Manual ECO series

eco204, eco267, eco274, eco285, eco414, eco415, eco424, eco445, eco618, eco625, eco655

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 Safety Messages

The classification of hazards is made pursuant to ISO 3864-2 and ANSI Y535.6 with the help of key words.

This Operating Manual uses the following Safety Messages:

Risk of death or serious injury		**DANGER** Danger indicates a hazard with a high level of risk which, if not avoided will result in death or serious injury.
		**WARNING** Warning indicates a hazard with a medium level of risk which, if not avoided will result in death or serious injury.
		**CAUTION** Caution indicates a hazard with a low level of risk which, if not avoided will result in death or serious injury.
Risk of damage		**PROHIBITION** A black graphical symbol inside a red circular band with a red diagonal bar defines a safety sign that indicates that an action shall not be taken or shall be stopped.
		**CAUTION!** A black graphical symbol inside a yellow triangle defines a safety sign that indicates a hazard.
		**MANDATORY ACTION** A white graphical symbol inside a blue circle defines a safety sign that indicates that an action shall be taken to avoid a hazard.
Cross-reference 		**NOTICE** Provides references and tips

Figure 1: Safety messages

2 Legal Information

Information given within the manual accurate as to: July 25, 2018, errors and omissions excepted.

These products are designed for industrial applications only. Cameras from SVS-Vistek are not designed for life support systems where malfunction of the products might result in any risk of personal harm or injury. Customers, integrators and end users of SVS-Vistek products might sell these products and agree to do so at their own risk, as SVS-Vistek will not take any liability for any damage from improper use or sale.

Europe

This camera is CE tested, rules of EN 55022:2010+AC2011 and EN61000-6-2:2005 apply.

The product is in compliance with the requirements of the following European directives:

2014/30/EU	Electromagnetic compatibility (EMC)
2011/65/EU	Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

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

USA and Canada

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.

Warning: This equipment is compliant with Class A of CISPR 32. In a residential environment this equipment may cause radio interference.

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.

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.
- Shock & Vibration Resistance is tested: For detailed Specifications refer to Specification.

3 Getting Started

3.1 Contents of Camera Set

- Camera
- Power supply (if ordered/option)
- DVD
- 3D CAD files
- Manuals
- Software: GigE-Kit (Win 32/64 & Linux)

3.2 Power supply

Connect the power supply with the Hirose connector.

CAUTION! – This camera does not support hotplugging

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

When using your own power supply (voltage range 10 -25 V DC) see also Hirose 12-pin for a detailed pin layout of the power connector. For power input specifications refer to specifications.

3.3 Camera status LED codes

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

The meaning of the blinking codes translates as follows:

Figure 1: Camera status LED codes

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

3.4 Software

Further information, documentations, release notes, latest software and application manuals can be downloaded in the download area on SVS-Vistek's download area. Depending on the type of camera you bought, several software packages apply.

3.4.1 SVCapture 2

SVCapture 2.x is a XML based software tool. It provides the possibility to control a GenICam based camera. The image result of any modification of a camera's adjustment is immediately visible, making it the ideal tool to optimize camera adjustments.

SVCapture is included in the SVCam Kit, you can download it for free from SVS-Vistek's download area.

Please refer to the SVCam Kit Install guide for details. You will find this document in the download area as well.

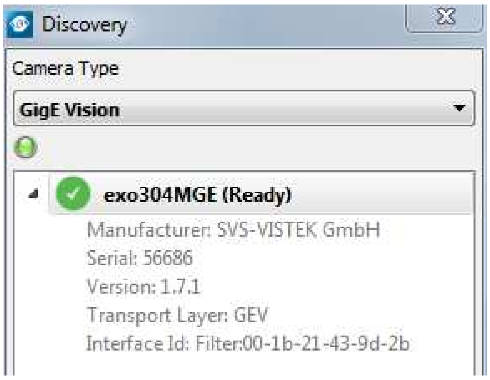
Generally, any GenICam based software package should be able to run a SVS-Vistek camera (GigE Vision, USB3, Camera Link).

