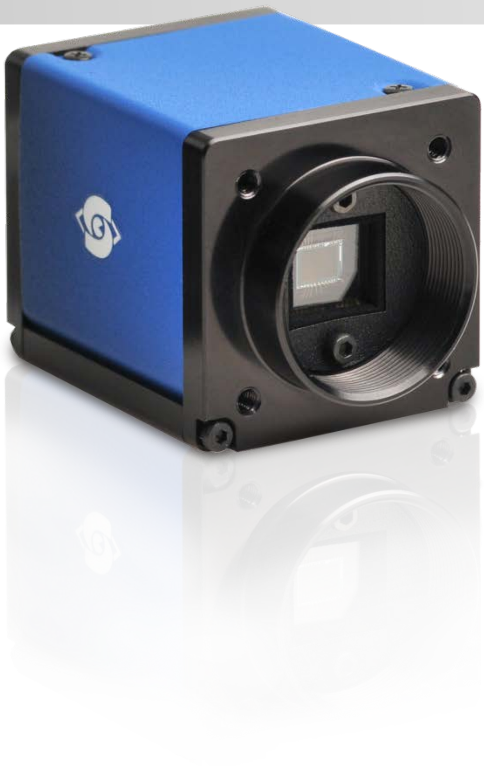

Manual ECO2 series

eco674, eco695, eco814, eco815, eco834, eco1050, eco2050, eco2150, eco, eco4050

Company Information

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This Operation Manual is based on the following standards::

DIN EN 62079
DIN EN ISO 12100
ISO Guide 37
DIN ISO 3864-2
DIN ISO 3864-4

This Operation Manual contains important instructions for safe and efficient handling of SVCam Cameras (hereinafter referred to as „camera“). This Operating Manual is part of the camera and must be kept accessible in the immediate vicinity of the camera for any person working on or with this camera.

Read carefully and make sure you understand this Operation Manual prior to starting any work with this camera. The basic prerequisite for safe work is compliant with all specified safety and handling instructions.

Accident prevention guidelines and general safety regulations shoud be applied.

Illustrations in this Operation Manual are provided for basic understanding and can vary from the actual model of this camera. No claims can be derived from the illustrations in this Operation Manual.

The camera in your possession has been produced with great care and has been thoroughly tested. Nonetheless, should you have reasons for complaint, then please contact your local SVS-VISTEK distributor. You will find a list of distributors in your area under: http://www.svs-vistek.com/company/distributors/distributors.php

Copyright Protection Statement

Contents

1 Conformity Issues

Information given within the manual accurate as to: 6/16/2016, errors and omissions excepted.

1.1.1 Europe

This camera is CE tested and the rules of EN 50022-2 apply.

All SVS-VISTEK cameras comply with the recommendation of the European Union concerning RoHS Rules

1.1.2 USA and Canada

Labeling requirements

This device complies with part 15 of the FCC Rules. Operation is subject to the following conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Information to the user

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at its own expense.

It is necessary to use a shielded power supply cable. You can then use the “shield contact” on the connector which has GND contact to the camera housing. This is essential for any use. If not done and camera is destroyed due to Radio Magnetic Interference (RMI) WARRANTY is void!

- Power: US/UK and European line adapter can be delivered. Otherwise use filtered and stabilized DC power supply.
  For power supply voltage refers to power supply and specification.
- Shock & Vibration Resistance is tested: For detailed Specifications refer to Specification.

1.2 Feature List:

ECO	ECO²	EXO	EVO	HR	SHR
0.3 to 5 Mpixel CCD	1 to 12 Mpixel CCD	0.3 to 12 Mpixel CMOS and CCD	1 to 12 Mpixel CMOS and CCD	10 to 29 Mpixel CMOS and CCD	47 Mpixel CCD
Sony 1 tap sensors	Sony and ON Semiconductor 1 and 2 tap sensors	Sony, ON Semi and CMOSIS 1, 2 and 4 tap / 8 channel	Sony and ON Semiconductor 1, 2 and 4 tap / 12 channel	ON Semiconductor 4 tap / 32 channel sensors	ON Semiconductor 16 (8 x 2) tap sensor
mono and color versions					
progressive scan or global shutter (image on demand)					
GigE Vision up to 120 MB/s		GigE Vision, Camera Link or USB3 Vision	Dual GigE Vision or Camera Link Medium	Dual GigE Vision, Camera Link or 4 x CoaXPress	Camera Link (HS 80 bit) or 2 x CoaXPress
64 MB internal memory		256+ MB internal memory	128 MB internal memory	128 MB internal memory	512 MB internal memory
8 or 12 bit pixel format					
		optional Power over Camera Link			
C or CS Mount	C Mount	C Mount	C, M42 (FFD 11.48) or MFT	M58 Mount (FFD 11.48)	M72 Mount (FFD 19.55)
			adjustable flange focal distance – optional F Mount		
dynamic control of focus, zoom and aperture					
38 x 38 x 33 mm	38 x 38 x 45 mm	50 x 50 x (43-47) mm	50 x 50 x 46 mm	70 x 71 x 55 mm	80 x 80 x 60 mm
optional "BlackLine" – IP Class up to IP67		precision machined housing	opt . "BlackLine" – up to IP67		
	manual or auto tap balancing				
			pixel clock setting for Camera Link		
2 x 2 binning			2 x 2 binning (4 x 4 for CL)		
horizontal and vertical image flip					
	custom defect pixel correction – custom defect pixel mapping				
			shading correction for GigE Vision		
area of interest (AOI – also "region" or "field" of interest)					
manual or delayed read out control – custom acquisition timing					
manual white balance					
manual, auto or external exposure time control – custom brightness target					
manual or auto gain					
manual offset					
PIV – particle image velocimetry (CCD sensors only)					
look up table (LUT) – custom pixel mapping					
internal, software or external trigger response					
integrated temperature sensor – SDK accessible					
up to 4 x open drain outputs		4 x open drain outputs	up to 2 x open drain outputs		
strobe controller – in-camera LED light driver/controller, up to 3 A – easy synchronization					
sequencer – up 16 programmable intervals with individual exposure & light					
4 x pulseloop module – generate strobes, exposure timing and/or additional trigger signals					
PWM – high frequency pulse width modulation					
signal safe through high-low filter, debouncer and prescaler for trigger input					
versatile I/O concept: 24V signal levels – RS232 – optional RS422 differential signal					
GenICam compatible – XML based control + Free Open SDK, compatible with all GenICam cameras (open Transport Layer) (32 & 64 bit)					
compatible with most 3rd party software					
GigE Vision	GigE Vision	GigE Camera, Link USB3	GigE Vision, Camera Link	GigE, Camera Link, CXP	Camera Link, CXP

1.2.1 Versatile I/O Concept

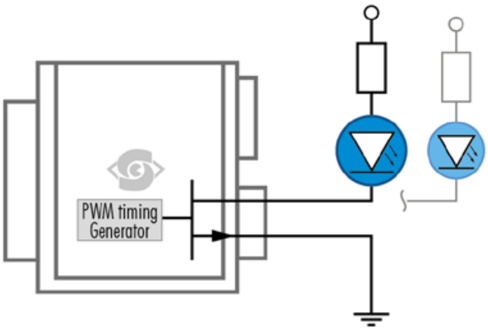


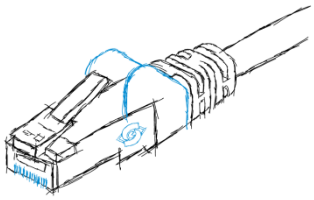
Figure 1: Illustration of 2IO concept of switching LEDs

Your camera is equipped with the 2io-Interface allowing full control of timing and illumination via the camera SDK. Each of the 2 outputs can be individually configured and managed using pulse-width control. The integrated sequencer allows multiple exposures with varied settings to be programmed, creating new and cost effective options.

- 2 x open drain in and out-put
- 2 x high power input – up to 25 volts
- Power MOSFET transistors

- PWM strobe control
- Sequencer for various configurations
  - Programmable computer software
- Trigger safe: debouncer, prescaler, high low trigger

1.2.2 GigE-Vision features



GigE Vision is an industrial interface standard for video transmission and device control over Ethernet networks. It provides numerous software and hardware advantages for machine vision. Being an industry standard, it facilitates easy and quick interchangeability between units, shortening design cycles and reducing development costs.

- Cost effective
- Wide range of „off the shelf" industrial-standard plugs and cables
- High bandwidth data transfer rate (120 MB/sec per output)
- Up to 100 m range without additional switch
- Wide range of applications in image processing
- Remote service capability
- GenICam compliant
- SDK for Windows XP/10 (32/64 bit) and Linux

2 Getting Started

2.1 Power supply

Connect the power supply.

CAUTION! – This camera does not support hotplugging

1. First, connect the data cable.
2. Then connect power supply.

When using your own power supply (e.g. 10 -25 V DC) make sure you connect Pin1 to GND and Pin 2 to VIN+.

See also Hirose 12-pin for a detailed pin layout of the power connector.

For power input specifications refer to specifications.

2.2 Flashing LED Codes

On power up, the camera will indicate its current status with a flashing LED on its back. The LED will change color and rhythm.

The meaning of the blinking codes translates as follows:

Flashing	Description
Yellow slow (1Hz)	No Connection
Yellow quickly (8 Hz)	Assignment of Network address
Yellow permanent	Network address assigned
Green permanent	Connected with application
Green slow (1Hz)	Streaming channel available
Green quickly (8 Hz)	Acquisition enabled
Red slow (1 Hz)	Problem with initialization
Red quickly (8 Hz)	Camera overheating
Blue permanent	Waiting for trigger
Cyan permanent	Exposure active
Violet permanent	Readout/FVAL

Figure 2: Table of flashing LED codes

2.3 Software

Your SVCam comes with a huge Software_Kit including:

> SVGigE_TL_Driver
(GigE drivers and transport layer DDLs)

> SVGigE_SDK
(collection of functions for operating SVCam GigE cameras

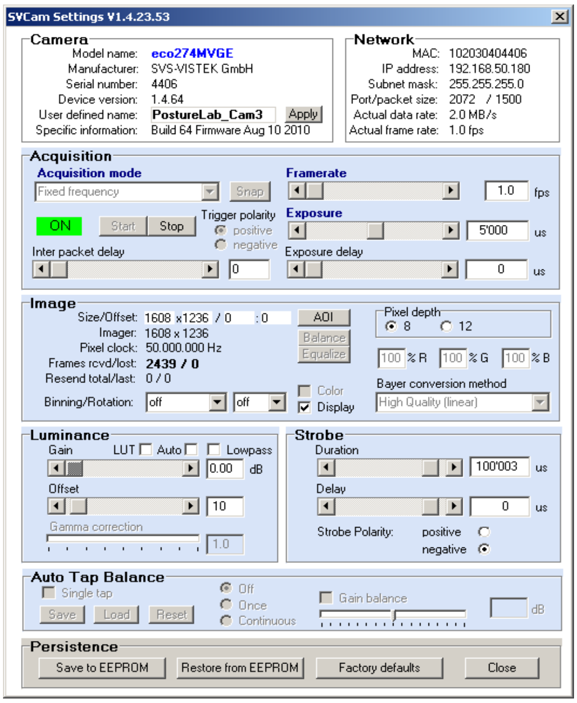
> SVCapture
(a viewer program for SVCam GigE cameras)

> SVCam_Firmware
(firmware update tool for SVCam GigE cameras)

For further information refer to dokumentations, release notes and application manuals provided on DVD or to be downloaded in the login area on: https://www.svs-vistek.com/en/login/svs-loginarea-login.php

2.3.1 SVCapture

SVCapture is a small software tool provided for free. It is a fast way to show the capabilities of your SVCam.



Get control of exposure timing, trigger delay, image correction etc. or control up to 4 LED lights connected to the SVCam directly via the PC. Use the built-in sequencer to program several intervals executed by one single trigger impulse.

FIGURE 3: SCREENSHOT OF SVCAPTURE

2.4 Firmware

Make sure your camera is running up-to-date firmware.

Some features may not have been implemented in older versions.

Essential when running a newer version of SVCapture or provided SDK.

2.4.1 Firmware Update GigE

A separate tool called “Firmware Update Tool.exe” is provided within the firmware folder.

Execute firmware update

Unpack Firmware whole ZIP-archive to any folder, e.g. “C:\temp”

Browse into “firmware”-folder, locate “_svgigeup.exe” and execute

Ensure proper network configuration!

Your camera should appear, choose camera by entering camera index, e.g. 1 and press ENTER.

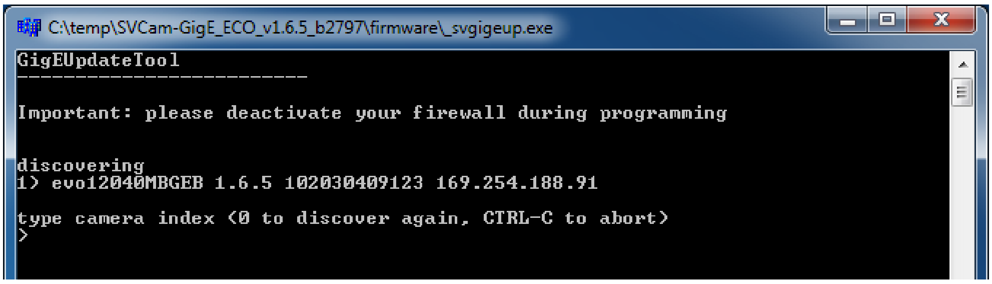


Figure 4: Searching the camera to be updated

Wait until firmware update has been finished

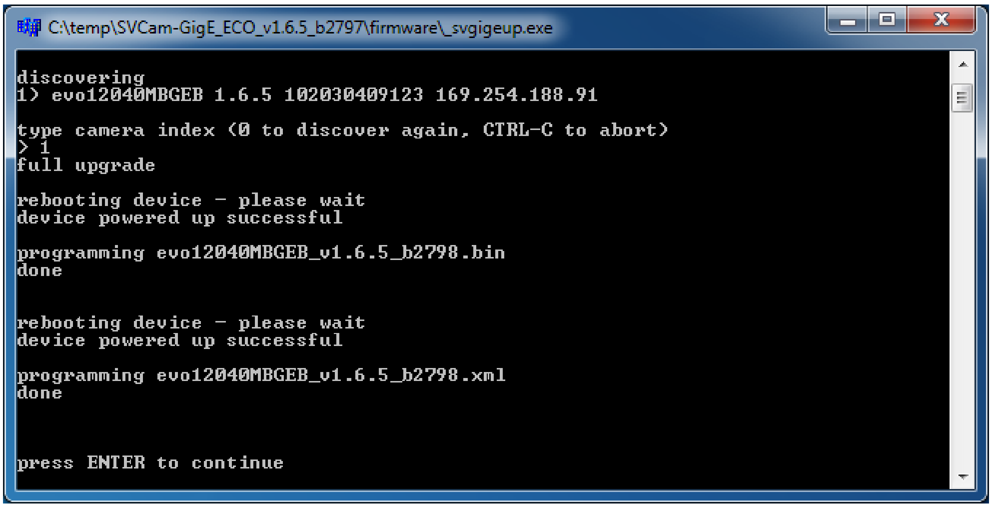


Figure 5: Firmware update has just been executed

2.5 Basic Driver Circuit

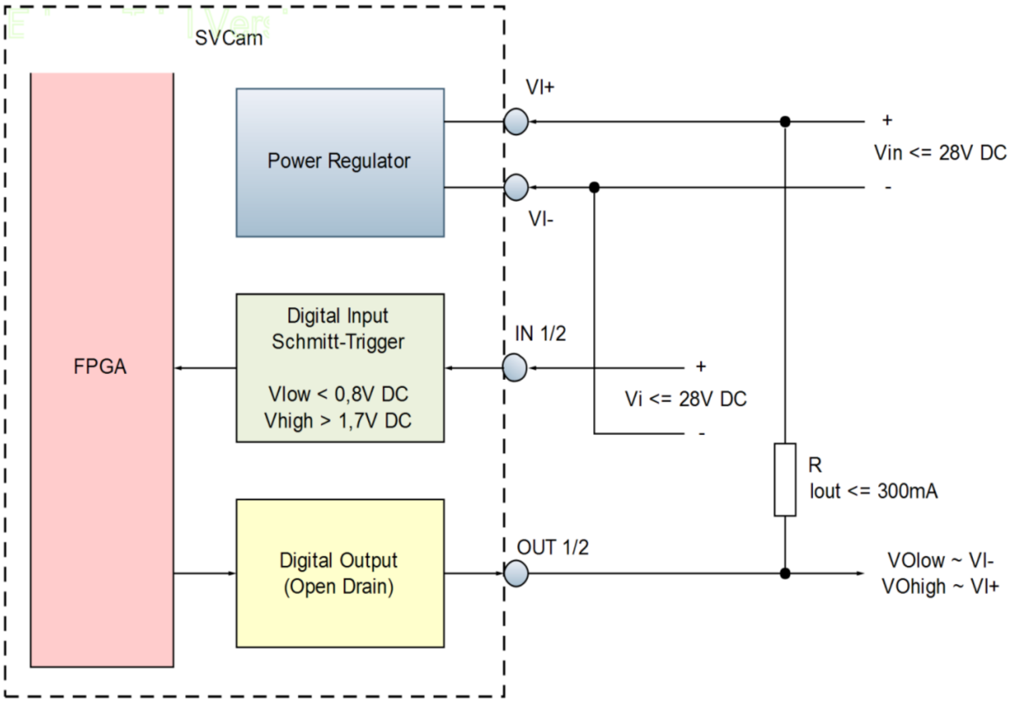


Figure 6: basic Illustration of driver circuit

3 Connectors

3.1 Input / output connectors

For further information using the **breakout box** and simplifying OIs refer **SVCam Connectivity** manual. To be found separate within the USP manuals.

3.1.1 Hirose™ 12Pin

For detailed information about switching lights from inside the camera, refer to strobe control.

Specification	
Type	HR10A-10R-12S
Mating Connector	HR10A-10R-12P

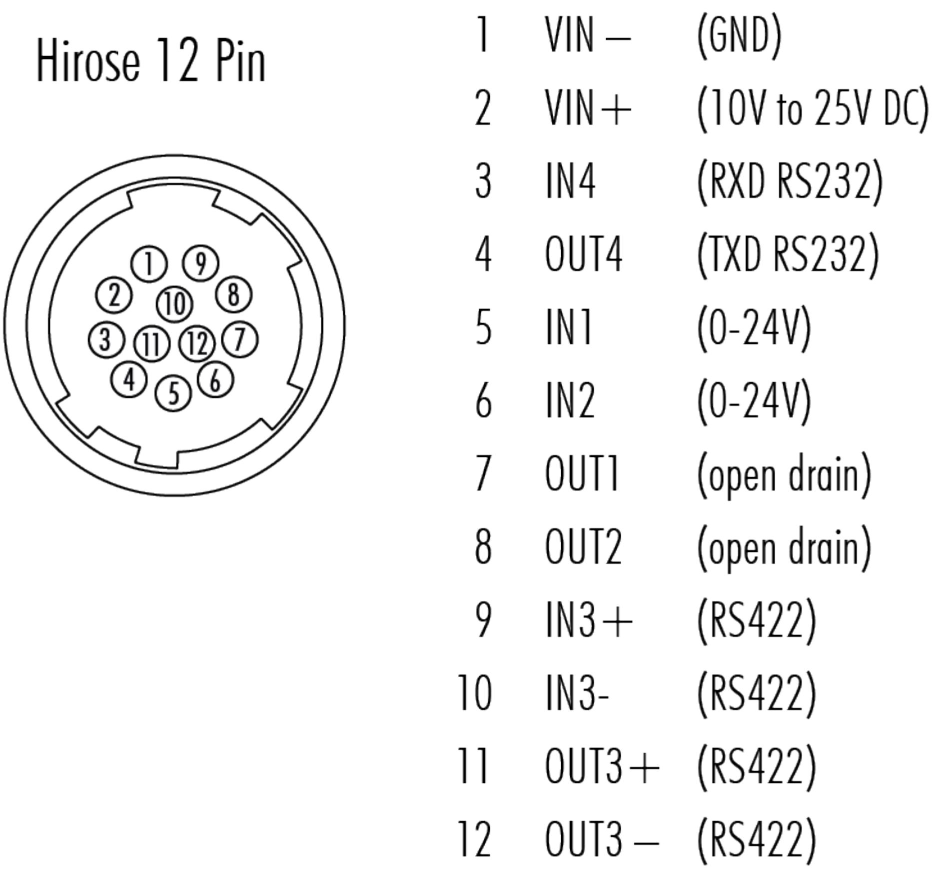


Figure 7: Illustration of Hirose 12 Pin & pin-out (HR10A-10R-12PB)

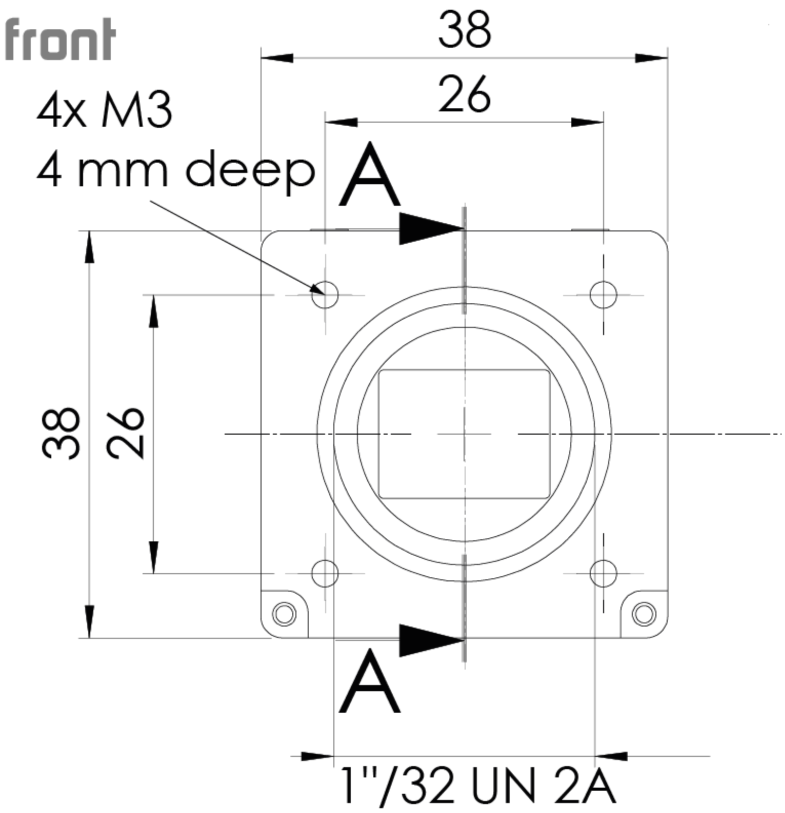
4 Dimensions

4.1 ECO² GigE C-mount

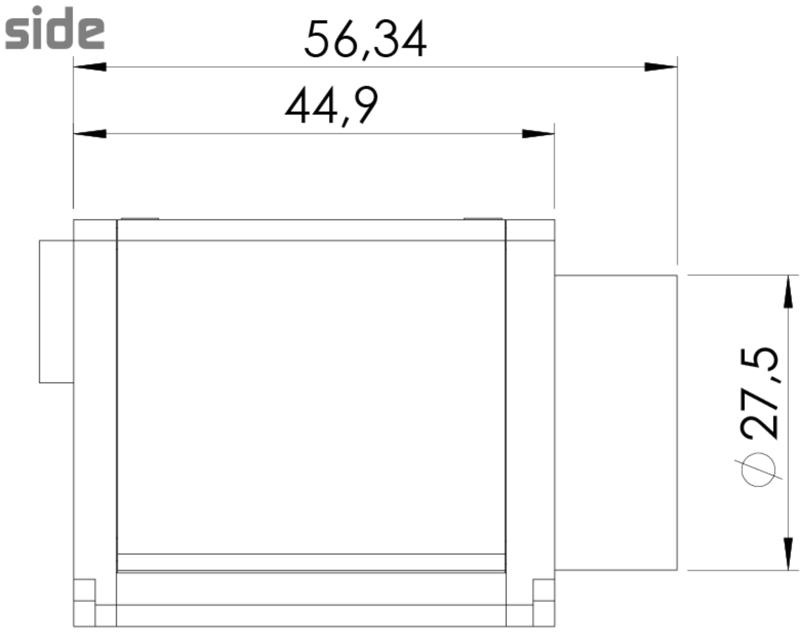
CAD step files available on DVD or SVS-VISTEK.com.

Including:
eco1050CTLGEC, eco1050MTLGEC, eco2050CTLGEC, eco2050MTLGEC, eco2150CTLGEC, eco2150MTLGEC, eco4050CTLGEC, eco4050MTLGEC, eco674CTLGEC, eco674MTLGEC, eco694CTLGEC, eco694MTLGEC, eco695CTLGEC, eco695MTLGEC, eco814CTLGEC, eco814MTLGEC, eco815CTLGEC, eco815MTLGEC, eco834CTLGEC, eco834MTLGEC

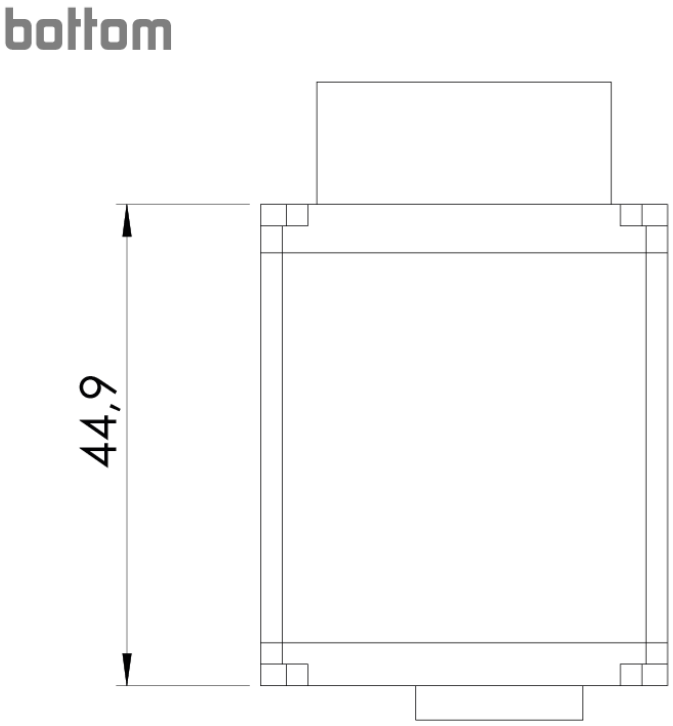
4.1.1 front



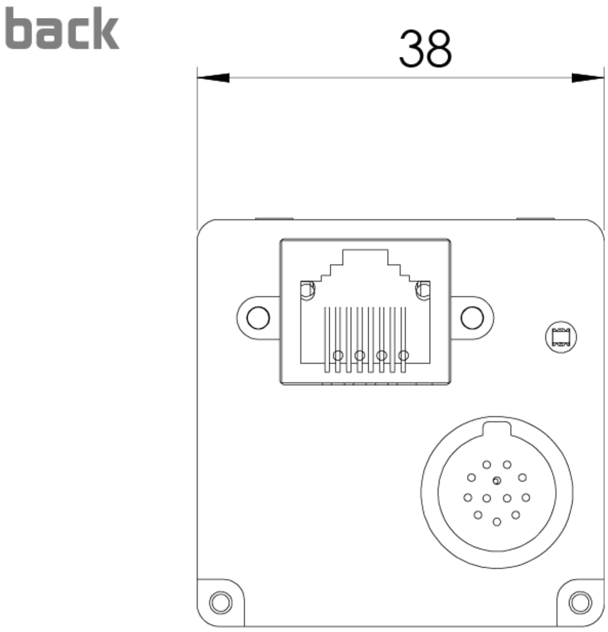
4.1.2 side Left



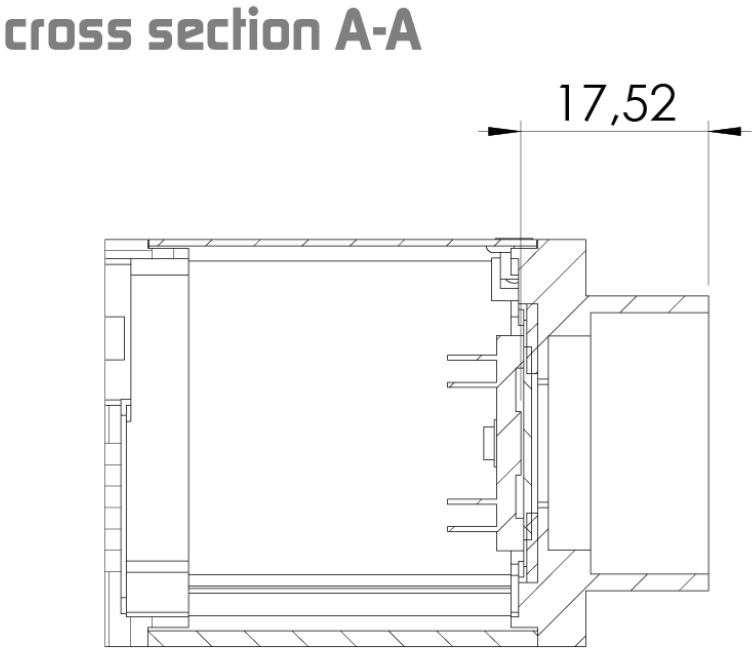
4.1.3 Bottom



4.1.4 Back



4.1.5 Cross Section



4.2 C & CS Mount

Different back-focus distances from sensor to lens.

- > C-Mount: 17,526 mm
- > CS-Mount: 12,526 mm
- > Diameter: 1 Inch
- > Screw Thread: 1/32 Inch

CS-Mount Cameras accept both types of lenses. C-Mount lenses require a 5mm adapter ring to be fitted. (Also available at SVS-VISTEK)

C-Mount Cameras only accept C mount lenses as the flange to sensor distance does not allow a CS mount lens close enough to the Sensor to achieve a focused image.

