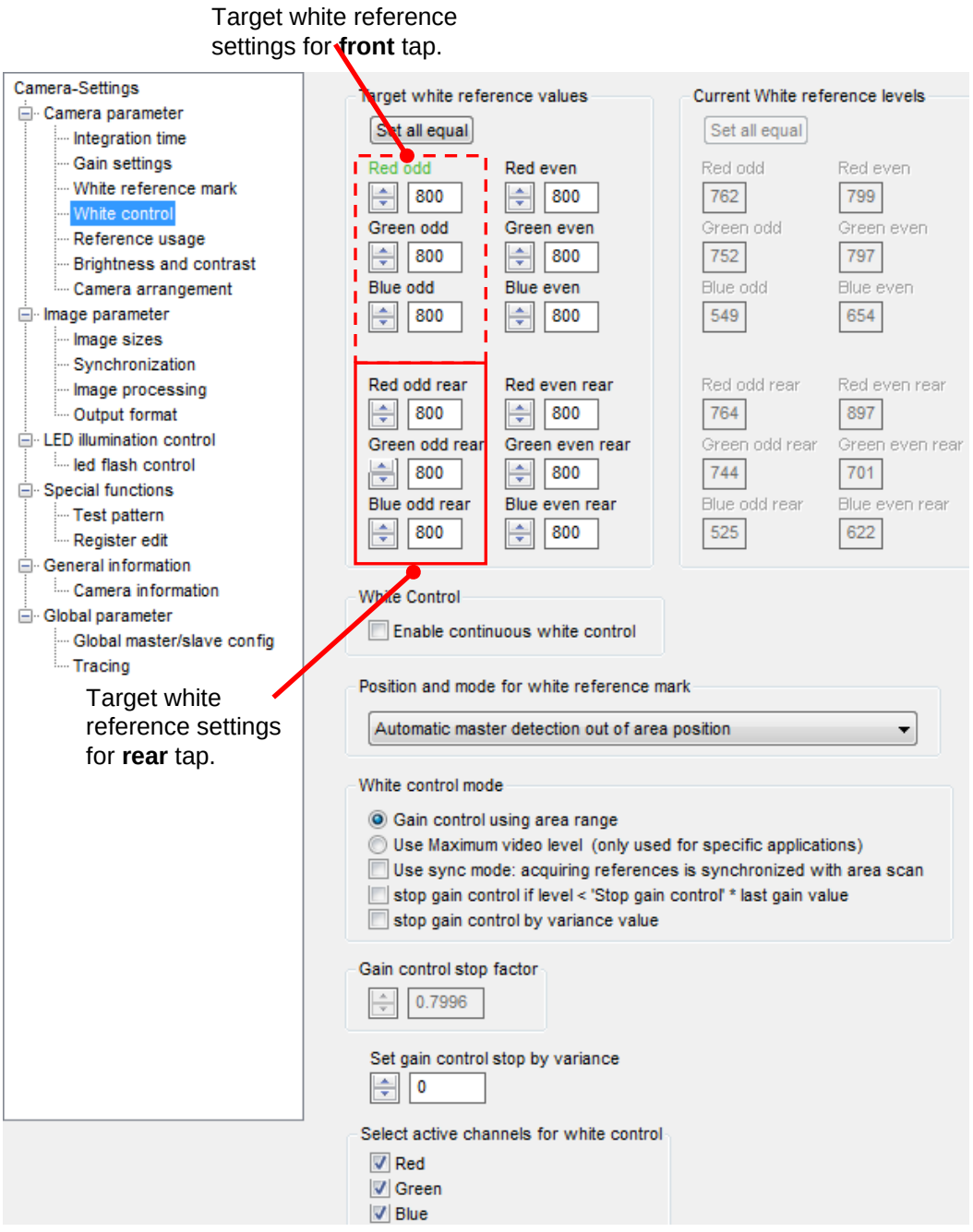
Tap balancing

- 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**  .

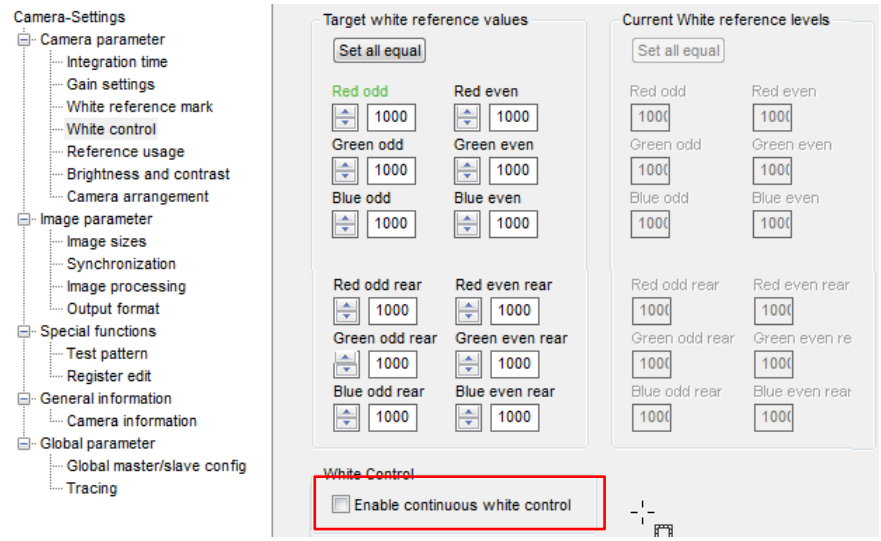
  Example with the front tap as the master tap and the rear tap as the slave tap:



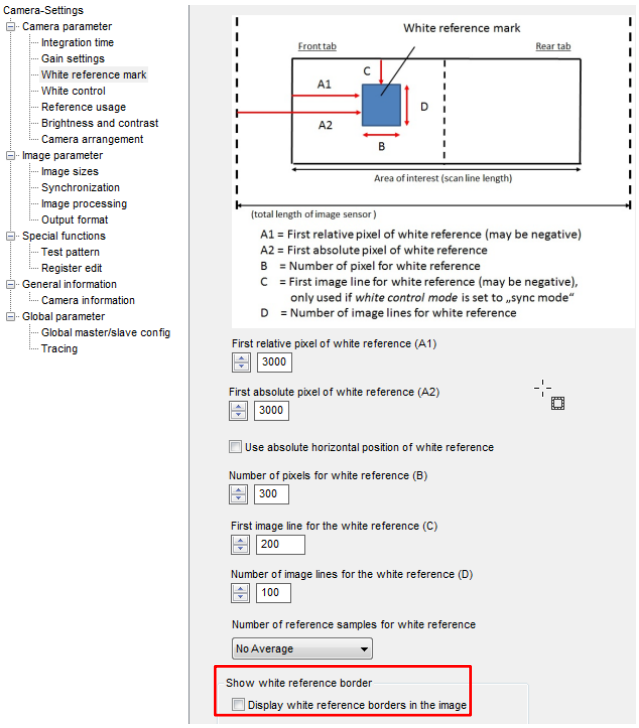
8

Disable white control

- If the result of the settings is satisfactory, click **White control** in the tree view, and then clear the **Enable continuous white control** check box:



- Click **White reference mark** in the tree view, and then clear the **Display white reference borders**… check box:



9

Transfer settings to the camera:

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

  The current camera parameters are saved non-permanently in the camera.

10

Save settings:

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

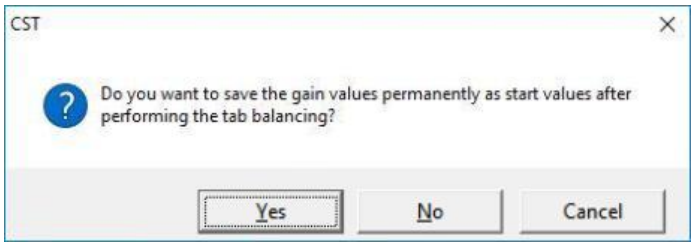
  The current camera parameters are now saved permanently in the camera.

10.3 Performing a tap balancing

Before the camera is finished at our production site, a tap balancing is done and saved on the camera. Sometimes an extra tap balancing is necessary.

The steps refer to the automatic white balancing.

It is recommended to perform a white balancing in advance.

1	**Prepare the setup for the operation:** • Stop the transport • Place a white reference target in front of the camera • Set the camera to free running (disable encoder and/or frame trigger) Optional: • Start an image acquisition with the frame grabber for controlling the result
2	• On the toolbar, click **Perform tap balancing** . 
3	• In the appearing dialog box, click **Yes** to save the gain values permanently as start values after performing tap balancing: 
5	• On the toolbar, click **Refresh**  . Optional: • Check the values of **Current camera gain values**, if necessary. It is recommended to keep the gaining values in the range of 80 to 200 for best image quality. • If the current gaining values are above 200, you could increase **Analog coarse gain** and repeat from step 2.
6	• On the toolbar, click **Burn setting permanently**  .
7	• If requested, transfer these gaining values to other settings.

NOTE	This function has to 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.

10.4 Generating black (offset) reference

To generate a black (offset) reference, click **Start reference wizard** on the toolbar.

You have three options to generate a black reference

1) Loading a reference image from disk (10.4.1)

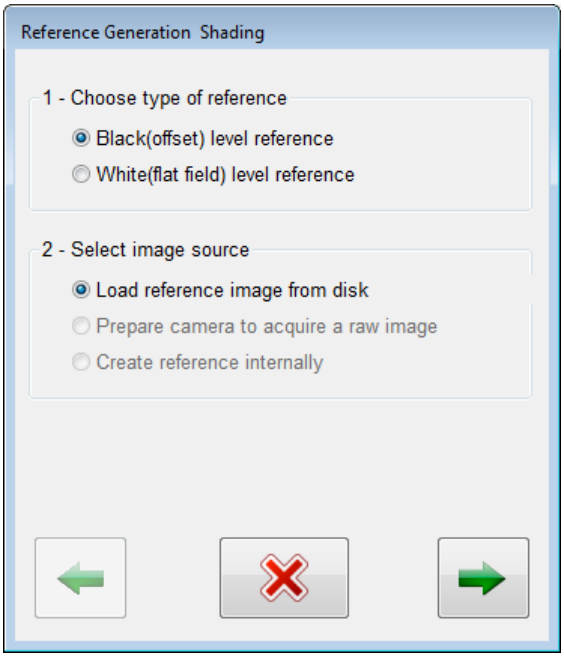
Use this function, if you have a stored black-level reference image on your hard disk.

2) Preparing the camera to acquire a raw image(10.4.2)

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 do an offset correction after grabbing the black reference. The wizard guides you through this process.

3) Creating a black-level reference internally (10.4.3)

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

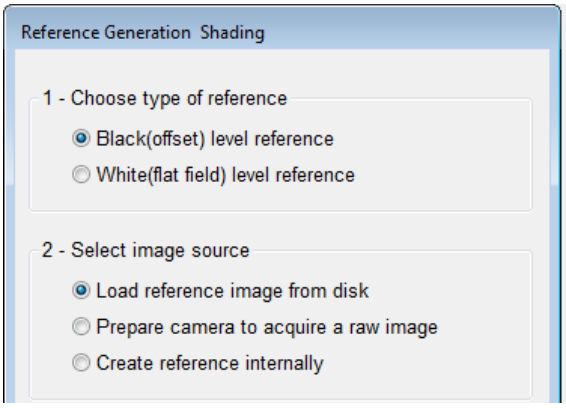


10.4.1 Loading a reference image from disk

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

1 Start the reference wizard and select reference type and image source

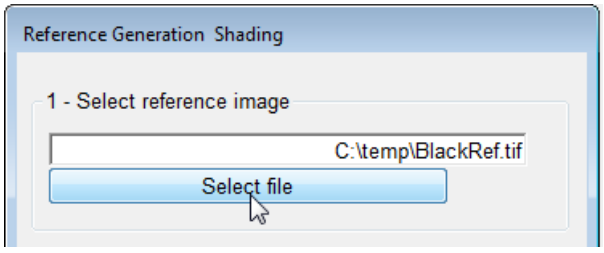
- On the toolbar, click **Start reference wizard**  .
- Click **Black (offset) level reference**.
- Click **Load reference image from disk**:



- Click **Next**  .

2 Select offset reference image

- Click **Select file**:

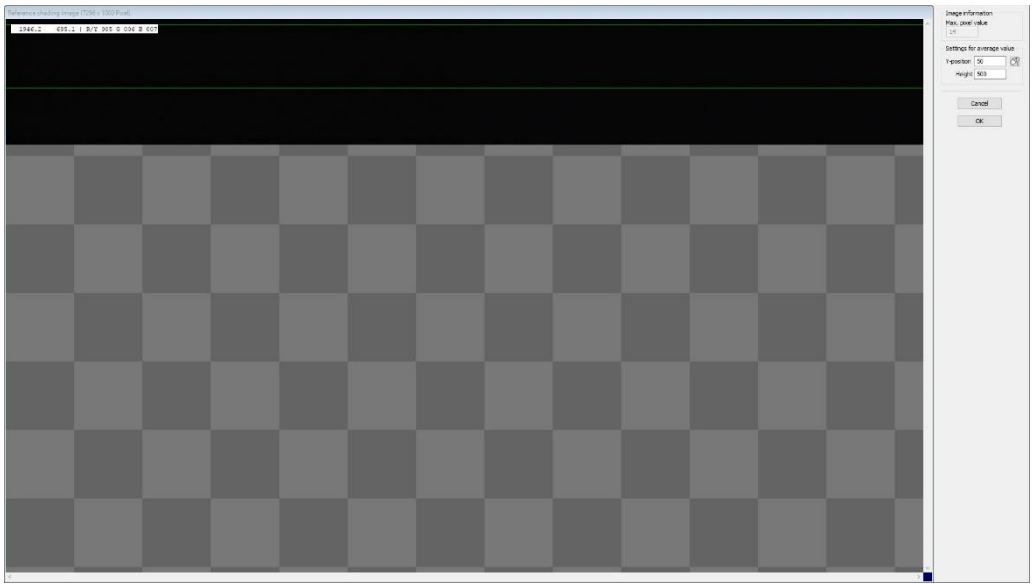


- In the file dialog box, select the reference file, and click **Open**.
- Click **Next**  .

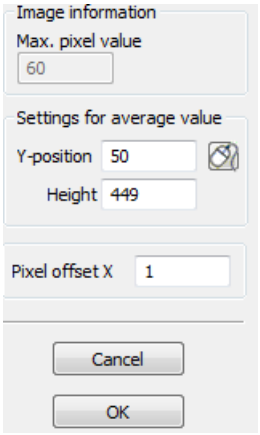
Define the area in which the reference values should be calculated

3

The dialog box shows the reference image:



On the right side, the following parameters are shown:



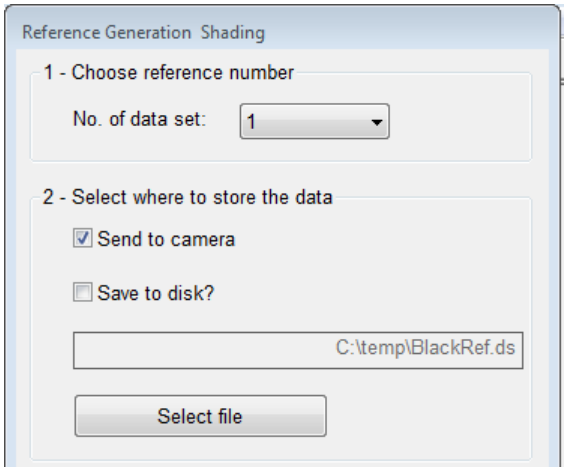
- At the **Y position** box and the **Height** box, specify the area which should be used to calculate the reference values.

  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**.

4 **Save reference data**

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

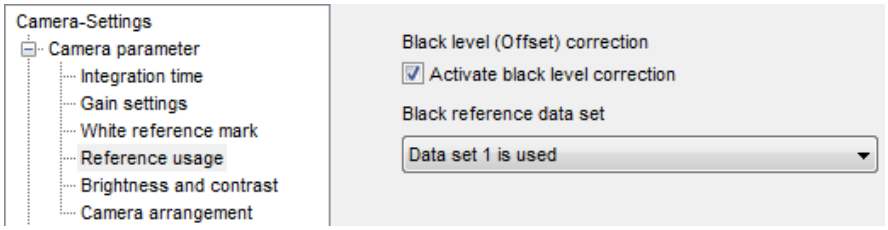


- If the reference data should not be sent to the camera, clear the **Send to camera** check box.
- To save the reference data to a file as backup, select the **Save to disk** check box, and then click **Select file** to specify folder and file name.
- Click **Next**  .

  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.

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

- 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 10.5 to generate a shading reference.

10.4.2 Preparing the camera to acquire a raw reference

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

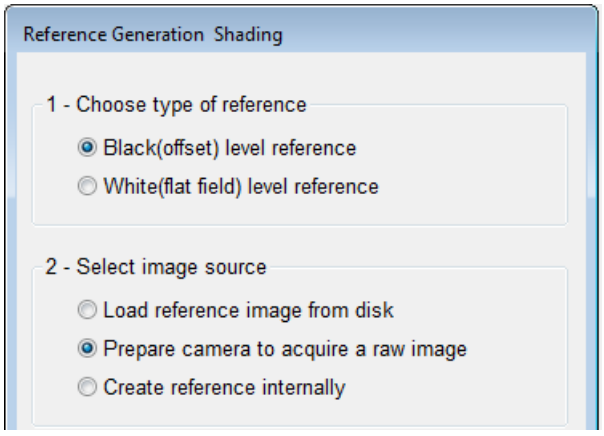
Make sure that all changes made to your current setting are saved permanently to the camera before using the Reference wizard. Otherwise, all changes get lost!

1 Get the camera to the desired working point

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

2 Start the reference wizard and select reference type and image source

- On the toolbar, click **Start reference wizard** .
- Click **Black (offset) level reference**.
- Click **Prepare camera to acquire a raw image**:



Click **Next** .

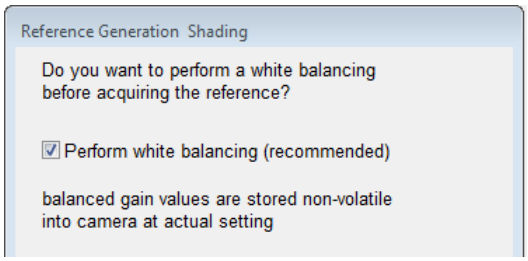
3

Optional: White balancing

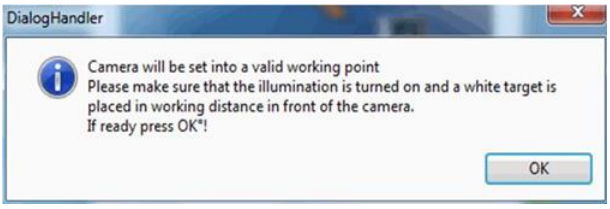
Decide whether you want to perform a white balancing:

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 4.



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



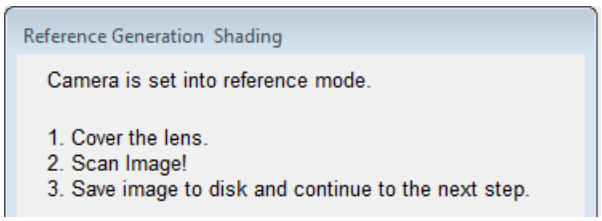
- Follow the instructions in the message box, and then click **OK**.

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

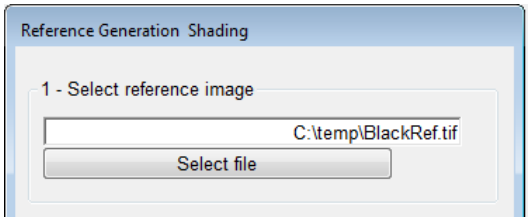
4

Acquire a black reference:

- 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**:

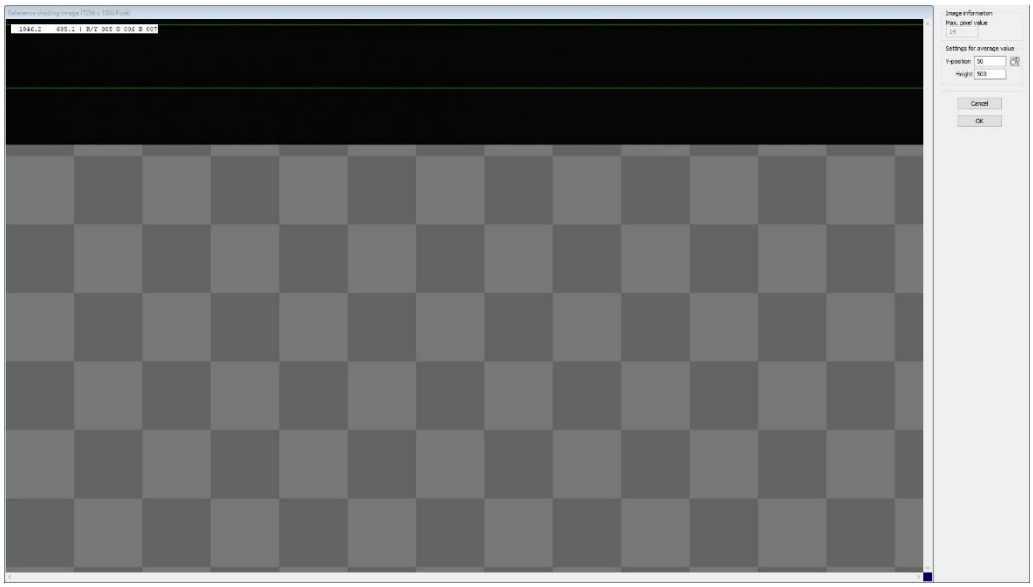


- Select the reference file in the appearing file dialog box, and then click **OK**:
- Click **Next**  .

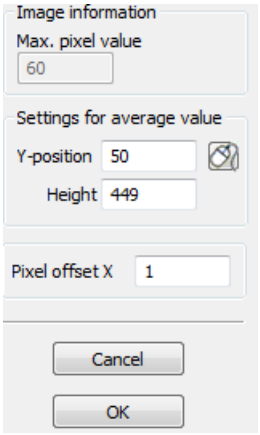
Define the area where the reference values should be calculated

5

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.