It is strongly recommended to uninstall the existing version of SVCam Kit or SVCapture before installing the new version. While installing, please deactivate your firewall and antivirus programs.

Quick guide install

> Download the SVCam Kit matching to your operating system
> Disable firewall and antivirus programs
> Unpack and install the software and the drivers required for your camera's interface type
> Enable firewall and antivirus programs

Connect your camera's interface cable and power. Start SVCapture. Select your interface type in the discovery dialogue, SVCapture should show your camera after about 30 seconds.



3.4.2 Firmware updater

Some features may not have been implemented in older versions. For updating your camera firmware to the most recent version, you need the firmware tool "Firmware Update Tool.exe" and the firmware file (download it from website, login area) matching your camera model.

Execute firmware update

> Download the GigE firmware tool and the firmware file from the SVS-Vistek website.
> Unpack everything into any folder, e.g. "C:\temp"
> Ensure proper network configuration
> Run the GigE update tool

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

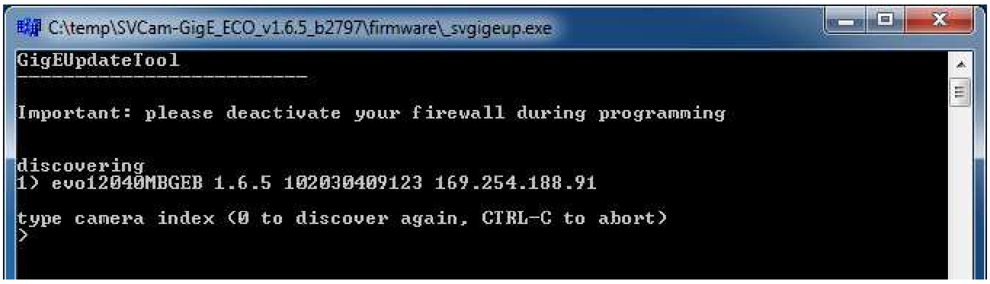


Figure 1: search camera for firmware update

Wail until firmware update has been finished

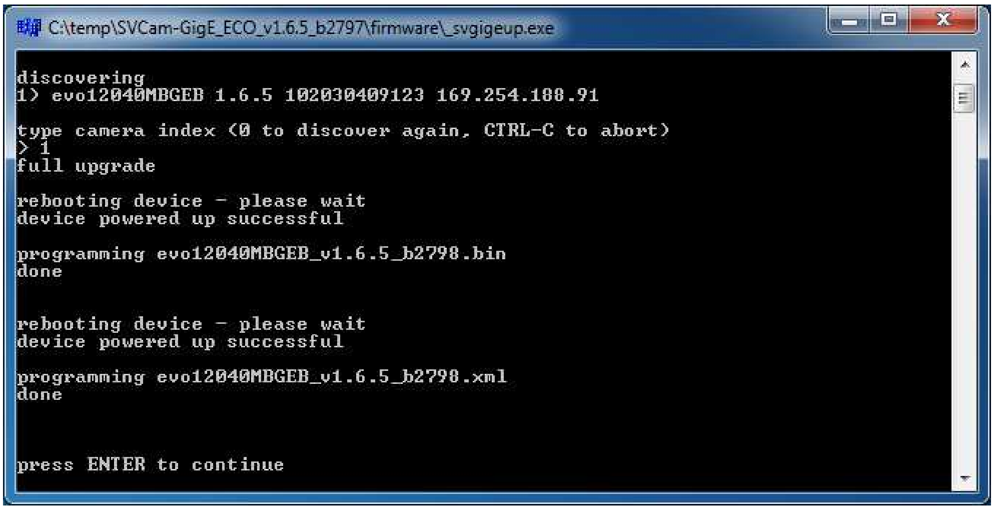


Figure 2: firmware update

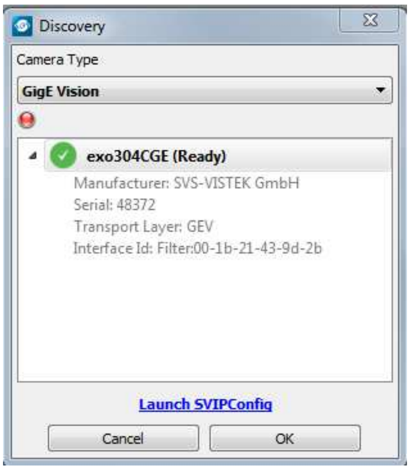
3.4.3 GigE IP Setup