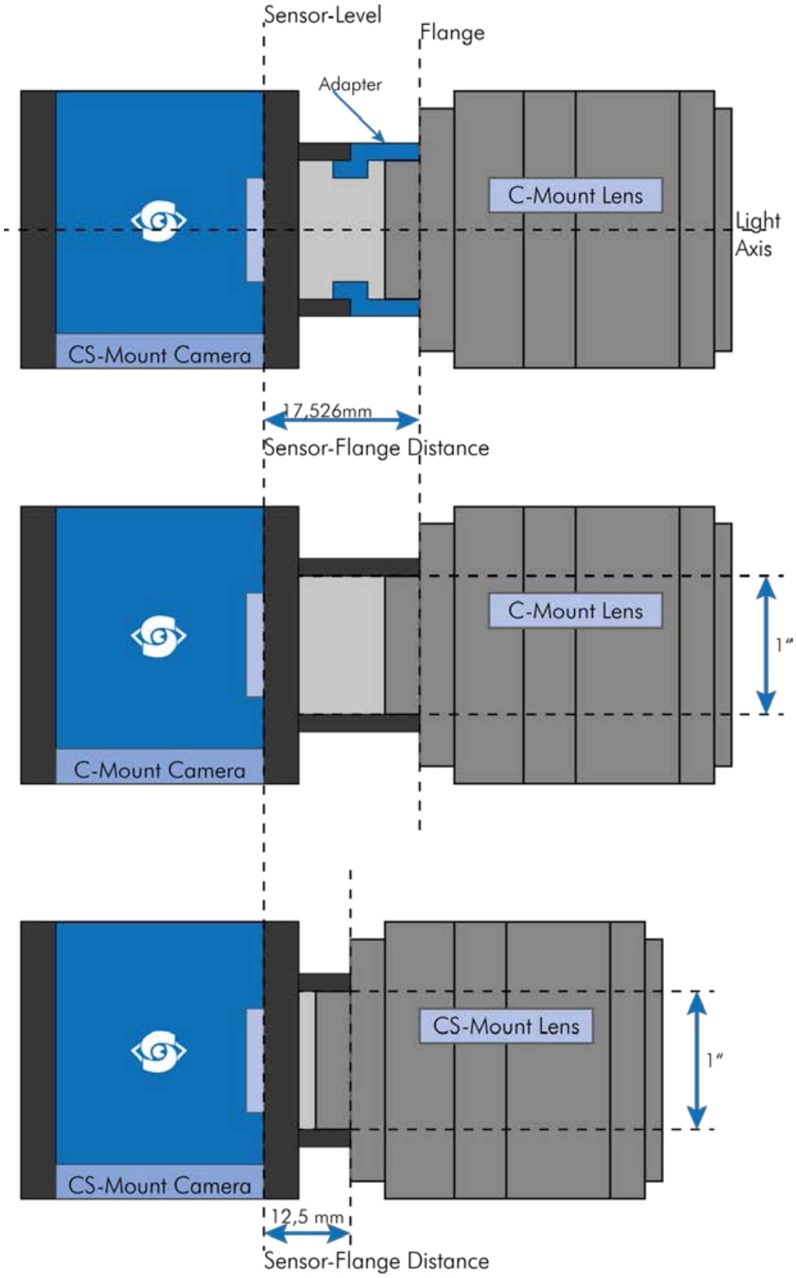


Figure 8: Illustration of C- & CS-Mount differences

5 Feature-Set

5.1 Basic Understanding

5.1.1 Basic Understanding of CCD Technology

Charge Coupled Device.

Light sensitive semiconductor elements arranged as rows and columns. Each row in the array represents a single line in the resulting image. When light falls onto the sensor elements, photons are converted into charge.

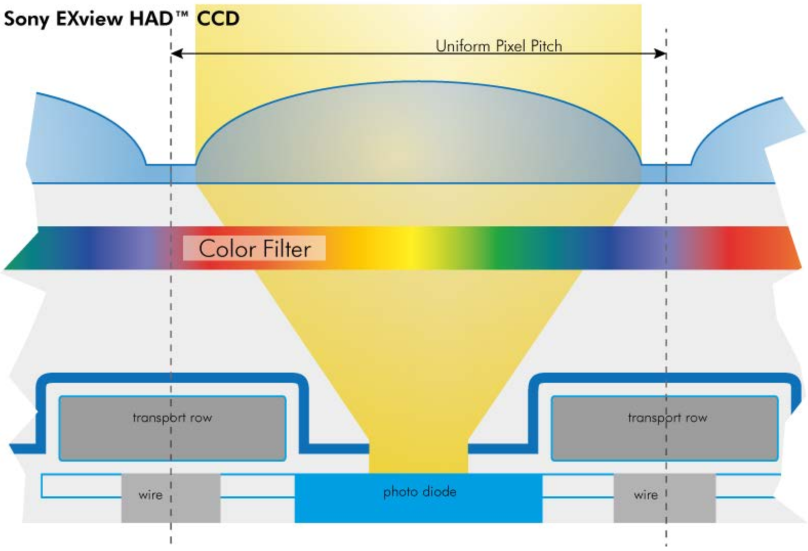
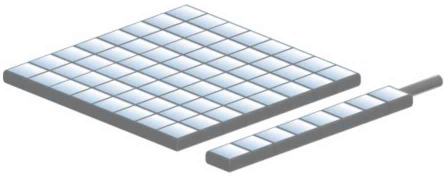


Figure 9: Illustration Cross-section of a CCD sensor from Sony



Charge is an integration of time and light intensity on the element

The sensor converts light into charge and transports it to an amplifier and subsequently to the analog to digital converter (ADC).

5.1.2 Interline Transfer

Interline Transfer is only used in CCD sensors.

With a single pixel clock the charge from each pixel is transferred to the vertical shift register. At this time, the light sensitive elements are again collecting light. The charge in the vertical registers is transferred line by line into the horizontal shift register. Between each (downward) transfer of the vertical register, the horizontal register transfers each line the output stage, where charge is converted to a voltage, amplified and sent on to the ADC. When all lines in the image have been transferred to the horizontal register and read out, the vertical registers can accept the next image…

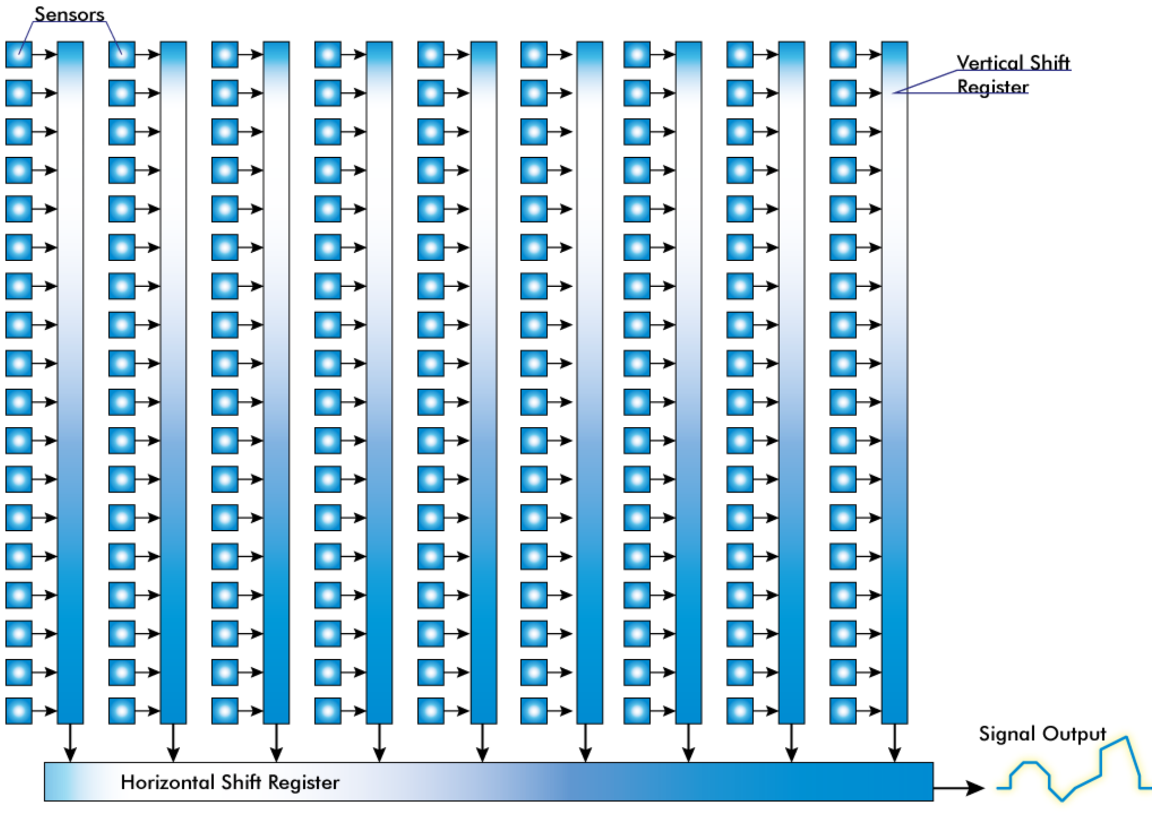


Figure 10: Illustration of interline transfer with columns and rows

5.1.3 Global Shutter / Progressive Scan

Figure 11: Example of rolling shutter

Unlike rolling shutter or interlaced scan modes all pixels are exposed at the same time. Fast moving objects will be captured without showing movement distortion.

Figure 12: motion blur

Figure 13: rolling shutter

Figure 14: interlaced

Figure 15: table of picture errors caused by exposure modes

5.1.4 Frames per Second

Frames per second, or frame rate describes the number of frames output per second. The inverse (1/ frame rate) defines the frame time.

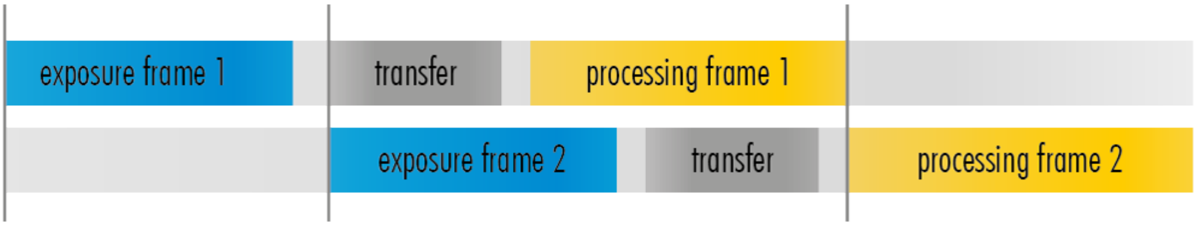
frame per second	frame time (Exposure)	applicable standard
0,25	4 s	
1	1s	
2	500ms	
20	50 ms	
24	$41,\overline{6}$ ms	Cinema
25	40 ms	PAL progressive
29,97	$33,\overline{366700033}$… ms	NTSC
30	$33,\overline{33}$ ms	NTSC
50	20 ms	PAL interlaced
75	$13,\overline{33}$ ms	
100	10 ms	

Virtually any value within the specification can be chosen.
Maximum frame rate depends on:

> Pixel clock
> Image size
> Tap structure
> Data transport limitation
> Processing time

5.1.5 Acquisition and Processing Time

The whole period of tome a picture is exposed, transferred and processed can differ and takes longer.



5.1.6 Exposure

See various exposure and timing modes in chapter: Basic capture modes.

Combine various exposure timings with PWM LED illumination, refer to sequencer.

Setting Exposure time

Exposure time can be set by width of the external or internal triggers or programmed by a given value.

5.1.7 Auto Luminance

Auto Luminance automatically calculates and adjusts exposure time and gain, frame-by-frame.

The auto exposure or automatic luminance control of the camera signal is a combination of an automatic adjustment of the camera exposure time (electronic shutter) and the gain.

The first priority is to adjust the exposure time and if the exposure time range is not sufficient, gain adjustment is applied. It is possibility to pre-define the range (min. / max. -values) of exposure time and of gain.

The condition to use this function is to set a targeted averaged brightness of the camera image. The algorithm computes a gain and exposure for each image to reach this target brightness in the next image (control loop). Enabling this functionality uses always both – gain and exposure time.

1.1.1.1 Limitation

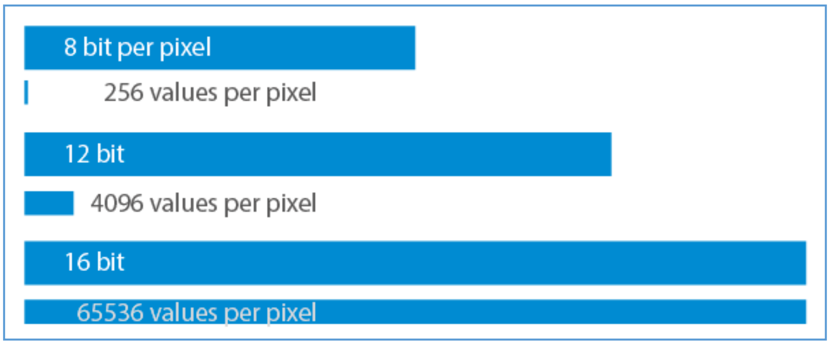
As this feature is based on a control loop, the result is only useful in an averaged, continuous stream of images. Strong variations in brightness from one image to next image will result in a swing of the control loop. Therefore it is not recommended to use the auto-luminance function in such cases.

5.1.1 Bit-Depth

Bit depth defines how many unique colors or grey levels are available in an image after digitization. The number of bits used to quantify limits the number of levels to be used.

e.g.: 4 bits limits the quantification levels to $2^4 = 16$.
Each pixel can represent 16 grey levels

8 bits to	2^8	=	256 values per pixel
12 bits to	2^{12}	=	4096 values per pixel
16 bit to	2^{16}	=	65536 values per pixel



Every additional bit doubles the number for quantification.

SVCam output is 8 or 12 bit.

Figure 16: Illustration of rising amount of values/gray scales by increasing the bit format.

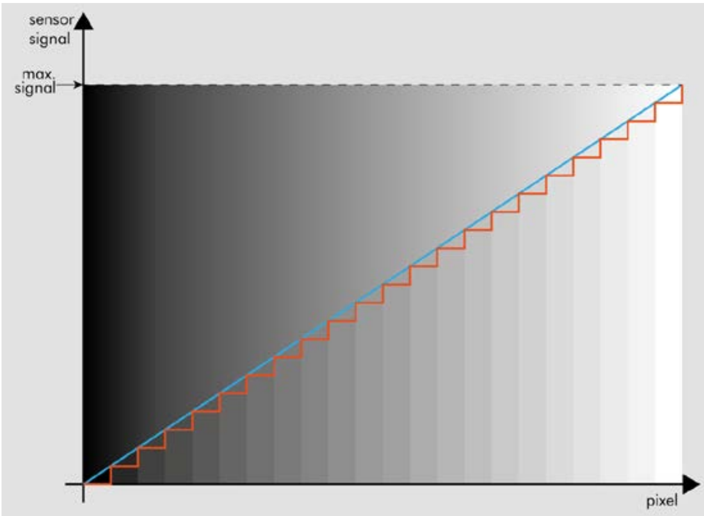


Figure 17: Simplified illustration of a quantification graph

Be aware that increasing the bit format from 8 to 12 bit also increases the total amount of data. According to the interface framerates cam be limited with higher bit depth values.

As SVCam's export pure RAW-format only, color will be added on the computer in accordance with the known Bayer-pattern.

Figure 18: Illustration of one shade difference in 8 bit format

As shown in figure 19 differences in shades of gray are hardly visable on screen or in print.

Figure 20: Figure of original picture - black & white

Figure 21: Figure of quantification with 6 shades of gray

5.1.2 Color

Color cameras are identical to the monochrome versions. The color pixels are transferred in sequence from the camera, in the same manner as the monochrome, but considered as “raw”-format.

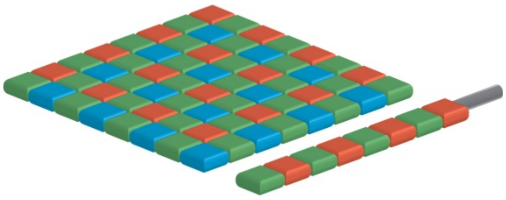


Figure 22: CCD with Bayer Pattern

The camera sensor has a color mosaic filter called “Bayer” filter pattern named after the person who invented it. The pattern alternates as follows:

E.g.: First line: GRGRGR... and so on. (R=red, B=blue, G=green) Second line: BGBGBG... and so on. Please note that about half of the pixels are green, a quarter red and a quarter blue. This is due to the maximum sensitivity of the human eye at about 550 nm (green).

Using color information from the neighboring pixels the RG and B values of each pixel is interpolated by software. E.g. the red pixel does not have information of green and blue components. The performance of the image depends on the software used.

> **NOTICE**
> It is recommended to use a IR cut filter for color applications!

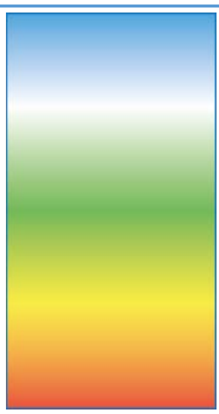
White Balance

The human eye adapts to the definition of white depending on the lighting conditions. The human brain will define a surface as white, e.g. a sheet of paper, even when it is illuminated with a bluish light.

White balance of a camera does the same. It defines white or removes influences of a color tint in the image.

Influences normally depend on the light source used. These tints are measured in Kelvin (K) to indicate the color temperature of the illumination.

Light sources and their typical temperatures:



Temperature	Common Light Source
10.000 – 15.000 K	Clear Blue Sky
6.500 – 8.000 K	Cloudy Sky / Shade
5.500 – 6500 K	Noon Sunlight
5.000 – 5.500 K	Average Daylight
4.000 – 5.000 K	Electronic Flash
4.000 – 5.000 K	Fluorescent Light
3.000 – 4.000 K	Early AM / Late PM
2.500 – 3.000 K	Domestic Lightning
1.000 – 2.000 K	Candle Flame

Figure 23: Table of color temperatures

5.1.3 Resolution – active & effective

As mentions in the specifications, there is a difference between the active and the effective resolution of almost every sensor. Some pixels towards the borders of the sensor will be used only to calibrate the sensor values.

These pixels are totally darkened. The amount of dark current in these areas is used to adjust the offset.

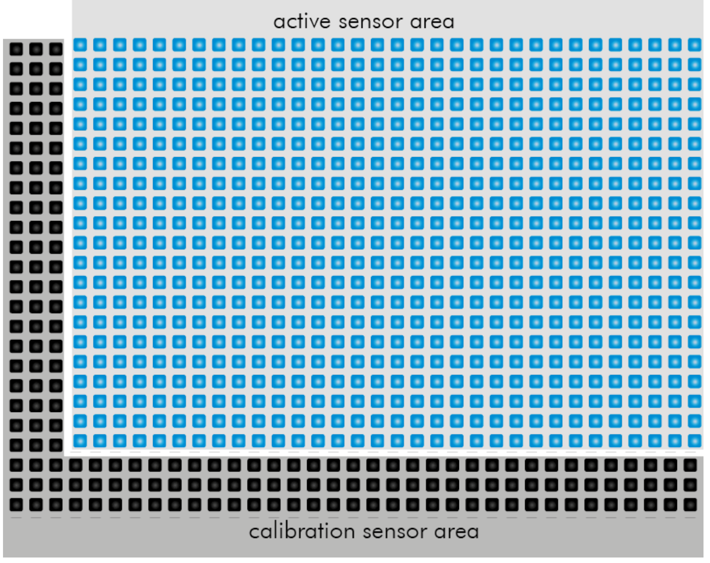


Figure 24: Illustration of active and effective sensor pixels

5.1.4 Offset

For physical reasons the output of a sensor will never be zero, even the camera is placed in total darkness or simply closed. Always there will be noise or randomly appearing electrons that will be detected as a signal.

To avoid this noise to be interpreted as a valuable signal, an offset will be set.

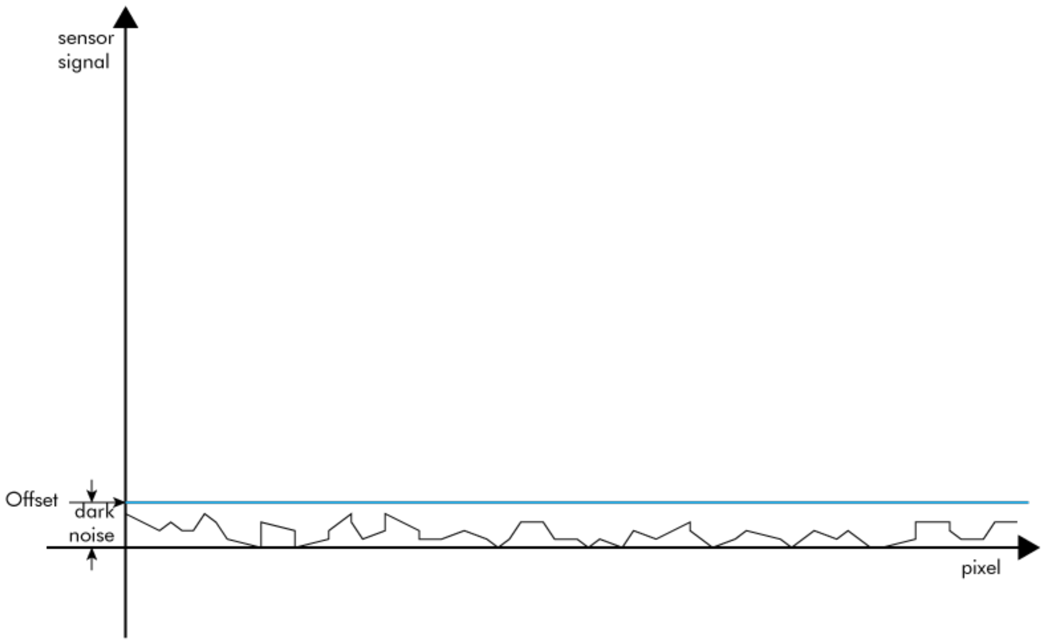


Figure 25: Illustration of dark noise cut off by the offset

Most noise is proportional to temperature. To spare you regulating the offset every time the temperature changes. A precedent offset is set by the camera itself. It references certain pixels that never were exposed to light as black (refer to "resolution – active and effective"). So the offset will be set dynamically and conditioned to external influences.

The offset can be limited by a maximum bit value. If higher values are needed, try to set a look up table.

In case of multi-tap CCD sensors:
Offset can be altered for each tap separately. Refer to "tap balancing".

5.1.5 Gain

Setting gain above 0 dB (default) is another way to boost the signal coming from the sensor. Especially useful for low light conditions.

Setting Gain amplifies the signal of individual or binned pixels before the ADC.

Referring to Photography adding gain corresponds to increasing ISO.

add 6 dB	double ISO value
6 dB	400 ISO
12 dB	800 ISO
18 dB	1600 ISO
24 dB	3200 ISO

Figure 26: Table of dB and corresponding ISO

NOTICE

Gain also amplifies the sensor's noise. Therefore, gain should be last choice for increasing image brightness. Modifying gain will not change the camera's dynamic range.

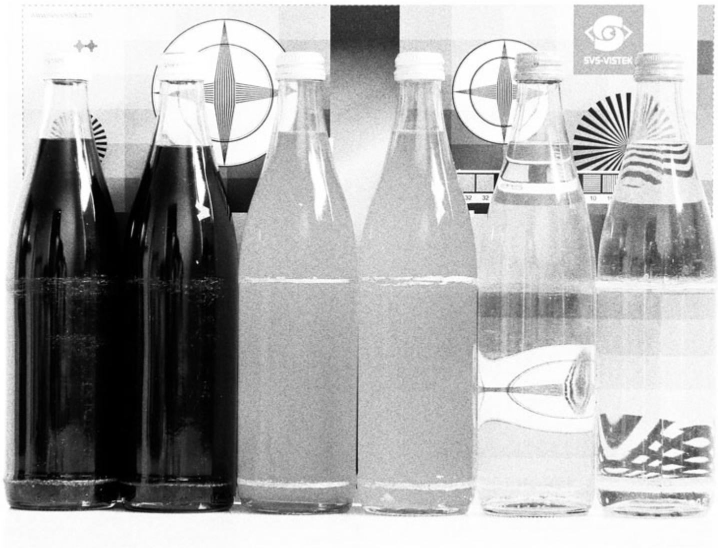


Figure 27: noise caused by increasing gain excessively

Auto Gain

For automatically adjusting Gain please refer to Auto Luminance.

5.1.6 Image Flip

Images can be mirrored horizontally or vertically. Image flip is done inside the memory of the camera, therefore not increasing the CPU load of the PC.

Figure 28: Figure of original image

Figure 29: Figure of image horizontally flipped

Figure 30: Figure of image vertically flipped

5.1.7 Binning

Binning provides a way to enhance dynamic range, but at the cost of lower resolution. Instead of reading out each individual pixel, binning combines charge from neighboring pixels directly on the chip, before readout.

Binning is only used with monochrome CCD Sensors. For reducing resolution on color sensors refer to Decimation.

Vertical Binning

Accumulates vertical pixels.

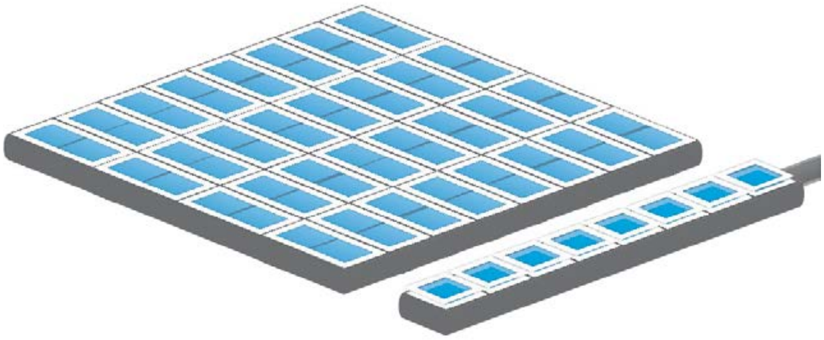


Figure 31: Illustration of vertical binning

Horizontal Binning

Accumulates horizontal pixels.

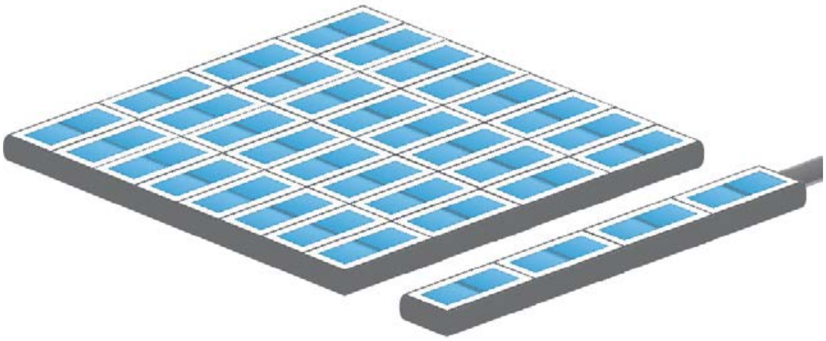


Figure 32: Illustration of horizontal binning

2×2 Binning

A combination of horizontal and vertical binning.

When DVAL signal is enabled only every third pixel in horizontal direction is grabbed.

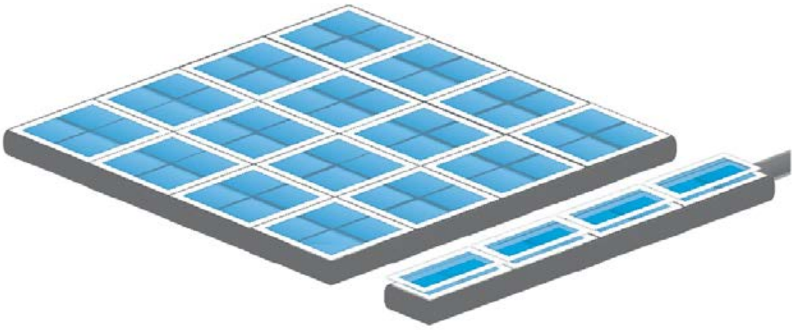


Figure 33: Illustration of 2x2 binning

5.1.8 Decimation

For reducing width or height of an image, decimation can be used. Columns or rows can be ignored.

Refer to partial scan / AOI to reduce data rate by reducing the region you are interested in.

Figure 34 Horizontal decimation Figure 35 Vertical decimation

Decimation on Color Sensors

The Bayer pattern color information is preserved with 1/3 horizontal and vertical resolution. The frame readout speed increases approx. by factor 2.5.

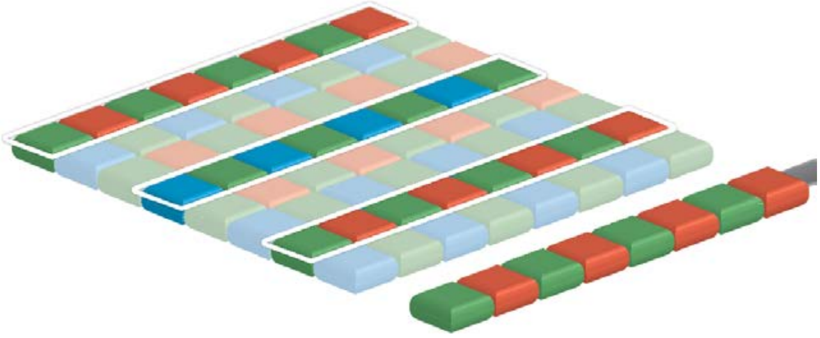


Figure 36: Illustration of decimation on color sensors

5.2 Camera Features

5.2.1 Tap Structure

Your camera may be equipped with a two, four or even higher taped sensor.

Camera output format	Tap geometry
1X–1Y	Single tap
1X–2YE	Dual tap
2X–1Y	Dual tap
2X–2YE	Four tap

Figure 37: table of tap geometray/configurations

Tap configuration.

For information according to your sensor refer to specifications.

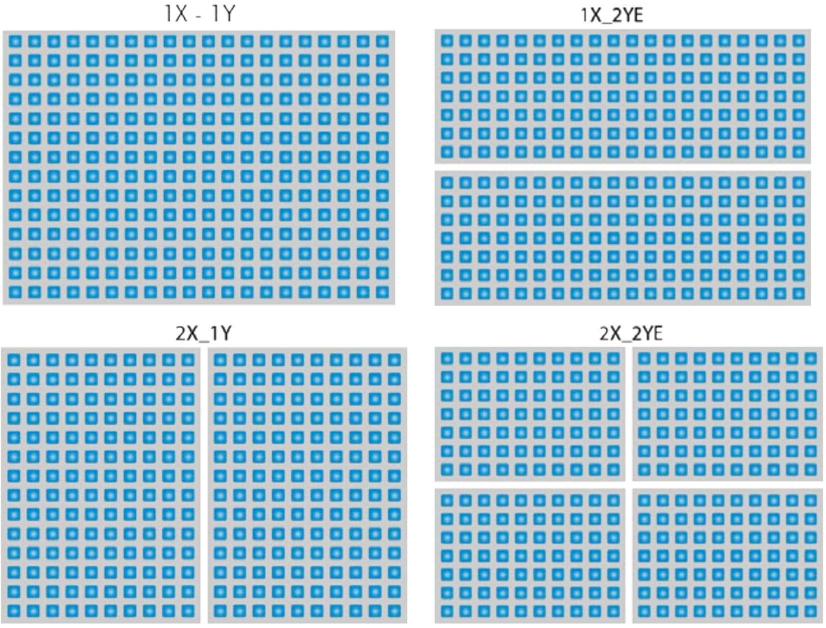


Figure 38: Illustrations of the nomenclature used in specifications

Single-Tap

In a single-tap CCD sensor the readout of pixel charge is done sequentially. Pixel by pixel, line by line. The maximum frame rate is determined by the pixel clock frequency and the total number of pixels to be read out.