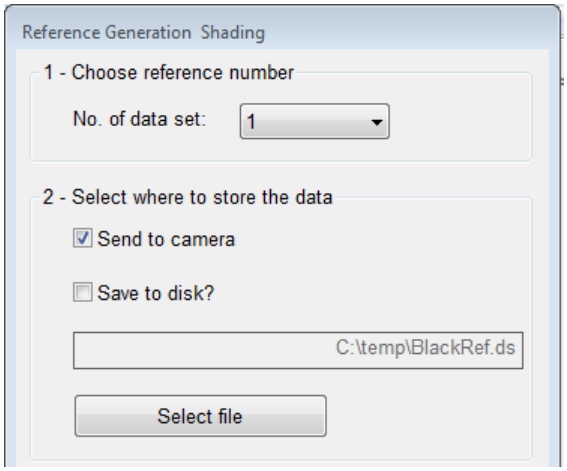
  Use at least 100 lines for calculating the reference values to eliminate noise. The values used for the reference are calculated by averaging each column in the selected area.

- Click **OK**.

6

Saving reference data

- In the **No. of data set** list, click the number of the data set in which the refrence 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**  .

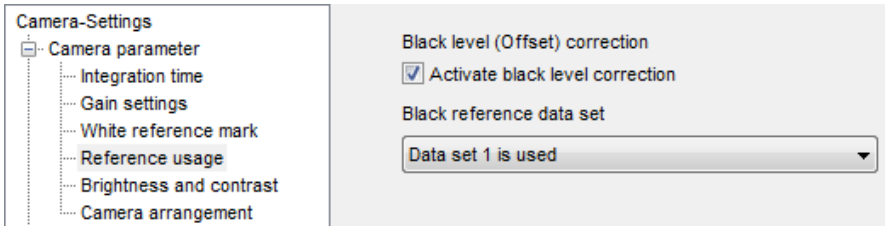
  If the reference data are sent to the camera, a progress bar is shown, and the camera is reset afterward to make sure that the initial settings are again active. The last used setting is activated automatically.

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

7

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

- 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:

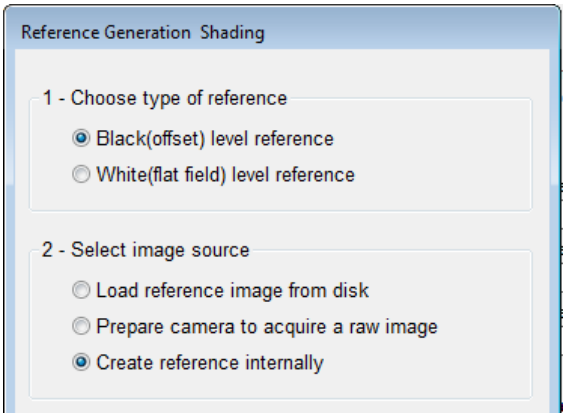


  At least a few pixels should have a value greater than 0 (for example 1 or 2) in the black image with activated black-level correction and covered lens. Otherwise, (if **all** pixels are 0) the image is over-compensated and you should repeat the steps for reference generation.

- Click **Transfer setting to camera**  to save the setting to volatile memory.
- You may proceed to section 10.5**Fehler! Verweisquelle konnte nicht gefunden erden.** to generate a shading reference.

10.4.3 Creating a black-level reference internally

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

1	**Get the camera to the desired working point**
	Prepare the camera: • Place a white reference in front of the camera • Check lighting and focusing • On the **White control** page, clear the **Enable continuous white control** check box. • On the toolbar, click **Transfer setting to camera**  .
2	**Start the reference wizard and select reference type and image source**
	• On the toolbar, click **Start reference wizard**  . • Click **Black (offset) level reference**. • Click **Create reference internally**:  • Click **Next**  .

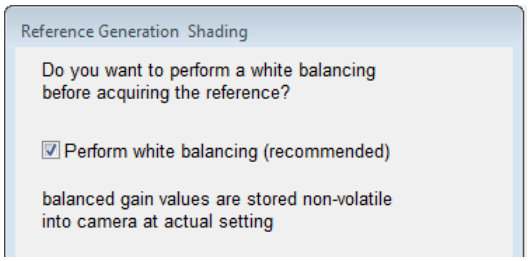
3

Optional: White balancing

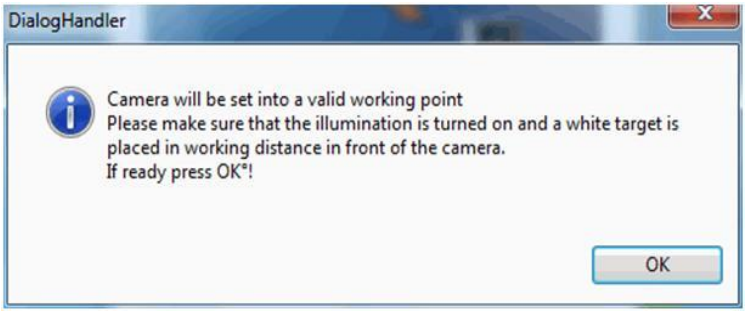
Decide whether you want to perform white balancing:

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 4.



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



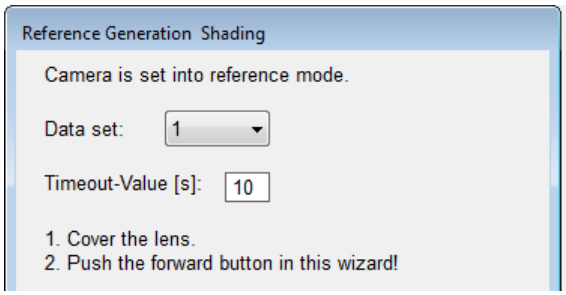
- Follow the instructions in the message box, and then click **OK**.

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

4

Start black-level correction:

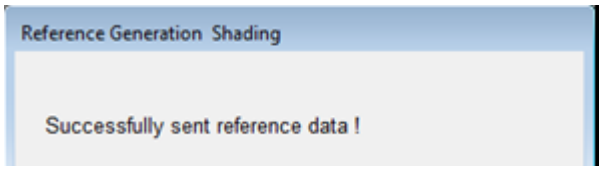
- In the **Data set** list, select the data set, in which the offset reference should be generated and stored:



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

5 **Wait for result**

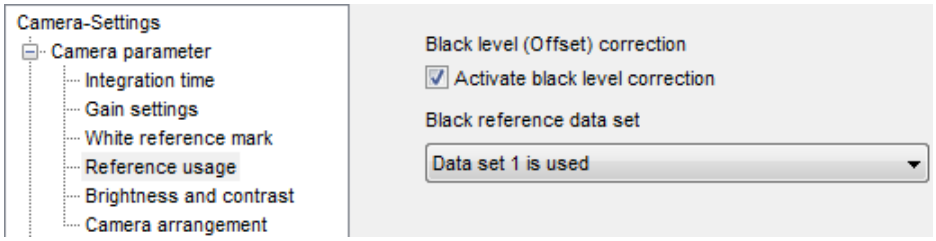
A progress bar is shown while the reference is created and stored. When it has finished successfully, the wizard shows the following message:



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

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

- 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 10.5 to generate a shading reference.

10.5 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) Using a stored white (gain) level reference image (10.5.1)

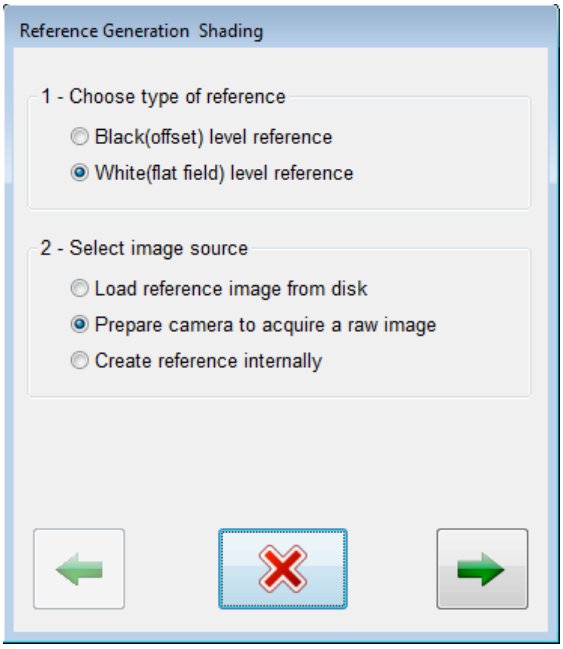
Use this function, if you have a stored white/shading reference image on your hard disk.

2) Preparing the camera to acquire a white (gain) reference (10.5.2)

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 do an offset correction after grabbing the black reference. The wizard guides you through this process.

3) Creating a white(gain) reference internally (10.5.3)

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


Reference Generation Shading
1 - Choose type of reference
Black(offset) level reference
White(flat field) level reference
2 - Select image source
Load reference image from disk
Prepare camera to acquire a raw image
Create reference internally

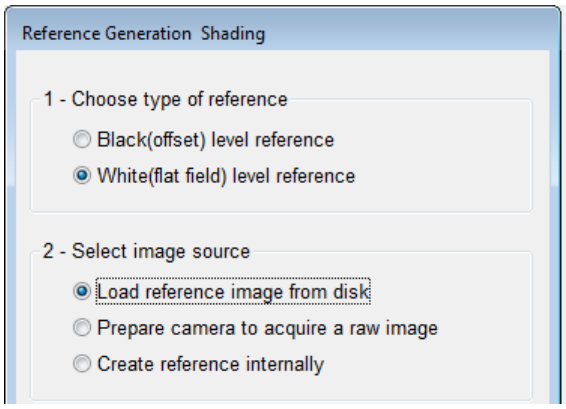
10.5.1 Loading a reference image from disk

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

Note: The white reference target must be placed in the best focus plane of the camera. Therefore any features on its surface (for example dust, scratches) end up in the calibration profile of the camera. To avoid this if you use a static (non-moving) white reference target, use a clean white ceramic or plastic material or 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 target.

1 Start the reference wizard and select reference type and image source

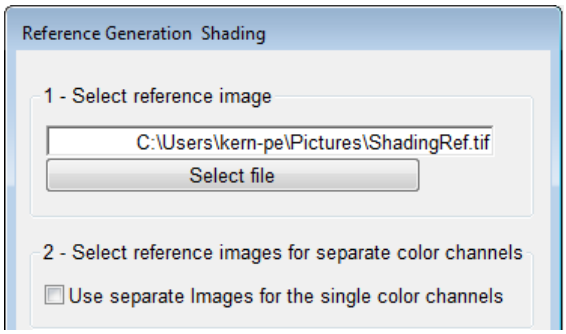
- On the toolbar, click **Start reference wizard**  .
- Click **White (flat-field) level reference**.
- Click **Load reference image from disk**:



Click **Next**  .

2 Choose suitable white reference image

- Click **Select file**:



- In the file dialog box, select the reference file, and click **Open**.
- Click **Next**  .

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.

3

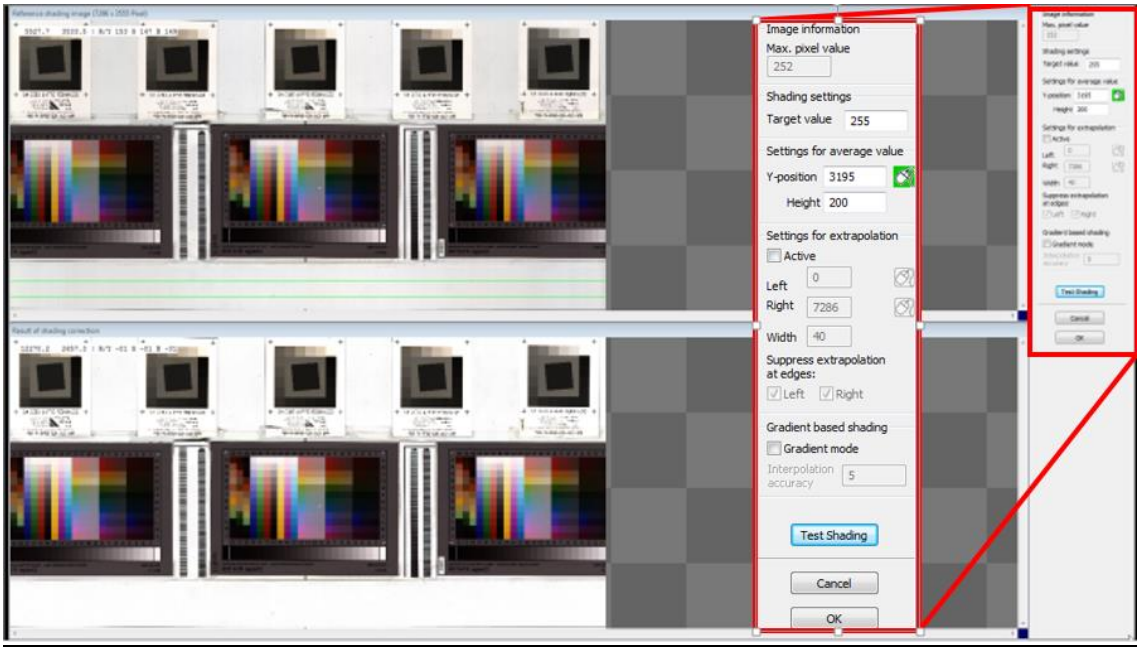
Define the area where the reference values should be calculated (a)

- 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:



- Click **OK**, and then proceed with **Step 5**.

4

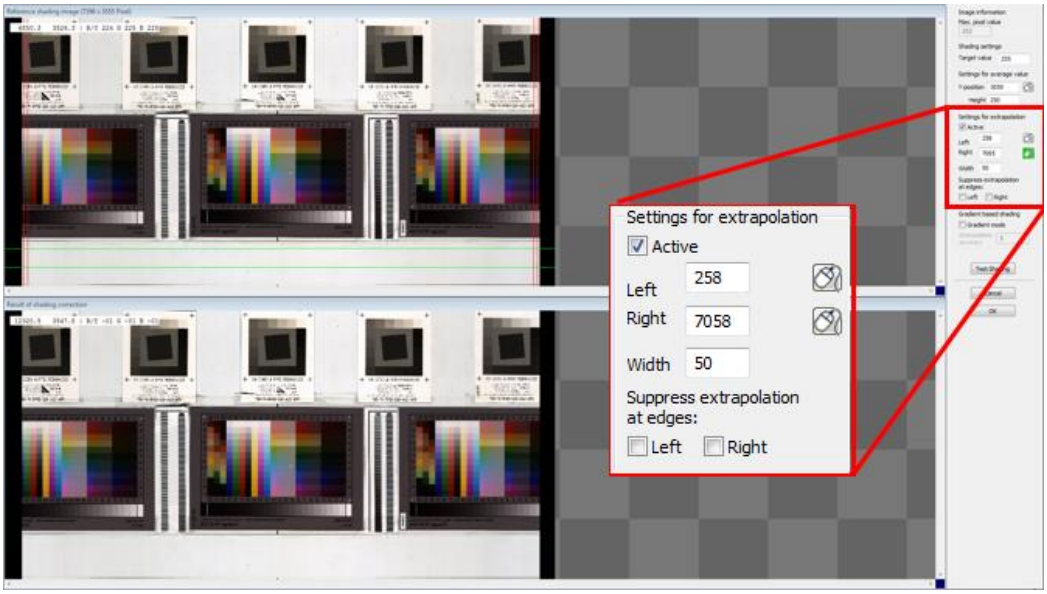
Define the area where the reference values should be calculated (b)

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:

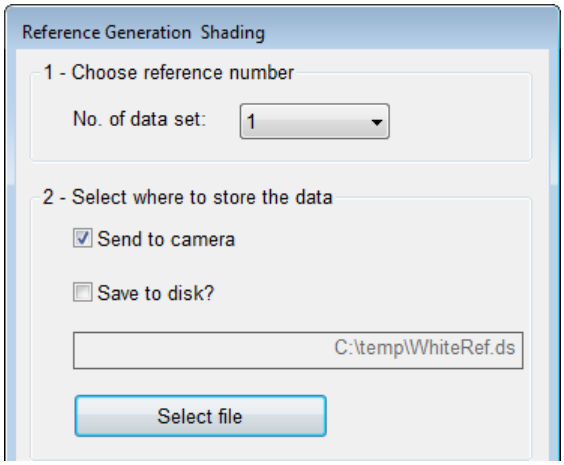


- In the **Settings for extrapolation** area, select the **Active** check box.
- Mark the edges of the white reference
  The extrapolation function can be used if the white reference target does not cover the full scan area. Activate the function and set the left/right regions close to the left/right edge of the white target. Either by entering the pixel number or by using of the mouse placement  function.
- Click **OK**, and then proceed with **Step 5**.

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:



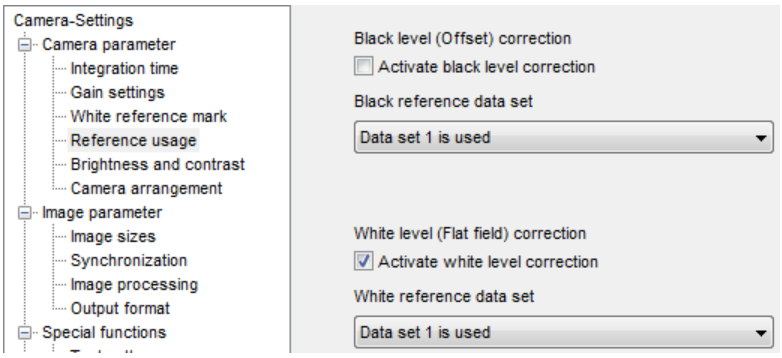
- If the reference data should not be sent to the camera, clear the **Send to camera** check box.
- To save the reference data to a file as backup, select the **Save to disk** check box, and then click **Select file** to specify folder and file name.
- Click **Next**  .

  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.

6

Activate shading correction and check the result in the image.

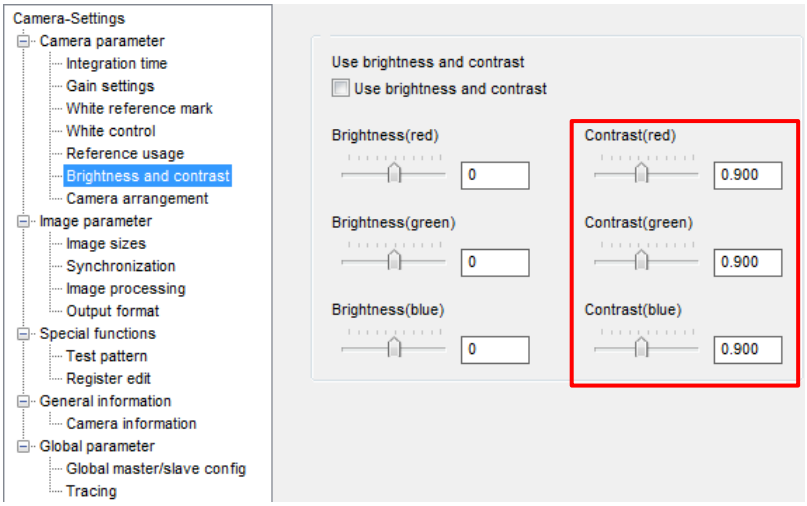
- On the toolbar, click **Show settings** , and then click **Reference usage**.
- To check white-level correction, select the **Activate white-level correction** check box and check that the just updated data set is used:



- 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 a using a contrast adjustment of 230/255=0,90.



7

Save the setting

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

10.5.2 Preparing the camera to acquire raw image

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!

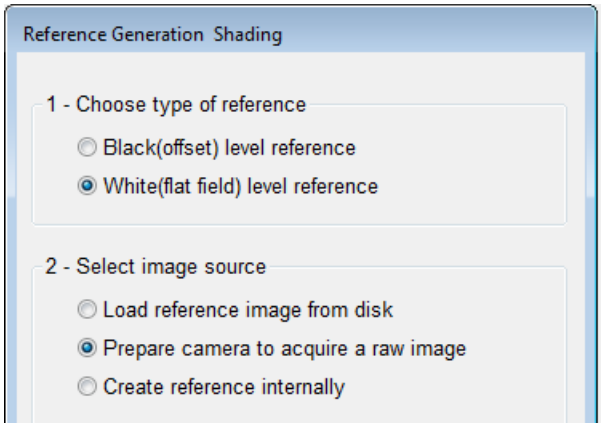
1 Get the camera to the desired working point

- 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

Note: The white reference target has to be placed in the best focus plane of the camera. Therefore any features on its surface (for example dust, scratches) end up in the calibration profile of the camera. To avoid this 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.

2 Start the reference wizard and select reference type and image source

- On the toolbar, click **Start reference wizard**  .
- Click **White (flat-field) level reference**.
- Click **Prepare camera to acquire a raw image**:



- Click **Next**  .

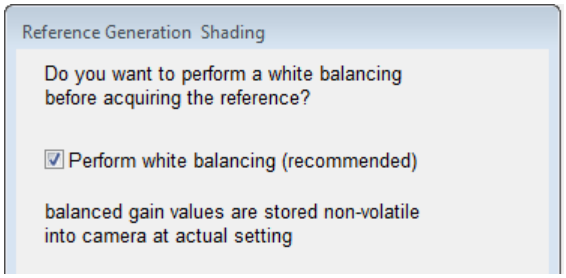
3

Optional: White balancing

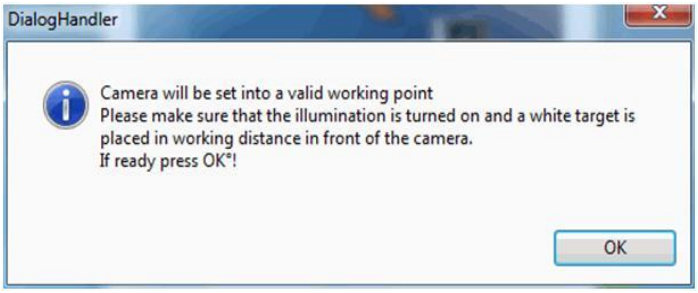
Decide whether you want to perform a white balancing:

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 4.



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



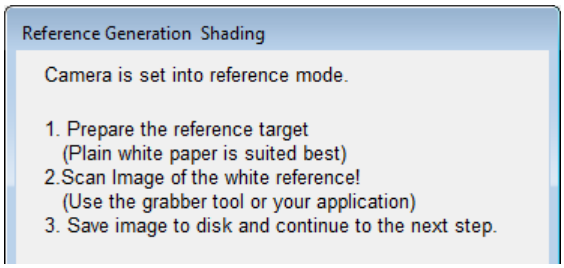
- Follow the instructions in the message box, and then click **OK**.