Your GigEVision camera needs a working network connection. Make sure the camera is attached to the network and is powered on. Make sure everything is plugged in properly and that the firewall settings are not blocking the connection to the camera or SVCapture.

Automatic camera detection

By default, SVS-Vistek GigE Vision cameras are trying to acquire a valid network address vie LLA or DHCP from the network.

For finding and accessing your camera, start SVCapture on your computer. As soon as the camera has booted, all SVS-Vistek GigE cameras are showing up in the main window. Select the camera you want to connect to and press ok.

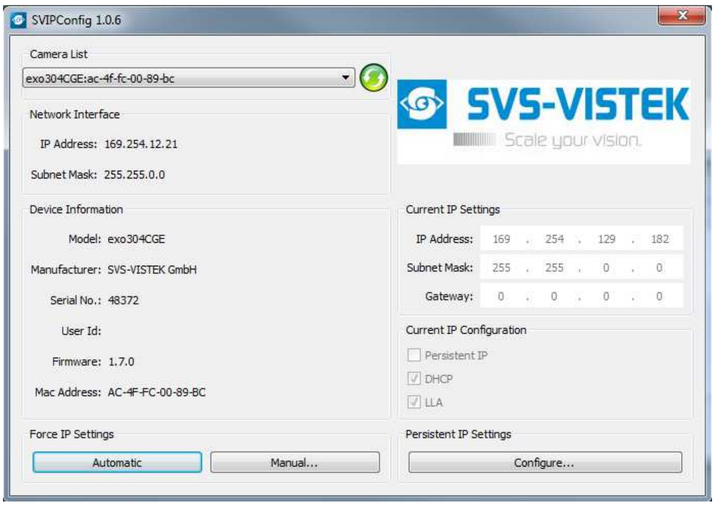


If you want to change automatic address or go back to automatic mode, use SVIPConfig.

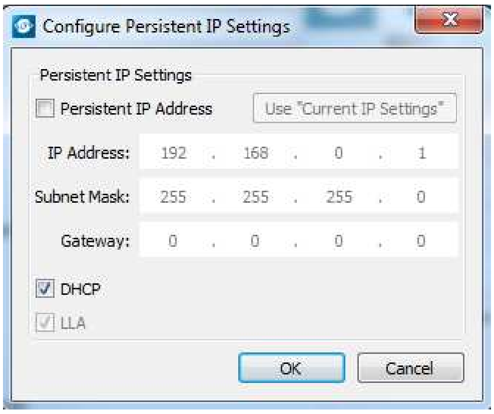
SVIPConfig

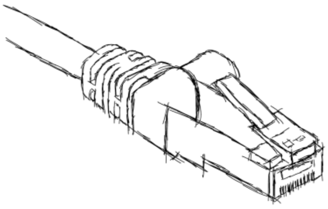
SVIPConfig allows to

> Assign a new IP address
(make sure the address is unique and that it is valid in the current subnet)
> Save a specific address as a permanent address to the camera (Persistent)
> Save automatic address mode to the camera



For saving a persistent IP configuration (configuration will survive power off) you need to check the „Persistent IP address“.





4 Connectors

4.1 GigE Vision

4.1.1 Network (TCP/IP)

Address Assignment

By default, the camera does not have a persistent IP address.

When forcing an IP address by using the PC internal network dialog, changes are only valid until the next restart of the Camera.