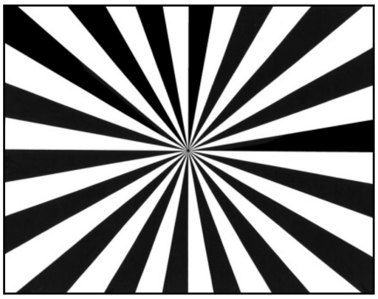


Figure 39: Figure of 1 Tap

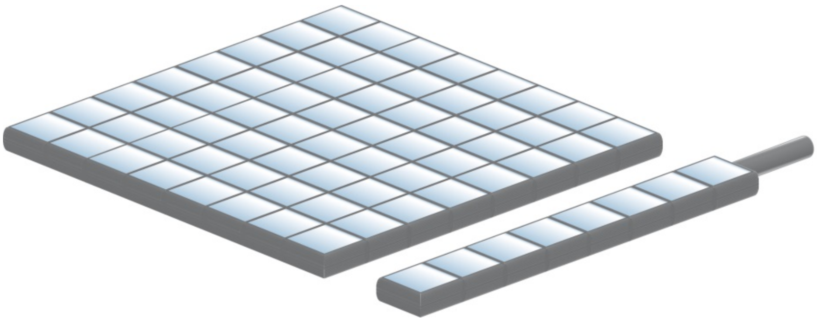


Figure 40: Illustration of 1 tap

Dual-Tap

In a dual-tap CCDs, (CCD with two outputs) the readout of pixel charge takes place in a serial/parallel sequence. Each line is divided in half and the pixels of both halves are read out simultaneously, line by line. For a given pixel clock frequency, only half the time is required to read out the entire array, resulting in twice the framerate.

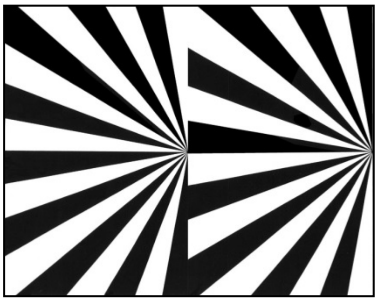


Figure 41: Figure of 2 taps

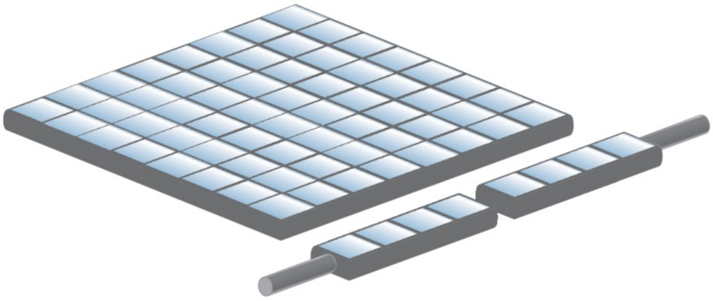


Figure 42: Illustration of 2 taps

1.1.1.1 Tap Reconstruction on GigE Vision

Tap reconstruction takes place within the Camera in order to display the image correctly. Further balancing still can be done after reconstruction.

5.2.2 Tap Balancing

In sensors with multiple the tap structure, parts of the picture may appear differently. Taps may display difference in dynamics and brightness.

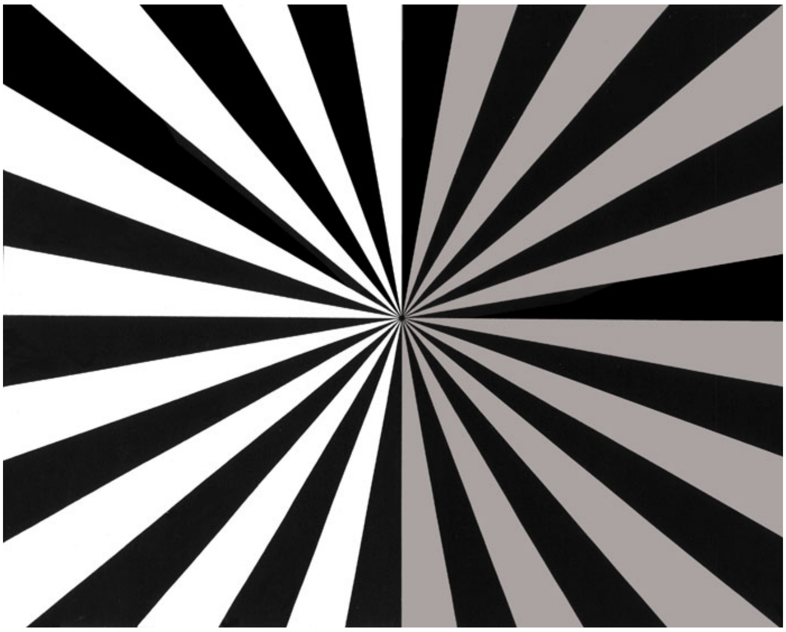


Figure 43: Figure of an unbalanced 2 tap image

To eliminate these differences, tap balancing offers gain adjustments separately for each tap.

This is due to the requirement for a dual or quad -ADC circuit to handle the simultaneous digitization of the two or more channels of analog signal coming from the CCD. The fact that the separate analog output channels not being perfectly linear and the separate output amplifiers having physically different slopes leads to the necessity to sometimes manually or automatically adjust the gain levels of each channel independently to obtain a homogenous image.

Automatic Tap Balancing

Automatic Tap Balancing analyses a narrow strip at the border of the taps. It adjusts the gain value to the average brightness value of these strips.

Continuously Tap Balancing

Automatic Tap Balancing can be done continuously. Taps will be balanced from one image to the next.

Tap Balancing once

When performing Tap Balancing once. Only one specific image will be analyzed. The gain-correction values will be saved and applied to subsequent images.

Manual Tap Balancing

Tap Balancing can be performed manually

5.2.3 System Clock Frequency

Default system clock frequency in almost every SVCam is set to 66.6 MHz. To validate your system frequency: refer to: specifications.

Using the system clock as reference of time, time settings can only be made in multiples of 15 ns.

$$t = \frac{1}{66.\overline{6}\,MHz} = \frac{1}{66\,666\,666.\overline{6}\,\frac{1}{s}} = 15 \cdot 10^{-9}\,s = 15\,ns$$

NOTICE

Use multiples of 15 ns to write durations into camera memory

5.2.4 Read-Out-Control

Read-Out-Control defines a delay between exposure and data transfer. Read-Out-Control is used to program a delay value (time) for the readout from the sensor.

With more than one camera connected to a single computer, image acquisition and rendering can cause conflicts for data transfer, on CPU or bus-system.

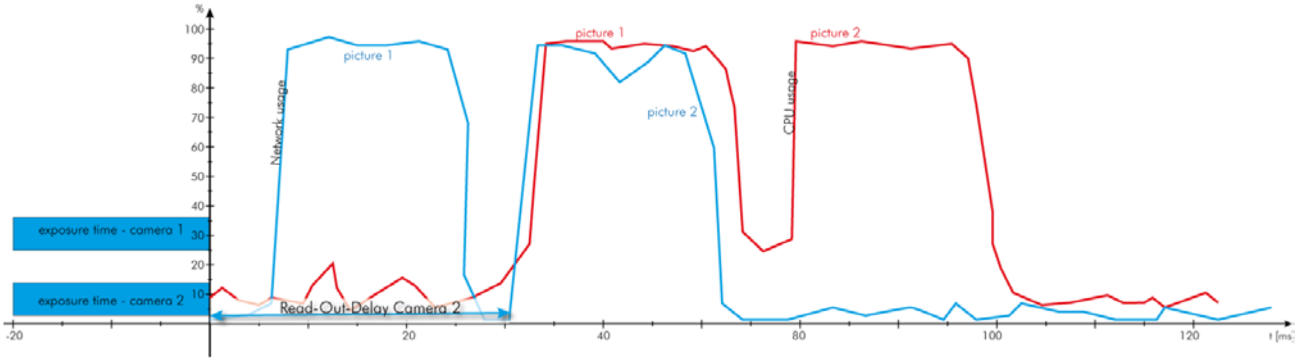


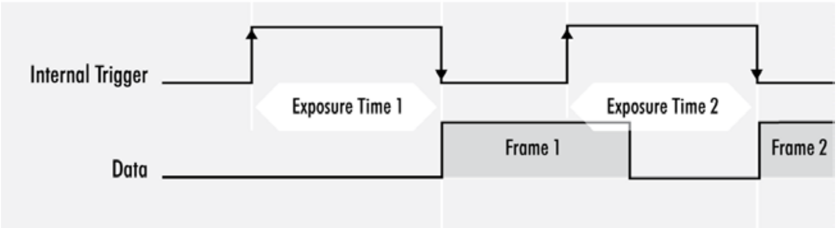
Figure 44: Illustration of physical data stream in time

5.2.5 Basic Capture Modes

Free Running

Free running (fixed frequency) with programmable exposure time. Frames are readout continously and valid data is indicated by LVAL for each line and FVAL for the entire frame.

Mode 0: Free Running with Programmable Exposure Time



There is no need to trigger the camera in order to get data. Exposure time is programmable via serial interface and calculated by the internal logic of the camera.

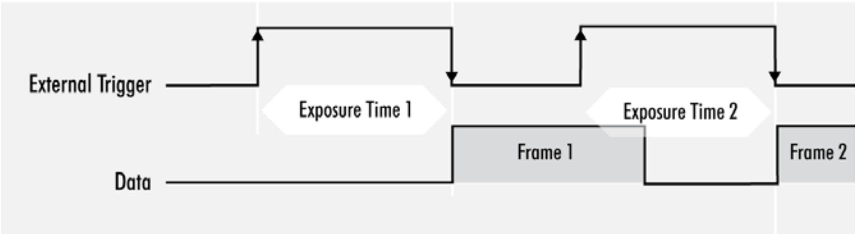
NOTICE

The fundamental signals are:
Line Valid: LVAL, Frame Valid: FVAL,
And in case of triggered modes: trigger input.

Triggered Mode (pulse width)

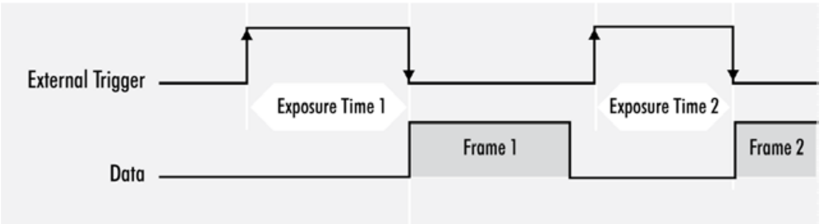
External trigger and pulse-width controlled exposure time. In this mode the camera is waiting for an external trigger, which starts integration and readout. Exposure time can be varied using the length of the trigger pulse (rising edge starts integration time, falling edge terminates the integration time and starts frame read out). This mode is useful in applications where the light level of the scene changes during operation. Change of exposure time is possible from one frame to the next.

Mode 1: External Trigger with Pulse Width Exposure Control (overlap)



Exposure time of the next image can overlap with the frame readout of the current image (rising edge of trigger pulse occurs when FVAL is high). When this happens: the start of exposure time is synchronized to the falling edge of the LVAL signal.

Mode 1: External Trigger with Pulse Width Exposure Control (non overlap)



When the rising edge of trigger signal occurs after frame readout has ended (FVAL is low) the start of exposure time is not synchronized to LVAL and exposure time starts after a short and persistant delay.

The falling edge of the trigger signal must always occur after readout of the previous frame has ended (FVAL is low).

External Trigger (Exposure Time)

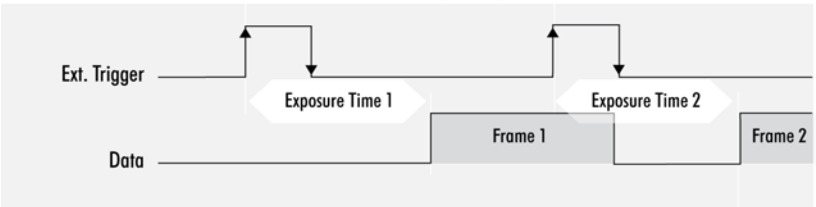
External trigger with programmable exposure time. In this mode the camera is waiting for an external trigger pulse that starts integration, whereas exposure time is programmable via the serial interface and calculated by the internal microcontroller of the camera.

At the rising edge of the trigger the camera will initiate the exposure.

The software provided by SVS-Vistek allows the user to set exposure time e.g. from 60 µs 60 Sec (camera type dependent).

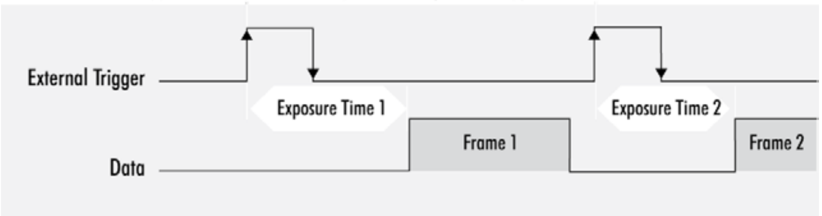
Exposure time of the next image can overlap with the frame readout of the current image (trigger pulse occurs when FVAL is high). When this happens, the start of exposure time is synchronized to the negative edge of the LVAL signal (see figure)

Mode 2: External Trigger with Programmable Exposure Time (overlap)



When the rising edge of trigger signal occurs after frame readout has ended (FVAL is low), the start of exposure time is not synchronized to LVAL and exposure time starts after a short and persistant delay.

Mode 2: External Trigger with Programmable Exposure Time (non overlap)

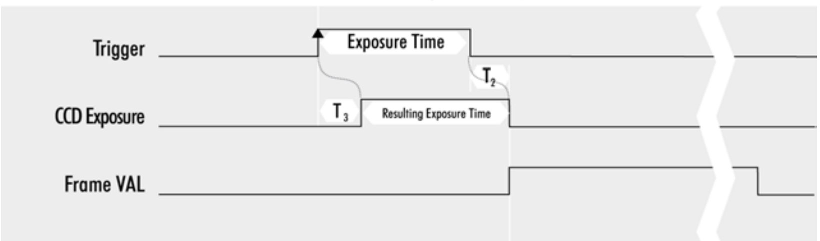


Exposure time can be changed during operation. No frame is distorted during switching time. If the configuration is saved to the EEPROM, the set exposure time will remain also when power is removed.

Detailed Info of External Trigger Mode

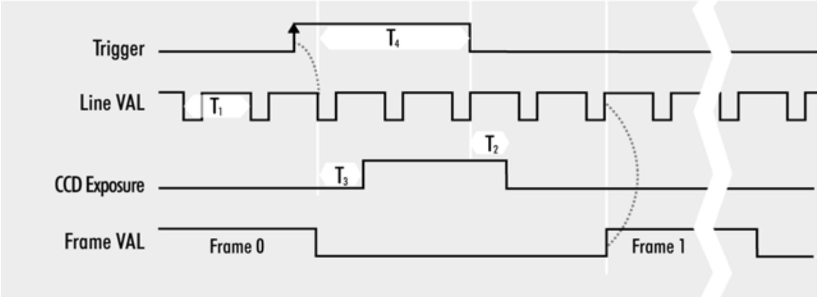
Dagrams below are aquivalent for CCD and CMOS technique.

Mode 1: External Trigger with Pulse Width Exposure Control (non overlap)



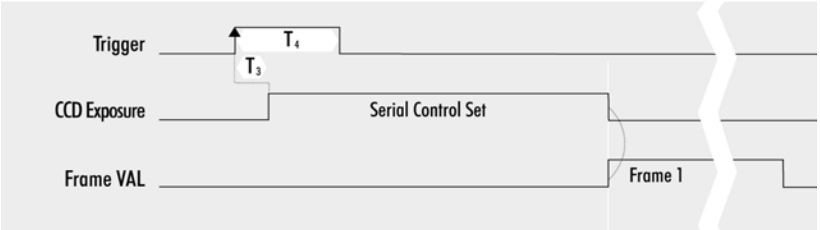
T_1: Line Duration T_2: Transfer Delay T_3: Exposure Delay T_4: min. Trigger Pulse Width

Mode 1: External Trigger with Pulse Width Exposure Control (overlap)



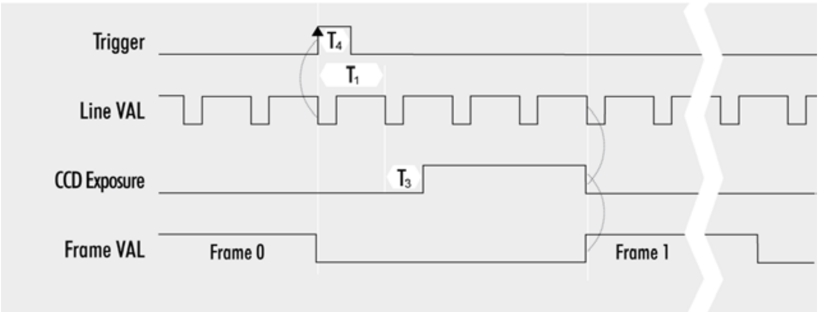
T_1: Line Duration T_2: Transfer Delay T_3: Exposure Delay T_4: min. Trigger Pulse Width

Mode 2: External Trigger with Programmable Exposure Time (non overlap)



T_1: Line Duration T_2: Transfer Delay T_3: Exposure Delay T_4: min. Trigger Pulse Width

Mode 2: External Trigger with Programmable Exposure Time (overlap)



T_1: Line Duration T_2: Transfer Delay T_3: Exposure Delay T_4: min. Trigger

Software Trigger

Trigger can also be initiated by software (serial interface).

NOTICE

Software trigger can be influenced by jitter. Avoid Software trigger at time sensitive applications

5.2.6 LookUp Table

The LookUp Table Feature (LUT) lets the user define certain values to every bit value that comes from the ADC.

To visualize a LUT a curve diagram can be used, similar to the diagrams used in photo editing software.

The shown custom curve indicates a contrast increase by applying an S-shaped curve. The maximum resolution is shifted to the mid-range. Contrasts in this illumination range is increased while black values will be interpreted more black and more of the bright pixels will be displayed as 100 % white…

For further Information about curves and their impact on the image refer to our homepage: Knowledge Base – LUT

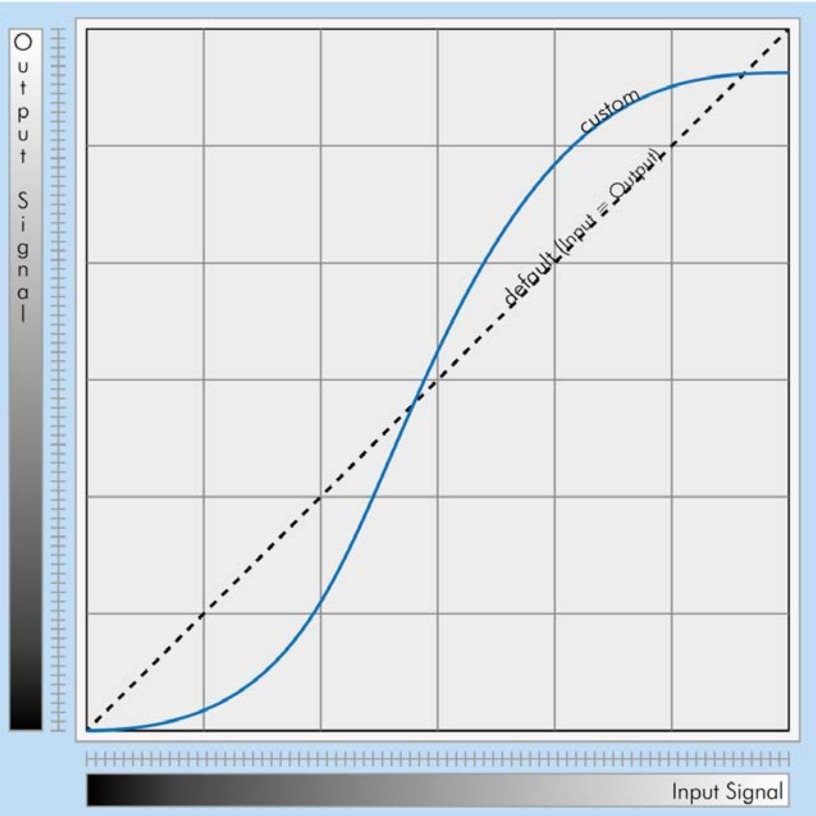


Figure 45: illustration of a custom LUT adding contrast to the midtones

NOTICE

LUT implementation reduces bit depth from 12 bit to 8 bit on the output.

Gamma Correction

Using the LookUp Table makes is also possible to implement a logarithmic correction. Commonly called Gamma Correction.

Historically Gamma Correction was used to correct the illumination behavior of CRT displays, by compensating brightness-to-voltage with a Gamma value between 1,8 up to 2,55.

The Gamma algorithms for correction can simplify resolution shifting as shown seen above.

Input & Output signal range from 0 to 1

$$\text{Output-Signal} = \text{Input-Signal}^{\text{Gamma}}$$

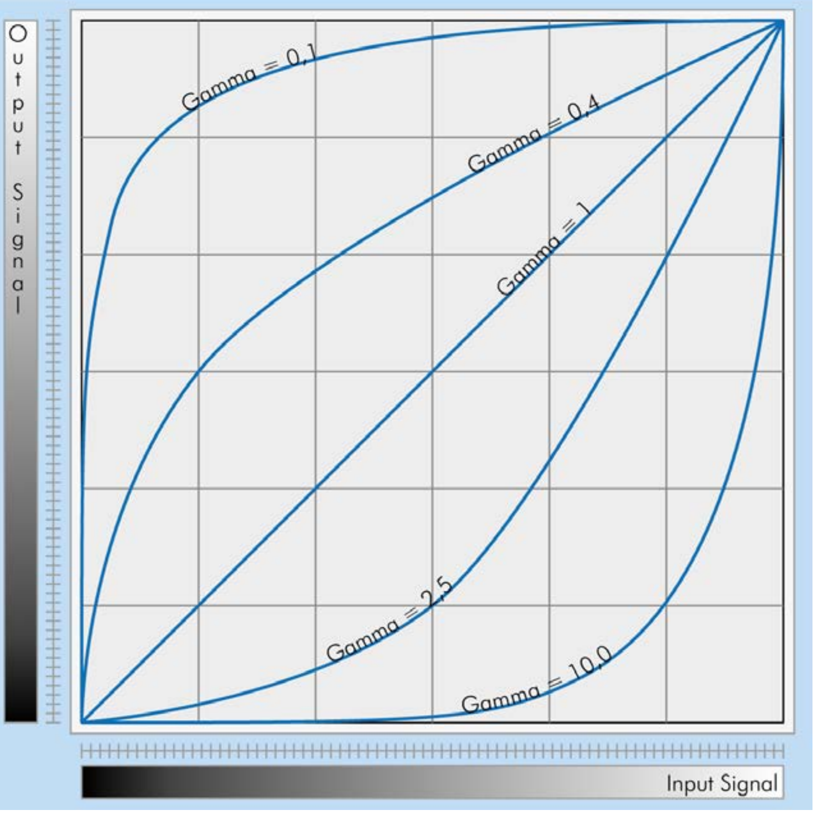


Figure 46: illustration of several gamma curves comparable to a LUT

Gamma values less than 1.0 map darker image values into a wider ranger.
Gama values greater than 1.0 do the same for brighter values.

NOTICE

Gamma Algorithm is just a way to generate a LUT. It is not implemented in the camera directly..

5.2.7 Partial Scan / AOI

In Partial Scan or Area-Of-Interest or Region-Of-Interest (ROI) -mode only a certain region will be read.

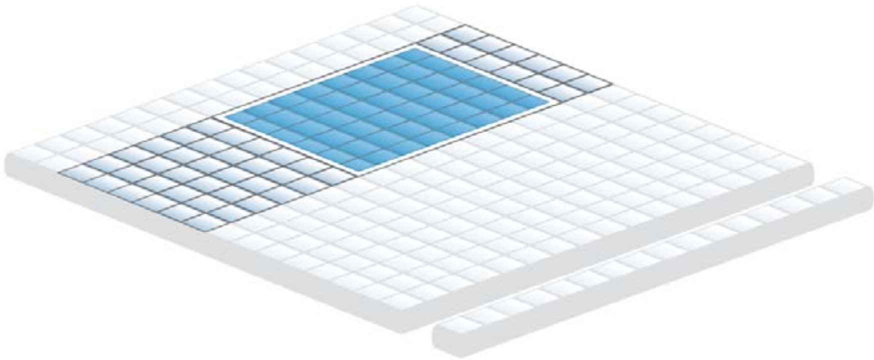


Figure 47: Illustration of AOI limitation on a CCD sensor

Selecting an AOI will reduce the number of horizontal lines being read. This will reduce the amount of data to be transferred, thus increasing the maximum speed in term of frames per second.

With CCD sensors, setting an AOI on the left or right side does not affect the frame rate, as lines must be read out completely.

5.2.8 Defect Pixel Correction

Defect Pixel Correction interpolates information from neighboring pixels to compensate for defect pixels or clusters (cluster may have up to five defect pixels).

All image sensor have defect pixels in a lesser or greater extent. The number of defects determines the quality grade and the value of all sensors integrated by SVS-VISTEK.

Defect Pixels either be dark pixels, i.e. that don't collect any light, or bright pixels (hot pixel) that always are outputting a bright signal.

The amount of hot pixels is proportional to exposure time and temperature of the sensor.

By default, all known defect pixels or clusters are corrected by SVS-VISTEK.

Under challenging conditions or high temperature environments additional defect pixels can may appear. These can be corrected.

- A factory created defect map (SVS map), defying known defects, is stored in the camera...
- A custom defect map can be created by the user. A simple txt file with coordinates has to be created. The user must locate the pixel defects manually.
- The txt file can be uploaded into the camera. Beware of possible Offset!
- Defect maps can be switched off to show all default defects, and switched back on to improve image quality.

Unlike Shading Correction, Defect Pixel Correction suppresses pixels or clusters and reconstructs the expected value by interpolating neighboring pixels that. The standard interpolation algorithm uses the pixel to the left or to the right of the defect. This simple algorithm prevents high runtime losses.

More sophisticated algorithms can be used by software.

Figure 48: Illustration of a defect pixel

5.2.9 Temperature Sensor

A temperature sensor is installed on the mainboard of the camera.

To avoid overheating, the temperature is constantly monitored and read. Besides software monitoring, the camera indicates high temperature by a red flashing LED. (See flashing LED codes)

5.3 I/O Features

5.3.1 Assigning I/O Lines – IOMUX

The IOMUX is best described as a switch matrix. It connects inputs, and outputs with the various functions of SVCam I/O. It also allows combining inputs with Boolean arguments.

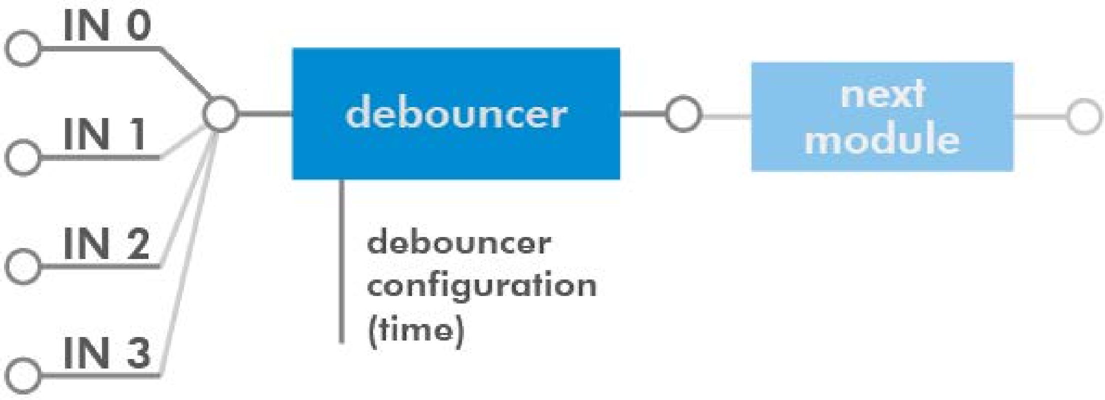


Figure 49: Illustration of an example configuration using the IOMUX to connect "IN0" to the "debouncer" and going on to the next module.

The input and output lines for Strobe and Trigger impulses can be arbitrarily assigned to actual data lines.

Individual assignments can be stored persistently to the EPROM.

Default setting can be restored from within the Camera.

Refer to pinout in input / output connectors when physically wiring.

Also the IOMUX can be illustrated as a three dimensional dice. Long address spaces indicate which signals are routed to witch module within the camera.