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

4

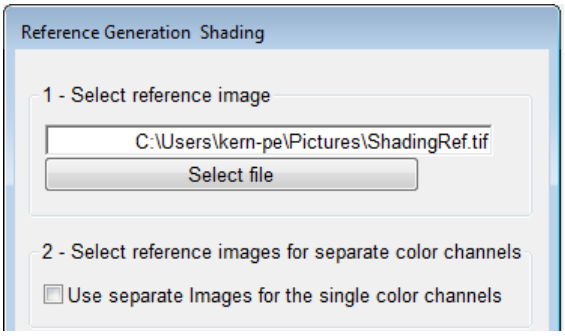
Acquire a shading reference:

- 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**:

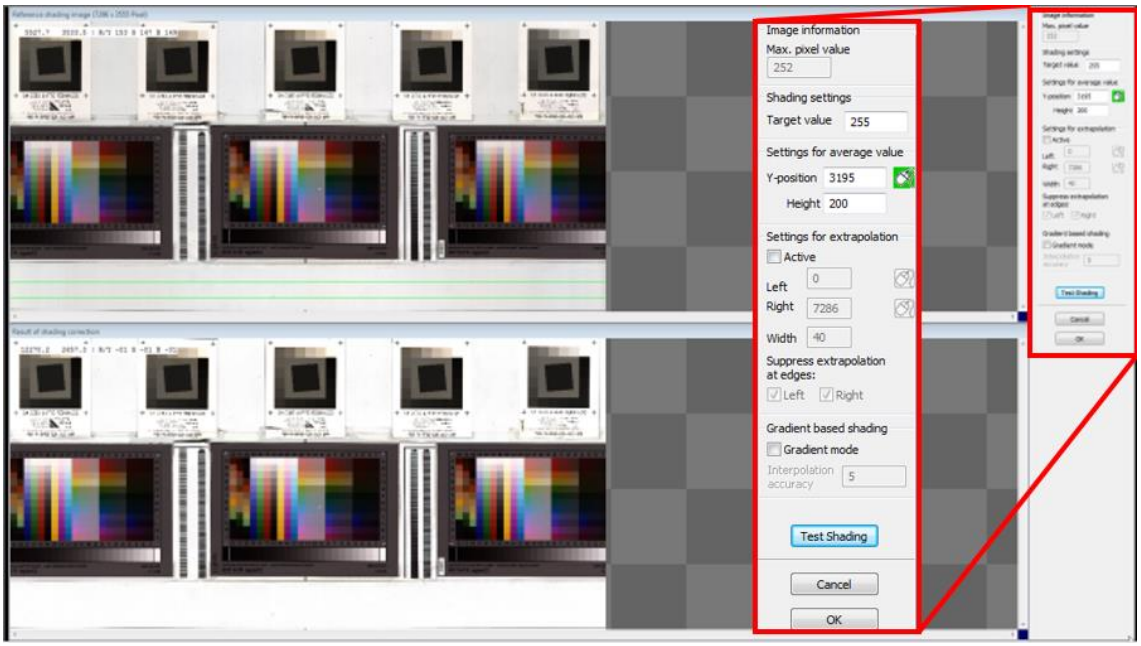


- Select the reference file in the appearing file dialog box, and then click **OK**.
- Click **Next**  .

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.

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**.
- 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.

- Click **OK**, and then proceed with **Step 7**.

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

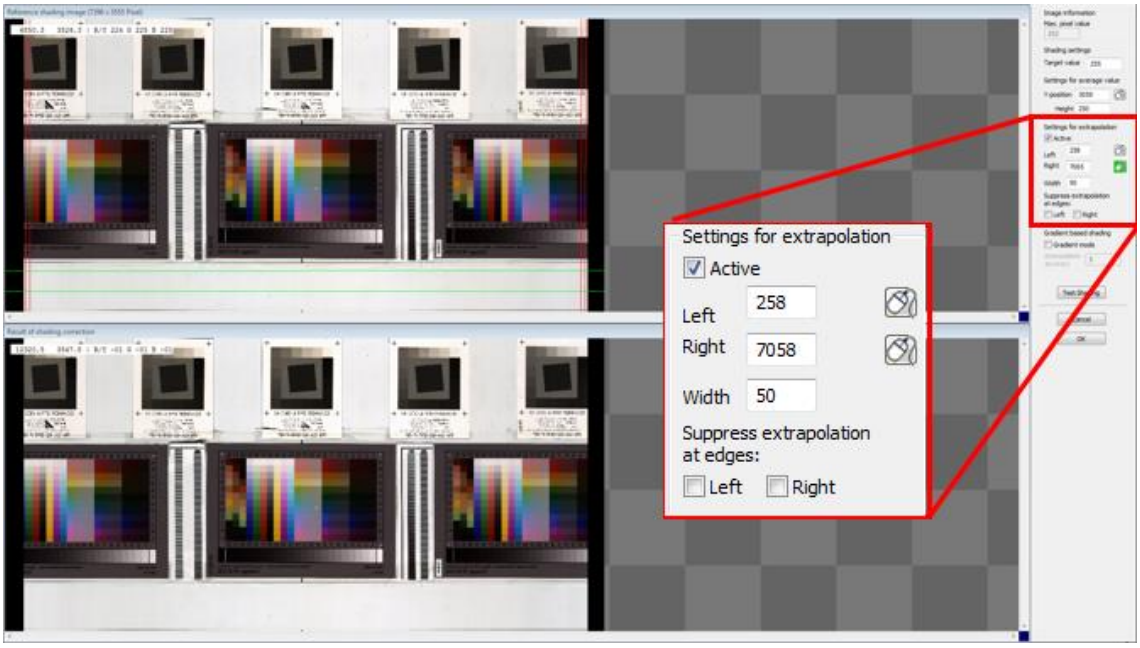
6

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:



- **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.

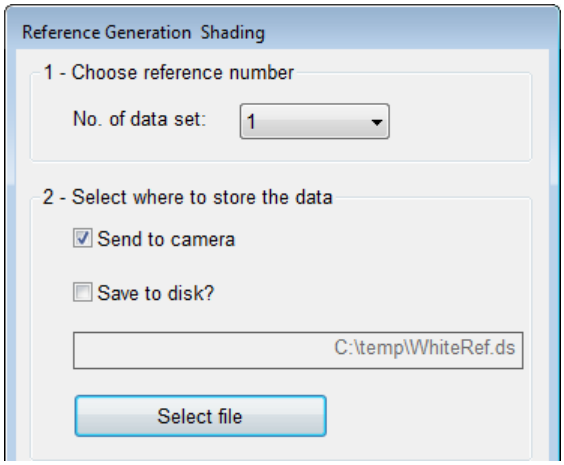
    Instead of entering values for the start positions, you can click  and then click the respective start position on the image.

- Click **OK**, and then proceed with **Step 7**.

7

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:

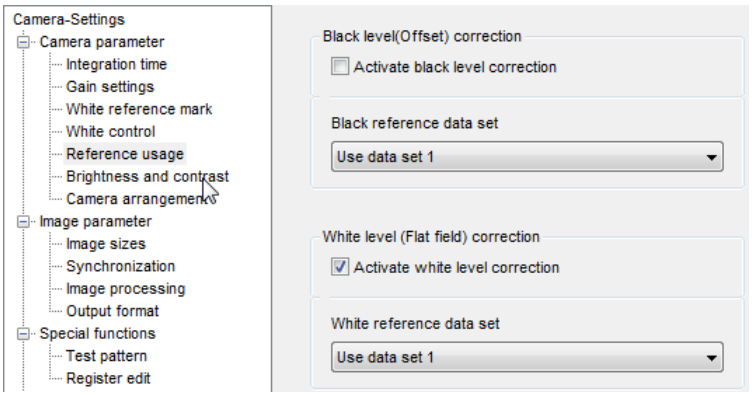


- If the reference data should not be sent to the camera, clear the **Send to camera** check box.
- To save the reference data to a file as backup, select the **Save to disk** check box, and then click **Select file** to specify folder and file name.
- Click **Next**  .

  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.

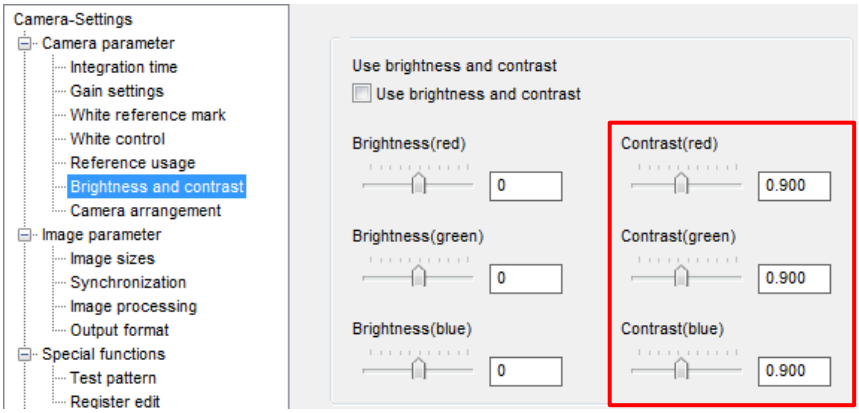
- On the toolbar, click **Show settings** , and then click **Reference usage**.
- To check white-level correction, select the **Activate white-level correction** check box and check that the just updated data set is used:



- 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 using a contrast adjustment of 230/255=0,90.



9 Save the setting

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

10.5.3 Creating a white (gain) reference internally

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

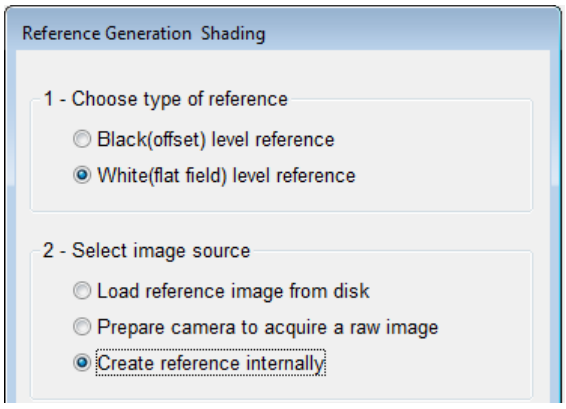
1 Get the camera to the desired working point

- 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

Note: The white reference target must be placed in the best focus plane of the camera. Therefore any features on its surface (for example dust, scratches) end up in the calibration profile of the camera. To avoid this 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.

2 Start the reference wizard, and select reference type and image source

- On the toolbar, click **Start reference wizard**  .
- Click **White (flat-field) level reference**.
- Click **Create reference internally**:



- Click **Next**  .

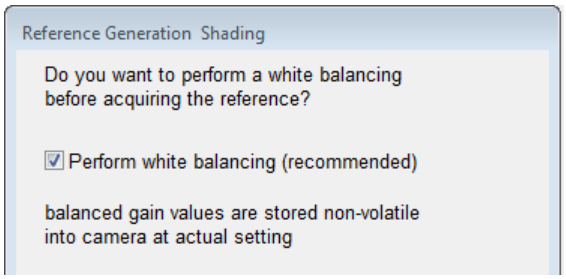
3

Optional: White balancing

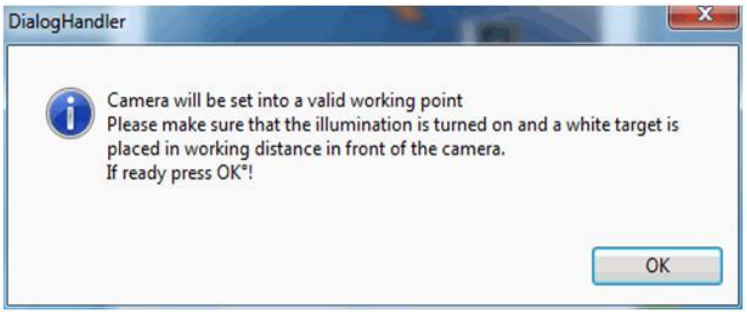
Decide whether you want to perform a white balancing:

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.



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

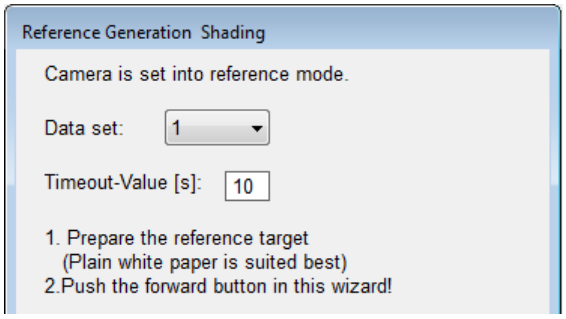


- Follow the instructions in the message box, and then click **OK**.

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

4 **Start the shading correction:**

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



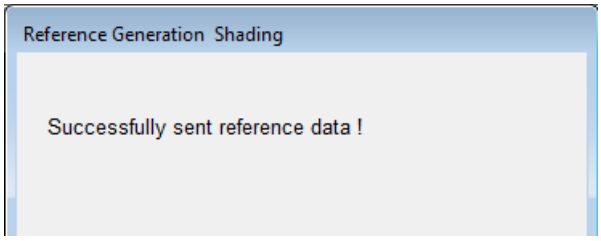
- In the **Timeout value** box, enter the timeout value in seconds.
- Move the target slightly or defocus the lens to avoid streaky images, if necessary.

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**  .

5 **Wait for result**

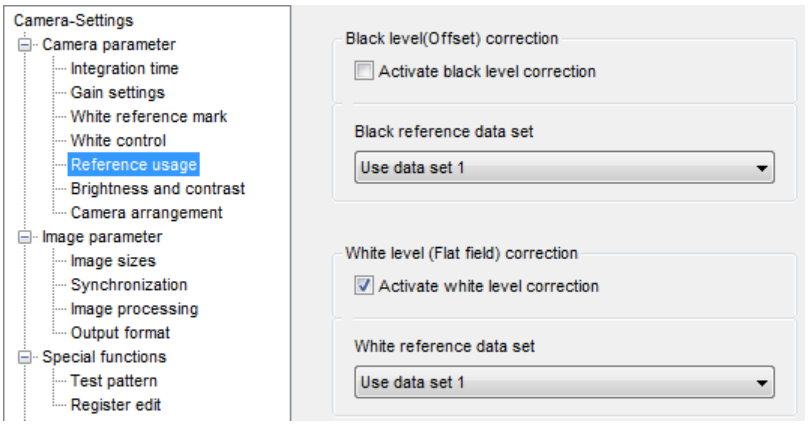
A progress bar is shown while the reference is created and stored. When it has finished successfully, the wizard shows the following message:



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

6 Activate shading correction and check the result in the image.

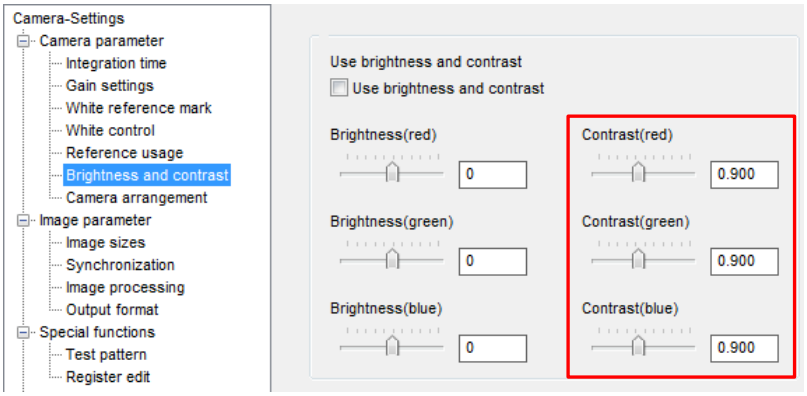
- On the toolbar, click **Show settings**  , and then click **Reference usage**.
- To check white-level correction, select the **Activate white-level correction** check box and check that the just updated data set is used:



- 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 using a contrast adjustment of 230/255=0,90.



7 Save the setting

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

10.6 Using continuous white control

10.6.1 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.

Operating point adjustment range with a reference for the operating point can be individually set with CST. This range must be inside the scanning range of the allPIXA camera.

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 adjusted automatically.

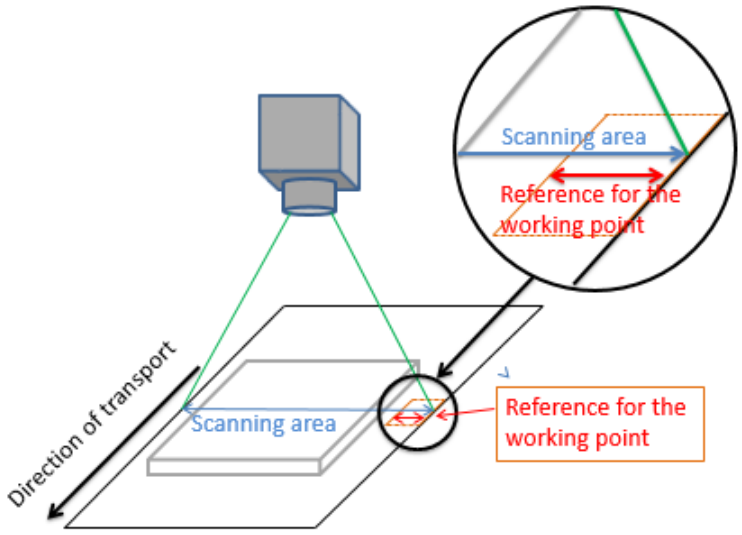
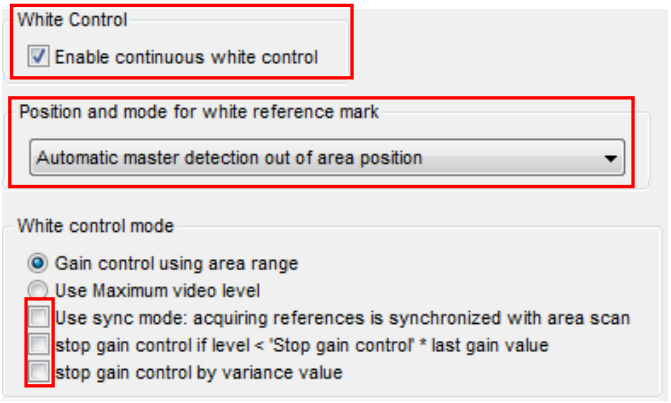


Figure 33: allPIXA camera with continuous automatic white balancing

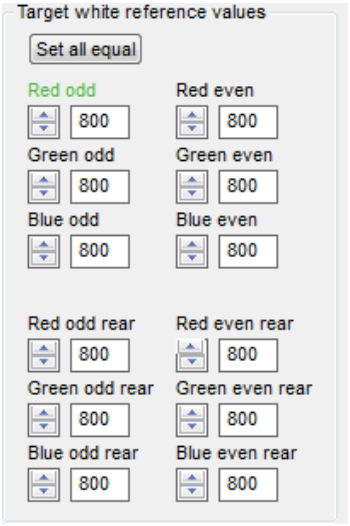
1	• Set up the camera
2	• Place the static white reference in front of the camera and check the position.
3	• In CST, on the toolbar, click **Show settings** , and on the tree view click **White reference mark**. • Select the **Display white reference borders in the image** check box. • Specify position and size of the white reference (see also section 11.3)

4

- In the tree view, click **White control**.
- Select the **Enable continuous white control** check box.
- Select the tap for white control
- Make sure that the **Use sync mode** check box is cleared:



- Set the target reference values:



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

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

5

- Wait for balanced image.
- Check for saturation.
- In CST, on the toolbar, click **Refresh current camera parameters** :
- On the toolbar, click **Burn setting permanently** , or press **F10**.

6

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

10.6.2 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 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 adjusted automatically.

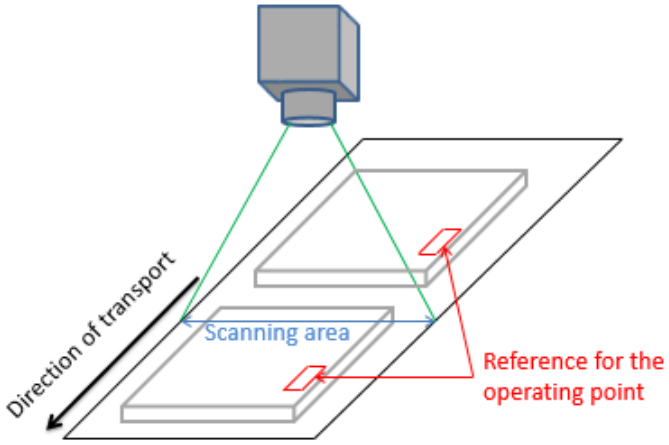


Figure 34: Image-synchronous operating point adjustment on the object (ROI)

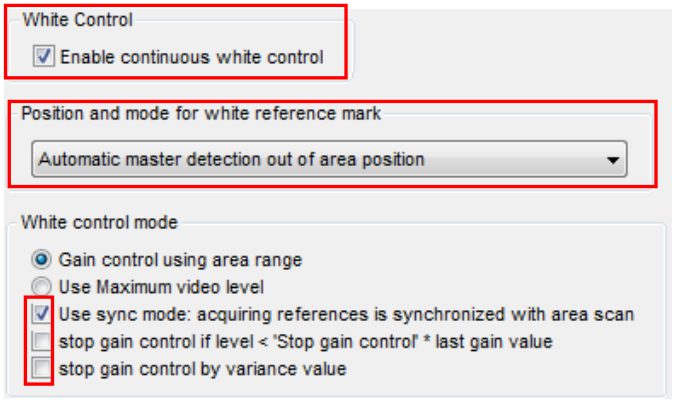
NOTE I	This mode requires an image trigger signal at the allPIXA camera. The image trigger can be provided by CC1 through the CameraLink or by the IO port of it. The allPIXA camera has to be operated in frame scan mode. Gain control has to be set to image synchronized mode.

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

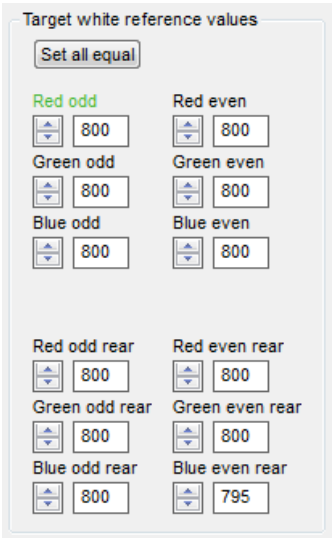
1	• Set up the camera.
2	• Start the transport with sample objects.
3	• In CST, on the toolbar, click **Show settings**  , and on the tree view click **White reference mark**. • Select the **Display white reference borders in the image** check box. • Specify position and size of the white reference area (see also section 11.3).