For a peer-to-peer connection of a GigE camera to a PC a network address assignment based on LLA (Local Link Address) is recommended. This involves a network mask “255.255.0.0” as well as a fixed preamble “169.254.xxx.xxx” of the network address range. A GigE camera will fall back to LLA when no DHCP server is available and no fixed network address was assigned to the camera.

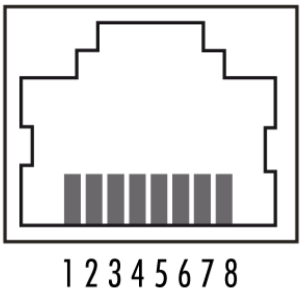


Figure 2: RJ45 female connector

Jumbo Frames

The transport efficiency in the streaming channel can be improved by using “jumbo frames”. This will reduce overhead caused by maintaining header data upon each data packet sent.

Figure 3: Illustration of data reduction with jumbo frames

NOTICE

Higher packet sizes require network cards that support jumbo packets.

Packet lost

In accordance with the TCP protocol, lost or corrupted packages will be resent.

NOTICE

Resends result in higher consumption of bandwidths and will lead to drop frames.
High quality cables prevent resends.

Connecting multiple Cameras

Multiple GigE cameras can be connected to a PC either via a switch or using dual or quad port network interface connectors (NIC).

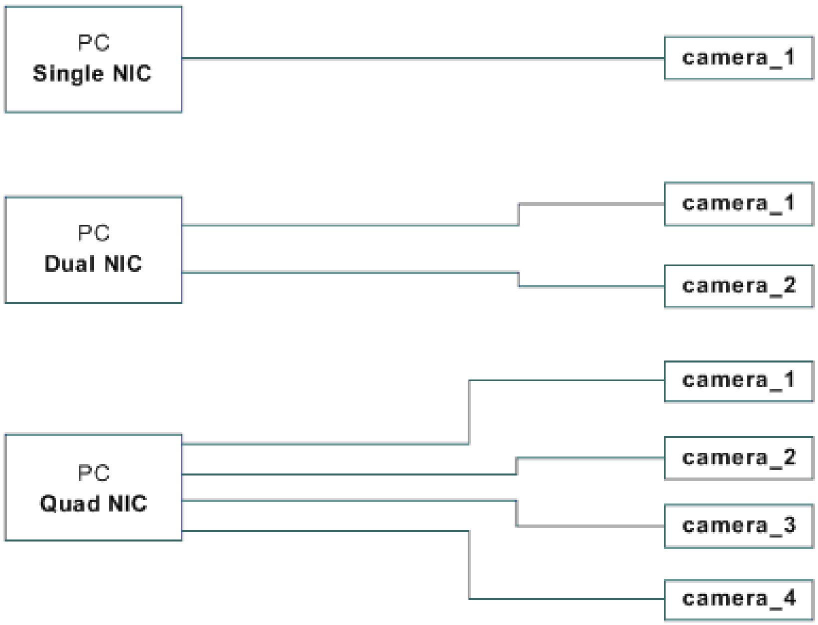


Figure 4: Illustration of connecting multiple cameras on multi NIPs

Multiple Cameras connected by a Switch

To connect multiple cameras by a switch, the switch must be managed. It might also be necessary to operate the cameras in an "inter packet delay" applying a smother image data stream.

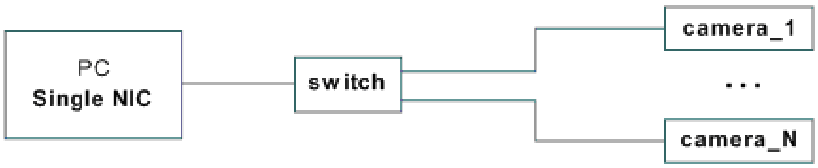


Figure 5: Illustration of connecting multiple cameras with a switch

Dual GigE Connection is not supported when using a switch.

NOTICE

Performance might be lost using multiple Cameras on a single port NIC.

Multicast

When images from a single camera need to be delivered to multiple PCs, multicast (RFC 2236) is used. A switch receives an image data stream from a camera and distributes it to multiple destinations in this mode.