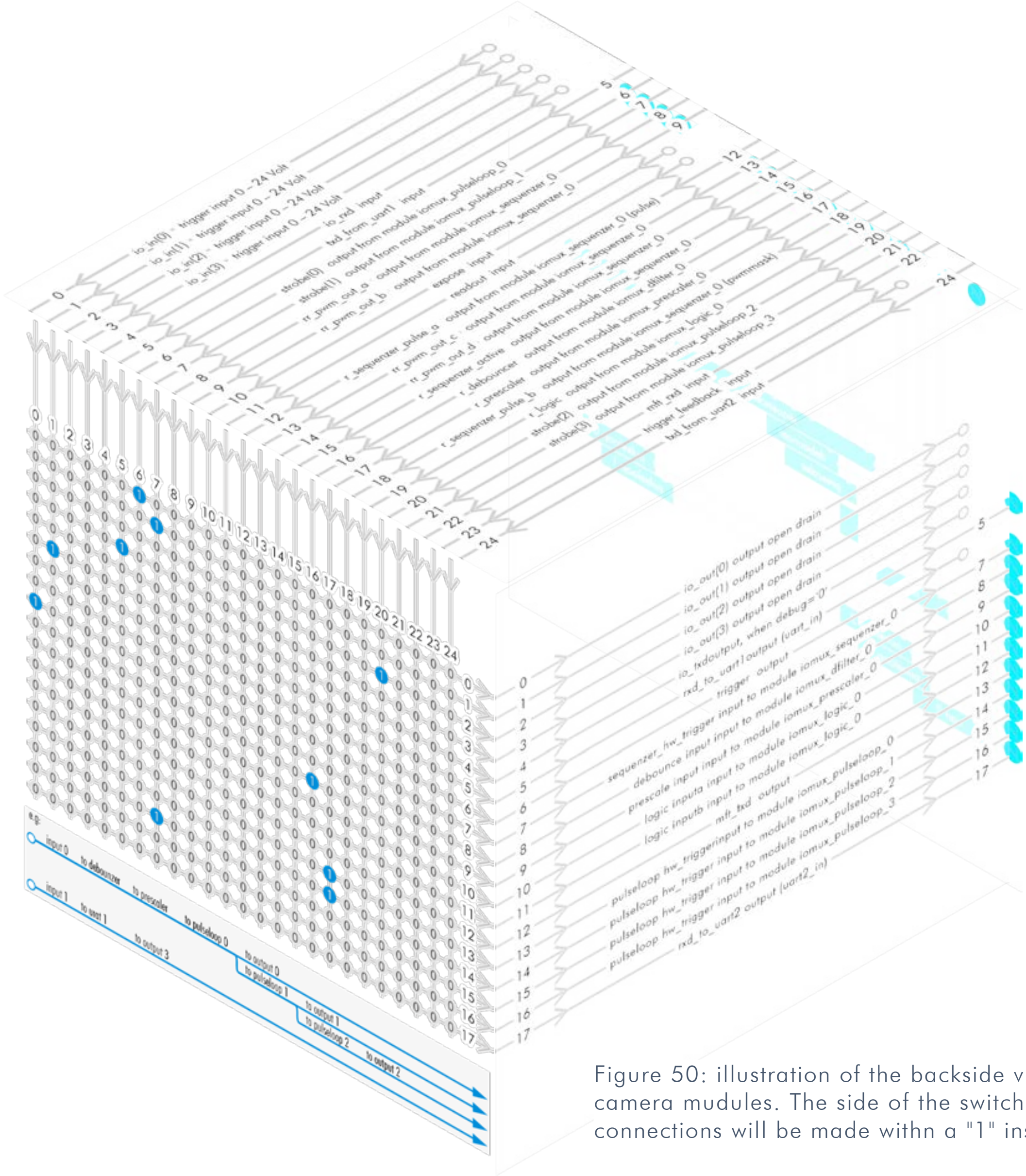
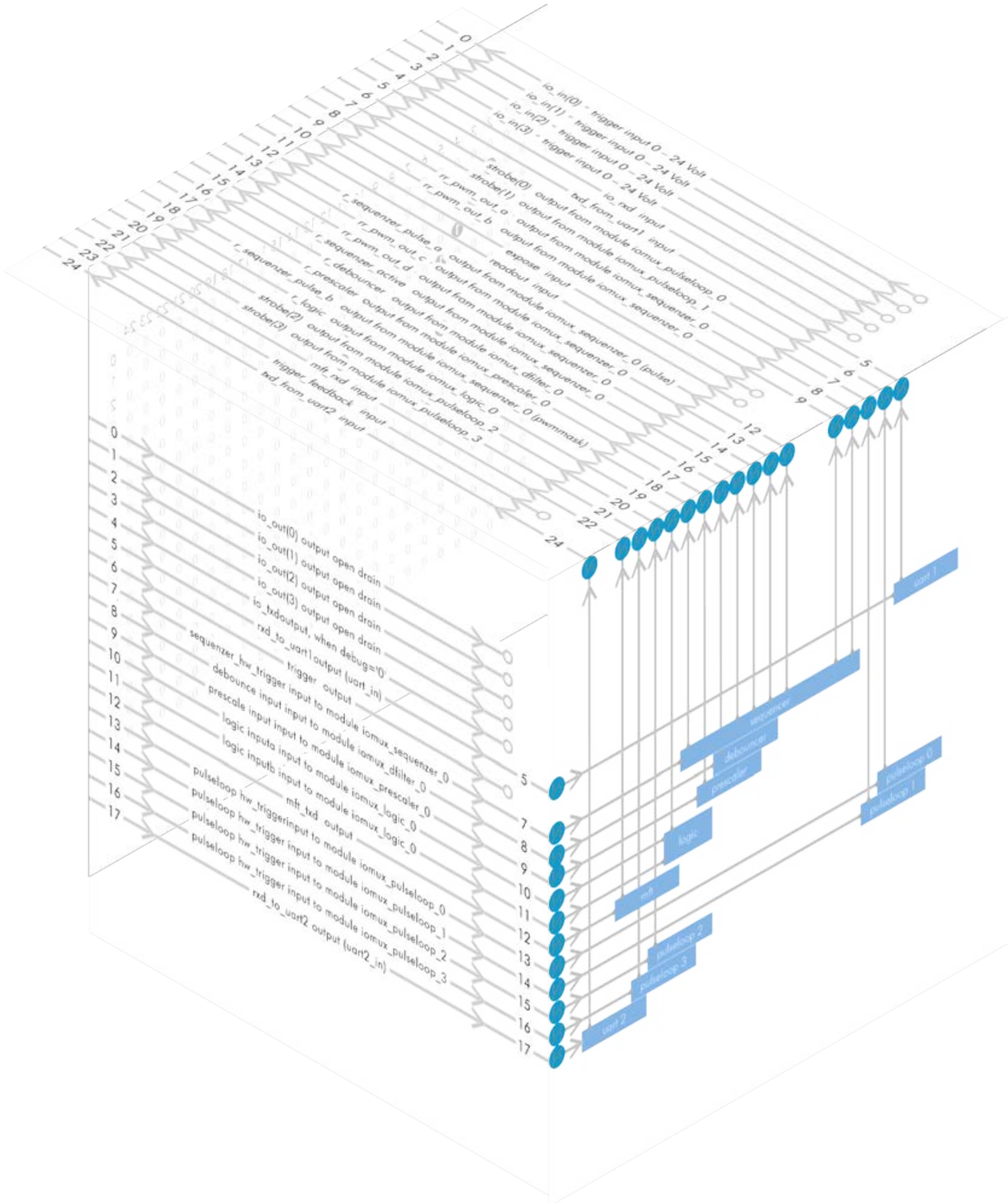


Figure 50: illustration of the backside view of the camera mudules. The side of the switch matrix. connections will be made withn a "1" instead of a "0"

Figure 51: illustration of frontside view to the camera modules.

Lines with open end indicate physical in- and outputs



input vector to switch matrix

nr.	name	description
0	io_in(0)	trigger input 0 – 24 Volt / RS-232 / opto *
1	io_in(1)	trigger input 0 – 24 Volt / RS-232 / opto *
2	io_in(2)	trigger input 0 – 24 Volt / RS-232 / opto *
3	io_in(3)	trigger input 0 – 24 Volt / RS-232 / opto *
4	io_rxd input	
5	txd_from_uart1	input
6	strobe(0)	output from module iomux_pulseloop_0
7	strobe(1)	output from module iomux_pulseloop_1
8	rr_pwm_out_a	output from module iomux_sequenzer_0
9	rr_pwm_out_b	output from module iomux_sequenzer_0
10	expose input	
11	readout input	
12	r_sequenzer_pulse_a	output from module iomux_sequenzer_0 (pulse)
13	rr_pwm_out_c	output from module iomux_sequenzer_0
14	rr_pwm_out_d	output from module iomux_sequenzer_0
15	r_sequenzer_active	output from module iomux_sequenzer_0
16	r_debouncer	output from module iomux_dfilter_0
17	r_prescaler	output from module iomux_prescaler_0
18	r_sequenzer_pulse_b	output from module iomux_sequenzer_0 (pwmmask)
19	r_logic	output from module iomux_logic_0
20	strobe(2)	output from module iomux_pulseloop_2
21	strobe(3)	output from module iomux_pulseloop_3
22	mft_rxd input	
23	trigger_feedback	input
24	txd_from_uart2	input

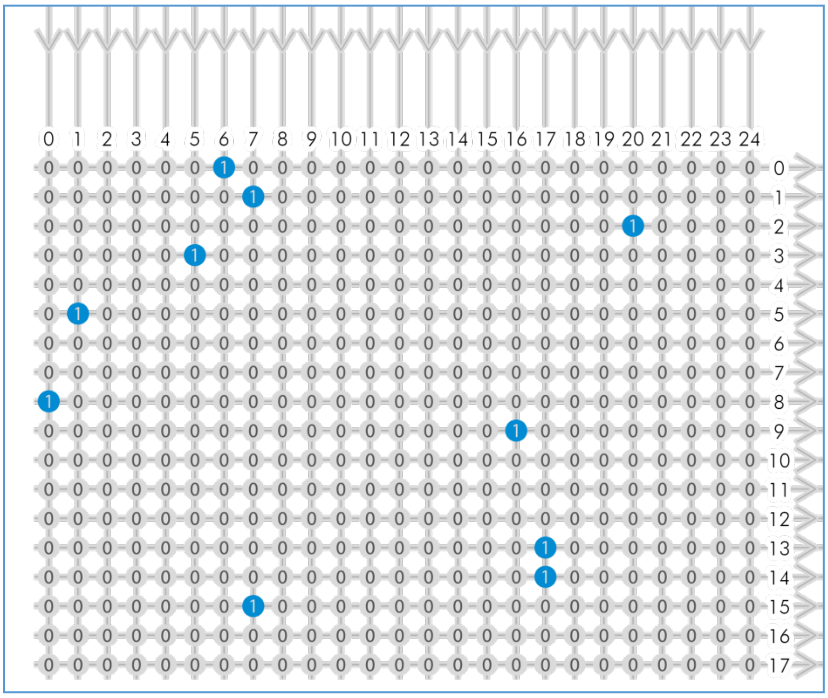
* refer to pinout or specifications

output vector from switch matrix

nr.	name / register	describtion
0	io_out(0)	output open drain
1	io_out(1)	output open drain
2	io_out(2)	output open drain *
3	io_out(3)	output open drain *
4	io_txd	output, when debug='0'
5	rxd_to_uart1	output (uart_in)
6	trigger	output
7	sequenzer_hw_trigger	input to module iomux_sequenzer_0
8	debounce input	input to module iomux_dfilter_0
9	prescale input	input to module iomux_prescaler_0
10	logic inputa	input to module iomux_logic_0
11	logic inputb	input to module iomux_logic_0
12	mft_txd	output
13	pulseloop hw_trigger	input to module iomux_pulseloop_0
14	pulseloop hw_trigger	input to module iomux_pulseloop_1
15	pulseloop hw_trigger	input to module iomux_pulseloop_2
16	pulseloop hw_trigger	input to module iomux_pulseloop_3
17	rxd_to_uart2	output (uart2_in)

* for physical number of open drain outputs refer to pinout or specifications

Example of an IOMUX configuration



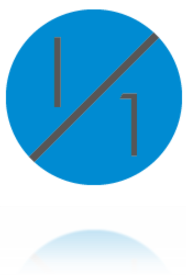
> The trigger signal comes in on line 0
> Debounce it.
connect line 0 to 8:
1000000000000000000000000
signal appears again on line 15 – debouncer out
> Use the prescaler to act only on every second pulse.
connect line 16 to 9.
0000000000000000100000000
signal appears again on line 17 – debouncer out
> Configure a strobe illumination with pulseloop module 0
connect line 17 to 13
signal from pulse loop module 0 appears on line 6
connect line 6 to 0 (output 0)
> Set an exposure signal with pulseloop module 1.
connect line 17 to 6
> Tell another component that the camera is exposing the sensor.
connect line 17 to 14
signal from pulse loop module 1 appears on line 7
connect line 7 to 1 (output 1)
> Turn of a light that was ON during the time between two pictures.
connect line 17 to 15
invert signal from pulse loop module 2
it appears on line 20
connect line 20 to 2 (output 2)

Inverter & Set-to-1

Inverter and “set to 1” is part of every input and every output of the modules included in the IOMUX.

Inverter

The inverter enabled at a certain line provides the reverse signal to or from a module.



Set to “1”

With set to “1” enabled in a certain line, this line will provide a high signal no matter what signal was connected to the line before.

Set to “1” – invers

The inverse of a set to “1” line will occour as a low signal, regardle the actual signal that came to the inverter modul.

5.3.2 Strobe Control

Drive LED lights form within your camera. Control them via ethernet.

Figure 52: use the breakout box to simplify your wiring

> SVCam cameras have built-in MOSFETs that can drive up to 3 Amperes.
> This allows using the cameras as a strobe controller – saving costs.
> High frequency pulse width modulation (PWM) for no flickering.
> Power to the LED light is provided through power of the camera.
> Setting of pulse, duty cycle is controlled via data connection / PC.
> LED-lights can be controlled over 4 different channels that can be used simultaneously or independent from each other
> According to the I/O specification of your camera two or four canals can be used as open drain. Refer to specifications.
> Max. current at 40 mSec. is 3 A

2 IO's high voltage drain

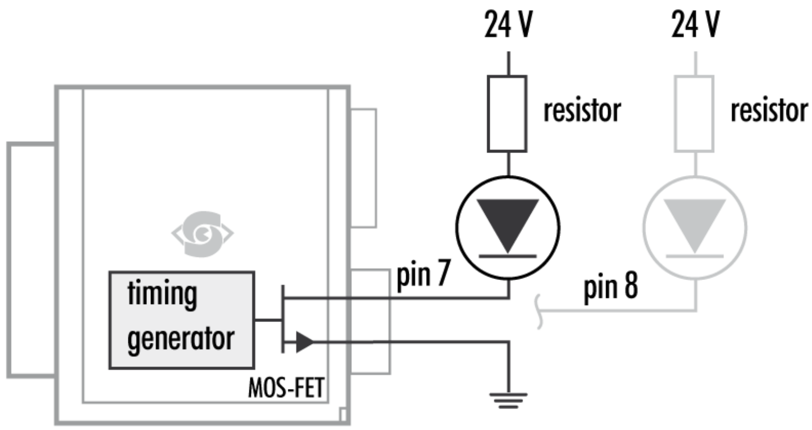


Figure 53: Illustration of two LEDs switched internal by the camera

For detailed connector pin out refer to Connectors.

For further information using the breakout box and simplifying OIs refer **SVCam Connectivity** manual. To be found separate within the USP manuals.

USE RIGHT DIMENSION OF RESISTOR!

To avoid overload of Driver, make sure to use the right dimension of resistor. If not done so, LEDs and/or Camera might be damaged.

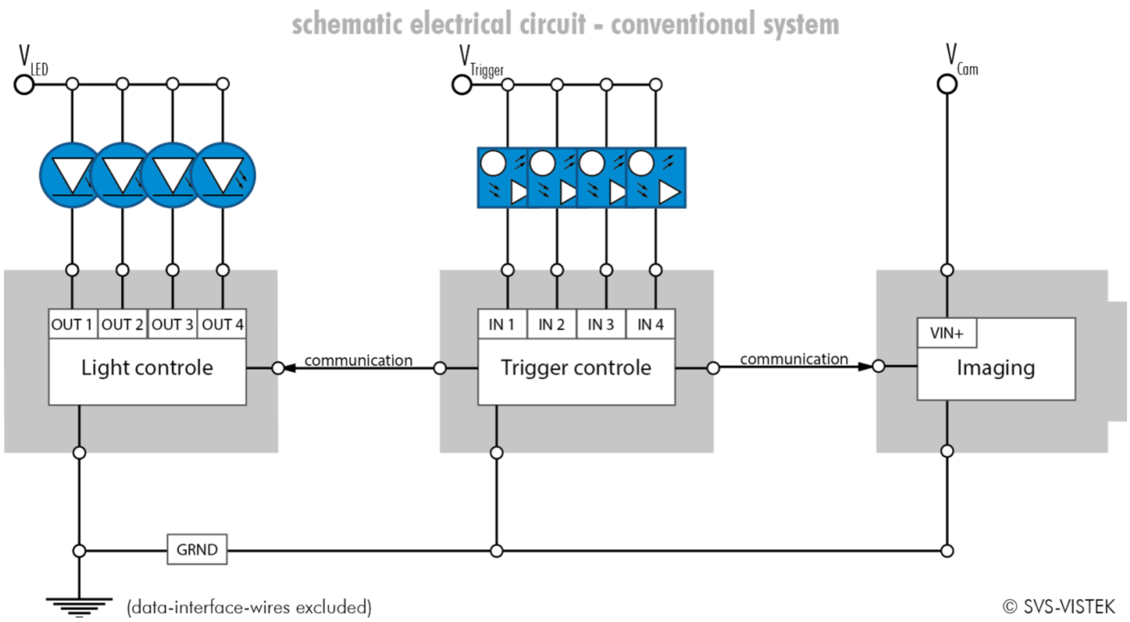


Figure 54: Illustration of conventional schematic electric circuit

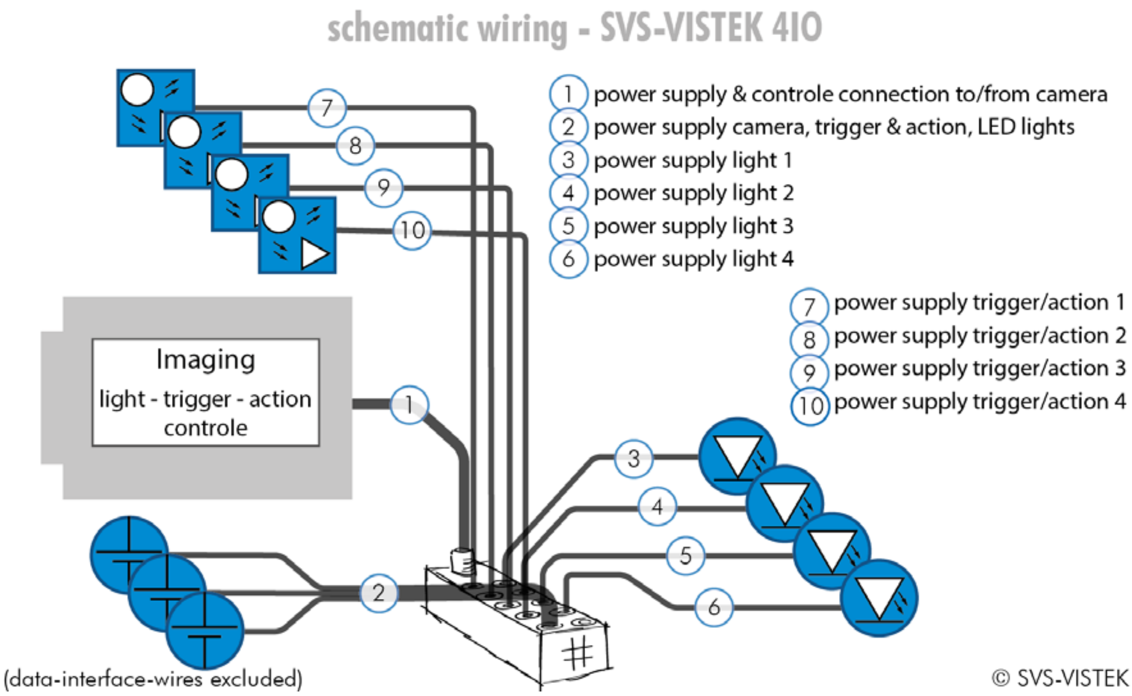


Figure 55: Illustration of schematic wiring with 4IO model using the break out box (matrix)

The pulseloop module

A fully programmable timer/counter function with four individual pulse generators (pulseloop0 - 3) that can be combined with all SVCam I/O functions, as well as physical inputs and outputs. All timing settings are programmable in 15ns intervals.

Programmable parameters:

> Trigger source (hardware or software)
> Edge or level trigger (HW trigger)
> Pulse output starting on low or high level
> Pre and post duration time
> Number of loops

Example applications

Initiated by an external trigger, the camera drives an LED illumination directly from the open drain output and initiates the camera exposure after a pre-defined delay.

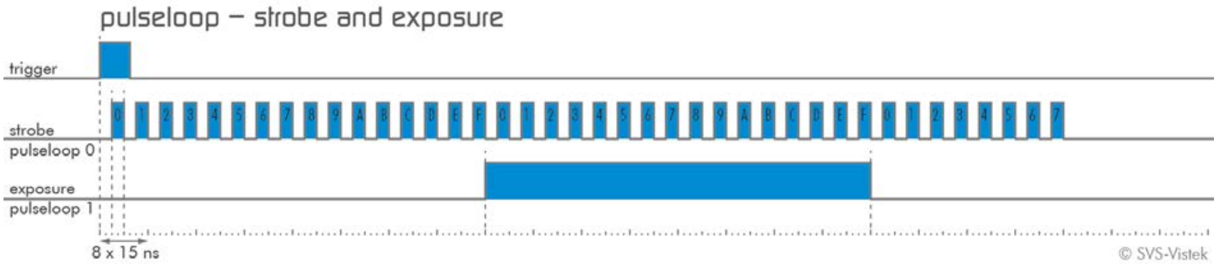


Figure 56: pulseloop for strobe and exposure

Camera cascade

Three cameras are triggered in cascade where the first camera is the master receiving the external trigger, and the master subsequently triggers the two slave cameras.

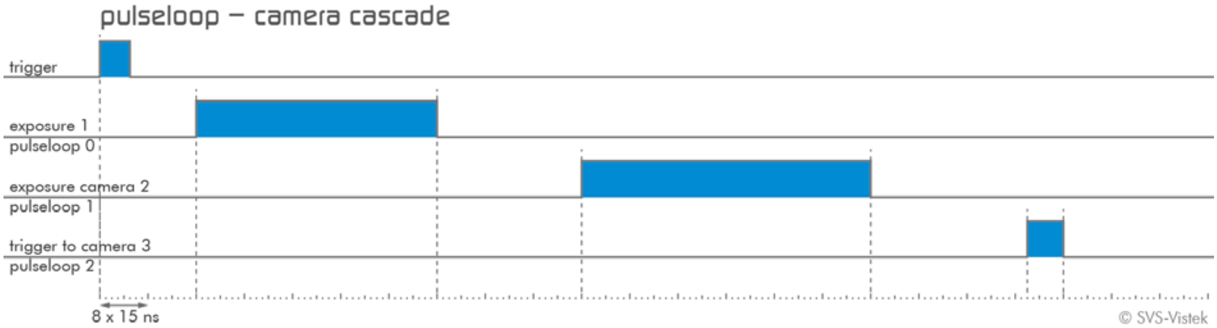
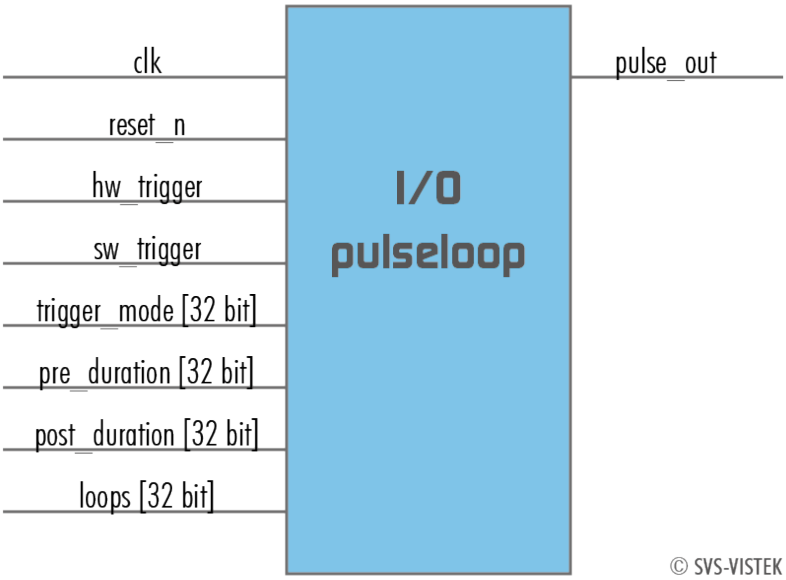


Figure 57: pulseloop – activating three cameras

Module pulseloop



LEDs in Continuous Mode

Example Calculation "No Flash" (CW Mode)	
Voltage drop al 5 LEDs, 2,2 V per LED (see spec. of LED)	11 V
Max. continuous current (see spec. of LED)	250 mA
Voltage Supply	24 V
Voltage drop at Resistor (24 V – 11 V)	13 V
Pull up Resistor R = $\frac{13\,V}{250\,mA}$	52 Ω

Total Power ($P = U \times I$)	6 W
Power at LEDs ($11\,V \times 250\,mA$)	2,75 W
Power Loss at Resistor ($13\,V \times 250\,mA$)	3,25 W

LEDs in Flash Mode

The MOS FETs at "OUT1" and "OUT2" are used like a "switch". By controlling "on time" and "off time" (duty cycle) the intensity of light and current can be controlled.

Current		"time ON" within a 1 Sec		PWM %	
0,75	A	500	ms	50	%
1	A	300	ms	33,3	%
2	A	70	ms	7	%
3	A	40	ms	4	%

Example: If pulse is 1.5 A the max. "on" time is 150 mSec. This means the "off" time is 850 mSec. The sum of "time on" and "time off" is 1000 mSec = 1 Sec.

NOTICE

The shorter the „time on" – the higher current can be used –the longer LEDs will work.

Strobe Timing

Exposure Delay

A value, representing the time between the (logical) positive edge of trigger pulse and start of integration time. Unit is 1µs. Default is 0µs.

Strobe Polarity

Positive or negative polarity of the hardware strobe output can be selected.

Strobe Duration

The exposure time of LED lights can be set in µsec. The min duration is 1 µsec. The longest time is 1 second.

Strobe Delay

The delay between the (logical) positive edge of trigger pulse and strobe pulse output can be set in µsec. Unit is 1µs. Default is 0µs.

Strobe Control Example Setup

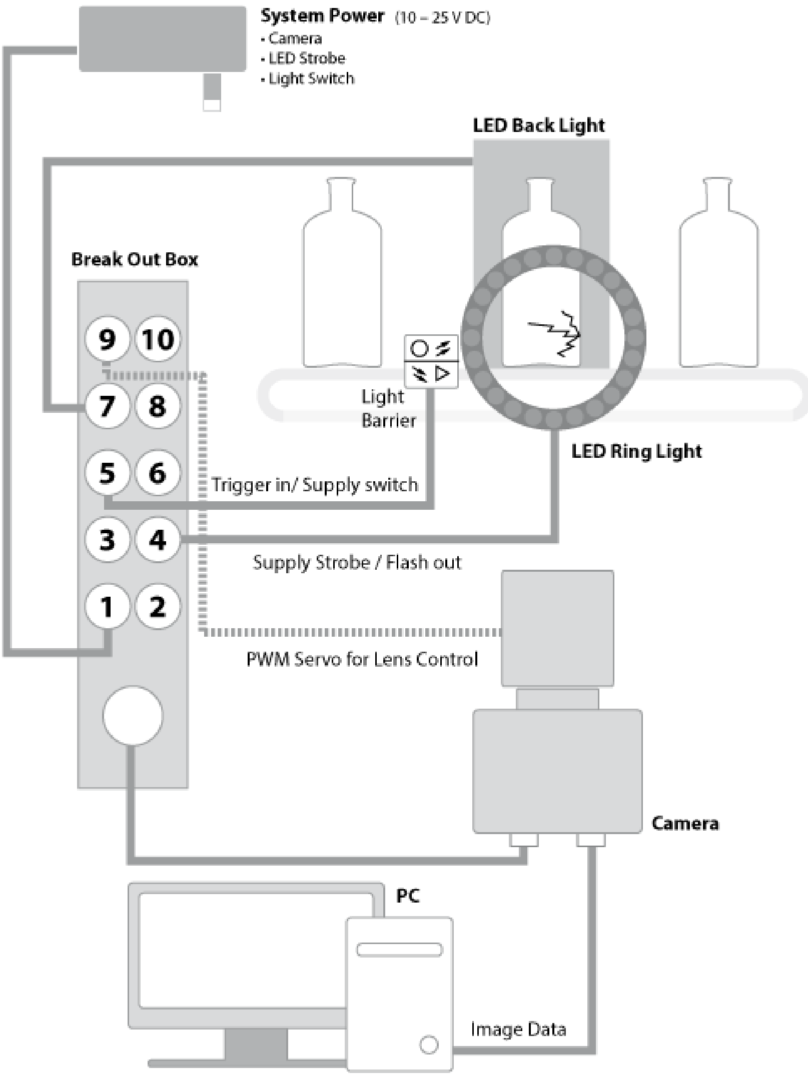


Figure 58: Illustration of an application using the 4IO

5.3.3 Sequencer

The sequencer is used when different exposure settings and illuminations are needed in a row.

E.g. the scenario to be captured may occur in three different versions and should therefore be recorded with three different light source settings. Each scenario/interval needs different illumination and exposure time.

The Sequencer allows not only detecting which scenario just appeared. Depending on the scenario there will be one optimal image for further analyzes.

Values to set	Unit	Description
Sequencer Interval	µs	Duration of the Interval
Exposure Start	µs	Exposure delay after Interval start
Exposure Stop	µs	Exposure Stop related to Interval Start
Strobe Start	µs	Strobe delay after Interval start
Strobe Stop	µs	Strobe Stop related to Interval Start
PWM Frequency	T	Basic duty cycle (1 / Hz) for PWM
PWM Line 1	%	Demodulation Result
PWM Line 2	%	Demodulation Result
PWM Line 3	%	Demodulation Result
PWM Line 4	%	Demodulation Result
Values can be set for every scenario/interval		

When setting "Exposure Start" and "Stop" consider 'read-out-time'. It has to be within the Sequencer Interval.

- Trigger Input can be set at the IOMUX.
- For pysikal trigger input refer to pinout or specifications
- After trigger signal all programmed Interval will start.
- Up to 16 Intervals can be programmed.

Sequencer settings can be saved to EPROM or to desktop

Example:

Values to set	Interval 0	Interval 1	Interval 2
Sequencer Interval	1.000.000 µs (1s)	1.000.000 µs (1s)	1.000.000 µs (1s)
Exposure Start	220.000 µs	875.000 µs	190.000 µs
Exposure Stop	700.000 µs	125.000 µs	720.000 µs
Strobe Start	110.000 µs	125.000 µs	350.000 µs
Strobe Stop	875.000 µs	875.000 µs	875.000 µs
PWM Frequency	4 Hz	4 Hz	4 Hz
PWM Line 0	100	0	80
PWM Line 1	20	50	0
PWM Line 2	0	100	30
PWM Line 3	-	-	-
Trigger set to negative slope		Use higher frequencies	

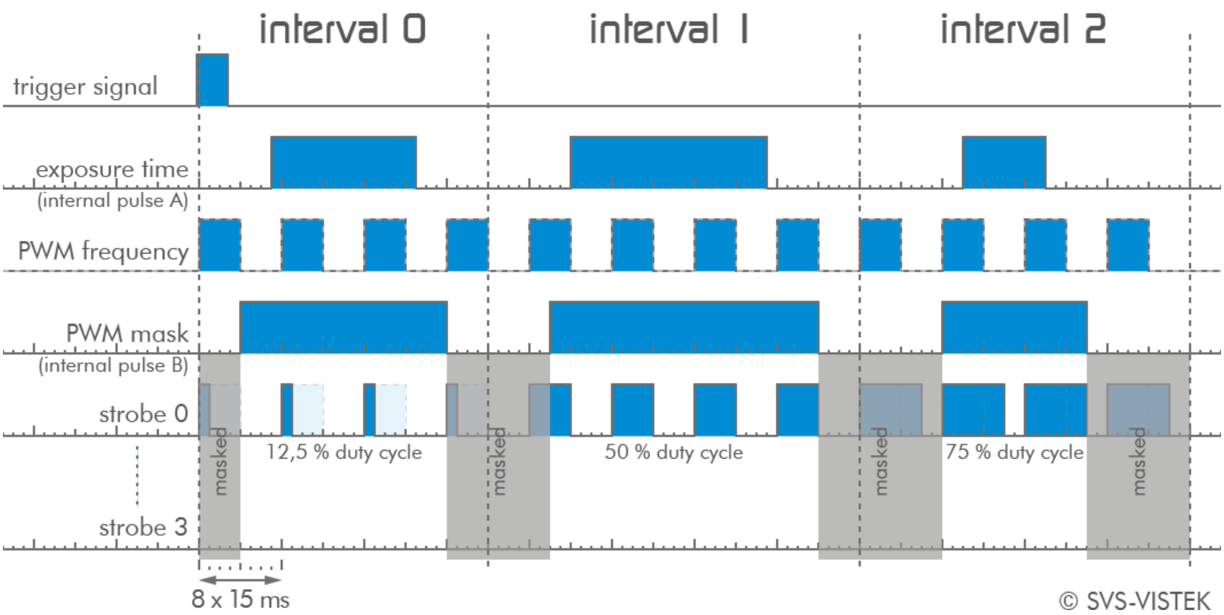


Figure 59: illustration of three sequencer intervals

5.3.4 PWM

Pulse width modulation

Description of the function used within the sequencer or implemented by the pulseloop module

During Pulse Width Modulation, a duty cycle is modulated by a fixed frequency square wave. This describes the ratio of ON to OFF as duty factor or duty ratio.