4

- In the tree view, click **White control**.
- Select the **Enable continuous white control** check box.
- Select the tap for white control
- Select the **Use sync mode** check box:



- Set the target reference values:



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

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

5

- Wait for balanced image.
- Check for saturation.
- In CST, on the toolbar, click **Refresh current camera parameters**:
- Set the initial gaining values.
- On the toolbar, click **Burn setting permanently**, or press **F10**.

6

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

10.7 Updating the firmware of the allPIXA camera

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

Perform the following steps to update the camera safely.

Download the current firmware from the Chromasens website (https://www.chromasens.de/en/user).

You either must have a valid partner account to access the software or follow the link provided by the shipment of the camera.

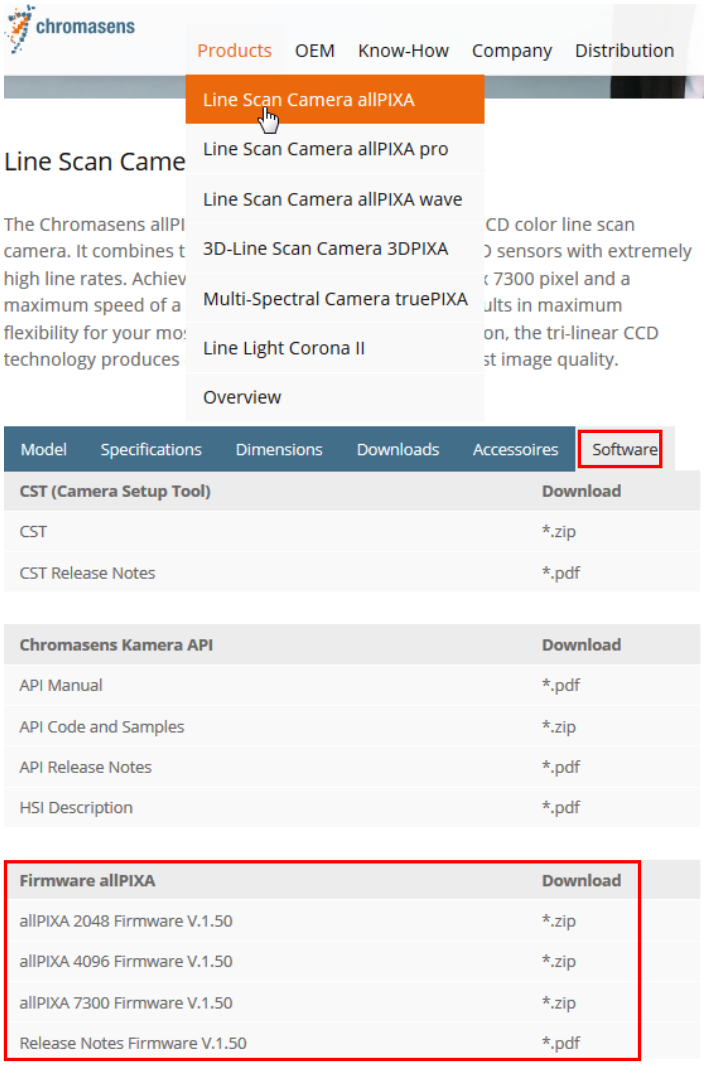
If you are not already registered, request an account. It is free of charge!

Be sure to enter valid information into the request form. Otherwise, you are not granted access to the site.

Be assured that your information is not passed on to others outside Chromasens.

The software can be found in the login section of the Chromasens homepage or directly by following the link that was delivered with your allPIXA wave-camera:

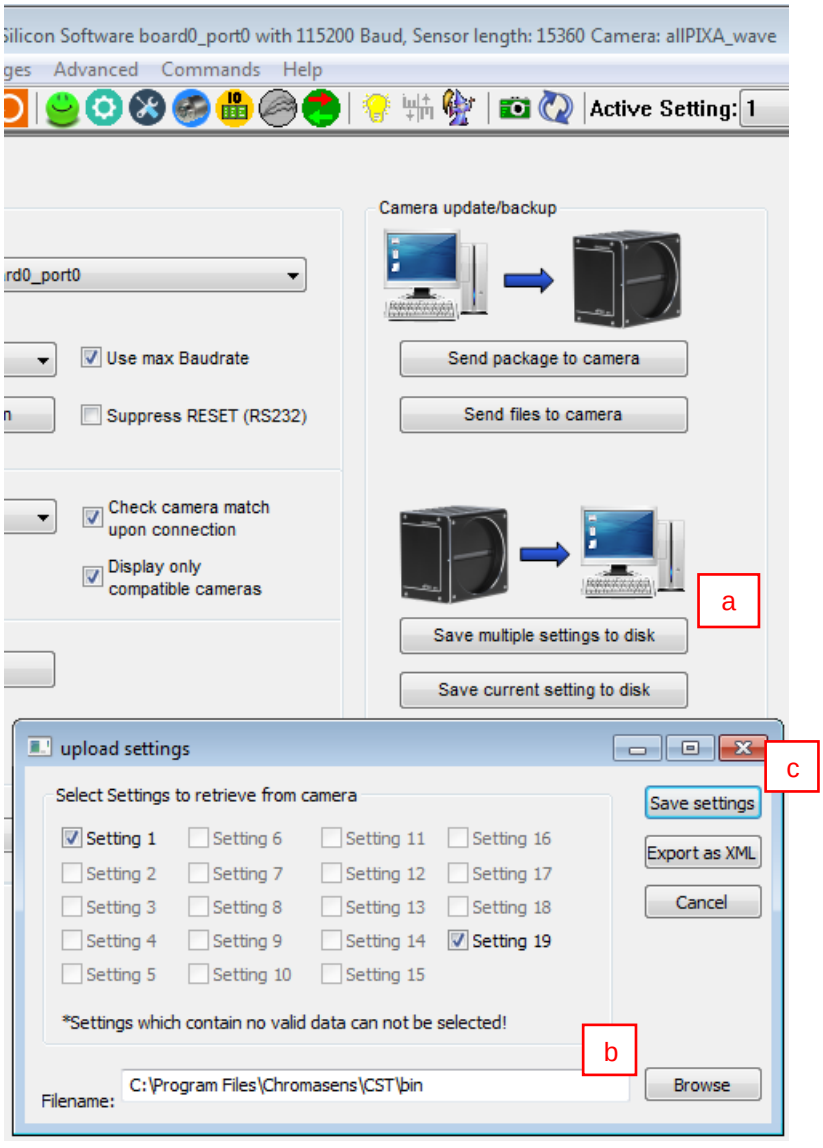
The Software can be found on the Chromasens homepage or directly by following the link that was delivered with your allPIXA-camera:



1

- Start CST and select the correct port to connect with the camera.
- Click **Show system configuration** to show the **System configuration** view.
- Backup your settings
  Some internal settings may be reset to factory defaults when you perform a firmware update. Therefore, it is recommended to save your own settings as backup.

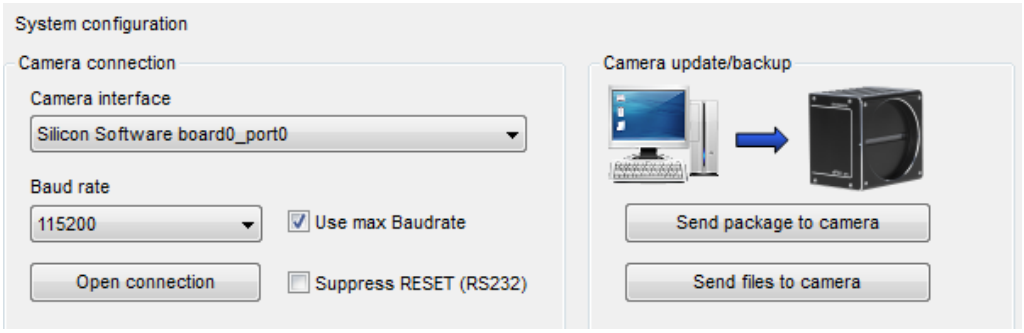
  - Click **Save multiple settings to disk** a, select a folder in the **Upload Settings** dialog box b and then click **Save settings** c.

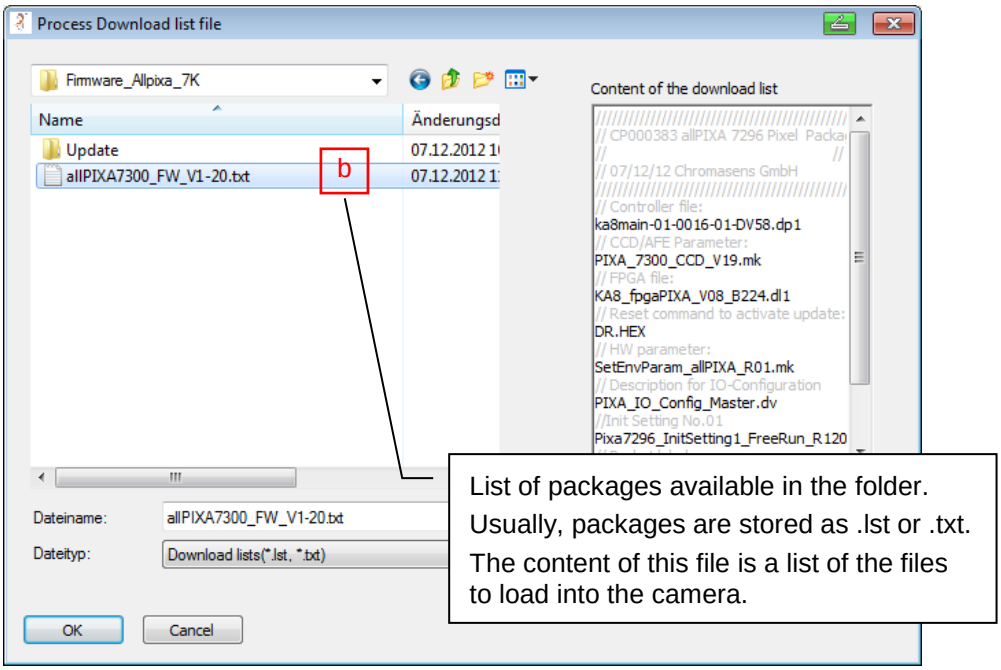


Settings are saved as single files in the specified folder. The setting number is appended to the specified filename.
(example: setting 17 is saved as backup_121207_17.mk)

2

- Click **Send package to camera**:





- 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**_Firmware_**VERSION**.txt
  (for example AllPIXA camera**7300**_Firmware_**V1_20**.txt)

  This file should be used in an allPIXA camera with the line length of 7,300 and contains the package Version 1.68

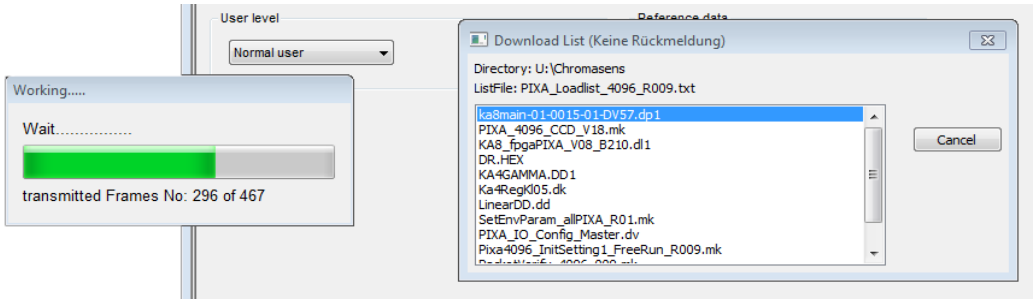
- Click **OK**.

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

3

The progress and the files that are downloaded to the camera are displayed in the **Download List** box.

The **Working** message box with the progress bar displays the progress of the current file:



Download is finished when the **Download List** box and the **Working** box are closed.

Then the log message view of the CST displays the following message:

14:07:27:409 Package download complete

4

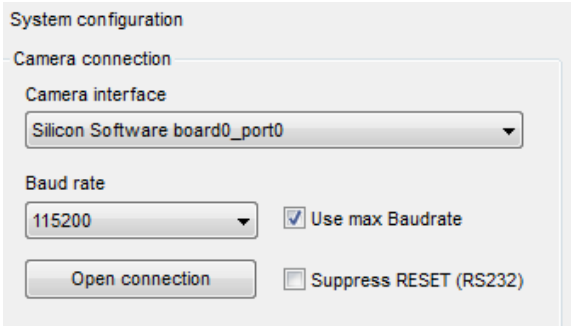
- Switch off power supply of the camera.
- Wait 5 seconds.
- Turn power on again.

  Wait until the Status LED of the camera is illuminated blue again. Depending on your setting, the LED could also be flashing blue.

5

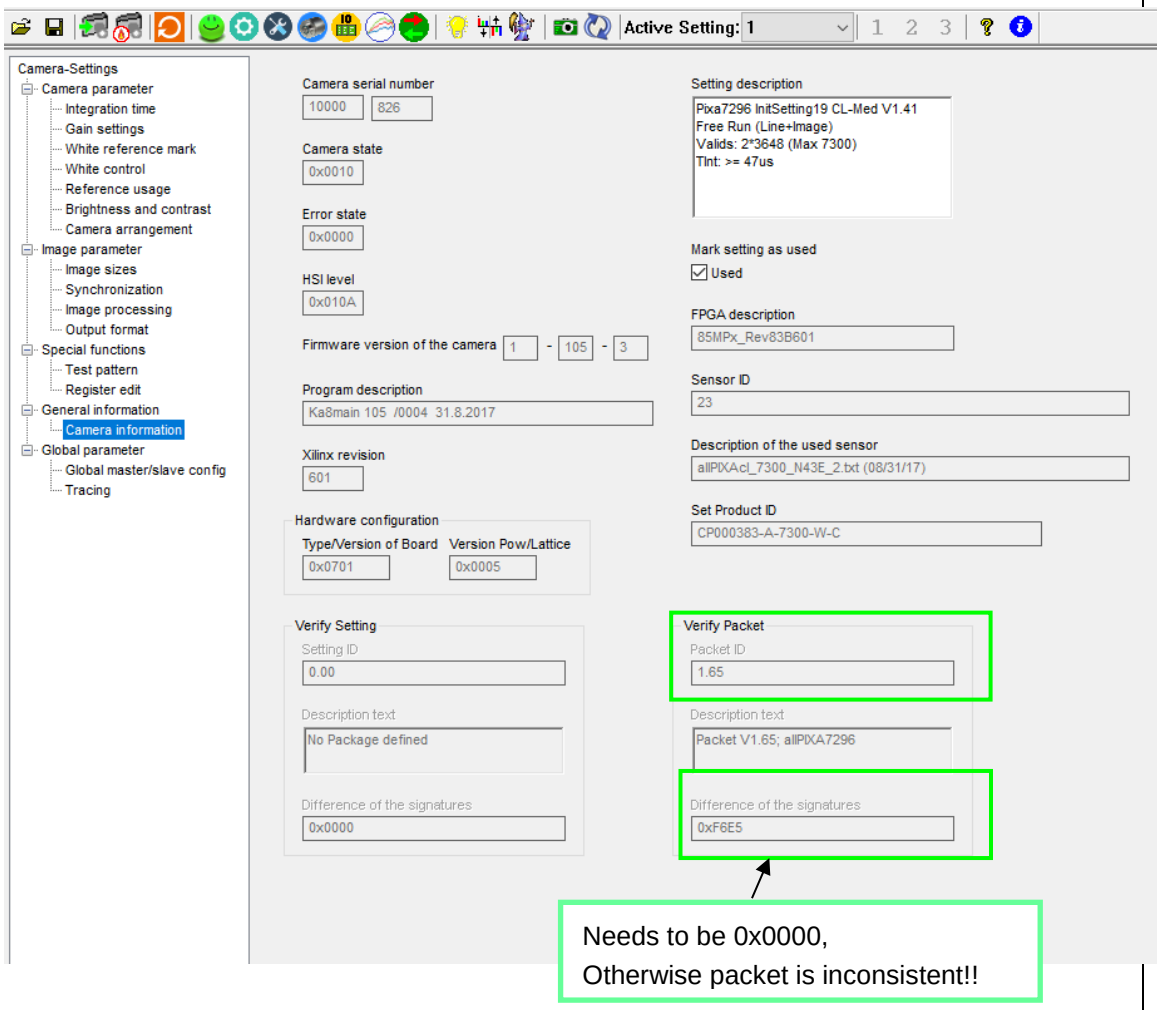
- Click **Open connection** to connect CST to the camera.

  It is not necessary to restart CST.



6

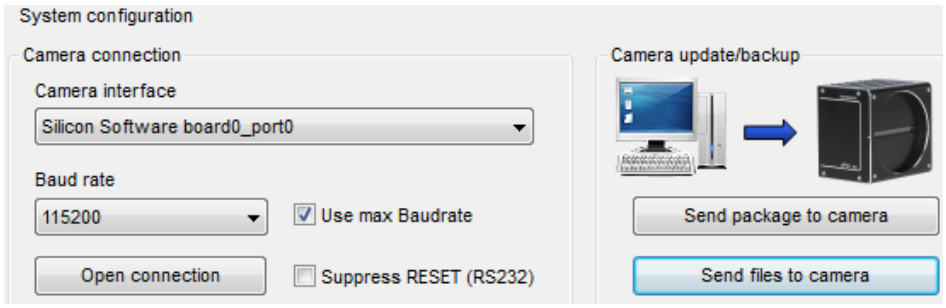
- On the toolbar, click **Show settings**, and then click **Camera information**.
- Check that **Packet ID** shows the correct version and that **Difference of the signatures** has the value 0x0000:



Now the camera is ready for operation again.

7

- On the toolbar, click **Set system settings**.
- Click **Send files to camera**.
- In the **Send data files to camera** file dialog box, select the respective setting files, and then click **OK**.



11 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, refer to chapter 9 *“*CST functions*”.*

The visibility of the parameters is defined by the selected user level in CST.

You can find a general overview of the camera parameters and their general functions on the CST user interface in section 9.3.

11.1 Integration time parameters

11.1.1 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	For 7.3k: If **CameraLink connection speed** is set to a different value than **High speed**, minimum integration time is higher. For more information, see section 0		
	Camera:	**Value CST:**	
Lower limit	2k:	16.45 µs	
	4k	29 µs	
	7.3k	47 µs	
Upper limit	All	12.3 ms	

The integration time determines the time for which light is collected at each scan line. If integration time is increased, the resulting scan lines are brighter and vice versa.

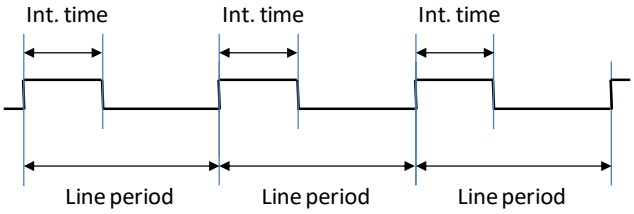
If you increase integration time, the transport speed of the target must be reduced accordingly to receive images of the same resolution in horizontal and vertical direction.

11.1.2 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

11.1.3 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	Is only available if the **Use line period** check box has been selected.		
Notes	Value must be greater than **Integration time**		
	Camera:	**Value CST**	
Lower limit	2k	> 16.45 µs	
	4k	> 29 µs	
	7.3k	> 47.1 µs	
Upper limit	All	12.36 ms	



11.2 Gain settings

11.2.1 Analog coarse gain

This parameter describes the CDS gain parameter of the camera which takes effect in step (1) of analog image processing (*section 4.6.1 "*Analog / digital image processing"*; Figure 9*).

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). So with this factor the possible output range can be adjusted. With this "adjustable two step amplification" it is possible to adjust the allPIXA for a wide range of applications.

Usage: If the current gaining values are higher than about 200, 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 gaining values in a range from 80 – 200 for best image quality by using the **Analog coarse gain function** to pre-adjust the actual gain range

Note: If the output signal of the CCD is higher than the possible input signal of the AFE, this might cause “saturation” in the image lower than 255. Therefore analog coarse gain has to be set to – 3 dB.

11.2.2 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 4.6.1*, *“Figure 9: Analog process of the allPIXA camera (block diagram)*”).

With active white control, this parameter refers to the gain values labeled with (3) in the diagram of section *4.10*.

	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. By increasing up to 168 steps, it doubles the signal.	
	Camera:	**Value:**
Lower limit	all	0
Upper limit	all	700

11.2.3 Camera startup gain values

	Name	
Name	Camera start gain values	
Function	In accordance with these values, the gaining values are updated at startup of the camera or if a setting is loaded 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

11.2.4 Store White balancing parameter

	Name	
Name	Store parameters	
Function	In accordance with these values the gaining values are updated at startup of the camera or if a setting is loaded 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

11.2.5 Copy White balancing parameter

	Name	
Name	Copy parameters	
Function	In accordance with these values the gaining values are updated at startup of the camera or if a setting is loaded 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

11.2.6 Update camera startup 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

11.3 White reference mark

11.3.1 Position and size in CCD direction

NOTE	**Attention:** The white reference area may not overstep the tap border.

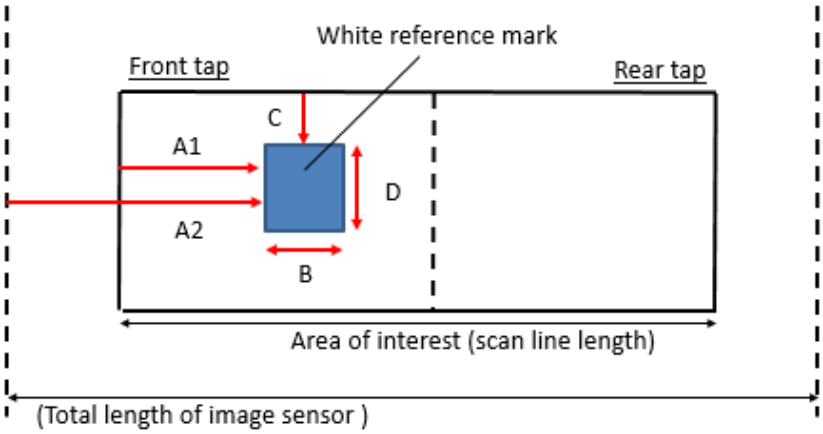
For the position in CCD direction of the white reference control zone you may have two possibilities:

"Relative" x position:

The x position of the white reference mark can be defined "relative" to the current image window. If defined *relative*, the reference position **moves** with changing the scan line length of the current scan window.