Since a GigE camera always needs a single controlling application, there will be only one master application. The controlling master application has to open a camera in multicast mode (IP 232.x.x.x for local multicast groups) in order to allow other applications to connect to the same image data stream. Other applications will become listeners to an existing image data stream. They do not have control access to the camera; however, potential packet resend requests will be served in the same manner as for the controlling application.

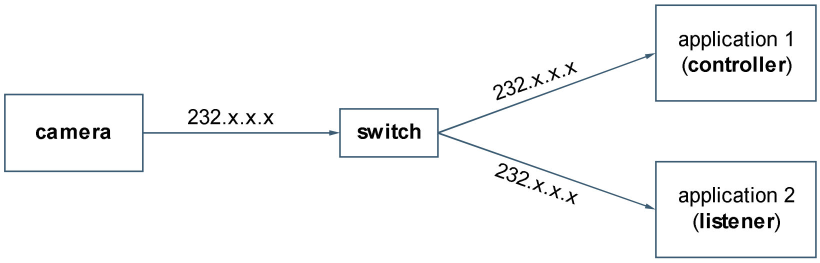


Figure 6: camera casting to multiple receivers (multicast)

4.1.2 XML Files

According to the GigE Vision standard a GigE camera provides an XML file that defines the camera's capabilities and current settings.

The XML file can be processed by software like SVCapture allowing displaying and saving it to disk. Settings can also be saved and restored on the Camera internal EEPROM.

4.2 Input / output connectors

Hirose™ 12Pin

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

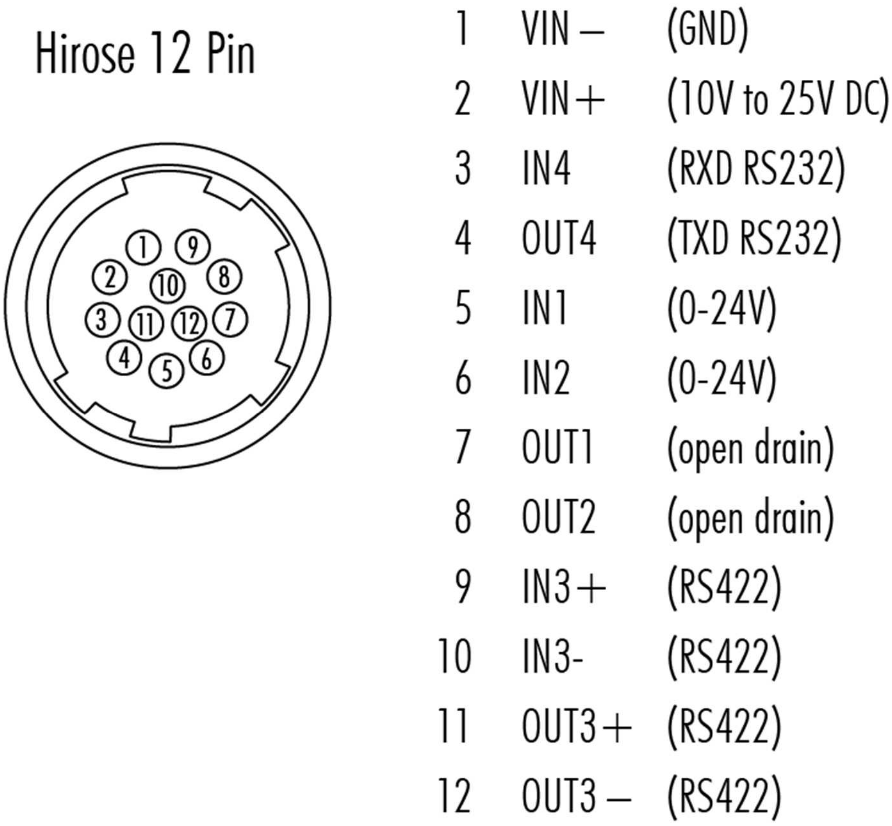


Figure 7: Hirose 12 Pin & pin layout

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

NOTICE

The PoE (Power over Ethernet) versions do not support RS232 on pins 3,4

5 The ECO

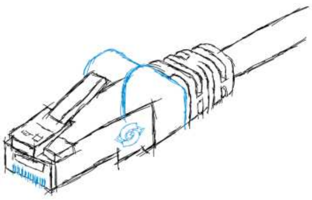
5.1 The SVCam ECO Series: Extremely small