Why PWM?

Many electrical components must be provided with a defined voltage. Whether it's because they do not work otherwise or because they have the best performance at a certain voltage range (such as diodes or LEDs).

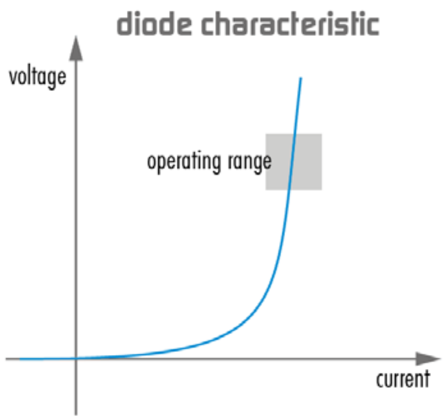
Diode characteristic

Since LEDs have a bounded workspace, the PWM ensures a variable intensity of illumination at a constant voltage on the diodes.

In addition, the lifetime of a diode increases. The internal resistance is ideal in this area. The diode gets time to cool down when operated with a PWM in its workspace.

Implementation of PWM

Modulation frequency:

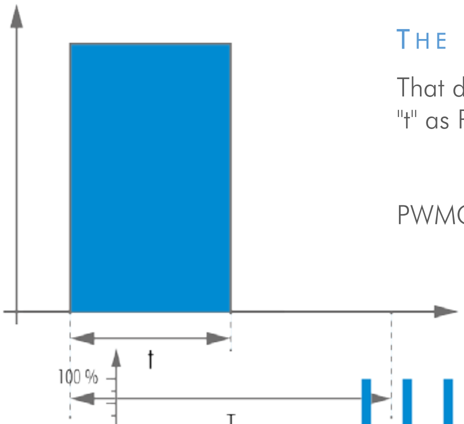


The basic frequency of the modulation is defined by the cycle duration "T".

$$T_{PWM} = \frac{1}{f_{PWM}}$$

Cycle duration "T" is written into the registry by multiple of the inverse of camera frequency. (15 ns steps) Refer to: [Time unit of the camera](#).

$$T_{PWM} = \frac{1}{66,\bar{6}MHz} \cdot \text{PWMMax[SeqSelector]} = 15\,ns \cdot \text{PWMMax[SeqSelector]}$$



The intensity of a PWM:

That duty ratio is calculated as: Δ% = t / T. It is written about the value of "t" as PWMChange0-3[SeqSelector] per sequence into the Registry.

PWMChange0-3[SeqSelector] is to be written as a percentage value.

Examples of PWMs:

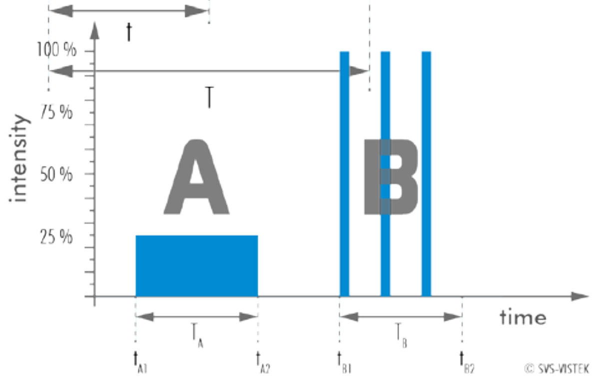


Figure 60: 25 % intensity

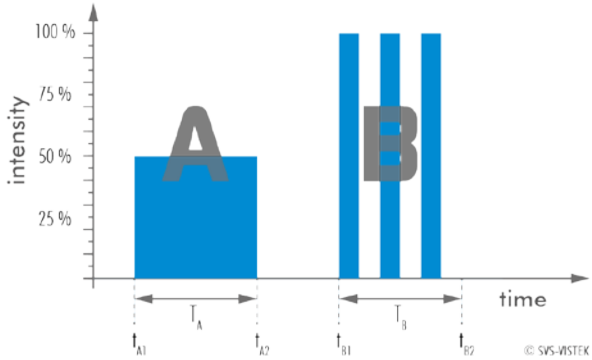


Figure 61: 50 % intensity

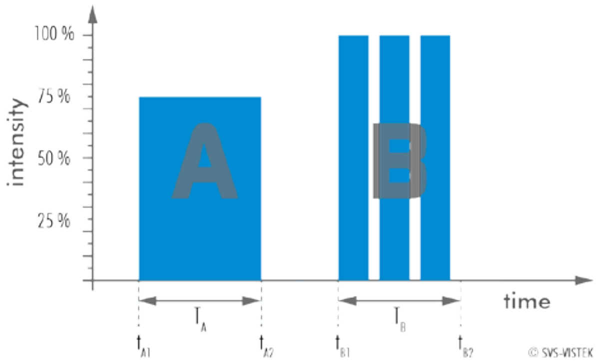


Figure 62: 75 % intensity

The integrals over both periods T_A and T_A are equal.

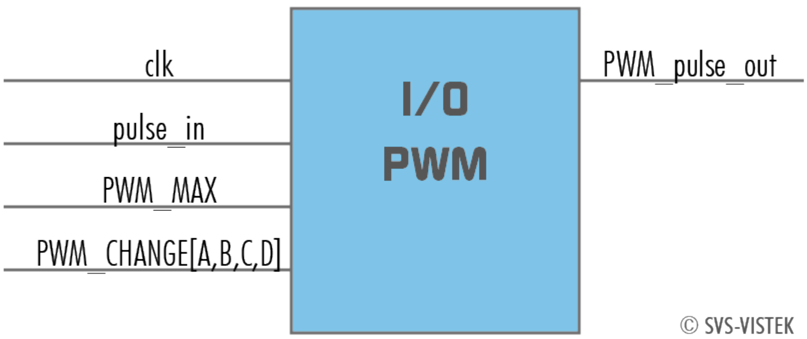
$$\int_{t_{A1}}^{t_{A2}} \mathbf{A} = \int_{t_{B1}}^{t_{B2}} \mathbf{B}$$

An equal amount of Photons will be emitted. The intensity of light is the same.

$$t_{A2} - t_{A1} = t_{B2} - t_{B1}$$

The periods T_A and T_B are equal in length.

The PWM module:



5.3.1 Opto Coupler

Avoiding all kinds of interferences from power sources or switches. High voltage peak levels can result in damages to your components. Also trigger interpretation can be disturbed by deviate voltage potentials within a system.

The opto coupler galvanically divides electrical circuits by emitting light on one side and interpreting light in the other. So no direct electric connection can interfere in the system.

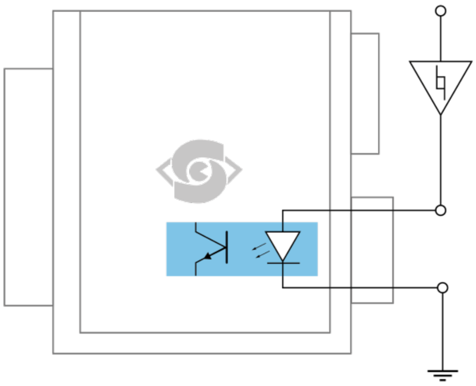


Figure 63: Illustration of the opto coupler within a SVCam

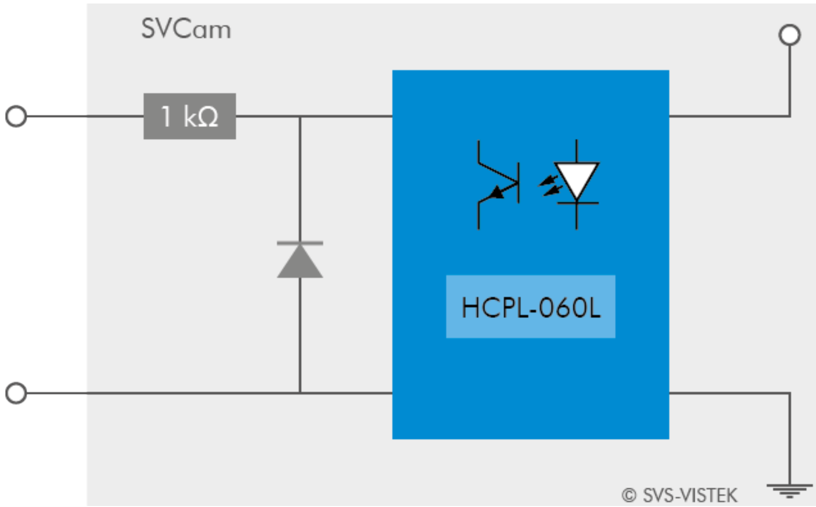


Figure 64: Illustration of the electrical circuit of the opto coupler

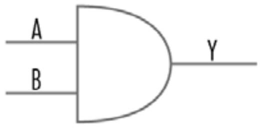
Voltage input from 5 to 24 V.

5.3.2 Logic input

The logic input combines trigger signals with Boolean algorithms.

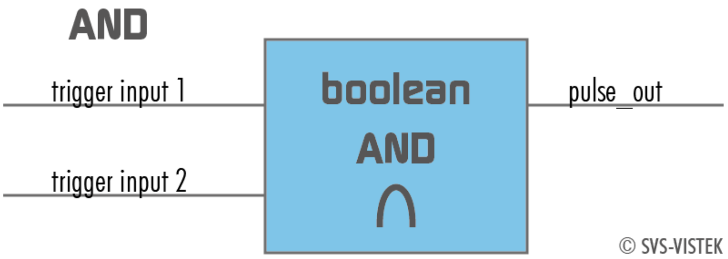
Within the camera a single AND operator is integrated. Here we will explain how to implement other Boolean operations with a single AND operator.

AND

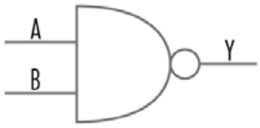


Both trigger inputs have to be true.

A	B	Y = A ∧ B
0	0	0
0	1	0
1	0	0
1	1	1



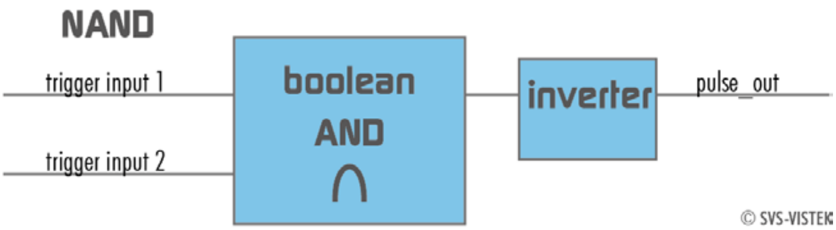
NAND

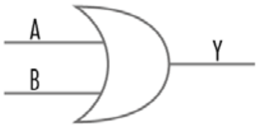


The NEGATIVE-AND is true only if its inputs are false.

Invert the output of the AND module.

A	B	Y = A NAND B
0	0	1
0	1	1
1	0	1
1	1	0



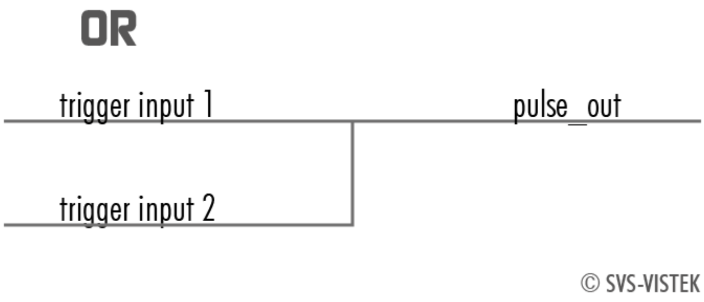


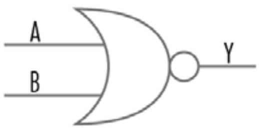
OR

If neither input is high, a low pulse_out (0) results.

Combine trigger input one and two.

A	B	Y = A v B
0	0	0
0	1	1
1	0	1
1	1	1



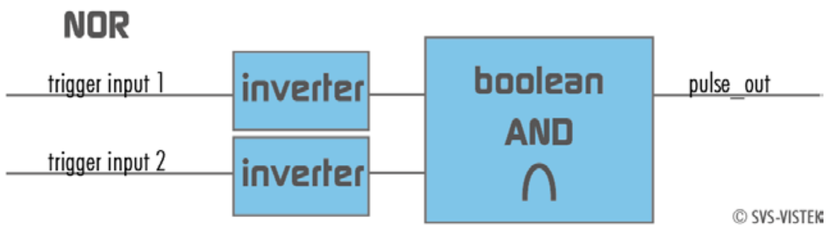


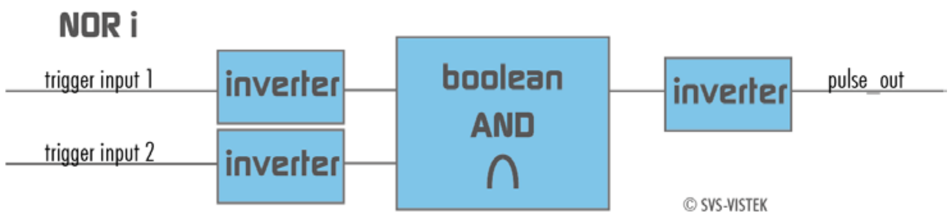
NOR

No trigger input – one nor two – results in a high or a low level pulse_out.

Invert both trigger inputs. By inverting the resulting pulse_out you will get the NOR I pulse

A	B	Y = A ⊽ B NOR	Y = A v B NOR i
0	0	1	0
0	1	0	1
1	0	0	1
1	1	0	1





5.3.3 Serial data interfaces

(ANSI EIA/) TIA-232-F

RS-232 and RS-422 (from EIA, read as Radio Sector or commonly as Recommended Standard) are technical standards to specify electrical characteristics of digital signaling circuits.

In the SVCam's these signals are used to send low-power data signals to control light or lenses (MFT).

Serial interface Parameter	RS-232	RS-422
Maximum open-circuit voltage	±25 V	±6 V
Max Differential Voltage	25 V	10 V
Min. Signal Range	±3 V	2 V
Max. Signal Range	±15V	10 V

Table 1: serial interface parameter – RS-232 and RS-422

RS-232

It is spited in receiving and transferring Data.

RXD receive data

TXD transmit data

Signal voltage values are:

low: -3 – -15 V

high: 3 – 15 V

With restrictions: refer to Table: serial interface parameter above.

Data is asynchron. Synchronization is implemented by fist and last bit of a package. Therefor the last bit can be longer, e.g. 1.5 or 2 times the bit duration). Datarate (bits per second) must be defined before transmission.

UART

Packaging Data into containers (adding start and stop bits) is implemented by the UART (Universal Asynchronous Receiver Transmitter)

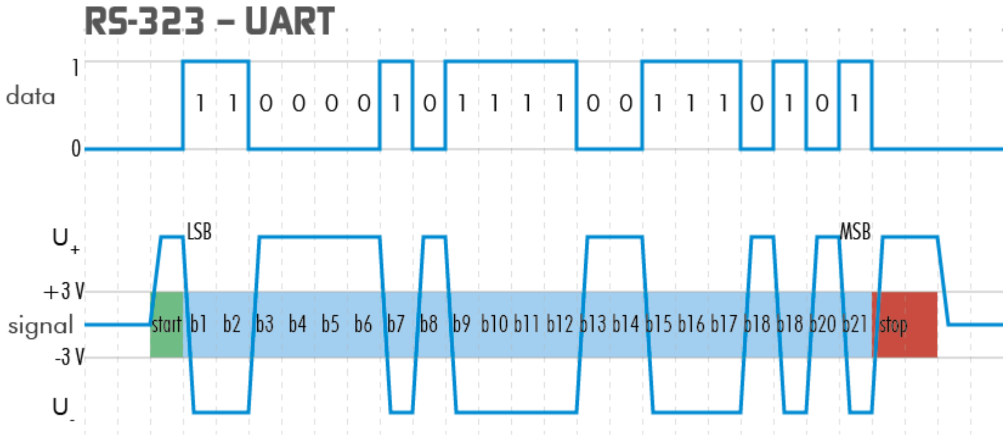


Figure 65: UART encoding of a data stream

RS-422

RS-422 is a differential low voltage communication standard.

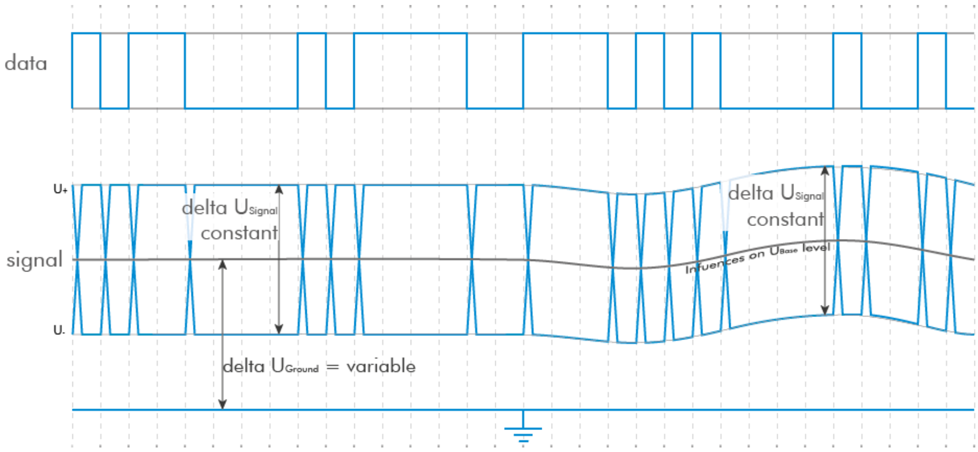


Figure 66: LVDS signal – non return to zero

Refer to specifications to see if RS-422 is implemented in your camera.

5.3.4 Trigger-Edge Sensitivity

Trigger-Edge Sensitivity is implemented by a "schmitt trigger". Instead of triggering to a certain value Schmitt trigger provides a threshold.

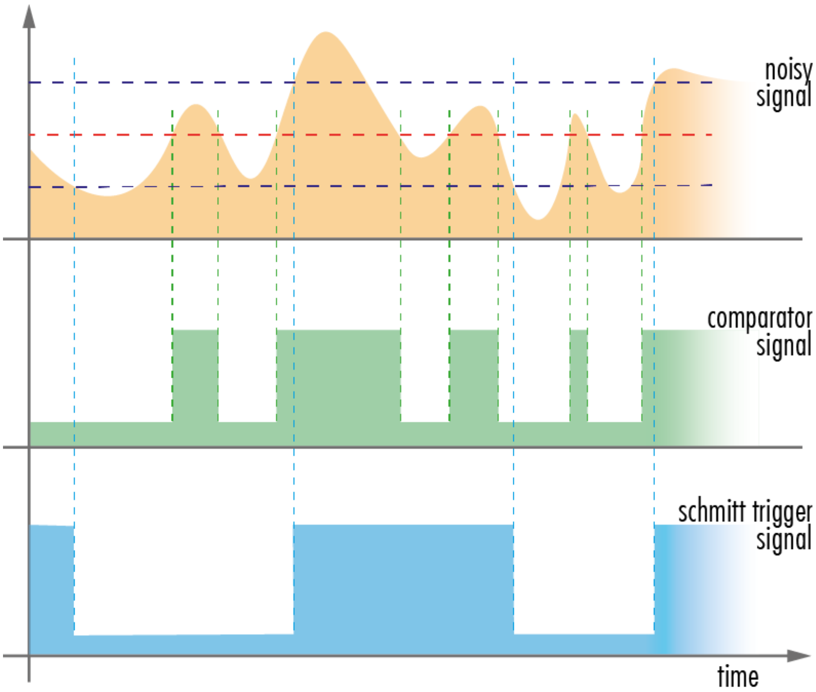


Figure 67:illlustration of schmitt trigger noise suspension - high to low I low to high

5.3.5 Debouncing Trigger Signals

Bounces or glitches caused by a switch can be avoided by software within the SVCam.

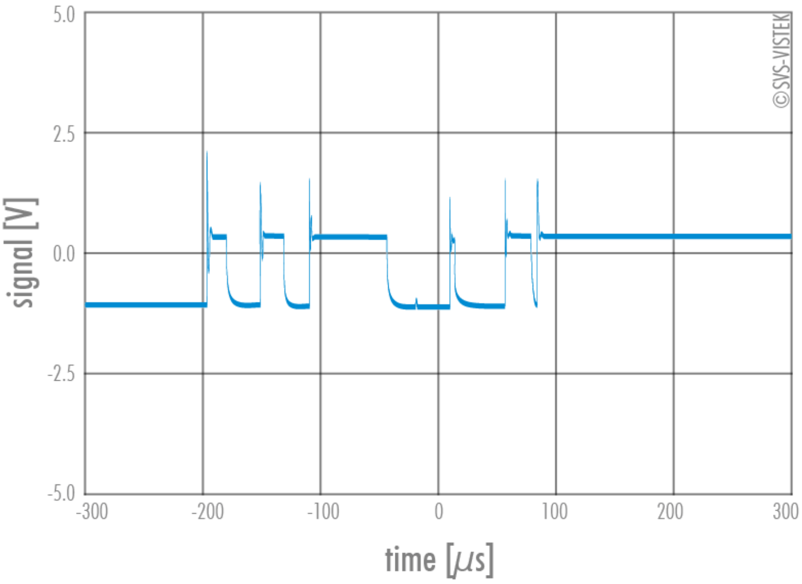


Figure 68: bounces or glitches caused by a switch during 300 μs

Therefor the signal will not be accepted till it lasts at least a certain time.

Use the IO Assignment tool to place and enable the debouncer module in between the "trigger" (schmitt trigger) and the input source (e.g.: line 1).

DebouncDuration register can be set in multiples of 15ns (implement of system clock). E.g. 66 666 ≈ 1 ms

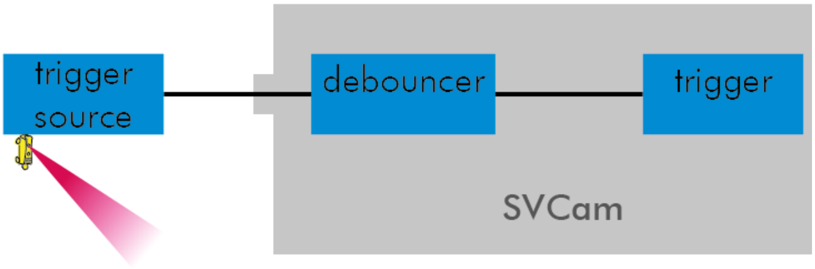


Figure 69: block diagram – debouncer in between the trigger source and the trigger

The Debouncer module

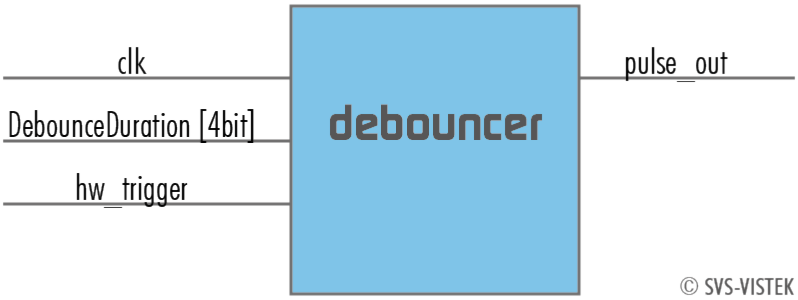


Figure 70: Illustration of the debouncer module

5.3.6 Prescale

The Prescaler function can be used for masking off input pulses by applying a divisor with a 4-bit word, resulting in 16 unique settings.

- Reducing count of interpreted trigger signal
- Use the prescaler to ignore a certain count of trigger signals.
- Divide the amount of trigger signals by setting a divisor.
- Maximum value for prescale divisor: is 16 (4 bit)

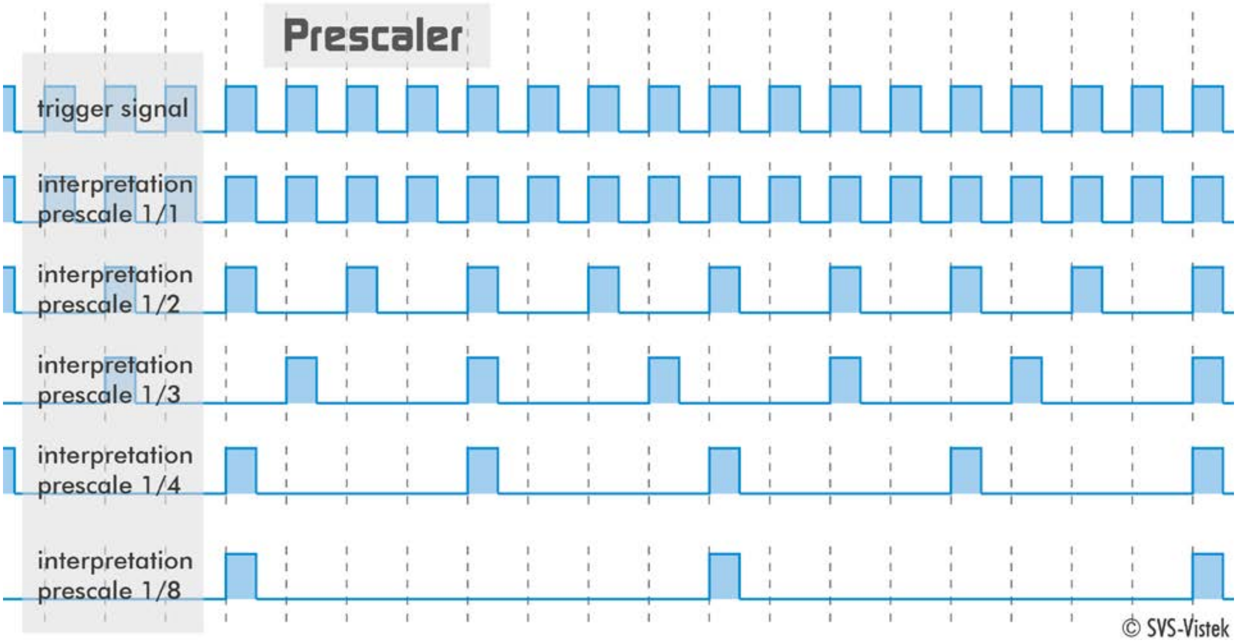


Figure 71: illustration of prescale values

The prescale module

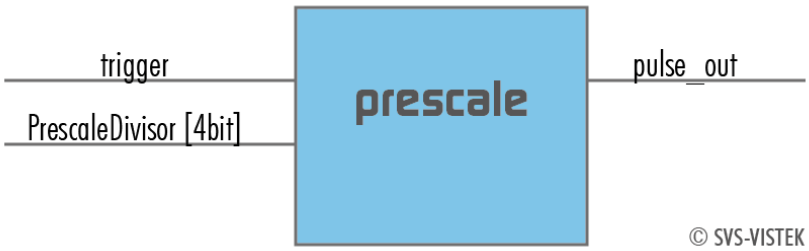


Figure 72: Illustration of the prescale module

5.3.7 IR Cut Filter

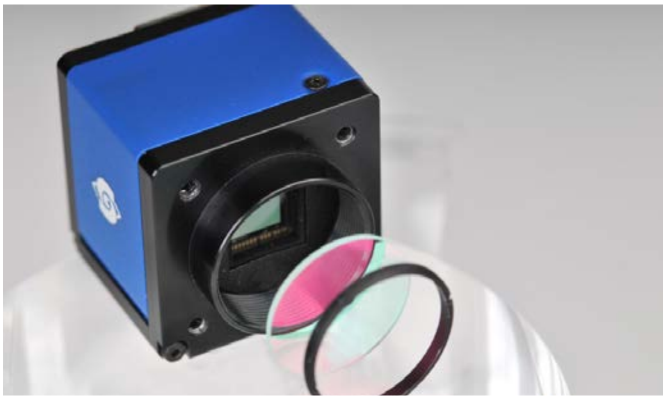
To avoid influences of infrared light to your image, some cameras are equipped with an IR cut filter or an anti-refection coated glass (AR filter).

Figure 73: An ECO standard & ECO Blackline - without and with IR cut filter

In addition filters raise the protection class of the camera by protecting the sensor and camera internals from environmental influences. So BlackLine models are equipped with an IR cut filter by default.

Please refer to your camera order to see if a filter is built in. Alternatively take a close look on the sensor. Build-in IR-filters are screwed within the lens mount. (See figure below)

Figure 74: Figure of ECO standard & ECO Blackline - without and with IR cut filter



All kind s of filter can be ordered and placed in front of the sensors. Please refer to your local distributer.

NOTICE

As the sensor is very sensitive to smallest particles, avoid dust when removing the lens or the protection cap

Image Impact of IR Cut Filter

As a reason of chromatic aberration limiting the spectral bandwidth of the light always results in sharper images.

Without an IR cut filter:

> Monochrome sensor images get muddy.
> Chroma sensor images get influenced by a greater amount of red than you would see with your eyes. White balance gets much more difficult. Contrasts get lost because of IR light influencing also blue and green pixels.

SVS-VISTEK recommends IR cut filter for high demands on color or sharpness whether monochrome or color sensors.

Spectral Impact of IR Cut Filters

IR cut filter do influence the spectral sensitivity of the sensor. The spectral graph below shows the wavelength relative impact of the SVS-VISTEK standard filter.

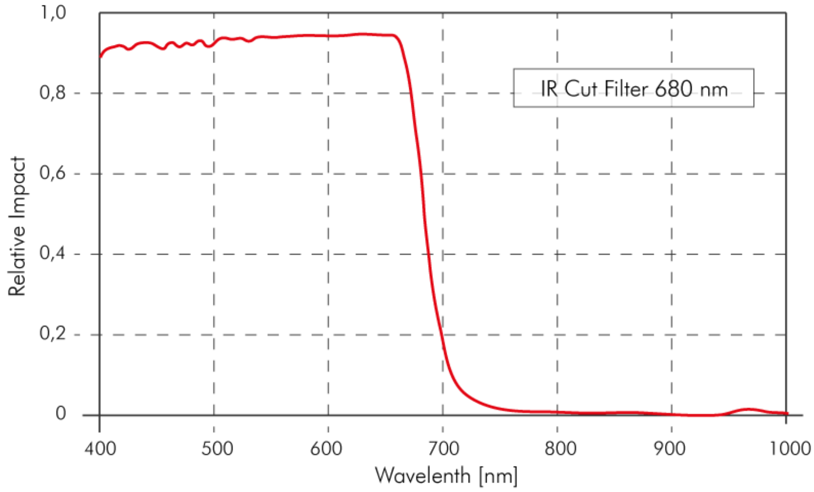


Figure 75: Diagram of light transmission – IR cut filter

Focal Impact of Filters

As an IR cut filter mainly consist of a small layer of glass (1 mm thick) there is an impact on the flange focal distance. Refraction within the layer cause shortening this distance.