"Absolute" x position

The x position of the white reference mark can be defined "absolute" within the maximum scan window. If defined *absolute*, the reference position **does not** move with changing the width of the current scan window.



A1= First relative pixel of white reference (may be negative) (see section 11.3.3)

A2= First absolute pixel of white reference (see section 11.3.4)

B = Number of pixels for white reference (see section 11.3.6)

C = First image line of white reference (may be negative), only used if *white control mode is set to "sync mode" (see section 0*)

D = Number of image lines for white reference (see section 11.3.8)

(*A): Number of valid pixels depends on the type of camera:

allPIXA camera7300: number of valid pixel = 7300

allPIXA camera4096: number of valid pixel = 4096

allPIXA camera2048: number of valid pixel = 2048

The **Use absolute horizontal white reference position** check box selects whether relative or absolute white reference mode is used.

Size of the white reference area is defined with "number of pixel for white reference"

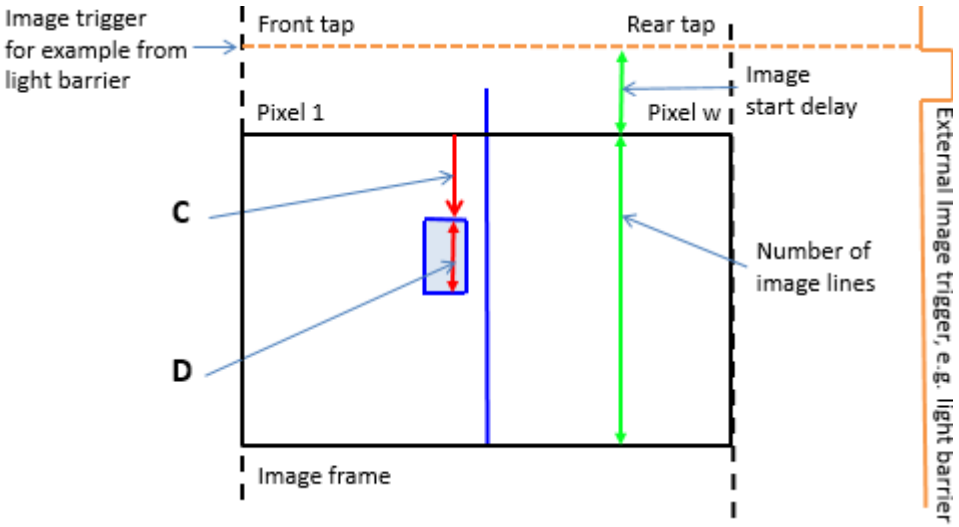
11.3.2 Position and size in transport direction (sync. mode)

By default, the reference area is not synchronized to image frame acquisition. Measurement of white reference values is done continuously, no matter if the image frame is active or not.

If **Use sync mode** is selected at **White control mode** (see section 11.4.5), 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 actual image window.

NOTE	**Attention:** Vertical reference white position **moves** with changing **Image start delay** of the actual scan window.



The size of the white reference area is defined with **Number of image lines for white reference**.

11.3.3 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 actual captured image)	
Channels	All	
Unit	Integer	
Dependency	None	
Notes		
Value:		
Lower limit	All	0
Upper limit	2k	1,022 – Number of pixels of white reference
	4k	4,096 – Number of pixels of white reference
	7.3k	3,646 – Number of pixels of white reference

11.3.4 First absolute pixel of white reference

Name		
Name	First absolute pixel of white reference	
Function	Describes the start of the control zone for the 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	
Upper limit	2k	1,022 – Number of pixels of white reference
	4k	4,096 – Number of pixels of white reference
	7.3k	3,646 – Number of pixels of white reference

11.3.5 Use absolute horizontal position of white reference

Name			
Name	Use absolute horizontal position of white reference		
Function	If this check box is selected, absolute horizontal position of white reference is used (see section 11.3.4), otherwise, relative position is used (see section 11.3.3)		
Channels	All		
Unit	Bool		
Dependency	None		
Notes			
	Camera:	**Value:**	**Function:**
Lower limit	All	0	Off
Upper limit	All	1	On

11.3.6 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		
	Camera:	**Value:**
Lower limit	All	2
Upper limit	All	1,022

11.3.7 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		
	Camera:	**Value:**
Lower limit	All	0
Upper limit	All	Image size – Number of vertical pixels

11.3.8 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	Only if the image synchronized mode is used for white balancing.	
Notes		
	Camera:	**Value:**
Lower limit	All	2
Upper limit	All	1,022

11.3.9 Number of reference samples (Average)

Name		
Name	Number of reference samples for white reference	
Function	Number of ROIs needed for averaging of current video value for closed-loop control, either with synchronization or in free-running mode.	
Channels	All	
Unit	Integer	
	None; 2; 4; 8; 16; 32	
Dependency	None	
Notes		
	Camera:	**Value CST:**
Lower limit	All	None
		2 samples
		4 samples
		8 samples
		16 samples
Upper limit	All	32 samples

11.3.10 Show white reference border

Name			
Name	Display white reference borders in the image		
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 has to be switched off for taking reference images regarding to black and white correction.		
	Camera:	**Value:**	**Function:**
Lower limit	All	0	Off
Upper limit	All	1	On

11.4 White control

11.4.1 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	
	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	• Refers to the white control mark. Inside this area the closed loop control tries to adjust gain to reach these desired values. • Value is a 10-bit video value, output range of the image at the CameraLink 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 *4.10*.

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 date. The maximum dark reference value is 64 (in 8 bit)
NOTE II	The level of the target value has to be adapted to the position of the white reference control zone (see **Figure 38**). For zone 1, the values have to 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.

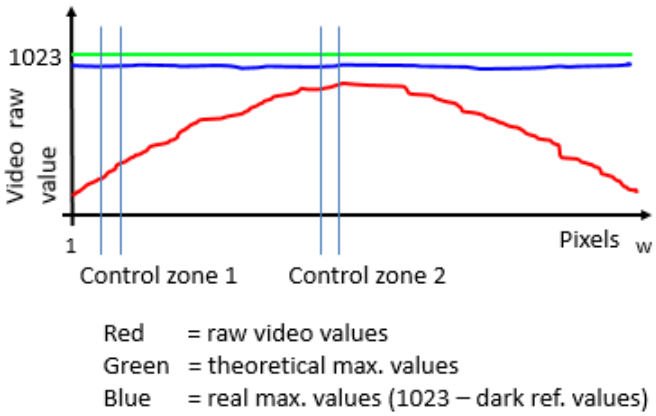


Figure 38: Sample of raw and theoretical video and dark reference values

11.4.2 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	• Refers to the white control mark. • 10-bit video value during output range of the image at the CameraLink 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 *4.10*.

11.4.3 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

11.4.4 Position and mode for white reference mark

	Name	
Name	Position and mode for white reference mark	
Function	Set the reference zone either to front tap, rear tap, both taps independently or automatic detection. If only one tap is selected the other tap is controlled as slave.	
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	Function only available if **User level** has been set to **Guru**. The exact size and position is described in section 11.3	
	Camera:	**Function:**
Lower limit	All	Master: Front tap Slave: Rear tap
	All	Master: Rear tap Slave: Front tap
	All	Taps are independent
Upper limit	All	Automatic master tap detection out of area position (recommended!)

11.4.5 White control mode

	Name	
Name	White control mode	
Function	Set the mode of the white control function	
Channels	All	
Unit		
Dependency	Only available if the **Enable white control** check box is selected.	
Notes	Function only available if **User level** has been set to **Guru**.	
	Camera:	**Value:**
	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 image 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 could be paused by using this option. For experienced users only.

11.4.6 Gain control stop factor

Name			
Name	Gain control stop factor		
Function	Sets the pause condition for the white control.		
Channels	All		
Unit	Float	**Step:**	1/1024
Dependency	It is only available if the check boxes **Enable continuous white control** and **Stop gain control** are both selected in the **White control** area.		
Notes	If you use this condition, the white control pauses: Average of all actual "Current white reference values" < value * Average of the last valid "Current white reference values".		
	Camera:	**Value CST:**	
Lower limit	All	0	
Upper limit	All	1,00	

1. **Description of paper (object) detection function:**

   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 certain situations during the scan 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 value 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 actual 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.

11.4.7 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 by use of 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.

11.4.8 Select active channels for white control

Name		
Name	Red / Green / Blue	
Function	Determines which channels are active during automatic white balancing	
Channels	All	
Unit		
Dependency	Applies only to all automatic gain control functions such as white balancing	
Notes	If you work with “white” illumination, leave all channels set to “Enabled” (Standard use of the allPIXA wave). 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.	
	Camera:	**Value CST:**
Lower limit	All	0
Upper limit	All	1,00

11.5 Reference usage

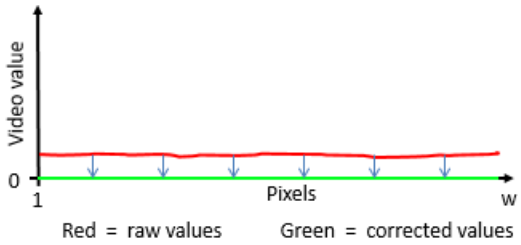
11.5.1 Black-level (offset) correction

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 of the pixel-by-pixel mode and corrects the different behavior of the individual pixels (**DSNU** = **D**ark **S**ignal **N**on-**U**niformity) 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 wave camera during factory calibration.

Four reference sets for the black-level correction are supported by the allPIXA wave camera as well as two reference sets for the shading correction. You can specify the reference position number if you create the reference using the Reference Wizard in CST, and it can be selected in the allPIXA wave 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 of *section 4.6.1.*

11.5.2 Black reference data set

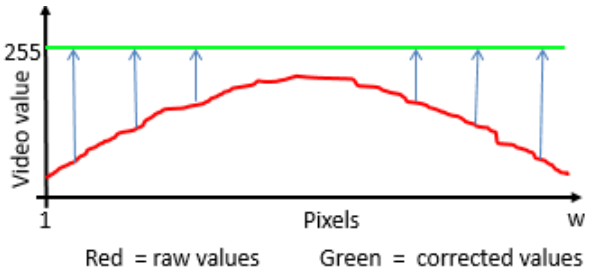
Name			
Name	Black reference data set		
Function	Select the data set for black-level correction.		
Channels	All		
Unit	Integer		
Dependency	None		
Notes	Four data sets for black reference can be stored inside of the camera. The number for the storage space has to be selected in the CST during the Shading wizard process.		
	Camera:	**Value:**	**Function:**
Lower limit	All	0	Data set 1 is used
Upper limit	All	3	Data set 4 is used

11.5.3 White-level (flat-field) correction

Name			
Name	Activate whit-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 of the pixel-by-pixel mode and corrects the different behavior of the individual pixels in the images (**PRNU = P**hoto **R**esponse **N**on-**U**niformity). Additionally, it compensates any non-homogeneities in illumination.

Four reference sets for the shading correction are supported by the allPIXA wave camera, as well as two reference sets for the black-level correction. The reference position number can be entered if the reference is created using the Reference Wizard in CST, and it can be selected in the allPIXA wave 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 of *section 4.10*.

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 afterwards.

11.5.4 White reference data set

Name			
Name	White reference data set		
Function	Select the data set for white-level 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 has to be selected in the CST during the Shading wizard process.		
	Camera:	**Value:**	**Function:**
Lower limit	All	0	Data set 1 is used
Upper limit	All	3	Data set 4 is used

11.6 Brightness and contrast

These parameters describe the digital gaining and offset parameters for the camera. Brightness and contrast adjustment takes place in step (3) of the digital image processing pipeline (section *4.6.1; "Figure 10: Digital process of the allPIXA camera (block diagram)"*).

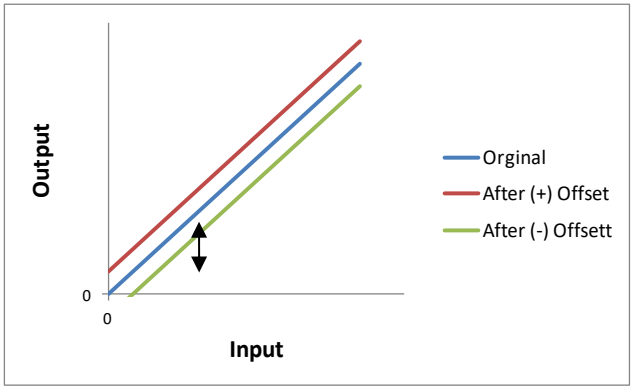
NOTE	If these parameters are used to adjust image brightness in a wide range to get brighter images, this may degrade image quality. First, use analog gaining to adjust brightness of the image (see sections 11.2.1 and 11.2.2). For instance, after adjusting analog gain and performing a shading correction (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 afterwards.

11.6.1 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

11.6.2 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.		
	Camera:	**Value:**	**Output image:**
Lower limit	all	-255	-64
Upper limit	all	255	64



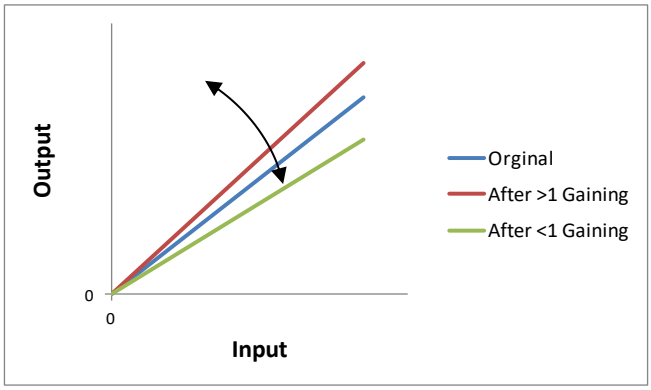
Take notice that using "Brightness" causes a digital offset in the image data:

Vid Brightness Out(x,y) = (VidIn(x,y) + Offset)

- VidIn(x,y) — Pixel-normalized image after the shading correction (0...2047 in 10Bit area)
- Offset — Additionally adjustable "Brightness" for this color separation (-255… 0 +255 in 10Bit area)
- (x, y) — Number of pixels within a line or column
- Vid Brightness Out(x,y) — Output of this step (area 0…1023)

11.6.3 Contrast

Name			
Name	Contrast		
Function	Digital gaining		
Channels	Red; Green; Blue		
Unit	Float	**Step**	0.001
	Linear		
Dependency	Only available if the **Use Brightness and Contrast** check box has been selected		
Notes			
	Camera:	**Value CST:**	
Lower limit	all	0	
Upper limit	all	2.00	



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 Additionally adjustable “Contrast” for this color separation (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 (see section 4.6.1; “*Figure 10: Digital process of the allPIXA camera (block diagram)*”:

1. Brightness
2. Contrast

11.7 Camera arrangement

11.7.1 Set 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**	0,001
	Linear		
Dependency	None		
Notes	The value “0” switches this function off. For cameras up to 4k the line delay can be set up to 6 lines, for cameras with sensor length more than 4k it is limited to 4 lines.		
	Camera:	**Value CST**	
Unit		In 1/1 lines	
Lower limit	All	0.0	
Upper limit	> 4,096 pixel	4.0	
Upper limit	<=4,096 pixel	6.0	

The trilinear lines of the allPIXA 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 3 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. For more information, see 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 camera enables this compensation with up to 4+4 lines spacing according to the camera with sensor length of more than 4,096 pixels, for sensor length up to 4,096 pixels a spacing of up to 6+6 lines is possible. 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 might 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 the transport resolution is lower than the optical one.

If you prefer 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 to the resolution in CCD direction (=optical resolution).

For calculation of the setting value, you may use one of the following formulas:

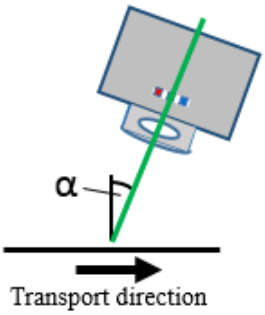
Either

$$Line\ distance = \frac{TransportResolution(dpi) * 4}{OpticalResolution(dpi) * cos(\alpha)}$$

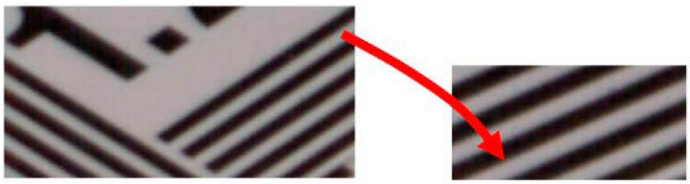
Or

$$Line\ distance = \frac{OpticalPixelSize\left(\frac{mm}{pixel}\right) * 4}{TransportPixelSize(\frac{mm}{pixel}) * cos(\alpha)}$$

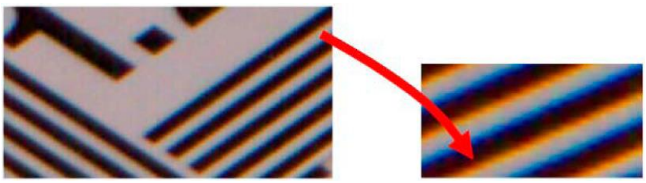
α viewing angle in transport direction (0° = perpendicular)



Function of the subpixel line shift:



With subpixel compensation

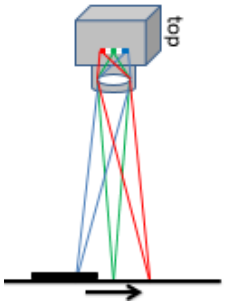
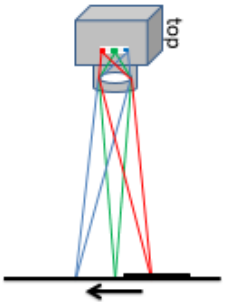


Without subpixel compensation

11.7.2 Set 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:**	**Function:**
Lower limit	All	0	Forward
Upper limit	All	1	Backward

Direction of the spatial correction depends on the direction of transport regarding to the orientation of the camera, that means that 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.

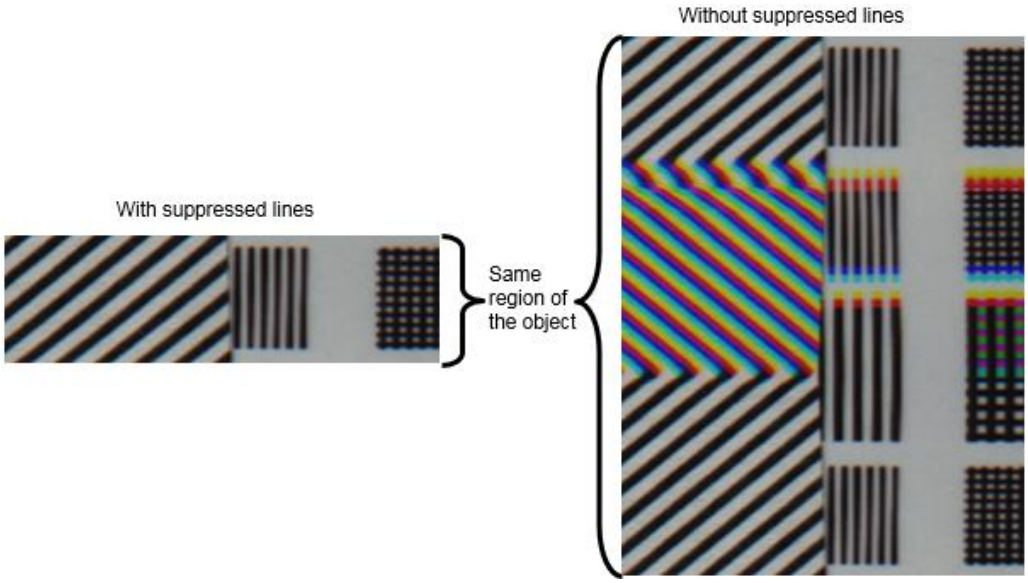
Direction:	Image for value „0“ - Forward:	Image for value „1“ - Backward:
		
		

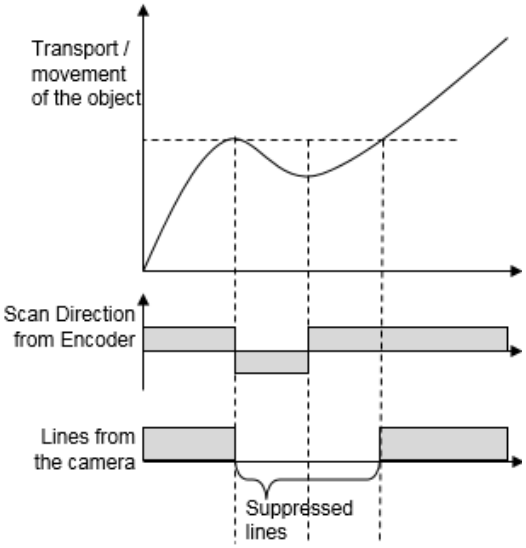
If the encoder is activated, the transport direction is determined in the encoder controller. By default, the direction is forwarded directly. If necessary, It can be inverted using the IO Configurator. For more information, see section 9.13.