A SVCam-ECO fits into any type of application. The SVCam-ECO series impresses with its minimal footprint. And that even without compromising on performance.

One of the world's smallest GigE vision cameras

Unparalleled flexibility with an excellent price-performance ratio: This is how one best would describe the SVCam-ECO series. Comprising 88 different variants, the cameras use well-known Sony CCD sensors with resolution ranging from VGA to 5 megapixel. The cameras are among the smallest industrial cameras and were specifically developed to provide the highest frame rates paired with excellent signal-to-noise ratio. Supporting GigE Vision and GenICam standards, the SVCam-ECO series opens up new possibilities for integrating into your specific applications.

5.2 GigE-Vision features



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

- 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
- ARM support (ARM/Jetson)
- SDK with GenTL support

6 Feature description

This chapter covers features of SVCam cameras. Not every feature might be supported by your specific camera model. For information about the features of your specific model, please refer to the specifications area with your exact model.

6.1 Basic Understanding

6.1.1 Global shutter

The shutter is describing the functionality of exposing the light sensitive pixels of the sensor to light for a limited time. With Global shutterall pixels are exposed to light at the same time. All pixel will be exposed to light at the same starting point, and all pixel light exposure will stop at the same time. Fast moving objects will be captured without showing movement distortion, except motion blur if the moving object is so fast that the same point of the object covers different pixels at start and end of the exposure time in the image.

A global shutter image is a snapshot of the whole scene. Below are illustrations of some images taken with different shutter types. The camera does not move, the bottles are sitting on an assemly line driving by.

Figure 7: moving object,iglobal shutter

Figure 8: moving object, rolling shutter

Figure 9: moving object, interlaced camera

Using flash with global shutter is straight forward: just make sure your flash is on while shutter is open, thus all pixels are exposed to light the same time. You might flash at any time within exposure time.

6.1.2 Rolling Shutter

Figure 10: propeller w/ rolling shutter artifacts

Rolling shutter is a method of reading out a CMOS sensor, where the whole scene is scanned line after line very rapidly. Rolling shutter cameras in general are more sensitive in their light response than global shutter ones.

Despite the speed of scanning one line after the other („rolling“) is very high, it is important to note that the instant of imaging a single line will be different to the point of time of the next line imaging. As this works out without any effect in the final image with still sceneries, with moving objects you get geometric distortions (see example of rotating propeller), showing fast moving structures in an predictable, in the first moment yet surprising way.

As it takes some time to read out a whole sensor (and the whole sensor has always to be read out!) you need to make sure that light conditions are stable while reading the sensor. This restriction applies especially to using PWM driven lights or flash lighting with rolling shutter. Unstable light conditions will result in a horizontal line structured pattern noise.

PWM lights with rolling shutter

PWM (Pulse Width Modulated) powered light or dimmed light is run at a fixed frequency. Experience teaches us this frequency might be less stable than expected. Unstable frequency might show up as unstable light, creating noise/line structures in the final rolling shutter image (in global shutter images the whole image is just more/less bright)

As a rule of thumb, make sure your PWM lighting frequency is at least double or triple the bitdepth of your image (e.g. 8bit image = 256, this means your PWM has to be switched at least 256*2=512 times) while exposing. If exposure time is 5ms,

required minimum PWM freq = 5ms/512 ~ 10µs ~ 100kHz

If you have the possibility to use a strobe controller or dimmer with linear regulation, this might be preferrable on short exposure times.