When ordering a standard camera with an extra IR cut filter you might have to compensate the focal length with an extra ring. Please refer to your local distributor for more detailed information on your camera behaving on C-Mount integrated filters.

As BlackLine models have an IR cut filter by default, the focal distance is compensated by default too.

NOTICE

Removing the IR cut filter lengthen the focal distance and will invalidate the warranty of your camera.

6 Specifications

6.1 eco1050*TLGEC

Model	eco1050MTLGEC	eco1050CTLGEC
familiy	ECO	ECO
active pixel w x h	1024 x 1024 px^2	1024 x 1024 px^2
max. frame rate	56,1 fps	56,1 fps
chroma	mono	bayer
interface	GigE Vision	GigE Vision
sensor		
sensor name	KAI-01050-A	KAI-01050-C
vendor	ON Semiconductor	ON Semiconductor
sensor architecture	area CCD	area CCD
readout/shutter type	interline progressive	interline progressive
sensor pixel clock	40 MHz	40 MHz
chroma	mono	bayer
equivalent format	1/2	1/2
active pixel w x h	1024 x 1024 px^2	1024 x 1024 px^2
effective pixel w x h	1040 x 1040 px^2	1040 x 1040 px^2
diagonal	7,96 mm	7,96 mm
pixel w x h	5,5 x 5,5 μm^2	5,5 x 5,5 μm^2
optic sensor w x h	5,63 x 5,72 mm^2	5,63 x 5,72 mm^2
active sensor diag.	7,96 mm	7,96 mm
max. frame rate	56,1 fps	56,1 fps
exposure time	6 μs / 60 s	6 μs / 60 s
max. gain	18 dB	18 dB
SNR	**58 dB**	**58 dB**
camera features		
firmware version	1.6.5	1.6.5
memory	64 MB	64 MB
CL_geometry		
frequency select		
camera pixel clock	40 MHz	40 MHz
exposure time adjust	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / - [bit]	x / x / - [bit]
binning h / v	2 / 2 [px]	2 / 2 [px]
LUT	12to8(1)	12to8(1)
AOI	1	1
white balancing	auto;manual	auto;manual
tap balancing	manual;auto	manual;auto

gain	auto;manual	auto;manual
offset	manual	manual
PIV mode		
readout control	manual;delayed	manual;delayed
flat field correction		
shading correction		
defect pixel correction	x	x
image flip	**horizontal;vertical**	**horizontal;vertical**
I/O features		
trigger modes	internal;software;external	internal;software;external
high low trigger	x	x
pulseloop	4	4
IOMUX	pwm(4);sequencer	pwm(4);sequencer
exposure output	x	x
trigger in 24 V	2	2
output open drain	2	2
opto input / output		
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power min. / max. [V]	**10 / 25**	**10 / 25**
housing features		
Mount	C-Mount	C-Mount
lens control		
dimensions w / h / d mm³	38 / 38 / 45 mm³	38 / 38 / 45 mm³
weight	150 g	150 g
protection class	IP40	IP40
temp. Sensor	Mainboard	Mainboard
temp. Ambient °C	-10 to 45 °C	-10 to 45 °C
power consumption	**4 W**	**4 W**
status	**available**	**available**
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1.1.2 Spectral Sensitivity Characteristics KAI-01050-C

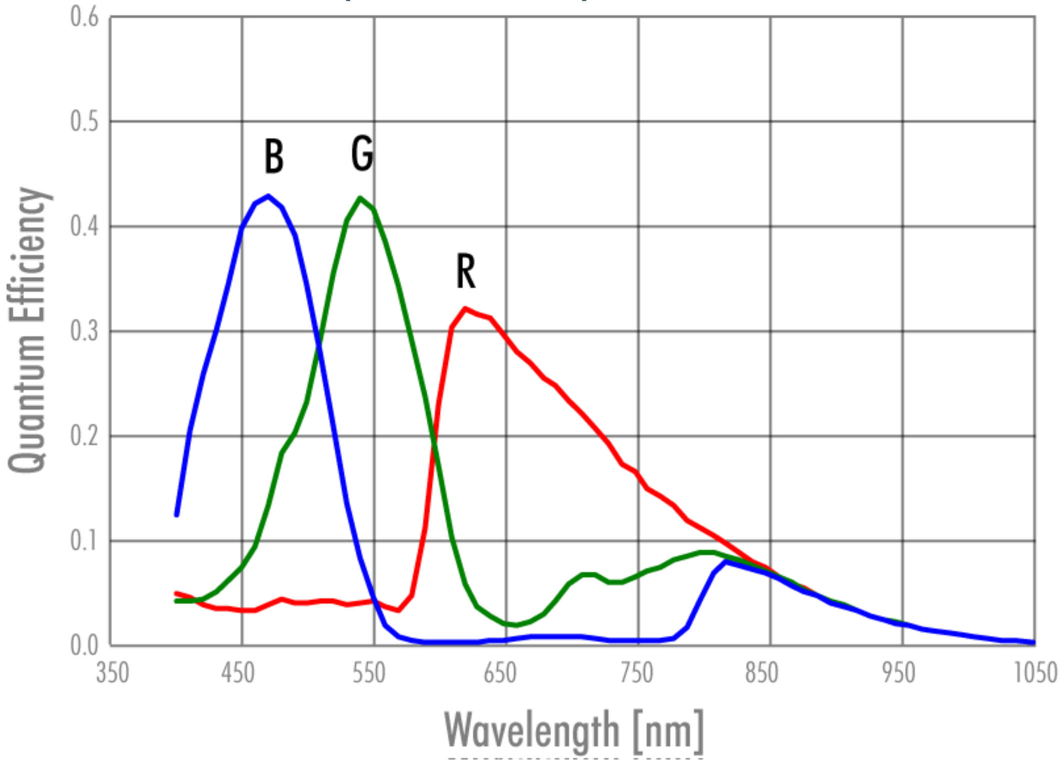

Figure 76: Spectral Sensitivity Characteristics KAI-01050-C

1.1.3 Spectral Sensitivity Characteristics KAI-01050-A

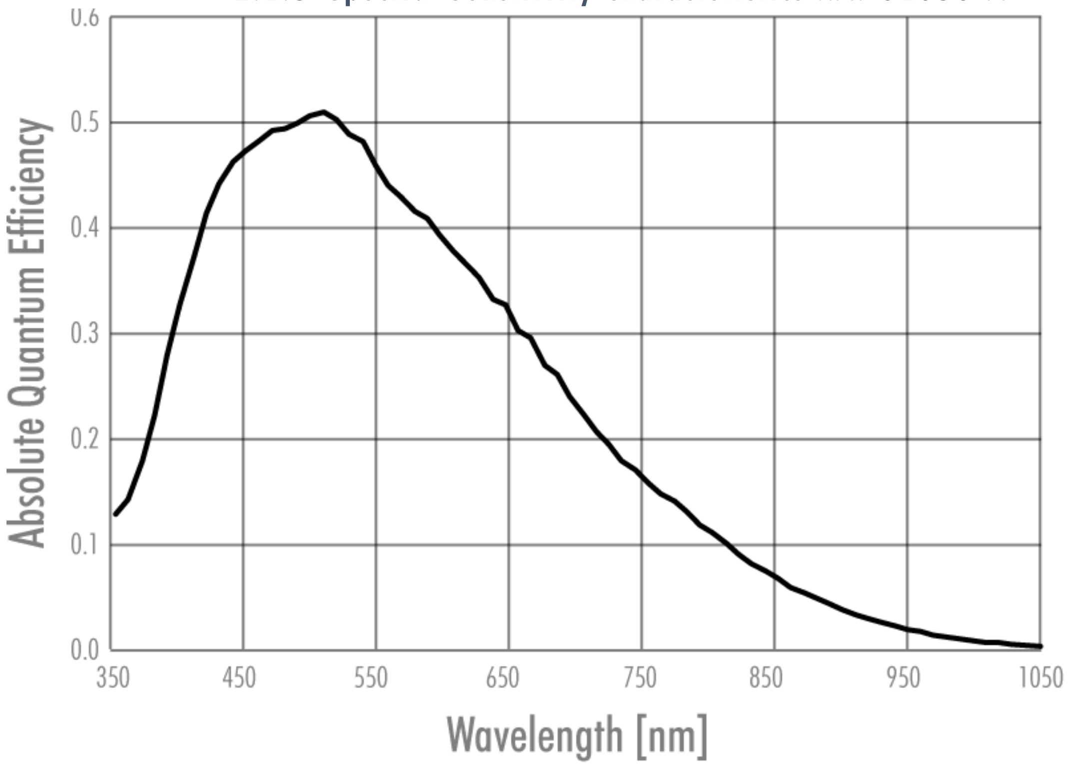

Figure 77: Spectral Sensitivity Characteristics KAI-01050-A

6.2 eco2050*TLGEC

Model	eco2050MTLGEC	eco2050CTLGEC
familiy	ECO	ECO
active pixel w x h	1600 x 1200 px^2	1600 x 1200 px^2
max. frame rate	33,2 fps	33,2 fps
chroma	mono	bayer
interface	GigE Vision	GigE Vision
sensor		
sensor name	KAI-02050-A	KAI-02050-C
vendor	ON Semiconductor	ON Semiconductor
sensor architecture	area CCD	area CCD
readout/shutter type	interline progressive	interline progressive
sensor pixel clock	40 MHz	40 MHz
chroma	mono	bayer
equivalent format	2/3	2/3
active pixel w x h	1600 x 1200 px^2	1600 x 1200 px^2
effective pixel w x h	1640 x 1240 px^2	1640 x 1240 px^2
diagonal	11 mm	11 mm
pixel w x h	5,5 x 5,5 μm^2	5,5 x 5,5 μm^2
optic sensor w x h	8,8 x 6,82 mm^2	8,8 x 6,82 mm^2
active sensor diag.	11 mm	11 mm
max. frame rate	33,2 fps	33,2 fps
exposure time	6 μs / 60 s	6 μs / 60 s
max. gain	18 dB	18 dB
SNR	**58 dB**	**58 dB**
camera features		
firmware version	1.6.5	1.6.5
memory	64 MB	64 MB
CL_geometry		
frequency select		
camera pixel clock	40 MHz	40 MHz
exposure time adjust	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / - [bit]	x / x / - [bit]
binning h / v	2 / 2 [px]	2 / 2 [px]
LUT	12to8(1)	12to8(1)
AOI	1	1
white balancing	auto;manual	auto;manual
tap balancing	manual;auto	manual;auto
gain	auto;manual	auto;manual
offset	manual	manual
PIV mode		
readout control	manual;delayed	manual;delayed

flat field correction		
shading correction		
defect pixel correction	x	x
image flip	**horizontal;vertical**	**horizontal;vertical**
I/O features		
trigger modes	internal;software;external	internal;software;external
high low trigger	x	x
pulseloop	4	4
IOMUX	pwm(4);sequencer	pwm(4);sequencer
exposure output	x	x
trigger in 24 V	2	2
output open drain	2	2
opto input / output		
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power min. / max. [V]	**10 / 25**	**10 / 25**
housing features		
Mount	C-Mount	C-Mount
lens control		
dimensions w / h / d mm³	38 / 38 / 45 mm³	38 / 38 / 45 mm³
weight	150 g	150 g
protection class	IP40	IP40
temp. Sensor	Mainboard	Mainboard
temp. Ambient °C	-10 to 45 °C	-10 to 45 °C
power consumption	**4 W**	**4 W**
status	**available**	**available**
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1.1.4 Spectral Sensitivity Characteristics KAI-02050-C

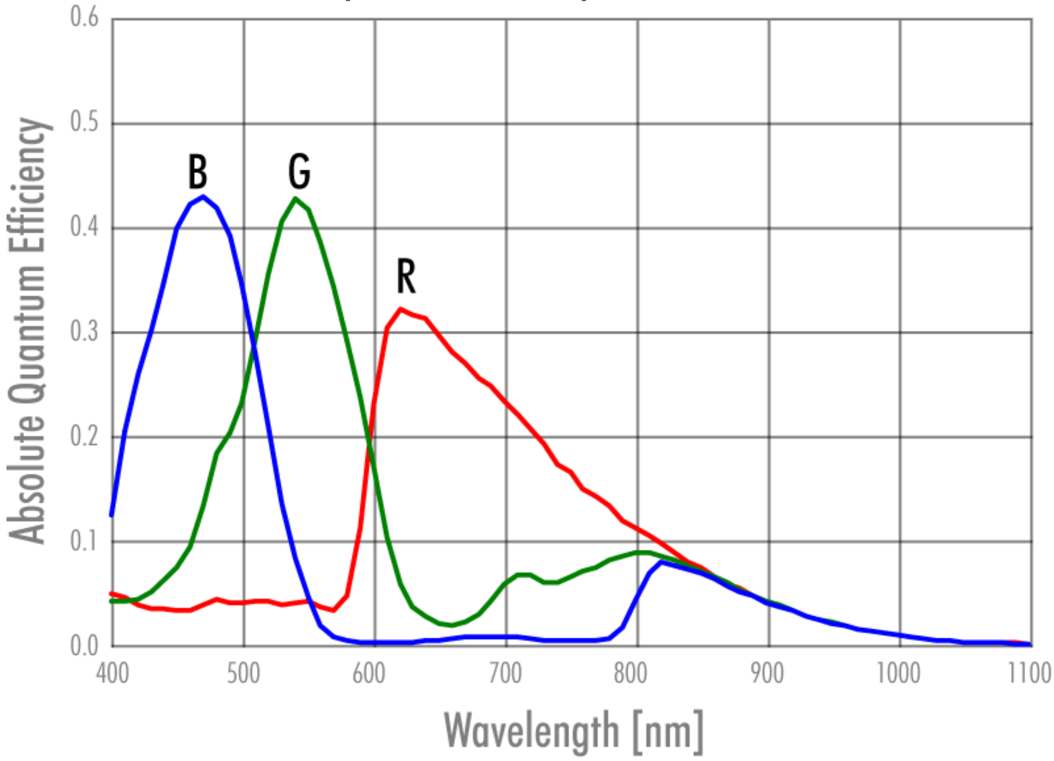

Figure 78: Spectral Sensitivity Characteristics KAI-02050-C

1.1.5 Spectral Sensitivity Characteristics KAI-02050-A

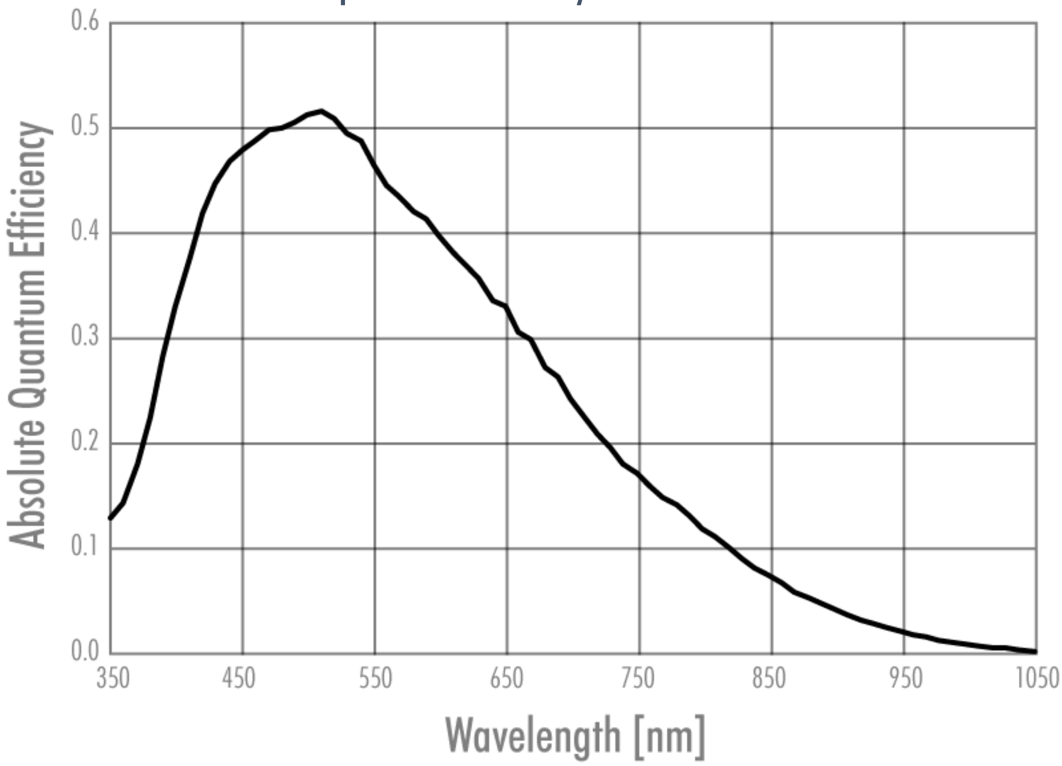

Figure 79: Spectral Sensitivity Characteristics KAI-02050-A

6.3 eco2150*TLGEC

Model	eco2150MTLGEC	eco2150CTLGEC
familiy	ECO	ECO
active pixel w x h	1920 x 1080 px²	1920 x 1080 px²
max. frame rate	31,7 fps	31,7 fps
chroma	mono	bayer
interface	GigE Vision	GigE Vision

sensor		
sensor name	KAI-02150-A	KAI-02150-C
vendor	ON Semiconductor	ON Semiconductor
sensor architecture	area CCD	area CCD
readout/shutter type	interline progressive	interline progressive
sensor pixel clock	40 MHz	40 MHz
chroma	mono	bayer
equivalent format	2/3	2/3
active pixel w x h	1920 x 1080 px²	1920 x 1080 px²
effective pixel w x h	1960 x 1120 px²	1960 x 1120 px²
diagonal	12,1 mm	12,1 mm
pixel w x h	5,5 x 5,5 µm²	5,5 x 5,5 µm²
optic sensor w x h	10,5 x 6,16 mm²	10,5 x 6,16 mm²
active sensor diag.	12,1 mm	12,1 mm
max. frame rate	31,7 fps	31,7 fps
exposure time	6 µs / 60 s	6 µs / 60 s
max. gain	18 dB	18 dB
SNR	**58 dB**	**58 dB**

camera features		
firmware version	1.6.5	1.6.5
memory	64 MB	64 MB
CL_geometry		
frequency select		
camera pixel clock	40 MHz	40 MHz
exposure time adjust	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / - [bit]	x / x / - [bit]
binning h / v	2 / 2 [px]	2 / 2 [px]
LUT	12to8(1)	12to8(1)
AOI	1	1
white balancing	auto;manual	auto;manual
tap balancing	manual;auto	manual;auto
gain	auto;manual	auto;manual
offset	manual	manual
PIV mode		
readout control	manual;delayed	manual;delayed

flat field correction		
shading correction		
defect pixel correction	x	x
image flip	**horizontal;vertical**	**horizontal;vertical**
I/O features		
trigger modes	internal;software;external	internal;software;external
high low trigger	x	x
pulseloop	4	4
IOMUX	pwm(4);sequencer	pwm(4);sequencer
exposure output	x	x
trigger in 24 V	2	2
output open drain	2	2
opto input / output		
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power min. / max. [V]	**10 / 25**	**10 / 25**
housing features		
Mount	C-Mount	C-Mount
lens control		
dimensions w / h / d mm^3	38 / 38 / 45 mm^3	38 / 38 / 45 mm^3
weight	150 g	150 g
protection class	IP40	IP40
temp. Sensor	Mainboard	Mainboard
temp. Ambient °C	-10 to 45 °C	-10 to 45 °C
power consumption	**4 W**	**4 W**
status	**available**	**available**
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1.1.6 Spectral Sensitivity Characteristics KAI-02150-C

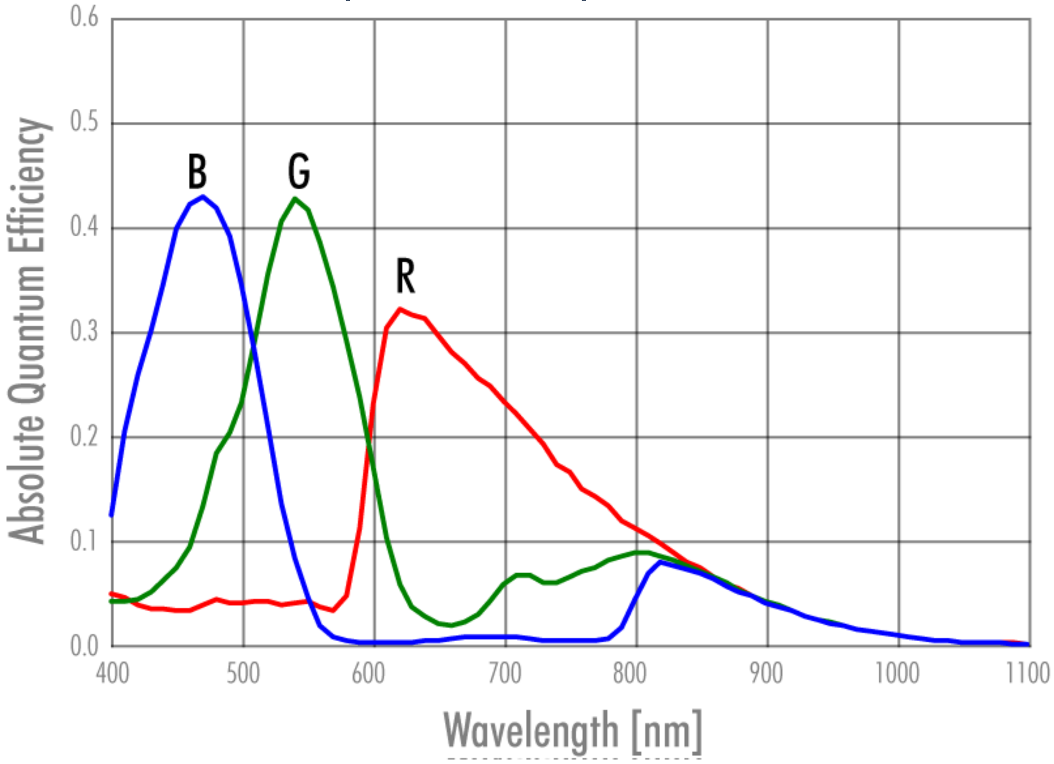

Figure 80 Spectral Sensitivity Characteristics KAI-02150-C

1.1.7 Spectral Sensitivity Characteristics KAI-02150-A

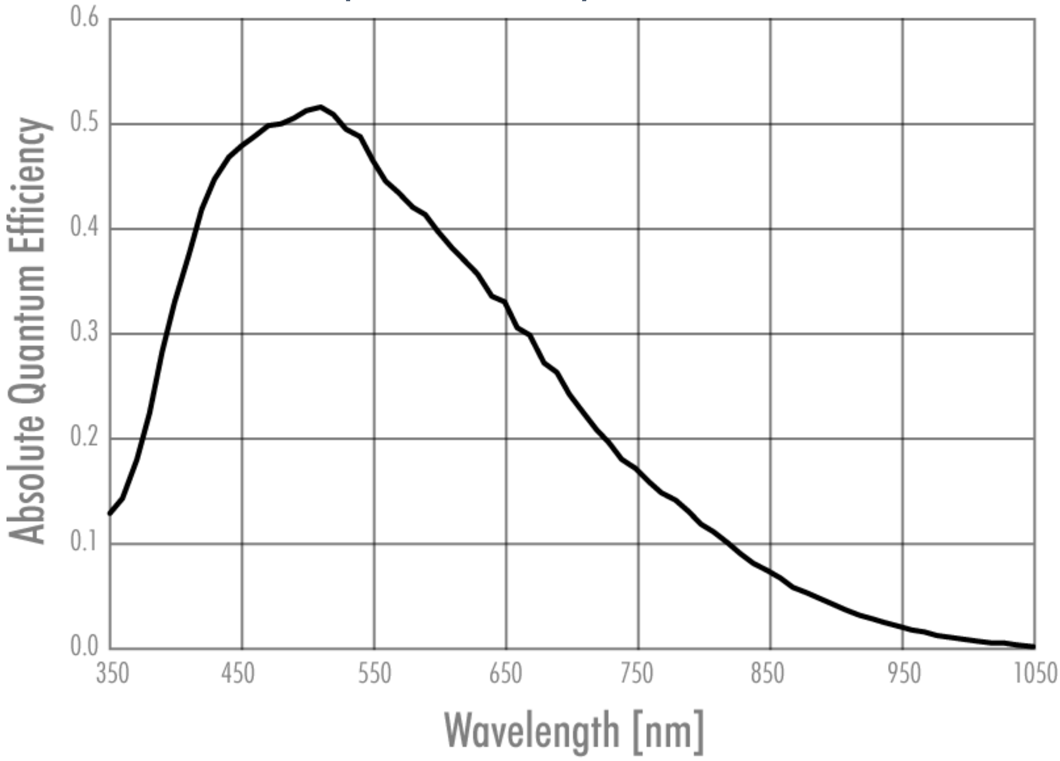

Figure 81: Spectral Sensitivity Characteristics KAI-02150-A

1.2 eco4050*TLGEC

Model	eco4050CTLGEC	eco4050MTLGEC
familiy	ECO	ECO
active pixel w x h	2336 x 1752 px^2	2336 x 1752 px^2
max. frame rate	16,8 fps	16,8 fps
chroma	bayer	mono
interface	GigE Vision	GigE Vision
sensor		
sensor name	KAI-04050-C	KAI-04050-A
vendor	ON Semiconductor	ON Semiconductor
sensor architecture	area CCD	area CCD
readout/shutter type	interline progressive	interline progressive
sensor pixel clock	40 MHz	40 MHz
chroma	bayer	mono
equivalent format	1	1
active pixel w x h	2336 x 1752 px^2	2336 x 1752 px^2
effective pixel w x h	2360 x 1776 px^2	2360 x 1776 px^2
diagonal	16,1 mm	16,1 mm
pixel w x h	5,5 x 5,5 μm^2	5,5 x 5,5 μm^2
optic sensor w x h	12,8 x 9,76 mm^2	12,8 x 9,76 mm^2
active sensor diag.	16,1 mm	16,1 mm
max. frame rate	16,8 fps	16,8 fps
exposure time	6 μs / 60 s	6 μs / 60 s
max. gain	18 dB	18 dB
SNR	**58 dB**	**58 dB**
camera features		
firmware version	1.6.5	1.6.5
memory	64 MB	64 MB
CL_geometry		
frequency select		
camera pixel clock	40 MHz	40 MHz
exposure time adjust	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / - [bit]	x / x / - [bit]
binning h / v	2 / 2 [px]	2 / 2 [px]
LUT	12to8(1)	12to8(1)
AOI	1	1
white balancing	auto;manual	auto;manual
tap balancing	manual;auto	manual;auto
gain	auto;manual	auto;manual
offset	manual	manual
PIV mode		
readout control	manual;delayed	manual;delayed

flat field correction		
shading correction		
defect pixel correction	x	x
image flip	**horizontal;vertical**	**horizontal;vertical**
I/O features		
trigger modes	internal;software;external	internal;software;external
high low trigger	x	x
pulseloop	4	4
IOMUX	pwm(4);sequencer	pwm(4);sequencer
exposure output	x	x
trigger in 24 V	2	2
output open drain	2	2
opto input / output		
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power min. / max. [V]	**10 / 25**	**10 / 25**
housing features		
Mount	C-Mount	C-Mount
lens control		
dimensions w / h / d mm³	38 / 38 / 45 mm³	38 / 38 / 45 mm³
weight	150 g	150 g
protection class	IP40	IP40
temp. Sensor	Mainboard	Mainboard
temp. Ambient °C	-10 to 45 °C	-10 to 45 °C
power consumption	**4 W**	**4 W**
status	**available**	**available**
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1.2.1 Spectral Sensitivity Characteristics KAI-04050-C