11.7.3 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	None	
Notes	Only available if the scan direction could be detected by two-channel encoder or input.	
	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:





11.7.4 Mode of lines/frame suppression

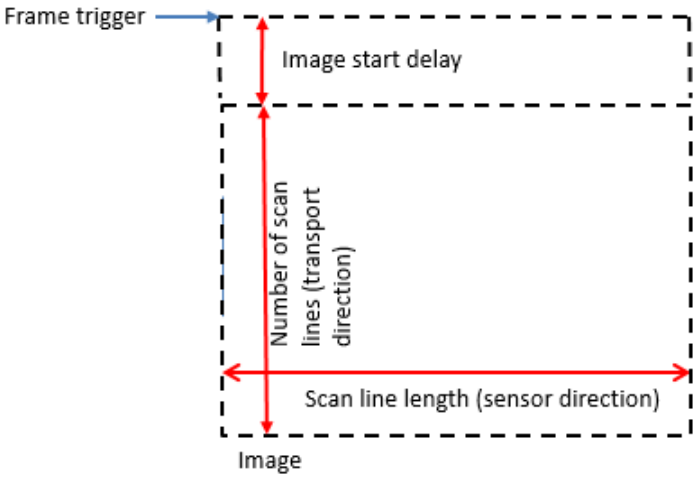
Name		
Name	Suppress lines/frames mode	
Function	Defines the direction for suppression	
Channels	All	
Unit	Bool	
Dependency	None	
Notes	Only available if the **Enable suppression of lines/frames** check box is selected.	
	Camera:	**Value:**
Lower limit	All	Suppress lines against selected direction
Upper limit	All	Suppress lines in selected direction

11.8 Image Sizes

11.8.1 Number of scan lines per image

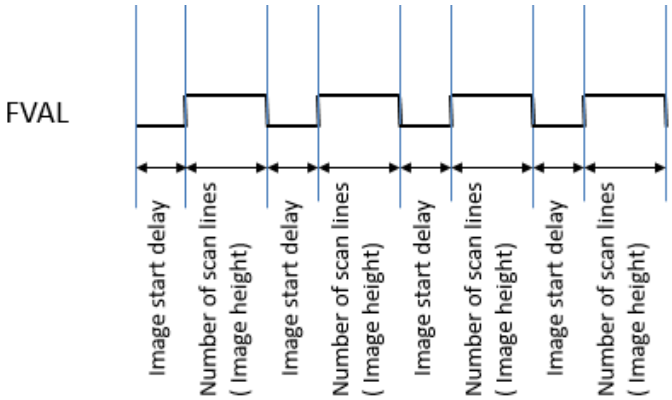
Name		
Name	Number of scan lines per image	
Function	Image size in transport direction	
Channels	All	
Unit	Integer	
Dependency	Only in frame scan mode	
Notes		
	Camera:	**Value:**
Lower limit	All	1
Upper limit	All	1048575

If the camera is supplied with information of the frame start at CC3 or CC4 (via CameraLink) or at the IO-Port, it is able to generate VSync and frame valid signal. The external signals have to be connected with the IO Configurator to the internal functions in CST. Without these signals the camera is able to send images in free-running mode.

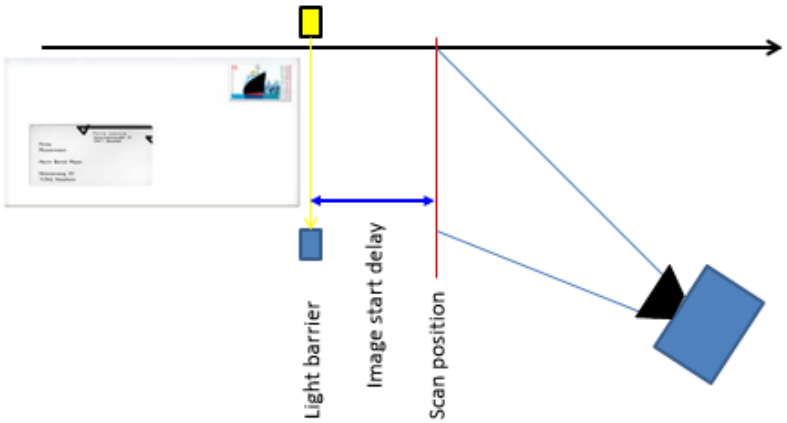


11.8.2 Image start delay (lines)

Name		
Name	Image start delay (lines)	
Function	Delay of image start after image trigger in lines, the image trigger could be taken internally or externally. With the default value 0, FVAL is always high.	
Channels	All	
Unit	Integer	
Dependency	Only in frame scan mode	
Notes		
	Camera:	**Value:**
Lower limit	All	0
Upper limit	All	65595 (64K-1)



Sample for using Image start delay:



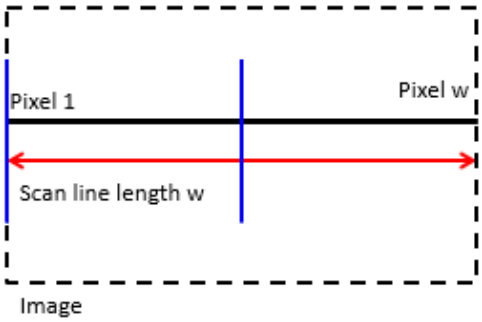
Please refer to *section 11.8.5 Synchronization.*

11.8.3 Scan line length

Name		
Name	Scan line length	
Function	Image width	
Channels	All	
Unit	Integer	
Dependency	None	
Notes	The numbers of pixel are centered to the visible area of the camera.	
	Camera:	**Value:**
Lower limit	All	2
Upper limit	2k:	2,048
	4k	4,096
	7.3k	7,300 (7,296 by default)

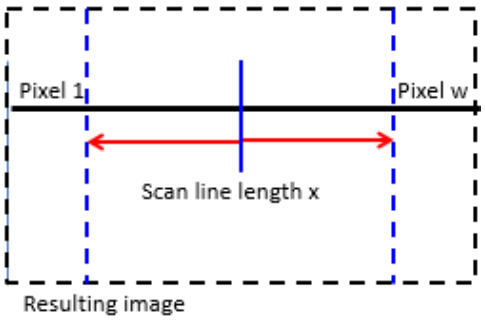
There are 2 different cases for scan line length:

- **Original: Scan line length equal to sensor length:**



Scan line length is set to the sensor length of the camera, for example 4096.

- **Cropping: Scan line length shorter than sensor length:**



The camera captures an image from a ROI which is centered in the sensor.

11.8.4 Horizontal binning

Name			
Name	Horizontal binning		
Function	Enables horizontal pixel reduction. Several neighbored pixels are averaged to one 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 frame 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 pixel for your application and combination of camera settings and used frame grabber.		
Notes	Only the amount of output data per line is affected. 0: 1/1 (no reduction) 3: 1/8 1: 1/2 4: 1/16 2: 1/4		
	Camera:	**Value:**	**Function:**
Lower limit	All	0	Off
Upper limit	All	4	1/ 16 reduction

11.8.5 Number of suppressed lines

Name		
Name	Number of suppressed lines	
Function	Number of lines which are ignored for output; causes reduction of data or resolution in transport direction.	
Channels	All	
Unit	Integer	
Dependency	None	
Notes		
	Camera	**Value**
Lower limit	All	0
Upper limit	All	255

NOTE This function is helpful for doing testing and system setups. If there is no encoder signal available and the speed for testing and setup is much lower than the nominal speed, the system can be tested with nominal integration time and gaining value.

Afterwards, the speed is as follows:

Vred=Vnominal / (1 + Number of suppressed lines)

11.9 Synchronization (frame synchronization)

The allPIXA camera is able to generate frame information. If you want to use this mode, you have to specify values for several parameters.

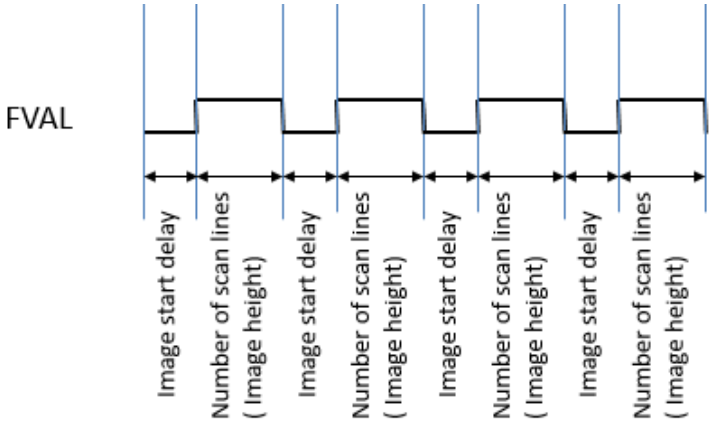
NOTE I	First, the hardware ports have to be connected to the internal functions of the camera. Therefore, use the IO Configurator in CST and refer to section 9.13 IO Configurator.
NOTE II	In case the camera is used in the “Triggered Frame Scan” with active LineTrigger or Encoder, the linesync (Encoder or LineTrigger) must fit some pulses before light barrier input.

11.9.1 Triggered frame scan

Name		
Name	Triggered frame scan	
Function	Enables the triggered frame scan modes	
Channels	All	
Unit	Integer	
Dependency	None	
Notes		
	Camera	**Function**
Lower limit	All	Free-running
	All	Use start conditions only
	All	Reserved
Upper limit	All	Start and stop condition

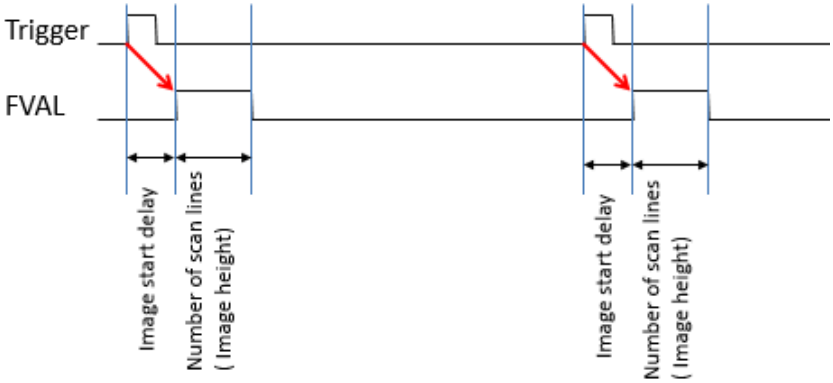
There are 4 different modes:

a) **Free-running:**
FVAL is generated continuously, depending on **Number of scan lines** (Image height) and **Image start delay**.

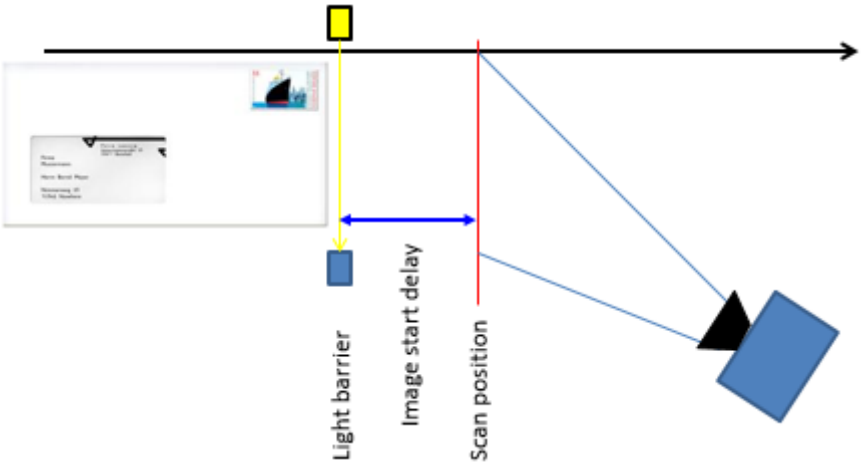


b) **Use start condition:**

FVAL is generated after receiving a 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 get a delay for a position of the light barrier before getting the scanning position.

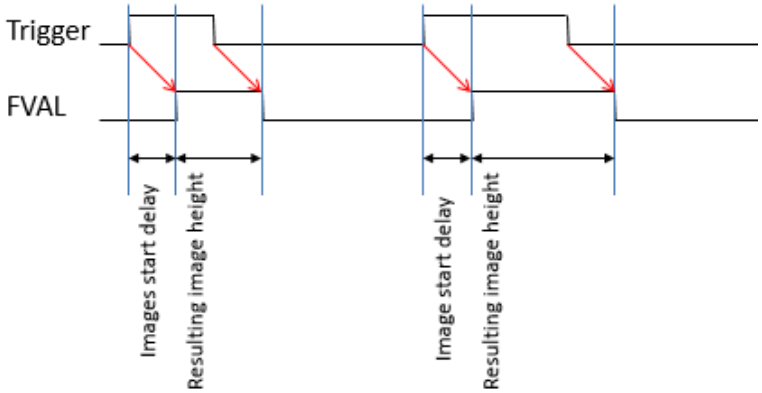


c) Reserved:

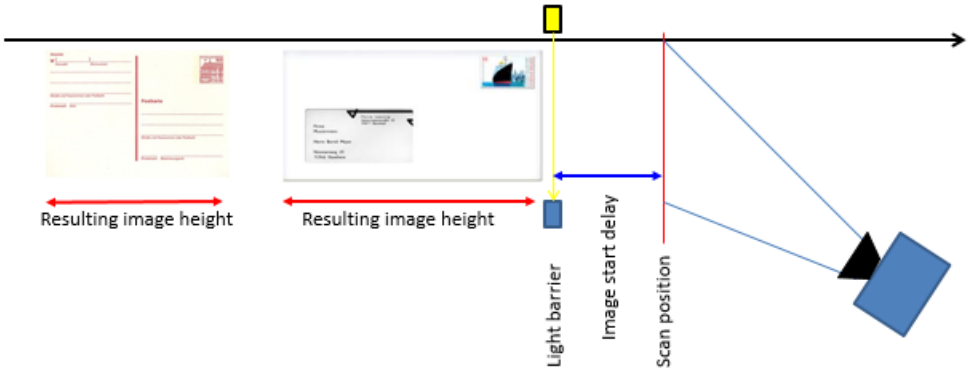
Reserved for OEM and future use.

d) Use start and stop condition:

FVAL is generated after receiving a trigger signal. The frame is delayed by the value of **Image start delay**. Image length depends on the length of pulse from the trigger port.



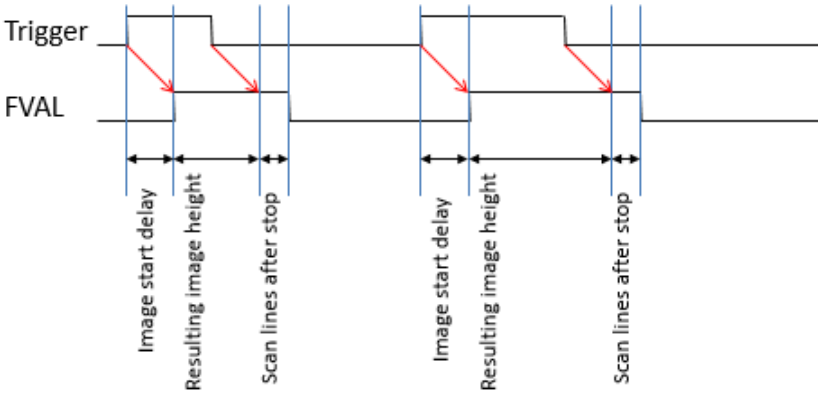
Sample: This function is useful for automatic detection of different object sizes; the camera sends a correctly sized image.



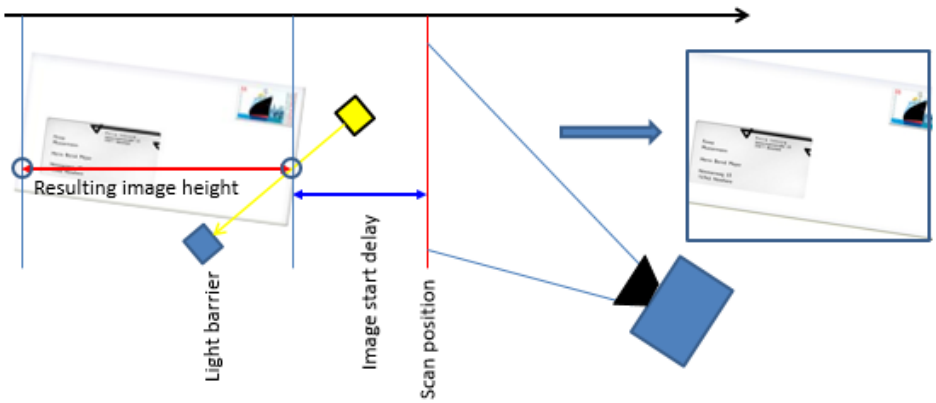
For information about **Number of scan lines** and **Image start delay**, see section 11.8.2.

11.9.2 Scan lines after stop

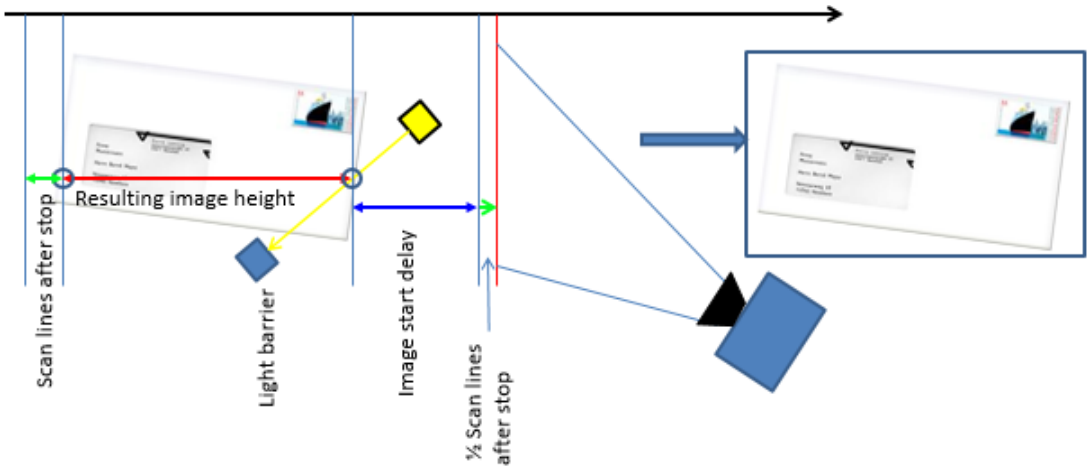
Name		
Name	Scan lines after stop	
Function	Sets the number of lines added to the image after the stop condition.	
Channels	All	
Unit	Integer	
Dependency	Only available if **Use start and stop condition** is selected at **Triggered frame scan**	
Notes		
	Camera	**Value**
Lower limit	All	0
Upper limit	All	65535



Sample: If the transported object is not rotated, the result with **Start and Stop condition** is not satisfactory.



If you use the parameter "Scan lines after stop", the setup deals with this issue:



- Sets a suitable value for the parameter **Scan line after stop**, for example 300 lines
- Reduces the value for the parameter **Image start delay** by the half of the value for **Scan lines after stop**. For example: Original value of 1000 lines – (300 lines / 2) = 850 lines

11.9.3 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 image trigger is detected after the specified **Maximum number of scan lines**.	
Channels	All	
Unit	Bool	
Dependency	Only available if **Use start and stop condition** is selected at **Triggered frame scan**	
Notes	The parameter **Maximum numbers of scan lines** must be set to a reasonable value.	
Camera		
Lower limit	All	Off
Upper limit	All	On

11.9.4 Maximum number of scan lines

Name		
Name	Maximum number of scan lines	
Function	Stops the image after getting the maximum numbers of lines in case no falling edge of the image 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	65535

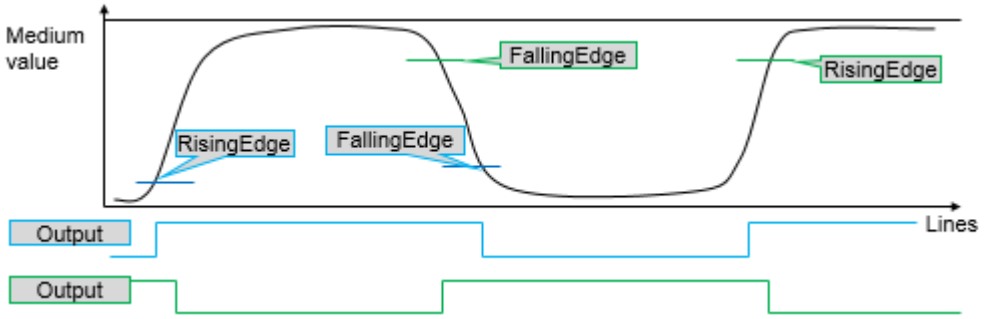
11.9.5 Internal frame trigger

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 9.13):

frame trigger / light barrier	CL1-CC3	All debouncing levels	LVDS	☐
	CL1-CC4	All debouncing levels	LVDS	☐
	X5-1/9	All debouncing levels	RS422	☐
	X5-2/10	All debouncing levels	RS422	☐
	internal frame trigger	All debouncing levels	---	☒
	X5-3	All debouncing levels	LVCMOS	☐

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):



11.9.5.1 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	###

11.9.5.2 ROI length

Name		
Name	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

11.9.5.3 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

11.9.5.4 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

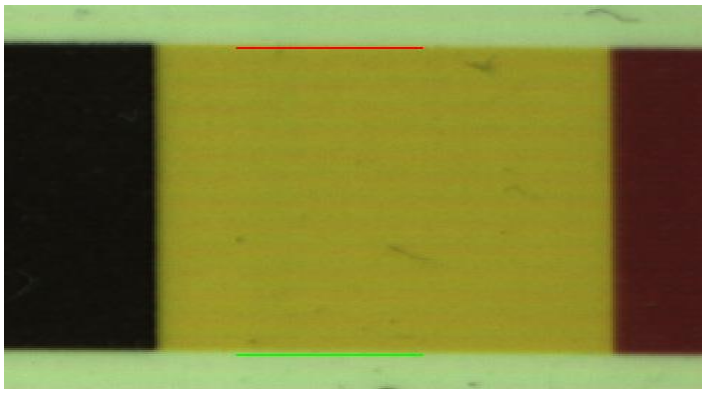
11.9.5.5 Color channel

	Name	
Name	Internal LB 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

11.9.5.6 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:



11.9.6 Input debouncing speed (Frame trigger)

To trigger images from an external source, the signal of the 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 or the D-Sub 15 IO port on the camera.

These external signals must be connected to the internal functions (LB 0 to LB 3) which have to be selected regarding to signal duration and signal quality of the trigger using the IO Configurator in CST.

The single inputs have different properties regarding the debouncing speed.

	Name	
Name	Input debouncing speed	
Function	Enables the internal ports to be used as frame trigger	
Channels	All	
Unit		
Dependency	Only active if **Use start condition** or **Use start and stop condition** is selected at **Triggered frame scan**.	
Notes		
	Camera	**Value**
	All	Peakholder (LB2)
	All	35 ns (LB1)
	All	4 image lines (LB3)
	All	70 image lines (LB0)

By using this option you can select the internal function ports for image trigger. The external ports (for example CC3 from Camera Link) must be connected to internal functions using the IO Configurator in CST (see section 9.13).