Flashing with Rolling Shutter

Scanning sensor lines takes time, an scanning time. There are 2 general options for flashing:

1. Make sure your flash is ON and stable the whole period of time while scanning/exposing. Minimum flash time is scanning time plus exposure time. In this case, while flashing you will get geometric distortions as mentioned above. Exposure will be determined by camera exposure time and light intensity
2. If flash time is less than scanning time then exposure time has to be at least scanning time + flash time, with a delay of scanning time. In other words, your exposure time will be scanning time plus flash time, while you use a flash delay of scanning time. Thus flash release will start after the delay of scanning time, as soon the sensor is fully open. You should keep the object in total darkness while the first scanning time.
   In this case, as all lines are sensitive to light at the same time after the first scan time, flashing time can be as short as you like. You will not see the typical geometric rolling shutter distortions as shown above. Imaging will be similar to global shutter. Exposure will be determined by flash time/intensity.

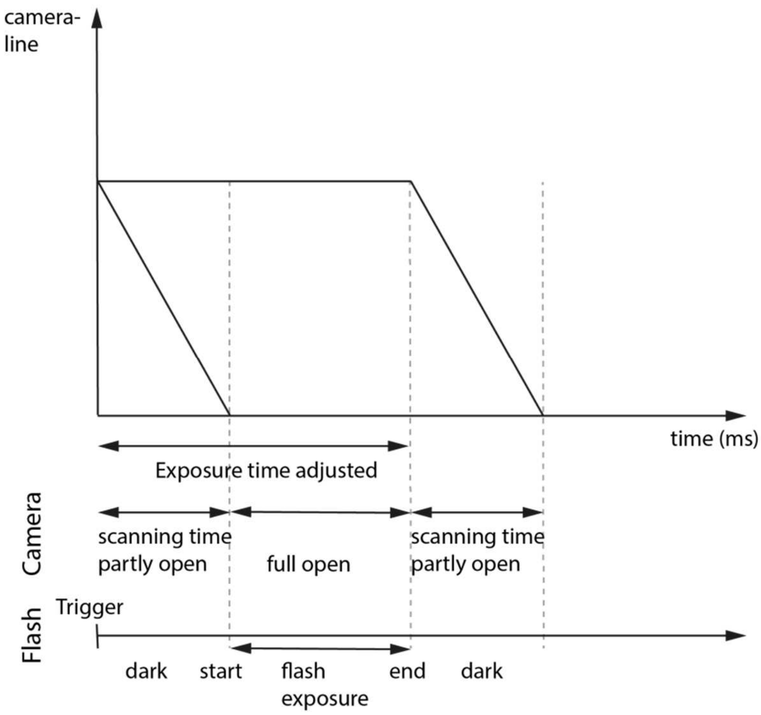


Figure 11: Rolling shutter lines light sensitivity versus time

As shown here, after triggering only part of the sensor is sensitive to light (scanning time). As soon as scanning time has finished, all pixels are sensitive to light, the sensor is fully open. While being fully open this is the time where flashing should happen. In the final scanning time, less and less pixels are sensitive to light until the sensor light sensitivity will finish.

Flashing of rolling shutter sensors is significantly different to global shutter flashing!

Rolling Shutter Limitations

Due to the principles of rolling shutter, some standard features of SVS-Vistek cameras are not applicable. This relates to following

Exposure Control with Rolling Shutter

In the graphics above, it is easy to see that external exposure control does not make sense with rolling shutter. Exposure delay and Overlapping Exposure as well is impossible with rolling shutter.

ROI with Rolling shutter

With Rolling shutter the whole sensor has to be read out – always. That means applying ROI will reduce the amount of final data being transmitted out of the camera (and the framerate might rise, due to the limited bandwidth of the interface). Nonetheless, the maximum achievable framerate with applied ROI will be the maximum framerate of the sensor reading the full sensor area (internal full sensor speed), please refer to the relating sensor specs.