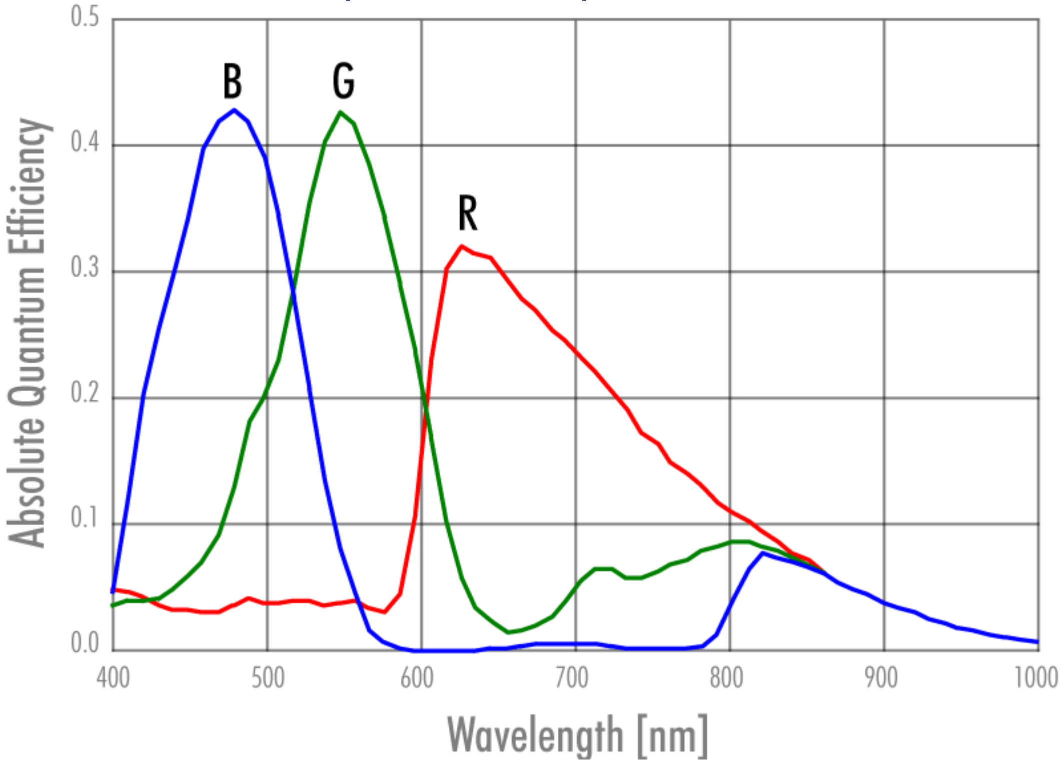

Figure 82: Spectral Sensitivity Characteristics KAI-04050-C

1.2.2 Spectral Sensitivity Characteristics KAI-04050-A

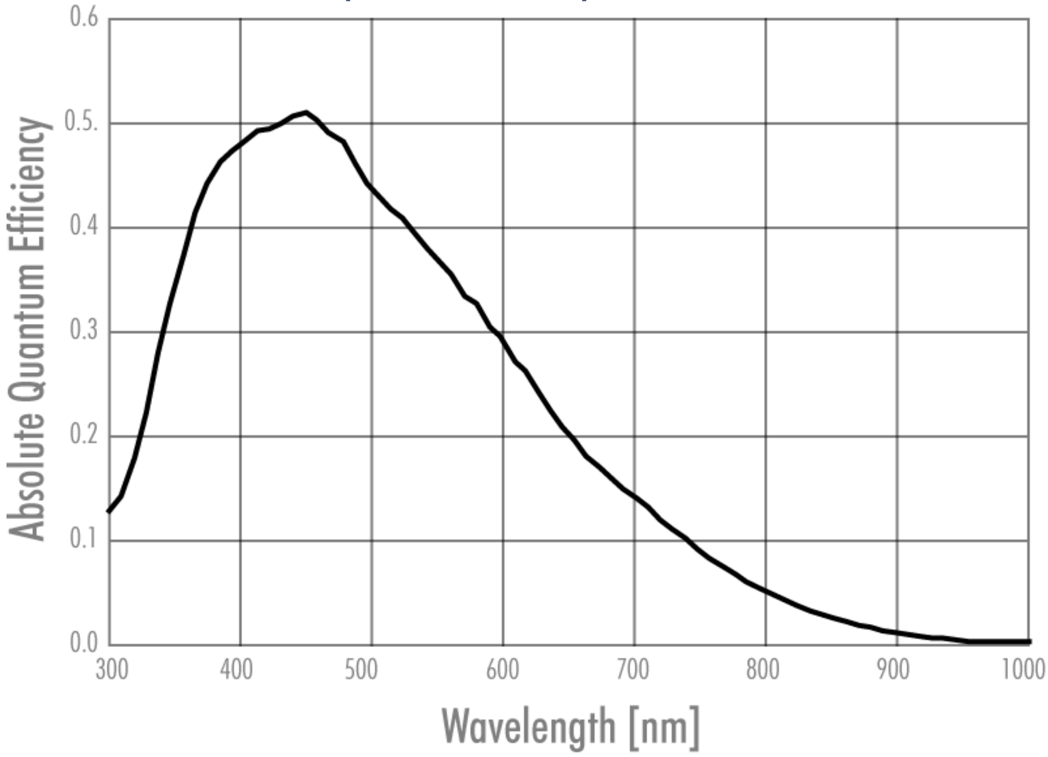

Figure 83: Spectral Sensitivity Characteristics KAI-04050-A

6.4 eco674*TLGEC

Model	**eco674MTLGEC**	**eco674CTLGEC**
familiy	ECO	ECO
active pixel w x h	1932 x 1452 px²	1932 x 1452 px²
max. frame rate	19,9 fps	19,9 fps
chroma	mono	bayer
interface	GigE Vision	GigE Vision

sensor		
sensor name	ICX674ALG	ICX674AQG
vendor	Sony	Sony
sensor architecture	area CCD	area CCD
readout/shutter type	interline progressive	interline progressive
sensor pixel clock	54 MHz	54 MHz
chroma	mono	bayer
equivalent format	1	1
active pixel w x h	1932 x 1452 px²	1932 x 1452 px²
effective pixel w x h	1940 x 1460 px²	1940 x 1460 px²
diagonal	10,98 mm	10,98 mm
pixel w x h	4,54 x 4,54 µm²	4,54 x 4,54 µm²
optic sensor w x h	8,77 x 6,62 mm²	8,77 x 6,62 mm²
active sensor diag.	10,98 mm	10,98 mm
max. frame rate	19,9 fps	19,9 fps
exposure time	42 µs / 60 s	42 µs / 60 s
max. gain	18 dB	18 dB
SNR	**62 dB**	**62 dB**

camera features		
firmware version	1.6.5	1.6.5
memory	64 MB	64 MB
CL_geometry		
frequency select		
camera pixel clock	40 MHz	40 MHz
exposure time adjust	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / - [bit]	x / x / - [bit]
binning h / v	2 / 2 [px]	2 / 2 [px]
LUT	12to8(1)	12to8(1)
AOI	1	1
white balancing	auto;manual	auto;manual
tap balancing	manual;auto	manual;auto
gain	auto;manual	auto;manual
offset	manual	manual
PIV mode		
readout control	manual;delayed	manual;delayed

flat field correction		
shading correction		
defect pixel correction	x	x
image flip	**horizontal;vertical**	**horizontal;vertical**
I/O features		
trigger modes	internal;software;external	internal;software;external
high low trigger	x	x
pulseloop	4	4
IOMUX	pwm(4);sequencer	pwm(4);sequencer
exposure output	x	x
trigger in 24 V	2	2
output open drain	2	2
opto input / output		
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power min. / max. [V]	**10 / 25**	**10 / 25**
housing features		
Mount	C-Mount	C-Mount
lens control		
dimensions w / h / d mm³	38 / 38 / 45 mm³	38 / 38 / 45 mm³
weight	150 g	150 g
protection class	IP40	IP40
temp. Sensor	Mainboard	Mainboard
temp. Ambient °C	-10 to 45 °C	-10 to 45 °C
power consumption	**4 W**	**4 W**
status	**available**	**available**
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1.2.3 **Spectral Sensitivity Characteristics** ICX674AQG

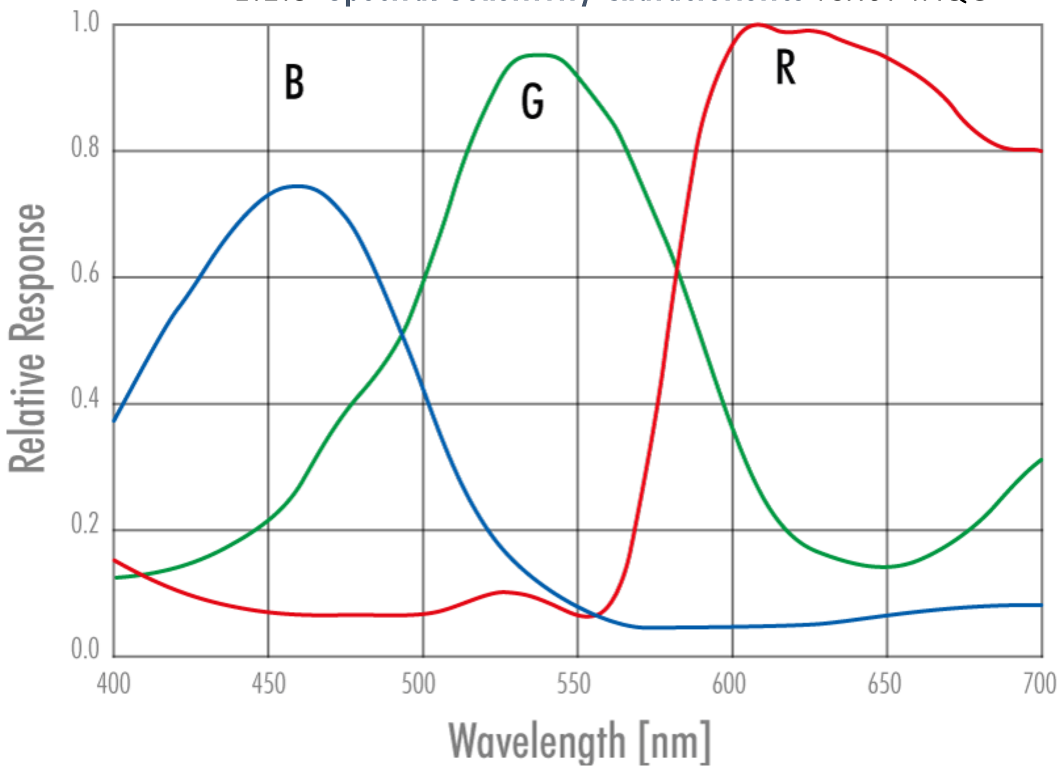

Figure 84: Spectral Sensitivity Characteristics ICX674AQG

1.2.4 **Spectral Sensitivity Characteristics** ICX674ALG

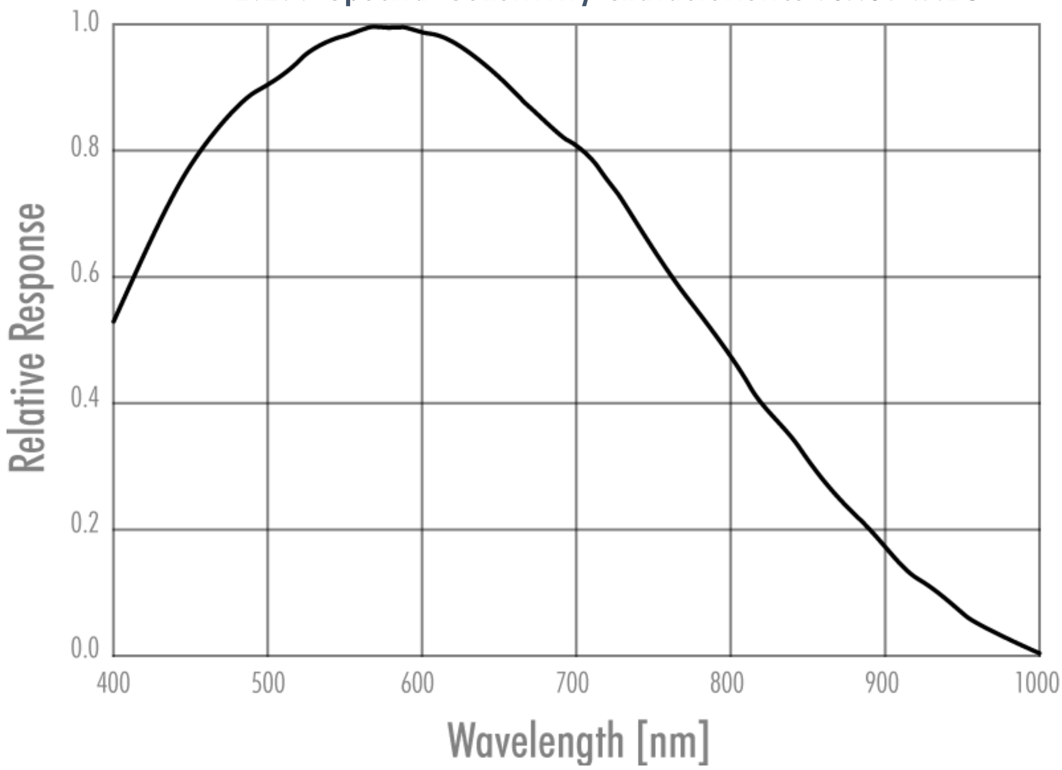

Figure 85: Spectral Sensitivity Characteristics ICX674ALG

6.5 eco694*TLGEC

Model	**eco694MTLGEC**	**eco694CTLGEC**
familiy	ECO	ECO
active pixel w x h	2750 x 2200 px^2	2750 x 2200 px^2
max. frame rate	10,1 fps	10,1 fps
chroma	mono	bayer
interface	GigE Vision	GigE Vision

sensor		
sensor name	ICX694ALG	ICX694AQG
vendor	Sony	Sony
sensor architecture	area CCD	area CCD
readout/shutter type	interline progressive	interline progressive
sensor pixel clock	54 MHz	54 MHz
chroma	mono	bayer
equivalent format	1	1
active pixel w x h	2750 x 2200 px^2	2750 x 2200 px^2
effective pixel w x h	2758 x 2208 px^2	2758 x 2208 px^2
diagonal	15,99 mm	15,99 mm
pixel w x h	4,54 x 4,54 μm^2	4,54 x 4,54 μm^2
optic sensor w x h	12,4 x 10,0 mm^2	12,4 x 10,0 mm^2
active sensor diag.	15,99 mm	15,99 mm
max. frame rate	10,1 fps	10,1 fps
exposure time	42 μs / 60 s	42 μs / 60 s
max. gain	18 dB	18 dB
SNR	**58 dB**	**58 dB**

camera features		
firmware version	1.6.5	1.6.5
memory	64 MB	64 MB
CL_geometry		
frequency select		
camera pixel clock	40 MHz	40 MHz
exposure time adjust	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / - [bit]	x / x / - [bit]
binning h / v	2 / 2 [px]	2 / 2 [px]
LUT	12to8(1)	12to8(1)
AOI	1	1
white balancing	auto;manual	auto;manual
tap balancing	manual;auto	manual;auto
gain	auto;manual	auto;manual
offset	manual	manual
PIV mode		
readout control	manual;delayed	manual;delayed

flat field correction		
shading correction		
defect pixel correction	x	x
image flip	**horizontal;vertical**	**horizontal;vertical**
I/O features		
trigger modes	internal;software;external	internal;software;external
high low trigger	x	x
pulseloop	4	4
IOMUX	pwm(4);sequencer	pwm(4);sequencer
exposure output	x	x
trigger in 24 V	2	2
output open drain	2	2
opto input / output		
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power min. / max. [V]	**10 / 25**	**10 / 25**
housing features		
Mount	C-Mount	C-Mount
lens control		
dimensions w / h / d mm³	38 / 38 / 45 mm³	38 / 38 / 45 mm³
weight	150 g	150 g
protection class	IP40	IP40
temp. Sensor	Mainboard	Mainboard
temp. Ambient °C	-10 to 45 °C	-10 to 45 °C
power consumption	**4 W**	**4 W**
status	**undefined**	**undefined**
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1.2.5 **Spectral Sensitivity Characteristics** ICX694AQG

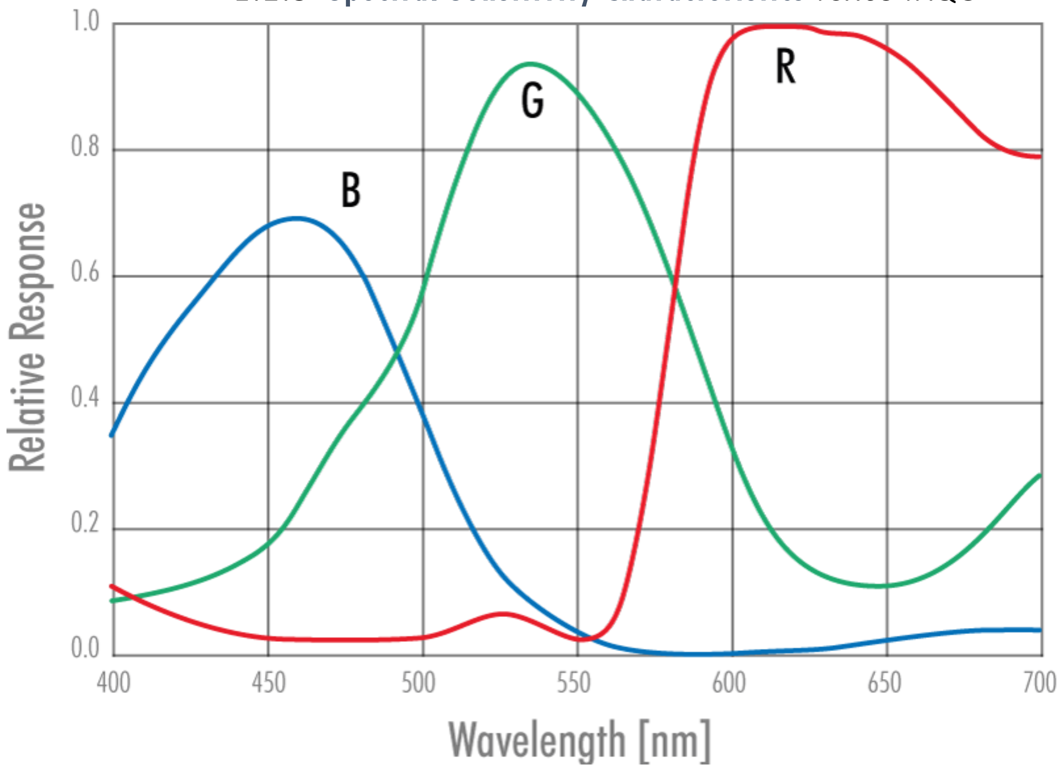

Figure 86: Spectral Sensitivity Characteristics ICX694AQG

1.2.6 **Spectral Sensitivity Characteristics** ICX694ALG

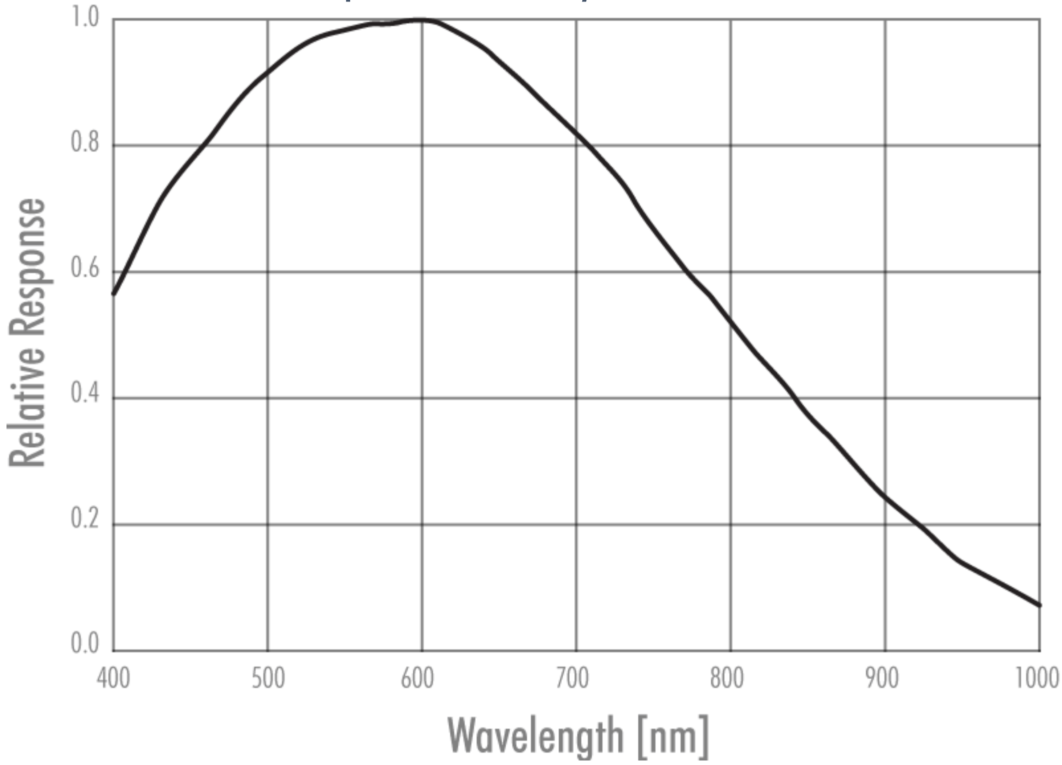

Figure 87: Spectral Sensitivity Characteristics ICX694ALG

6.6 eco695*TLGEC

Model	**eco695CTLGEC**	**eco695MTLGEC**
familiy	ECO	ECO
active pixel w x h	2750 x 2200 px²	2750 x 2200 px²
max. frame rate	10,1 fps	10,1 fps
chroma	bayer	mono
interface	GigE Vision	GigE Vision
sensor		
sensor name	ICX695AQG	ICX695ALG
vendor	Sony	Sony
sensor architecture	area CCD	area CCD
readout/shutter type	interline progressive	interline progressive
sensor pixel clock	54 MHz	54 MHz
chroma	bayer	mono
equivalent format	1	1
active pixel w x h	2750 x 2200 px²	2750 x 2200 px²
effective pixel w x h	2758 x 2208 px²	2758 x 2208 px²
diagonal	15,99 mm	15,99 mm
pixel w x h	4,54 x 4,54 μm²	4,54 x 4,54 μm²
optic sensor w x h	12,4 x 10,0 mm²	12,4 x 10,0 mm²
active sensor diag.	15,99 mm	15,99 mm
max. frame rate	10,1 fps	10,1 fps
exposure time	42 μs / 60 s	42 μs / 60 s
max. gain	18 dB	18 dB
SNR	**58 dB**	**58 dB**
camera features		
firmware version	1.6.5	1.6.5
memory	64 MB	64 MB
CL_geometry		
frequency select		
camera pixel clock	40 MHz	40 MHz
exposure time adjust	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / - [bit]	x / x / - [bit]
binning h / v	2 / 2 [px]	2 / 2 [px]
LUT	12to8(1)	12to8(1)
AOI	1	1
white balancing	auto;manual	auto;manual
tap balancing	manual;auto	manual;auto
gain	auto;manual	auto;manual
offset	manual	manual
PIV mode		
readout control	manual;delayed	manual;delayed

flat field correction		
shading correction		
defect pixel correction	x	x
image flip	**horizontal;vertical**	**horizontal;vertical**
I/O features		
trigger modes	internal;software;external	internal;software;external
high low trigger	x	x
pulseloop	4	4
IOMUX	pwm(4);sequencer	pwm(4);sequencer
exposure output	x	x
trigger in 24 V	2	2
output open drain	2	2
opto input / output		
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power min. / max. [V]	**10 / 25**	**10 / 25**
housing features		
Mount	C-Mount	C-Mount
lens control		
dimensions w / h / d mm^3	38 / 38 / 45 mm^3	38 / 38 / 45 mm^3
weight	150 g	150 g
protection class	IP40	IP40
temp. Sensor	Mainboard	Mainboard
temp. Ambient °C	-10 to 45 °C	-10 to 45 °C
power consumption	**4 W**	**4 W**
status	**available**	**available**
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1.2.7 Spectral Sensitivity Characteristics ICX695AQG

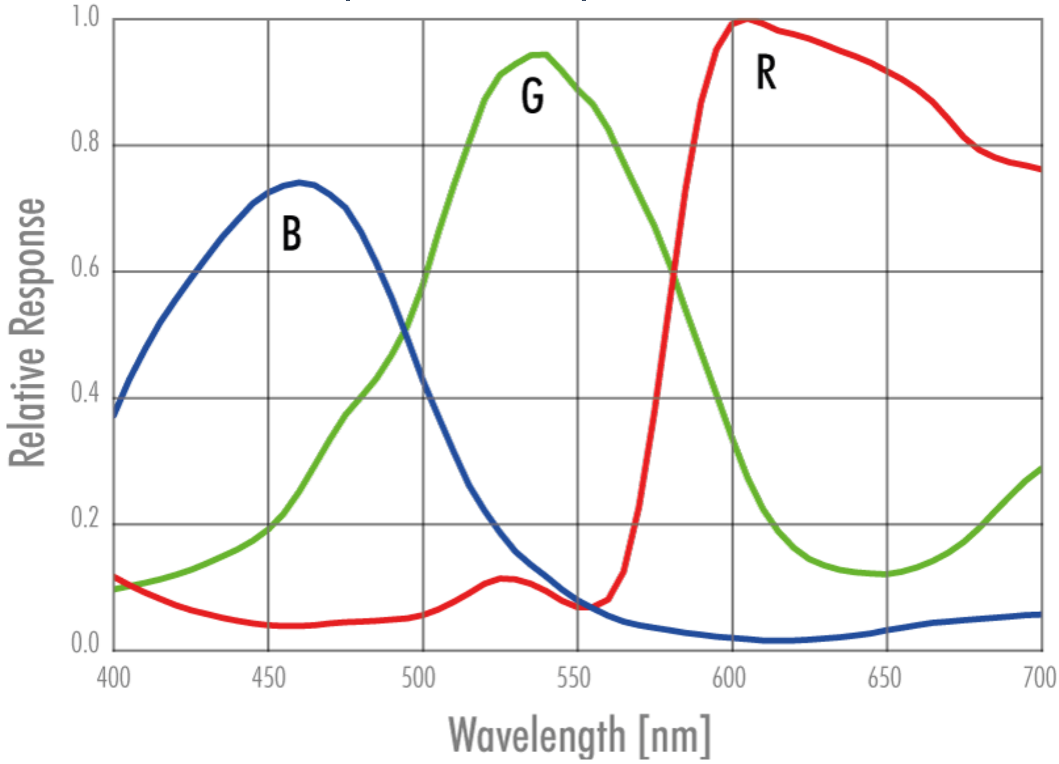

Figure 88: Spectral Sensitivity Characteristics ICX695AQG

1.2.8 Spectral Sensitivity Characteristics ICX695ALG

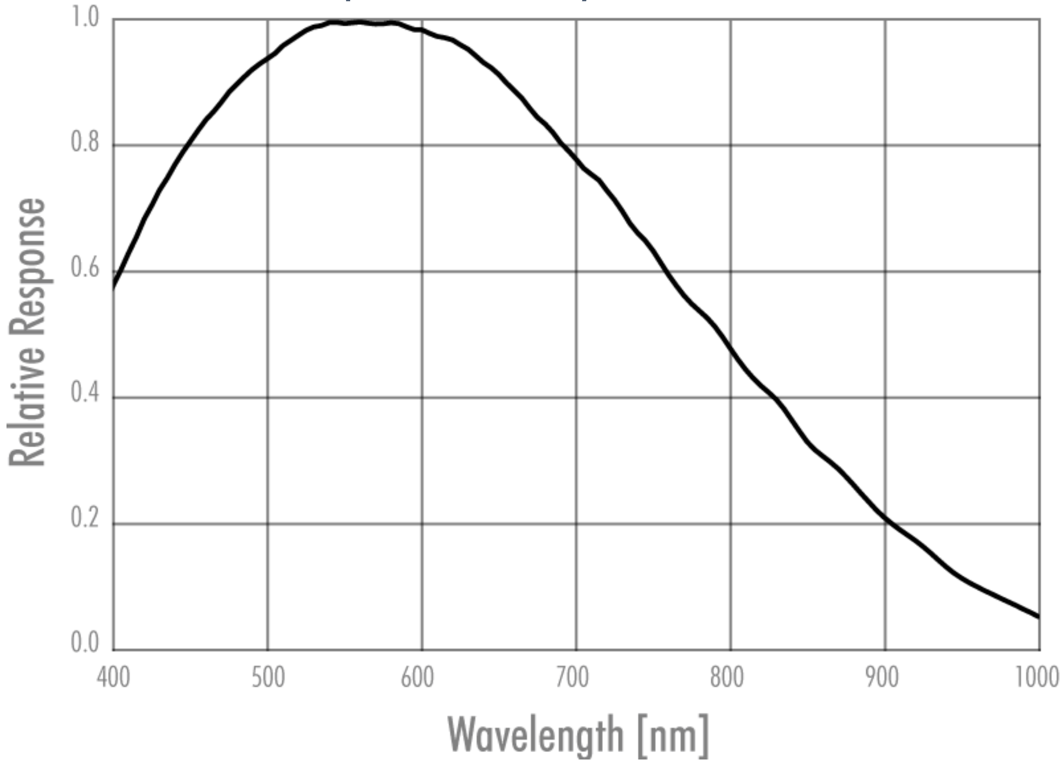

Figure 89: Spectral Sensitivity Characteristics ICX695ALG

6.7 eco814*TLGEC

Model	**eco814CTLGEC**	**eco814MTLGEC**
familiy	ECO	ECO
active pixel w x h	3380 x 2704 px²	3380 x 2704 px²
max. frame rate	7 fps	7 fps
chroma	bayer	mono
interface	GigE Vision	GigE Vision
sensor		
sensor name	ICX814AQA	ICX814ALA
vendor	Sony	Sony
sensor architecture	area CCD	area CCD
readout/shutter type	interline progressive	interline progressive
sensor pixel clock	54 MHz	54 MHz
chroma	bayer	mono
equivalent format	1	1
active pixel w x h	3380 x 2704 px²	3380 x 2704 px²
effective pixel w x h	3388 x 2712 px²	3388 x 2712 px²
diagonal	15,97 mm	15,97 mm
pixel w x h	3,69 x 3,69 μm²	3,69 x 3,69 μm²
optic sensor w x h	12,4 x 10,0 mm²	12,4 x 10,0 mm²
active sensor diag.	15,97 mm	15,97 mm
max. frame rate	7 fps	7 fps
exposure time	42 μs / 60 s	42 μs / 60 s
max. gain	18 dB	18 dB
SNR	**58 dB**	**58 dB**
camera features		
firmware version	1.6.5	1.6.5
memory	64 MB	64 MB
CL_geometry		
frequency select		
camera pixel clock	40 MHz	40 MHz
exposure time adjust	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / - [bit]	x / x / - [bit]
binning h / v	2 / 2 [px]	2 / 2 [px]
LUT	12to8(1)	12to8(1)
AOI	1	1
white balancing	auto;manual	auto;manual
tap balancing	manual;auto	manual;auto
gain	auto;manual	auto;manual
offset	manual	manual
PIV mode		
readout control	manual;delayed	manual;delayed

flat field correction		
shading correction		
defect pixel correction	x	x
image flip	**horizontal;vertical**	**horizontal;vertical**
I/O features		
trigger modes	internal;software;external	internal;software;external
high low trigger	x	x
pulseloop	4	4
IOMUX	pwm(4);sequencer	pwm(4);sequencer
exposure output	x	x
trigger in 24 V	2	2
output open drain	2	2
opto input / output		
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power min. / max. [V]	**10 / 25**	**10 / 25**
housing features		
Mount	C-Mount	C-Mount
lens control		
dimensions w / h / d mm³	38 / 38 / 45 mm³	38 / 38 / 45 mm³
weight	150 g	150 g
protection class	IP40	IP40
temp. Sensor	Mainboard	Mainboard
temp. Ambient °C	-10 to 45 °C	-10 to 45 °C
power consumption	**4 W**	**4 W**
status	**available**	**available**
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1.2.9 Spectral Sensitivity Characteristics ICX814AQA