There are different methods for debouncing the signal:

- LB 0: 60 output lines
- LB 1: 4 clock pulses ~ 35 ns
- LB 2: no debouncing, peak holder
- LB 3: 4 output lines

Selection of the internal functions for triggering the image is done in CST.

11.9.7 Scan pattern

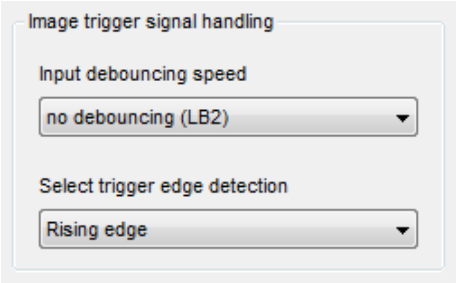
	Name	
Name	Select trigger edge detection	
Function	This determines whether the trigger is evaluated at the rising or at the falling edge.	
Channels	All	
Unit		
Dependency	Only active if **Use start condition** or **Use start and stop condition** is selected.	
Notes		
	Camera	**Value**
	All	Falling edge
	All	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**.

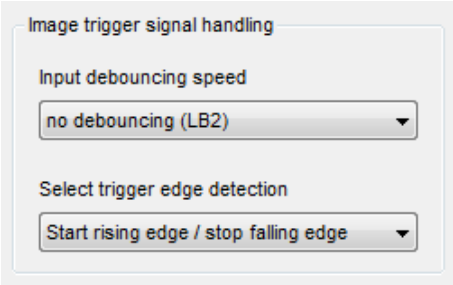
The state of the ports is checked synchronized with the line frequency clock. At each rising edge of the line frequency clock, the status is checked and the debouncing condition must be complied with.

The following tables show suitable sequences and their function (screen shots from CST):

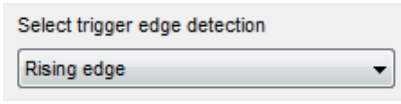
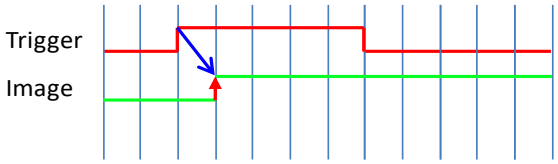
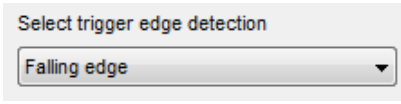
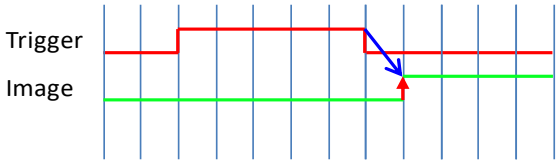
If **Use start condition only** is selected as triggered frame scan parameter:



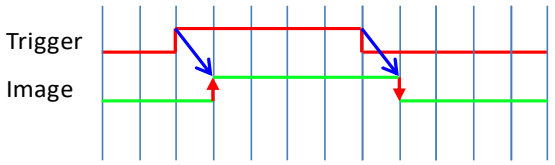
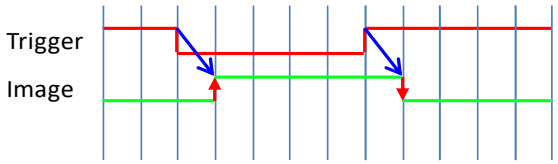
If **Start and stop condition** is selected as triggered frame scan parameter:



1. Use start condition only

Select trigger edge detection	Function
	These sequences cause a frame start at a rising edge: 
	These sequences cause a frame start at a falling edge. 

2. Use start and stop condition

Select trigger edge detection	Function
Select trigger edge detection Start rising edge / stop falling edge	These sequences cause a frame start at a rising edge and the frame stop at a falling edge. 
Select trigger edge detection Start falling edge / stop rising edge	These sequences cause a frame start at a falling edge and the frame stop at a rising edge. 

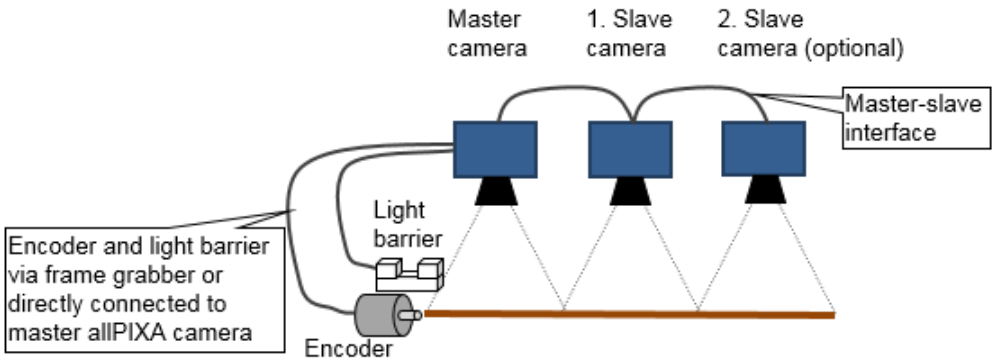
11.9.8 Master/slave

	Name	
Name	Set global master-slave mode	
Function	Synchronization of more than one allPIXA cameras	
Channels	All	
Unit		
Dependency	The slave camera(s) must know whether the master runs with encoder/line-trigger or in free-running mode!	
Notes	• The position of the image in transport direction (Y) of each camera could be set separately. The image length is defined by the master. • Also the position (X + Y) and the size of the white reference could be set separately.	
	Camera	**Value**
Lower limit	All	Get master-slave from setting
	All	Camera acts as master
	All	Camera acts as slave
Upper limit	All	Auto-select by input

If more than one camera is used, for example in print inspection, these cameras must be synchronized very accurately to achieve the best system performance.

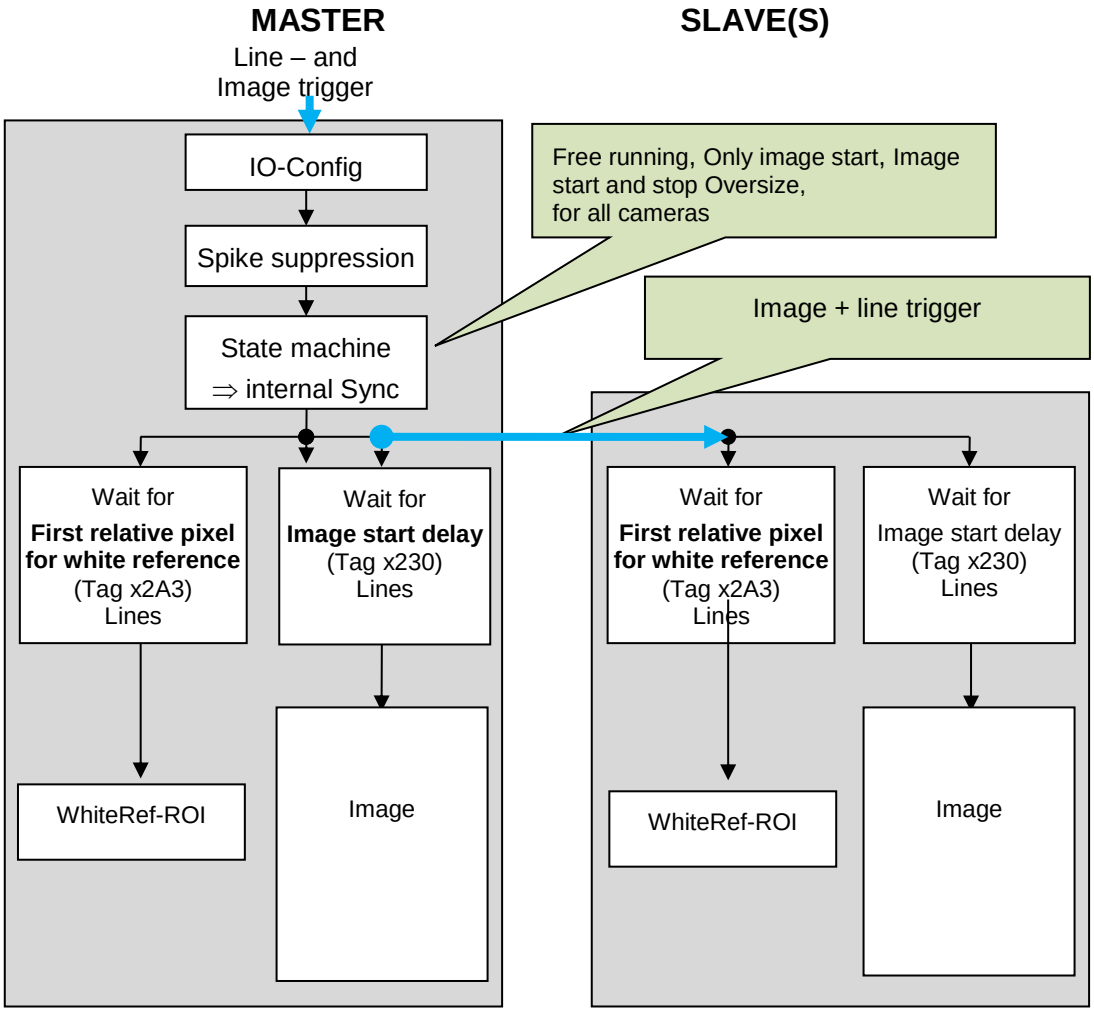
Principle of the master-slave synchronization:

The trigger signals from light barrier and/or encoder are connected to the master camera only. This could be done with the CC-bits via the frame grabber or directly connected to the master allPIXA camera. This trigger information is transferred via the master-slave interface to the slave camera(s). Due to this synchronization interface all cameras are running with exactly the same timing for lines and optional frames.



NOTE	• This parameter is part of a setting. It may change from one setting to another. • If the parameter is the same in each setting the master-slave mode can be set global (see section 11.15.1)

Parameter and region of interest of the master-slave synchronization:



NOTE	
	• The slave camera(s) must know whether the master runs with encoder/line trigger or in free-running mode • 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

Connection the cameras for master-slave synchronization:

Selecting master and slave:

There are several options to set the desired camera to the master:

(a) Software:

The cameras have dedicated settings or the PC sets the camera to master or slave via the parameter **Set global master-slave mode**.

(b) Hardware:

The cameras are able to look at an input to set master/slave.
One of the camera inputs, for example I/O Connector 3 acts as the so called "nSelMaster"-Input.

This input is held high via an internal Pull-up ⇒ Slave by default.
A low level at this input switches the camera to master.
At this D-Sub 15 a bridge is connected from the nSelMaster at pin3 to GND at pin 11.

Master-Slave and the I/O Configuration:

If the cameras are set to **Auto-select by input**, the input for the nSelMaster must be set at the I/O Configuration.

In this case the nSelMaster is configured to the Pin3 of the I/O Connector as described above:

If the software sets the camera to master or slave, no configuration of nSelMaster is needed.

	User Comment	External Pin	Signal name	IO-Standard	Internal Function	Bit Value
19		IO-Interface-3	GPIO_P4	LVTTL	LB3 + LB2	☐
20	nSelMaster	IO-Interface-3	GPIO_P4	LVTTL	SelSyncMaster	☒
21		CL1-12/25	CL_CC4	LVDS	SelSyncMaster	☐
22	Master/Slave interface	IO-Interface-6/8	MS-Interface	LVTTL	MS_Interface	☒

Connecting the master/slave interface

The master/slave interface consists of two signals. These two signals have to be connected 1:1 between the master and the slave camera(s).

	User Comment	External Pin	Signal name	IO-Standard	Internal Function	Bit Value
19		IO-Interface-3	GPIO_P4	LVTTL	LB3 + LB2	☐
20	nSelMaster	IO-Interface-3	GPIO_P4	LVTTL	SelSyncMaster	☒
21		CL1-12/25	CL_CC4	LVDS	SelSyncMaster	☐
22	Master/Slave interface	IO-Interface-6/8	MS-Interface	LVTTL	MS_Interface	☒

NOTE	
	• At least one ground signal must be connected in addition to the two timing signals

Example:

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	LVCMOS	**nSelMaster (Bridge to 0 V)**	**Open, internal PullUp**
4	LVCMOS	-	-
5	3.3 V over 100 Ohm	open	open
6	LVCMOS	**Master/Slave-interface**	**Master/Slave-interface**
7	0 V	**0 V**	**0 V**
8	LVCMOS	**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	LVCMOS	-	-
13	0 V	**0 V**	**0 V**
14	LVCMOS	-	-
15	5 V over 100 Ohm	open	open

1:1 connections

11.10 Image processing

11.10.1 Mirror image horizontally

Name		
Name	Mirror image horizontally	
Function	Mirrors the lines inside the camera.	
Channels	All	
Unit	Bool	
Dependency	None	
Notes	Function has to be switched off for the acquisition of the black value and shading reference (white balancing).	
	Camera:	**Function:**
Lower limit	All	Off
Upper limit	All	On

This function changes the sequence of the pixels within the line, that means that 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

11.10.2 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. Swapping the channels can be done in real-time inside the camera. It is usually faster than doing it with the frame grabber.		
	Camera:	**Value:**	**Function:**
Lower limit	All	0	Off
Upper limit	All	1	On

11.10.3 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	• 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!** • **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:**	
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.

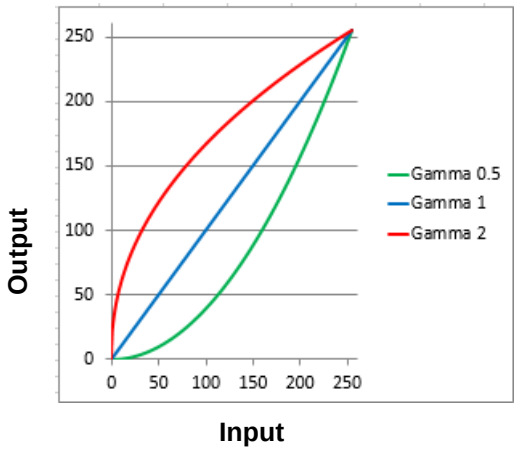


Figure 39: Gamma correction

11.10.4 Color conversion matrix

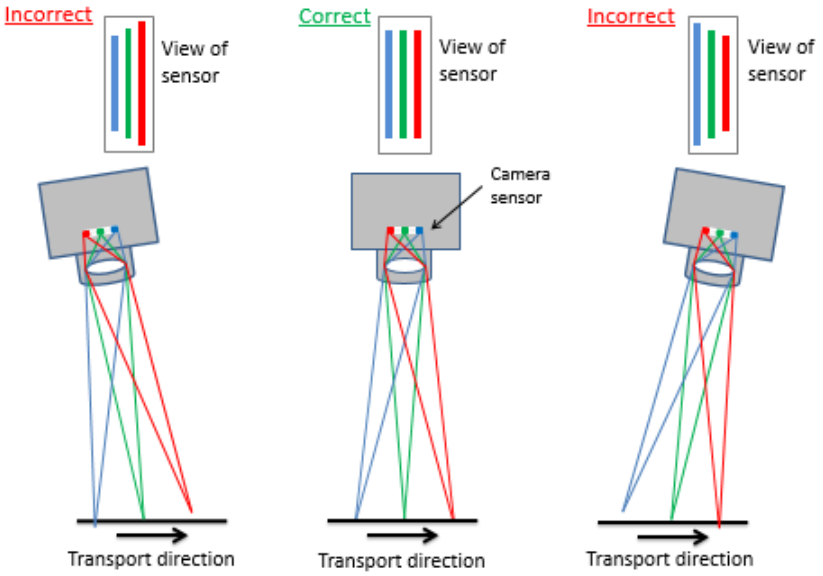
Name			
Name	Use color conversion matrix		
Function	Enables the color conversion by a 3x3 matrix for example from RGB to sRGB		
Channels	All		
Unit	Bool		
Dependency	None		
Notes	Color conversion matrix has to be generated offline and must be transferred to the camera.		
	Camera:	**Value:**	**Function:**
Lower limit	All	0	Off
Upper limit	All	1	On

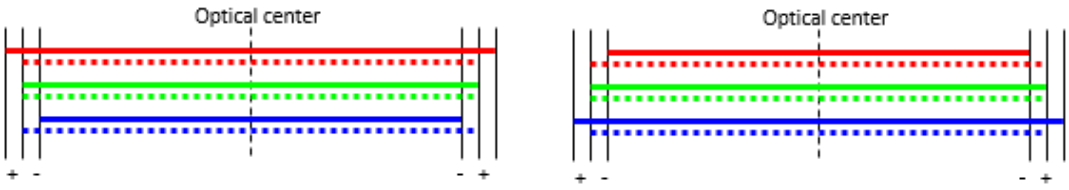
11.10.5 Select active CCM

Name		
Name	Select active CCM	
Function	Selects the number of the used color conversion matrix. 4 matrix tables are selectable.	
Channels	All	
Unit	Integer	
Dependency	Only available if the **Use color conversion matrix** check box has been selected	
Notes	Table 0 is the default table and not editable in CST.	
	Camera:	**Function:**
Lower limit	All	Matrix 1
Upper limit	All	Matrix 4

11.10.6 Use keystone correction

Name			
Name	Use keystone correction		
Function	Enables the function keystone correction.		
Channels	Red, Blue		
Unit	Bool		
Dependency	None		
Notes			
	Camera:	**Value:**	**Function:**
Lower limit	All	0	Off
Upper limit	All	1	On



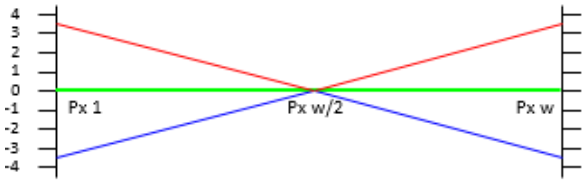


Sign: negative refers to red channel

Sign: positive refers to red channel

before correction,
after correction,

Sample with correction value of +3.5:

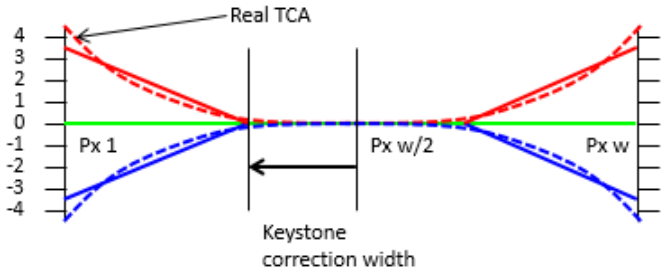


11.10.7 Pixel shift for correction

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			
	Camera:	**Value:**	
Lower limit	All	- 4,0	
Upper limit	All	+ 4,0	

11.10.8 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	2k	1,024
Upper limit	4k	2,048
Upper limit	7.3k	3,648



TCA (= Transversal Chromatic Aberration) is an objective-caused displacement of 3 colors increasing at the edge.

11.11 Output format

11.11.1 Video output mode

Name		
Name	Video output mode	
Function	Sets the output on the CameraLink port to different modes, for example RGB as standard or to gray-level output.	
Channels	All	
Unit	Integer	
Dependency	None	
Notes	For the gray image calculation, the values of “Color w8s” are used.	
	Camera:	**Function:**
Lower limit	All	3x8 Bit / RGB
	All	2x8 Bit / Gray / Base
	All	2x10 Bit / Gray / Base
Upper limit	All	2x12 Bit / Gray / Base
	OEM versions	Special modes are available

11.11.2 Color weights

Name			
Name	Color weights		
Function	Calculates the grey value for the pixel by 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 CameraLink is set to “Gray mode”		
Notes	The sum of these 3 parameters should be **1**. A higher value makes the image “brighter”, a lower value makes it “darker”. Standard values by NTCS and the default values in the camera are the following: Red: 0.299 Green: 0.587 Blue: 0.114		
	Camera:	**Value:**	
Lower limit	All	0,0	
Upper limit	All	1,0	

11.11.3 CameraLink connection speed

Name		
Name	CameraLink connection speed	
Function	Sets the pixel clock on the CameraLink port to 85, 72.86 MHz or 63,75 MHz	
Channels	All	
Unit	Integer	
Dependency	None	
Notes	• This function reduces only the pixel clock at the output, the internal clock is not changed. • The minimum integration time might be limited by this function. Please see the limitations in the table mentioned below. • For some applications it would be helpful to reduce the speed, for example to be able to use the camera with longer cables.	
	Camera:	**Function**
Lower limit	All	72.86 MHz
	All	85 MHz
Upper limit	All	63,75 MHz

Minimum integration time for different camera types at different output pixel clocks:

Frequency:	Base mode:			Medium mode:		
	2k	4k	7.3k	2k	4k	7.3k
85.00 MHz	24.4 µs	48.5 µs	86.1 µs	16.5 µs	29.0 µs	47.0 µs
72.86 MHz	28.3 µs	56.5 µs	100.4 µs	16.5 µs	29.0 µs	50.3 µs
63.75 MHz	32.5 µs	64.6 µs	114.8 µs	16.5 µs	32.5 µs	57.6 µs

11.11.4 Type of CameraLink interface

Name		
Name	Type of CameraLink interface	
Function	Sets the output to Medium or Base mode	
Channels	All	
Unit	Integer	
Dependency	None	
Notes	• If Base mode is used, line rates and integration time are limited. For more information, refer to the table shown below. • Output is in one-tap configuration in Base mode instead of two taps in Medium mode. • For Base mode the CameraLink connector 1 has to be used.	
	Camera	**Function**
Lower limit	All	CameraLink Base
Upper limit	All	CameraLink Medium

Minimum integration time for different camera types at different CameraLink port types:

Frequency:	Base mode			Medium mode		
	2k	4k	7.3k	2k	4k	7.3k
85.00 MHz	24.4 µs	48.5 µs	86.1 µs	16.5 µs	29.0 µs	47.0 µs
72.86 MHz	28.3 µs	56.5 µs	100.4 µs	16.5 µs	29.0 µs	50.3 µs
63.75 MHz	32.5 µs	64.6 µs	114.8 µs	16.5 µs	32.5 µs	57.6 µs

11.11.5 Insert mode

Name		
Name	Insert mode	
Function	Enables different camera data displayed 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 set by the check boxes.	
	Camera	**Function**
	All	First line info block
	All	Test ramp in last line
	All	Check sum in last line
	All	Info block in each line
	All	Activate pixel 9-16
	All	Grey value sum ←→ Contrast value sum

Information is displayed in the image as shown below:

- **First line info block**:
  Image-related information is shown in the first 22 pixels of the image's first line.
  The image functionality is required.
- **Info block in each line**:
  Line-related information is shown in the first 10 or 17 pixels of each line, depending on the selections for **Insert Mode**.
- There are 2 options for the image's last line:
  - **Test ramp in last 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.
  - **Check sum in last line**: The check sum for the image data is inserted into the last transmitted pixels of each tap. In the resulting image they are located centrically on both sides of the tap border. Image functionality is required.