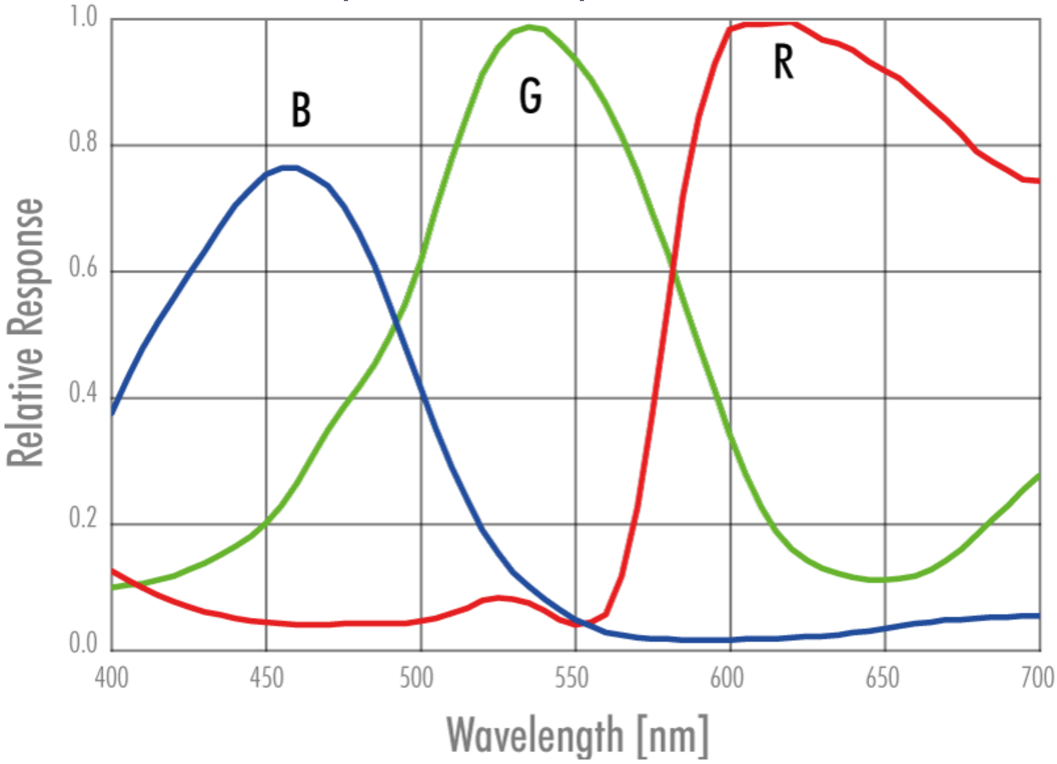

Figure 90: Spectral Sensitivity Characteristics ICX814AQA

1.2.10 Spectral Sensitivity Characteristics ICX814ALA

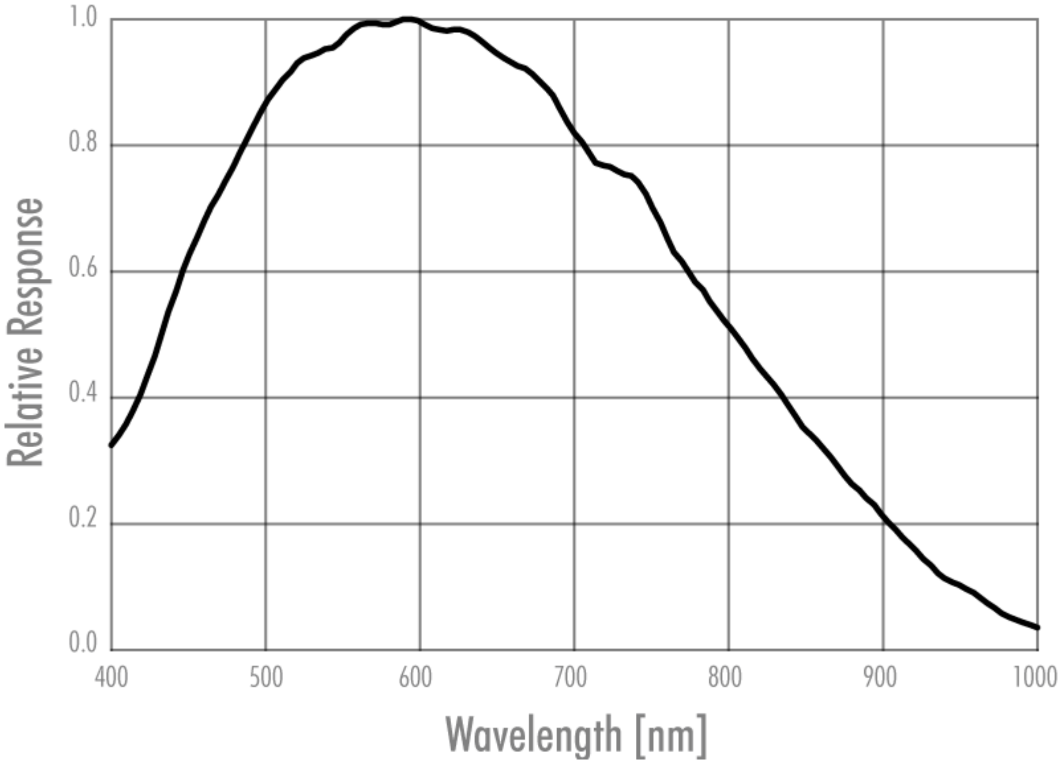

Figure 91: Spectral Sensitivity Characteristics ICX814ALA

6.8 eco815CTLGEC

Model	eco815CTLGEC	eco815MTLGEC
familiy	ECO	ECO
active pixel w x h	3380 x 2704 px^2	3380 x 2704 px^2
max. frame rate	7 fps	7 fps
chroma	bayer	mono
interface	GigE Vision	GigE Vision
sensor		
sensor name	ICX815AQA	ICX815ALA
vendor	Sony	Sony
sensor architecture	area CCD	area CCD
readout/shutter type	interline progressive	interline progressive
sensor pixel clock	54 MHz	54 MHz
chroma	bayer	mono
equivalent format	1	1
active pixel w x h	3380 x 2704 px^2	3380 x 2704 px^2
effective pixel w x h	3388 x 2712 px^2	3388 x 2712 px^2
diagonal	15,97 mm	15,97 mm
pixel w x h	3,69 x 3,69 μm^2	3,69 x 3,69 μm^2
optic sensor w x h	12,4 x 10,0 mm^2	12,4 x 10,0 mm^2
active sensor diag.	15,97 mm	15,97 mm
max. frame rate	7 fps	7 fps
exposure time	42 μs / 60 s	42 μs / 60 s
max. gain	18 dB	18 dB
SNR	**58 dB**	**58 dB**
camera features		
firmware version	1.6.5	1.6.5
memory	64 MB	64 MB
CL_geometry		
frequency select		
camera pixel clock	40 MHz	40 MHz
exposure time adjust	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / - [bit]	x / x / - [bit]
binning h / v	2 / 2 [px]	2 / 2 [px]
LUT	12to8(1)	12to8(1)
AOI	1	1
white balancing	auto;manual	auto;manual
tap balancing	manual;auto	manual;auto
gain	auto;manual	auto;manual
offset	manual	manual
PIV mode		
readout control	manual;delayed	manual;delayed

flat field correction		
shading correction		
defect pixel correction	x	x
image flip	**horizontal;vertical**	**horizontal;vertical**
I/O features		
trigger modes	internal;software;external	internal;software;external
high low trigger	x	x
pulseloop	4	4
IOMUX	pwm(4);sequencer	pwm(4);sequencer
exposure output	x	x
trigger in 24 V	2	2
output open drain	2	2
opto input / output		
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power min. / max. [V]	**10 / 25**	**10 / 25**
housing features		
Mount	C-Mount	C-Mount
lens control		
dimensions w / h / d mm³	38 / 38 / 45 mm³	38 / 38 / 45 mm³
weight	150 g	150 g
protection class	IP40	IP40
temp. Sensor	Mainboard	Mainboard
temp. Ambient °C	-10 to 45 °C	-10 to 45 °C
power consumption	**4 W**	**4 W**
status	**available**	**available**
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1.2.11 Spectral Sensitivity Characteristics ICX815AQA

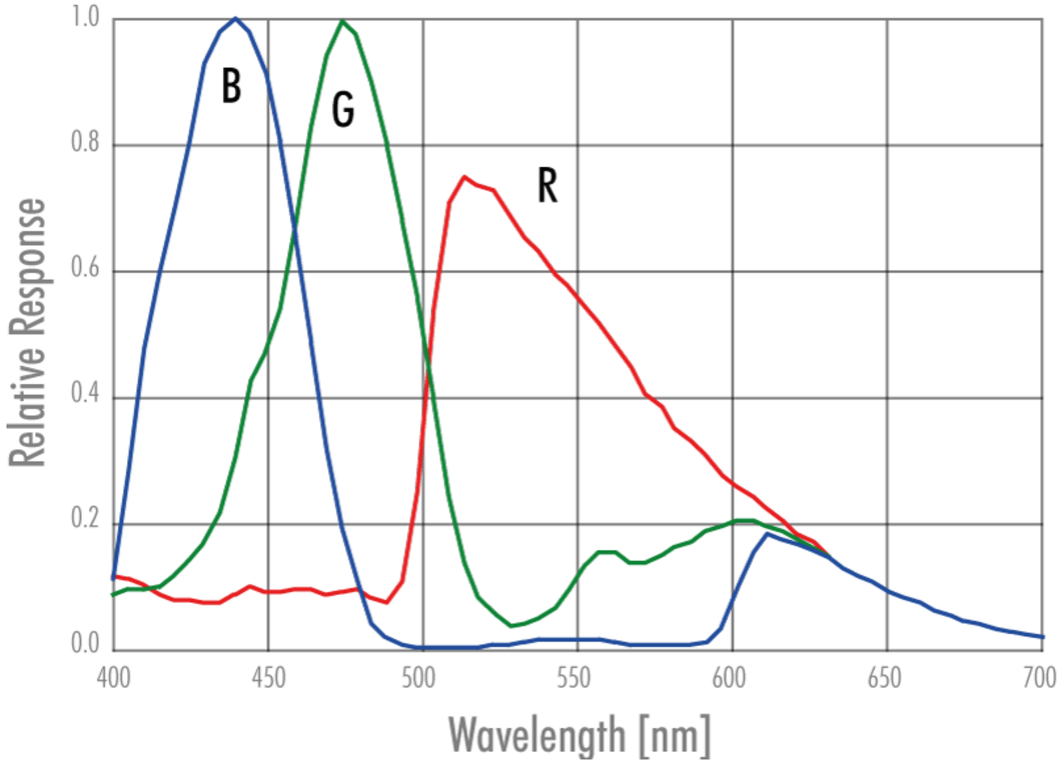

Figure 92: Spectral Sensitivity Characteristics ICX815AQA

1.2.12 Spectral Sensitivity Characteristics ICX815ALA

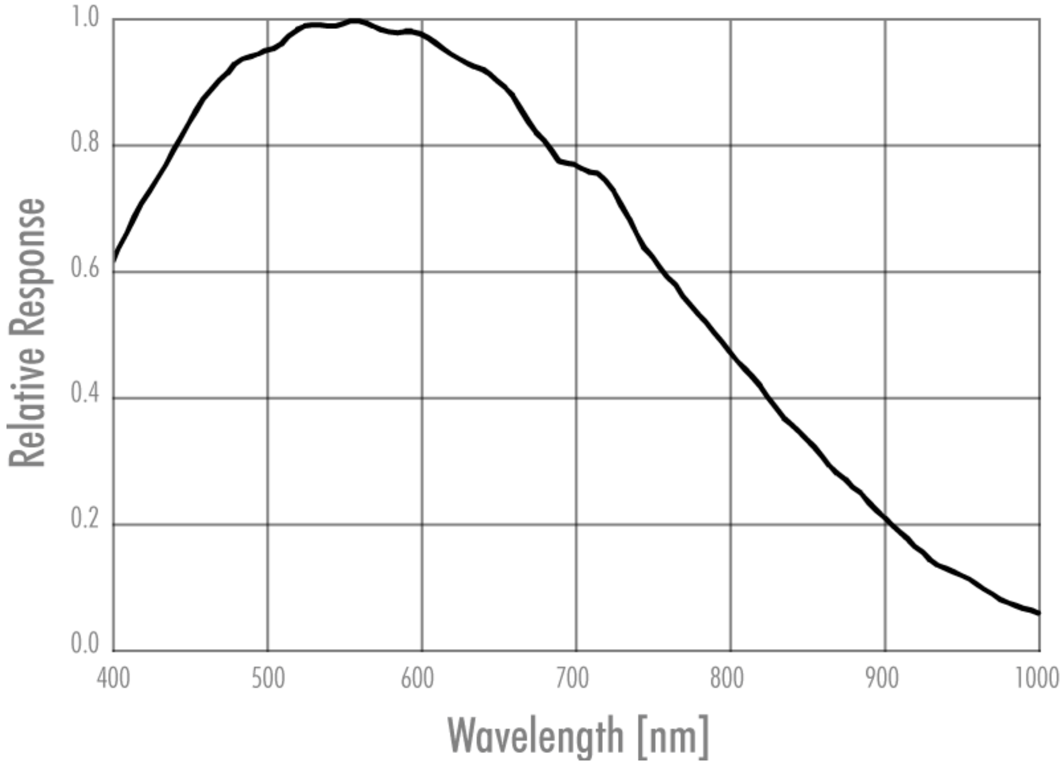

Figure 93: Spectral Sensitivity Characteristics ICX815ALA

6.9 eco834*TLGEC

Model	**eco834MTLGEC**	**eco834CTLGEC**
familiy	ECO	ECO
active pixel w x h	4242 x 2830 px^2	4242 x 2830 px^2
max. frame rate	5,5 fps	5,5 fps
chroma	mono	bayer
interface	GigE Vision	GigE Vision

sensor		
sensor name	ICX834ALG	ICX834AQG
vendor	Sony	Sony
sensor architecture	area CCD	area CCD
readout/shutter type	interline progressive	interline progressive
sensor pixel clock	54 MHz	54 MHz
chroma	mono	bayer
equivalent format	1	1
active pixel w x h	4242 x 2830 px^2	4242 x 2830 px^2
effective pixel w x h	4250 x 2838 px^2	4250 x 2838 px^2
diagonal	15,81 mm	15,81 mm
pixel w x h	3,1 x 3,1 μm^2	3,1 x 3,1 μm^2
optic sensor w x h	13,1 x 8,79 mm^2	13,1 x 8,79 mm^2
active sensor diag.	15,81 mm	15,81 mm
max. frame rate	5,5 fps	5,5 fps
exposure time	42 μs / 60 s	42 μs / 60 s
max. gain	18 dB	18 dB
SNR	**55 dB**	**55 dB**

camera features		
firmware version	1.6.5	1.6.5
memory	64 MB	64 MB
CL_geometry		
frequency select		
camera pixel clock	40 MHz	40 MHz
exposure time adjust	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / - [bit]	x / x / - [bit]
binning h / v	2 / 2 [px]	2 / 2 [px]
LUT	12to8(1)	12to8(1)
AOI	1	1
white balancing	auto;manual	auto;manual
tap balancing	manual;auto	manual;auto
gain	auto;manual	auto;manual
offset	manual	manual
PIV mode		
readout control	manual;delayed	manual;delayed

flat field correction		
shading correction		
defect pixel correction	x	x
image flip	**horizontal;vertical**	**horizontal;vertical**
I/O features		
trigger modes	internal;software;external	internal;software;external
high low trigger	x	x
pulseloop	4	4
IOMUX	pwm(4);sequencer	pwm(4);sequencer
exposure output	x	x
trigger in 24 V	2	2
output open drain	2	2
opto input / output		
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power min. / max. [V]	**10 / 25**	**10 / 25**
housing features		
Mount	C-Mount	C-Mount
lens control		
dimensions w / h / d mm^3	38 / 38 / 45 mm^3	38 / 38 / 45 mm^3
weight	150 g	150 g
protection class	IP40	IP40
temp. Sensor	Mainboard	Mainboard
temp. Ambient °C	-10 to 45 °C	-10 to 45 °C
power consumption	**4 W**	**4 W**
status	**available**	**available**
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1.2.13 Spectral Sensitivity Characteristics ICX834AQG

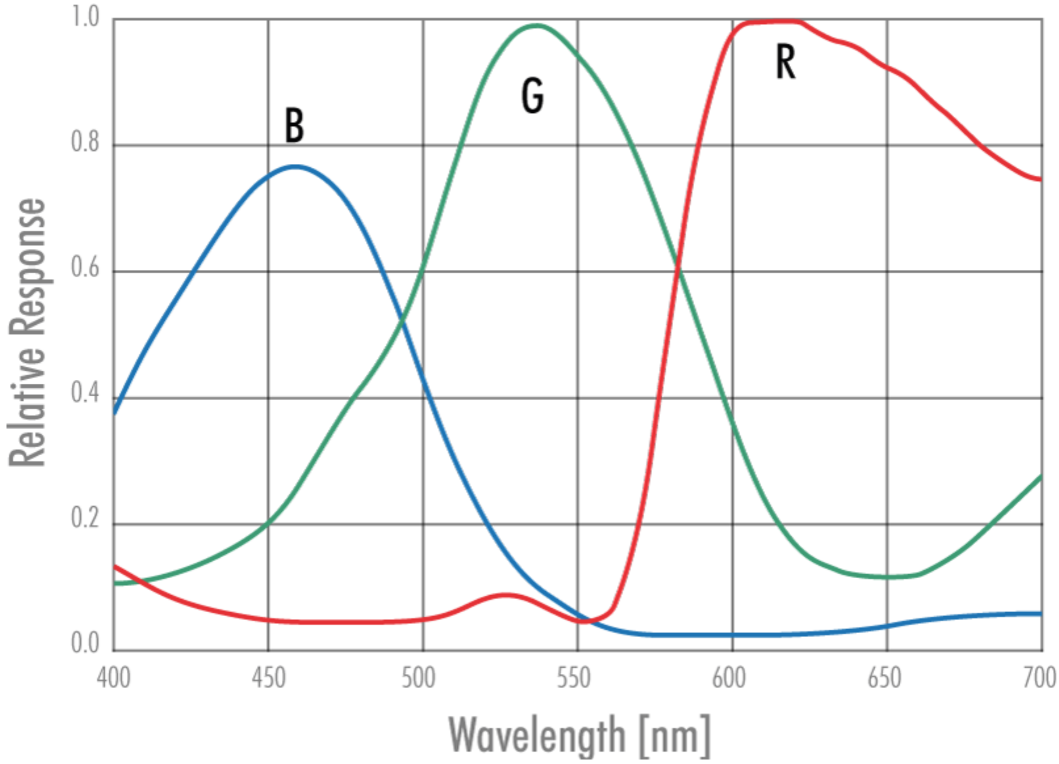

Figure 94: Spectral Sensitivity Characteristics ICX834AQG

1.2.14 Spectral Sensitivity Characteristics ICX834ALG

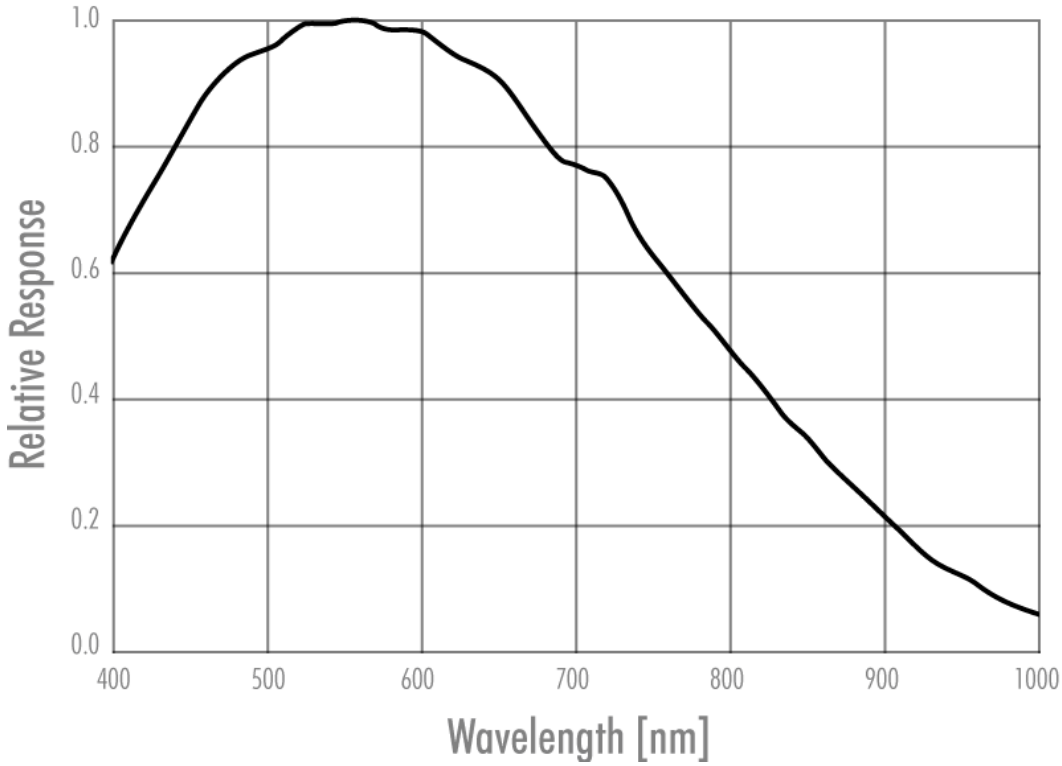

Figure 95: Spectral Sensitivity Characteristics ICX834ALG

7 Terms of warranty

Standard Products Warranty and Adjustment	Seller warrants that the article to be delivered under this order will be free from defects in material and workmanship under normal use and service for a period of 2 years from date of shipment. The liability of Seller under this warranty is limited solely to replacing or repairing or issuing credit (at the discretion of Seller) for such products that become defective during the warranty period. In order to permit Seller to properly administer this warranty, Buyer shall notify Seller promptly in writing of any claims,; provide Seller with an opportunity to inspect and test the products claimed to be detective. Such inspection may be on customer's premises or Seller may request return of such products at customer's expense. Such expense will subsequently be reimbursed to customer if the product is found to be defective and Buyer shall not return any product without prior return authorization from Seller. If a returned product is found to be out of warranty or found to be within the applicable specification, Buyer will have to pay an evaluation and handling charge, independent of possible repair and/or replacement costs. Seller will notify Buyer of the amount of said evaluation and handling charges at the time the return authorization is issued. Seller will inform Buyer of related repair and/or replacement costs and request authorization before incurring such costs. Buyer shall identify all returned material with Sellers invoice number, under which material has been received. If more than one invoice applies, material has to be clearly segregated and identified by applicable invoice numbers. Adjustment is contingent upon Sellers examination of product, disclosing that apparent defects have not been caused by misuse, abuse, improper installation of application, repair, alteration, accident or negligence in use, storage, transportation or handling. In no event shall Seller be liable to Buyer for loss of profits, loss of use, or damages of any kind based upon a claim for breach of warranty.
Development Product Warranty	Developmental products of Seller are warranted to be free from defects in materials and workmanship and to meet the applicable preliminary specification only at the time of receipt by Buyer and for no longer period of time in all other respects the warranties made above apply to development products. The aforementioned provisions do not extend the original warranty period of any article which has been repaired or replaced by Seller.
Do not break Warranty Label	If warranty label of camera is broken warranty is void. Seller makes no other warranties express or implied, and specifically, seller makes no warranty of merchantability of fitness for particular purpose.
What to do in case of Malfunction	Please contact your local distributor first.

8 Troubleshooting

8.1 FAQ

Problem	Solution
Camera does not respond to light.	Check if camera is set to “Mode 0“. I.e. free running with programmed exposure ctrl. When done, check with the program “Convenient Cam“ if you can read back any data from the camera, such as “Mode“, “type“ of CCD, exposure time settings, etc.. If “Mode 0“ works properly, check the signals of the camera in the desired operation mode like “Mode 1“ or “Mode 2“. In these modes, check if the ExSync signal is present. Please note that a TTL signal must be fed to the trigger connector if it is not provided by the frame grabber (LVDS type). The typical signal swing must be around 5 V. Lower levels will not be detected by the camera... If you use a TTL level signal fed to the “TB 5 connector“ check the quality and swing. If these signals are not present or don't have the proper quality, the camera cannot read out any frame (Mode 1 and 2). Beware of spikes on the signal.
Image is present but distorted.	Check the camera configuration file of your frame grabber. Check number of “front- and back porch“ pixel. Wrong numbers in configuration file can cause sync problems. Check if your frame grabber can work with the data rate of the camera.
Image of a color version camera looks strange or false colors appear.	If the raw image looks OK, check the camera file to see if the pixels need to be shifted by either one pixel or one line. The image depends on the algorithm used. If the algorithm is starting with the wrong pixel such effects appear.
Colors rendition of a color versions not as expected – especially when using halogen light.	Halogen light contains strong portions of IR radiation. Use cut-off filters at around 730 nm like “Schott KG 3“ to prevent IR radiation reaching the CCD.
No serial communication is possible between the camera and the PC.	Use “load camera DLL” and try again.

Please fax this form to your local distributor. The right Fax number you can find on our homepage: http://www.svs-vistek.com

SENDER:

FIRM:

TEL:

MAIL:

8.2 Support Request Form / Check List

Dear valued customer,

In order to help you with your camera and any interfacing problems we request that you fill in a description of your problems when you use the camera. Please fax or email this form to the dealer/distributor from which you purchased the product.

	Operating System (E.g. Win 7, XP):
Which Camera are you using?	Type (e.g.: svs3625MTHCPC):
	Serial Number:
Which Accessories are you using?	Power Supply:
	Cable:
	Lens Type and Focal Length:
Firmware	No. of Version:
	Operation Mode:
	Please send a screenshot of “ConvCam” screen or log file.
In case of EURESYS Grabber:	Brand and Type:
	Driver Version:
	If Patch please specify:
	Camera file used:
Short Description of Problem	(E.g. missing lines, noisy image, missing bits etc.):

8.2.1 Space for further descriptions, screenshots and log-files:

9 Glossary of Terms

Aberration
Spherical aberration occurs when light rays enter near the edge of the lens; Chromatic aberration is caused by different refractive indexes of different wavelengths of the light. (Blue is more refractive than red)

ADC
Analogue-to-Digital Converter, also known as A/D converter

Aperture
In optics, Aperture defines a hole or an opening through which light travels. In optical system the Aperture determines the cone angle of a bundle of rays that come to a focus in the image plane. The Aperture can be limited by an iris, but it is not solely reliant on the iris. The diameter of the lens has a larger influence on the capability of the optical system.

Bayer Pattern
A Bayer filter mosaic or pattern is a color filter array (CFA) deposited onto the surface of a CCD or CMOS sensor for capturing RGB color images. The filter mosaic has a defied sequence of red, green and blue pixels such that the captured image can be transported as a monochrome image to the host (using less bandwidth); where after the RGB information is recombined in a computer algorithm.

Binning
Binning combines the charge from two (or more) pixels to achieve higher dynamics while sacrifying resolution.

Bit-Depth
Bit-depth is the number of digital bits available at the output of the Analog-to-Digital Converter (ADC) indicating the distribution of the darkest to the brightest value of a single pixel.

Camera Link
Camera Link is a multiple-pair serial communication protocol standard [1] designed for computer vision applications based on the National Semiconductor interface Channel-link. It was designed for the purpose of standardizing scientific and industrial video products including cameras, cables and frame grabbers.

CCD
Charge Coupled Device. Commonly used technology used for camera sensors used to detect & quantify light, i.e. for capturing images in an electronic manner. CCDs were first introduced in the early 70ies.

CMOS
Complementary Metal–Oxide–Semiconductor. A more recently adopted technology used for camera sensors with in-pixel amplifiers used to detect & quantify light, i.e. capturing images in an electronic manner.

CPU
Central Processing Unit of a computer. Also referred to as the processor chip.

dB
Decibel (dB) is a logarithmic unit used to express the ratio between two values of a physical quantity.

Decimation
For reducing width or height of an image, decimation can be used (CMOS sensors only). Columns or rows can be ignored. Image readout time is thereby reduced.

Defect map
Identifies the location of defect pixels unique for every sensor. A factory generated defect map is delivered and implemented with each camera.

EPROM
Erasable Programmable Read Only Memory is a type of memory chip that retains its data when its power supply is switched off.

External Trigger
Erasable Programmable Read Only Memory is a type of memory chip that retains its data when its power supply is switched off.

fixed frequency
or programmed exposure time. Frames are read out continuously.

Gain
In electronics, gain is a measure of the ability of a two-port circuit (often an amplifier) to increase the power or amplitude of a signal from the input to the output port by adding energy to the signal.

Gamma	Gamma correction is a nonlinear operation used to code and decode luminance values in video or still image systems.
GenICam	Provides a generic programming interface for all kinds of cameras and devices. Regardless what interface technology is used (GigE Vision, USB3 Vision, CoaXPress, Camera Link, etc.) or which features are implemented, the application programming interface (API) will always be the same.
GigE Vision	GigE Vision is an interface standard introduced in 2006 for high-performance industrial cameras. It provides a framework for transmitting high-speed video and related control data over Gigabit Ethernet networks.
GPU	Graphics Processing Unit of a computer.
Hirose	Cable connectors commonly used for power, triggers, I/Os and strobe lights
ISO	see Gain.
Jumbo Frames	In computer networking, jumbo frames are Ethernet frames with more than 1500 bytes of payload. Conventionally, jumbo frames can carry up to 9000 bytes of payload. Some Gigabit Ethernet switches and Gigabit Ethernet network interface cards do not support jumbo frames.
Mount	Mechanical interface/connection for attaching lenses to the camera.
Multicast	Multicast (one-to-many or many-to-many distribution) is an ethernet group communication where information is addressed to a group of destination computers simultaneously. Multicast should not be confused with physical layer point-to-multipoint communication.
PWM	Pulse width modulation. Keeping voltage at the same level while limiting current flow by switching on an off at a very high frequency.
Partial Scan	A method for reading out fewer lines from the sensor, but “skipping” lines above and below the desired area. Typically applied to CCD sensors. In most CMOS image sensors an AOI (area of interest) or ROI (region of interest) can be defined by selecting the area to be read. This leads to increased frame rate.
Pixel clock	The base clock (beat) that operates the sensor chip is. It is typically also the clock with which pixels are presented at the output node of the image sensor.
RAW	A camera RAW image file contains minimally processed data from the image sensor. It is referred as raw in its meaning. SVS-VISTEK plays out RAW only.
Read-Out-Control	Read-Out control defines a delay between exposure and image readout. It allows the user to program a delay value (time) for the readout from the sensor. It is useful for preventing CPU overload when handling very large images or managing several cameras on a limited Ethernet connection.
Shading	Shading manifests itself a decreasing brightness towards the edges of the image or a brightness variation from one side of the image to the other. Shading can be caused by non-uniform illumination, non-uniform camera sensitivity, vignetting of the lens, or even dirt and dust on glass surfaces (lens).
Shading correction	An in-camera algorithm for real time correction of shading. It typically permits user configuration. By pointing at a known uniform evenly illuminated surface it allows the microprocessor in the camera to create a correction definition, subsequently applied to the image during readout.
Shutter	Shutter is a device or technique that allows light to pass for a determined period of time, exposing photographic film or a light-sensitive electronic sensor to light in order to capture a permanent image of a scene.

Strobe light	A bright light source with a very short light pulse. Ideal for use with industrial cameras, e.g. for “freezing” the image capture of fast moving objects. Can often be a substitute for the electronic shutter of the image sensor. Certain industrial cameras have dedicated in-camera output drivers for precisely controlling one or more strobe lights.
Tap	CCD sensors can occur divided into two, four or more regions to double/quadruple the read out time.
TCP/IP	TCP/IP provides end-to-end connectivity specifying how data should be packetized, addressed, transmitted, routed and received at the destination.
USB3 Vision	The USB3 Vision interface is based on the standard USB 3.0 interface and uses USB 3.0 ports. Components from different manufacturers will easily communicate with each other.
Trigger modes	Cameras for industrial use usually provide a set of different trigger modes with which they can be operated. The most common trigger modes are: (1) Programmable shutter trigger mode. Each image is captured with a pre-defined shutter time; (2) Pulse-Width Control trigger. The image capture is initiated by the leading edge of the trigger pulse and the shutter time is governed by the width of the pulse; (3) Internal trigger or Free-Running mode. The camera captures images at the fastest possible frame rate permitted by the readout time.
XML Files	Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format which is both human-readable and machine-readable

10 Index of figures

11 Index