Information:

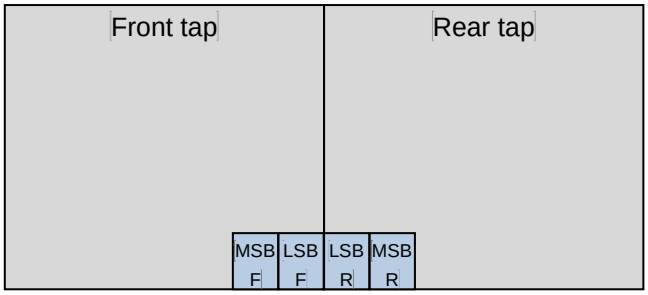
Overview of LastLine IMGChk Sum:

Pixel line	0	1	..	n/2-3	n/2-2	n/2-1	n/2	n/2+1	n/2+2	..	n-1
…	Vid	Vid	..	Vid					Vid	..	Vid
LastLine R	Vid	Vid	..	Vid	ChkSumRed Front(15:8)	ChkSumRed Front(7:0)	ChkSumRed Rear(7:0)	ChkSumRed Rear(15:8)	Vid	..	Vid
LastLine G	Vid	Vid	..	Vid	ChkSumGreen Front(15:8)	ChkSumGreen Front(7:0)	ChkSumGreen Rear(7:0)	ChkSumGreen Rear(15:8)	Vid	..	Vid
LastLine B	Vid	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 2 pixels of each tap. The number of pixels of the camera n is 4096 when using 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, from Pixel 0:0 until m:n-2 (with n-1 pixel per tap and m-lines within the image). This means that the CHK sum is naturally not included in the sum.

Position in the image:



11.11.5.1 First line information

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 with power on with 0 and could be preset by software. Px 6 MSByte, Px 7 LSByte, Each with the same value for RGB.
Integration time	8 – 9	16 bit value of the actual integration time for the CCD in pixel clocks at 85 MHz. Integration times, which are measured in µs, are IntTime/85. 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 pixel clocks. Line time, measured in µs, is LineTime/85. 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 overflows 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 by software. Px 14: MSByte Px 15 higher MidByte Px 16 lower MidByte Px 17 LSByte Each with the same value for RGB.
Error register	18	In case of any default, it will be inserted here.
Time stamp	19 – 20 – 21	„Real time clock". 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) Sample: TimeStamp = 0x123456 ➔ 0x1234 = 4660 seconds since start = 1h, 17min, 40 seconds ➔ 0x56 = 86 *4= 344 ms. Px 19 MSByte Px 20 MidByte Px 21 LSByte Each with the same value for RGB.
Markers	0 – 5 – 10 – 22	It is used for marking the info block with red pixels. Red xFF Blue x00 Green x00

Overview off 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.	Time stamp			

11.11.5.2 Each line information

Information	Pixel	Channel	Description
Error register	1	R	In case of any default, 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 actual line time for the CCD in pixel clocks. The line time, measured in µs, is LineTime/85. 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

			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 software. 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. Red MSByte integer part Green LSByte integer part Blue decimal place
Time stamp	5	R/G/B	„Real time clock" 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) 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 for each color of the last whole line. Pixel 6 FrontTap Pixel 7 Reartap
Grey value sum	10 - 15	R/G/B	Grey 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. Pixel 10 Red front Pixel 11 Green front Pixel 12 Blue front Pixel 13 Red front Pixel 14 Green front Pixel 15 Blue front For each pixel, this order is shown: Red MSByte Blue MidByte Green LSByte It can be shown optionally with Contrast value sum.
Contrast value sum	10 - 15	R/G/B	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. Note: for example with 2048 pixels there are only 2047 difference values. For ordering please refer to the "Contrast value sum" as follows: $LineContrast = \sum_{i=first\ pixel\ in\ line}^{last\ pixel\ in\ line-1} \lvert Pixel\ value_{i+1} - Pixel\ value_{i} \rvert$ It can be shown optionally with Gray value sum.
Markers	0,9,16	R/G/B	It is used for marking the info blocks with red pixels. Red xFF Blue x00 Green x00

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										GreyValSum 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 (23:16)	MaxVal. Rear (7:0)	Reserved	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	Line count (15:8)	Line time (15:8)	Encoder clock (15:8)	Next line pos. (7:0)	Time stamp (15:8)	MaxVal. Front (15:8)	MaxVal. Rear (7:0)	Reserved	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	Line count (7:0)	Line time (7:0)	Encoder clock (7:0)	Next line pos. Frac.(7:0)	Time stamp (7:0)	MaxVal. Front (7:0)	MaxVal. Rear (7:0)	Reserved	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	

11.11.6 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	**Value**	**Function**
	All	0	First pixels
	All	1	Last pixels
	All	2	First and last pixels

11.12 Special functions

11.12.1 Test pattern

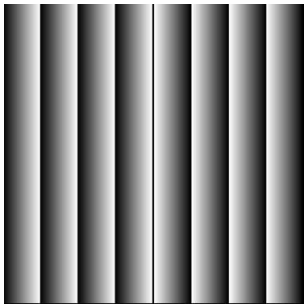
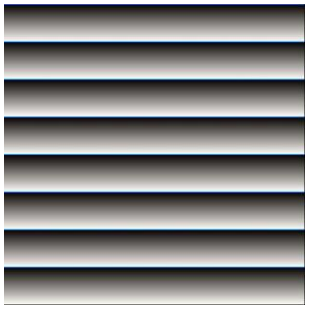
To be able to check the system setup, it is helpful to generate exactly defined test images inside the camera.

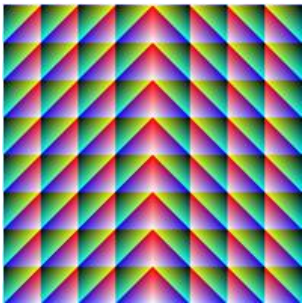
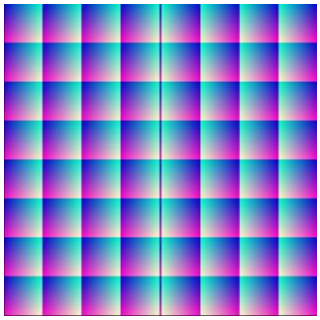
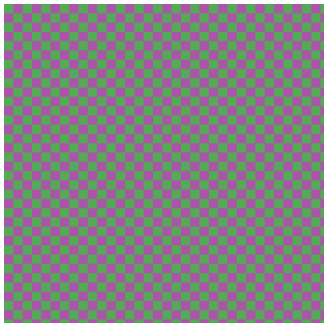
This explicitly helps to check:

1. Frame grabber connection
2. Frame grabber setting
3. Transmission quality over the CameraLink 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 the analog image processing. They pass all the digital image processing steps	
	Camera	**Value**
Lower limit	All	0 (no pattern)
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

	**Test pattern 3:** Red: X-Ramp Green: XY-Ramp Blue: Y-Ramp
	**Test pattern 4:** Sequence of 4 toggling images; 3 test patterns with parameter **Test pattern level** and one live image
	**Test pattern 5:** Grey value with parameter **Test pattern level**

11.12.2 Set 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 3 to 5	
Notes	Refers to 10-bit image data	
	Camera	**Value**
Lower limit	All	0
Upper limit	All	1023

11.13 Register edit

All registers can be written directly on the camera.

There are two possibilities to directly modify the register:

- **Permanent modification:**

  Values entered by the user are stored in the setting. If the setting is burned, they are available after the camera is restarted or after the setting has been loaded.

  You can find this function in CST at **Camera settings > Special functions > Register edit**. There are 4 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 itself by using this function. Therefore this is function is only available if **User level** has been set to **Guru**. For more information, see section 9.14 “Setting the user level in CST**”.**

11.14 Camera information

11.14.1 Camera serial number

Note	All allPIXA wave 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 the camera type and serial number of the camera		
Channels	All		
Unit	Two integers		
Dependency	None		
Notes	The first value is the camera type (10000 for the allPIXA camera). The second value is the serial number		
	Camera	**Value camera type**	**Value serial number**
Lower limit	All	10000	0
Upper limit	All	10000	65535

11.14.2 Setting description

Name		
Name	Setting description	
Function	You can write a short description for each setting of the camera.	
Channels	All	
Unit	String up to 40 characters	
Dependency	None	
Notes	Keep in mind that a carriage return counts as two characters! This may result in descriptions that seem to be cut by the camera.	
	Camera	**Value**
	All	

11.15 Global Parameters

All camera parameters can be stored non-volatile within a data set called setting. Every parameter can be changed from one setting to another except the parameter listed in this section.

The parameters described in this section are valid, independently of the selected setting. They are global.

11.15.1 Global master/slave config

Name		
Name	Set global master-slave-mode	
Function	Synchronization of more than one allPIXA cameras	
Channels	All	
Unit		
Dependency	The slave camera(s) must know if the master runs with encoder/line-trigger or in free-running mode!	
Notes		
	Camera	**Value**
Lower limit	All	Get master-slave mode from setting
	All	Camera acts as master
	All	Camera acts as slave
Upper limit	All	Auto-select by input

NOTE	• This parameter overwrites the master-slave setup stored within each setting (see section 11.9.8)

11.15.2 Tracing

For test and debugging purposes, the camera writes process data to an internal logging memory. Which data are logged, can be selected by selecting check boxes on the **Tracing** page.

For more information, ask the Chromasens support.

E-Mail: support@chromasens.de

NOTE	• Logging of process data reduces performance of the internal microcontroller. Therefore the internal trace should only be activated for testing. All tracing should be deactivated in real production mode of the camera.

11.16 Line trigger and encoder setup (Line synchronisation)

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 might jitter. Therefore, a pulsed illumination which is synchronous to the trigger signal might cause problems in image quality.

NOTE II	If the camera is used in the “Triggered Frame Scan” with active LineTrigger or encoder, the linesync (Encoder or LineTrigger) has to fit some pulses before light barrier input.

11.16.1 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. Without encoder, camera speed is defined by the values of **Integration time** and optionally by **Line period time**. If encoder is enabled, camera speed if defined by an external line trigger or by encoder pulses.	
Channels	All	
Unit	Bool	
Dependency	None	
Notes	If you use this mode, the external ports must be connected with the internal function using the IO Configurator of CST.	
	Camera	**Function**
Lower limit	All	Off / Internal
Upper limit	All	On / external

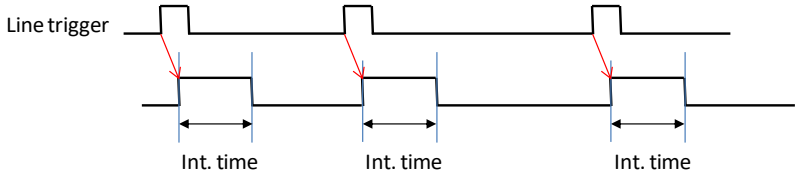
11.16.2 Synchronization mode

Name		
Name	Synchronization mode	
Function	Selects the mode **Encoder** or **Line trigger mode**.	
Channels	All	
Unit	Integer	
Dependency	Only available if **Enable Encoder** is active.	
Notes	If you use this mode, the external ports must be connected with the internal function using the IO Configurator of CST.	
	Camera:	**Values:**
	All	Encoder (Continue update)
	All	Line trigger mode (Const. int. time)

The following two modes are available:

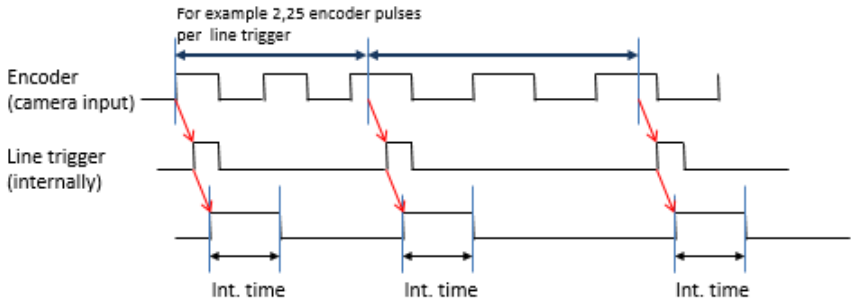
- **Line trigger mode:**

  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.



NOTE	Minimum pulse duration of the line trigger or encoder has to be 5 pulses of the internal pixel clock of 85 MHz. Minimum pulse duration is 60ns. Otherwise, the pulse might be ignored due to debouncing within the camera. Minimum speed with encoder mode is: V,min = mm/Encoder pulse / 0,789s

Example for the required minimum speed with encoder mode:

Encoder has 12,5 pulses per mm

1 Encoder pulse is 1/12,5mm = 0,08mm

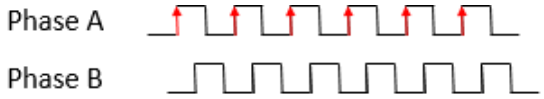
⇒ V, min = 0,08mm/0,789s = 0,101mm/s

11.16.3 Encoder channels

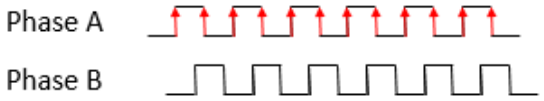
Name			
Name	Encoder channels		
Function	Sets the mode according to the edges of the encoder will be taken for speed measurement.		
Channels	All		
Unit	Integer		
Dependency	Only available if **Encoder** is selected at **Synchronization mode**		
Notes	If you use this mode, the external ports must be connected with the internal function using the IO Configurator of CST.		
	Camera	**Value**	**Function**
Lower limit	All	0	One Channel full step
	All	1	One Channel encoder
Upper limit	All	2	2 Channel encoder

The following three modes are available:

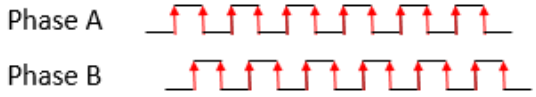
0. **One Channel full step (1 edge per step):**



1. **One Channel encoder (2 edges per step):**



2. **Two Channel encoder (4 edges per step):**



NOTE	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.

11.16.4 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** 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	None
		2x
		4x
		8x
Upper limit	All	16x

11.16.5 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 increment (full step)		
Dependency	Only available if **Encoder** 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 detailed calculation, see section 11.16.6.

11.16.6 Vertical image resolution

Name			
Name	Vertical image resolution		
Function	Sets 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** 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)
Upper limit	All	65535

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 calculated automatically with one of the following formulas with the values that were specified using CST:

$$EncoderPulsesPerLine = \frac{EncoderChannel\left(\frac{Edges}{Step}\right) * 25{,}4\ \left(\frac{mm}{inch}\right) * 1000}{EncoderResolution\left(\frac{\mu m}{Step}\right) * VerticalImageResolution(\frac{Dots}{inch})}$$

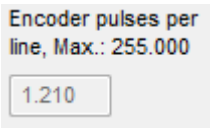
By using dots per inch (dpi) for this calculation, you must use the following formula:

$$EncoderPulsesPerLine = FullIncrementResolution(dpi) * \frac{Edges/step}{TransportResulution(dpi)}$$

The value for encoder pulses per line can also be calculated with the following formula:

$$EncoderPulsesPerLine = TransportResolution\left(\frac{\mu m}{pixel}\right) * \frac{Edges/step}{FullIncrementResolution(\frac{\mu m}{incr})}$$

Afterwards CST shows the result.



NOTE	**Vertical image resolution** and **Integration time** have to be suitable to the speed of the transport. The time for one line (Speed divided by resolution) should be longer than the shortest possible integration time. In case of higher speed, the camera switches to free-running line mode.

11.16.7 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 specified value of signals from external line trigger source.	
Channels	All	
Unit	integer	
Dependency	Only available if **Enable encoder** is selected.	
Notes		
	Camera	**Value**
Lower limit	All	1
Upper limit	All	256

If line trigger reduction is used, the vertical image resolution is reduced by factor:

$$TransportResolution, reduced[dpi] = \frac{TransportResolution[dpi]}{\text{Line trigger reduction factor}}$$

$$TransportResolution, reduced[\mu m] = \text{Line trigger reduction factor} * TransportResolution[\mu m]$$

12 Appendix

12.1 Calculations

12.1.1 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:

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

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

Calculate the image distance:

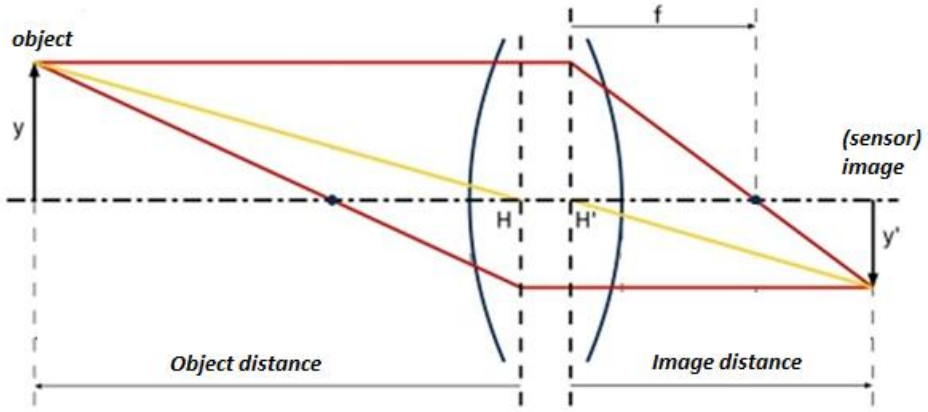
$$ImageDistance = FocalLenght * (m + 1)$$

Calculate the object distance:

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

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

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



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

You can see a calculation example on the next page.

Example:

Camera:	allPIXA 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

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

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

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

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

(w/o glass plates in the optical path)

12.1.2 Calculating the distance rings for the allPIXA camera

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

To calculate the needed distance rings, you need 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

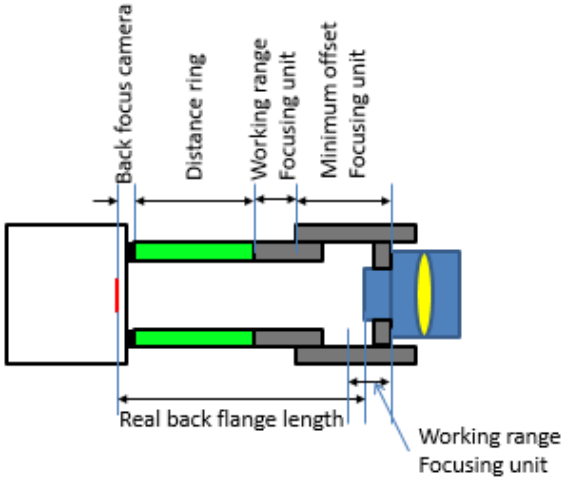


Figure 40

A calculation example is shown on the next page.

Example:

Camera:	allPIXA camera 7300	
Lens:	Linos Apo Rodagon 90 mm	
	90.1 mm real focal length	
	93.5 mm flange length@infinite	
Focusing unit:	Modular Fokus	
	Minimum offset	20 mm
	Maxium 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:

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

   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 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.

12.1.3 Calculating the integration time

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

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

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

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

Calculate the integration time with the formula as follows:

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

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

12.1.4 Communication to the camera via the Chromasens API

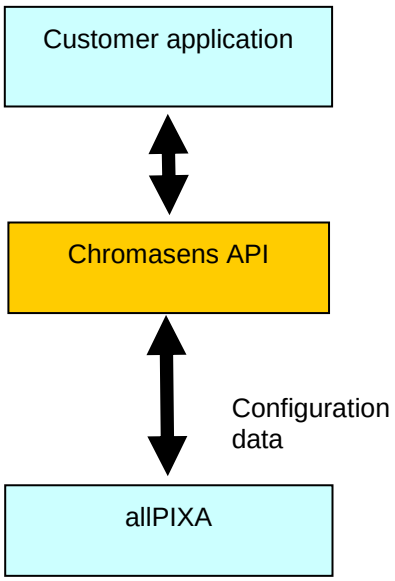


Figure 41: Chromasens API

The Chromasens API provides a set of functions for communication with the allPIXA camera.

With these functions, connection to the camera can be established via CameraLink 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 download area on our website.

13 Maintenance and cleaning of the allPIXA camera

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

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

13.1 Cleaning intervals

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

13.2 Cleaning process

	Body of the allPIXA camera heats up during operation. Before cleaning, you have to 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.

14 Service and repair

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

Body of the allPIXA wave camera heats up during operation.

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

Do not perform any repairs at the device by yourself, except, if you need to maintain, exchange spare parts or adjust scanning position.

The manufacturer of the superior system is responsible for all repairs and service matters, repair activities as well as exceeding the exchange of spare parts have to be done by the manufacturer of the superior system which is either the device manufacturer Chromasens GmbH or the exclusively authorized partner.

Keep the original package for a possible return of the device because the device has to be returned in the original package to avoid damages.

14.1 Return address for repair

Please contact the Chromasens service first before you return the camera.

Please ask for an RMA number before you return the camera to the manufacturer.

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

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

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

14.2 Disposal

The device consists of different kinds of material and for its disposal the materials have to be separated according to the local regulations. The material has to be disposed properly to avoid and to minimize any environmental or human impact.

15 EC conformity declaration

EC Declaration of Conformity

The manufacturer:

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

declares, that the following device and all corresponding variations

Device name:	allPIXA
Product number:	CP000383

were developed in accordance to the Directive 2004/108/EC electromagnetic compatibility and corresponding to the following standards:

IEC 61000-6-2:2005:	Immunity for industrial environments
IEC 61000-6-4:2006:	Emission standard for industrial environments
FCC:	Class B

The devices are lines can cameras, which are used for optical scanning. The nominal supply voltage is 24V and the integration of the devices into higher-level systems is documented.

The product specification and documentation is provided in the original versions.

The declaration of conformity becomes invalid if changes are made on the devices, or the use is not in accordance with the documentation.

05/02/2012 / Constance

date / location

signature CEO

signature Head of QM

Chromasens GmbH
Max-Stromeyer-Straße 116
78467 Konstanz
Germany

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

www.chromasens.de
info@chromasens.de