6.1.3 Exposure speed

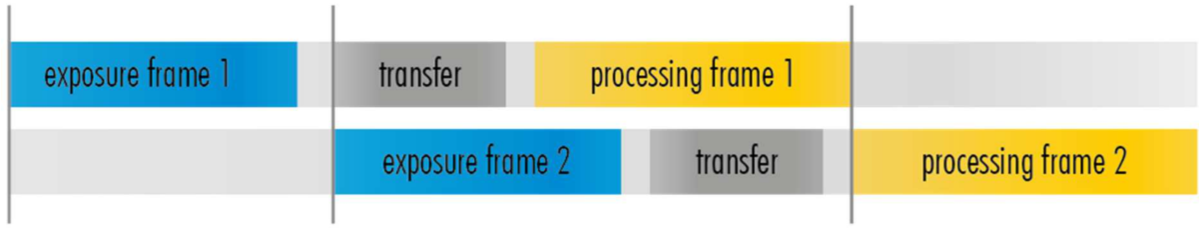
Frames per second, or frame rate describes the number of frames output per second (1/ frame time). Especially GigE and USB cameras cannot guarantee maximum predictable framerates with heavy interface bus load.

Maximum frame rate might depend on

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

6.1.4 Acquisition and Processing Time

The camera has to read the sensor, process the data to a valid image and transfer this to the host computer. Some of these tasks might are done in parallel. This implies the data transfer does not end immediately after end of exposure.



6.1.5 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.

6.1.6 Auto exposure

Auto Luminance or auto exposure 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.

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.

6.1.7 Bit-Depth

Values of brightness are internally represented by numbers. The number of bits for brightness representation is limiting the number of colour values that can be represented. 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.

No of grey values = $2^{\text{bit depth}}$

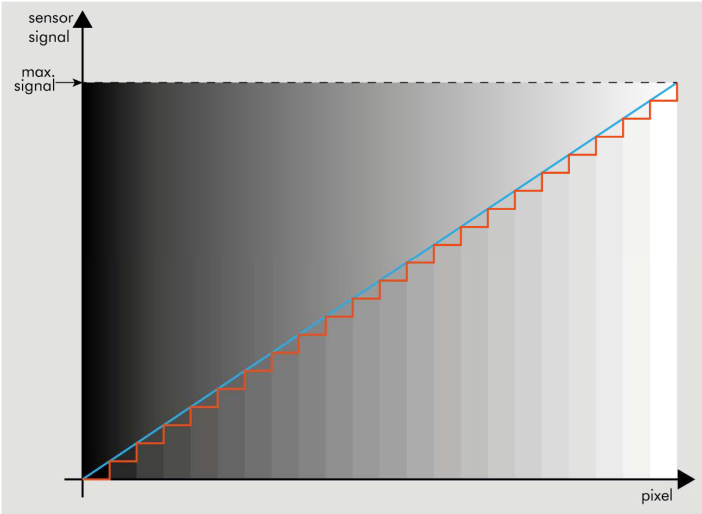


Figure 3: High vs low bit depth representation of brightness values

As SVCams export pure RAW-format only, color has to be created on the host computer in accordance with the known Bayer-pattern by computing the brightness values of RGB into colour values.

6.1.8 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.

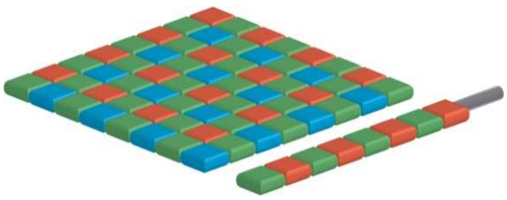


Figure 12: CCD with Bayer Pattern

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 an 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 based on a non-white illumination.

6.1.9 Resolution

As mentioned in the specifications, there is a difference between the numerical sensor resolution and the camera resolution. Some pixels towards the borders of the sensor will be used only internally to calibrate sensor values ("dark pixels"). The amount of dark current in these areas is used to adjust the offset.

For calculating image sizes, the maximum camera resolution is determining maximum image resolution. See specifications of your model.

6.1.10 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 (dark noise: noise generated without light exposure).

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

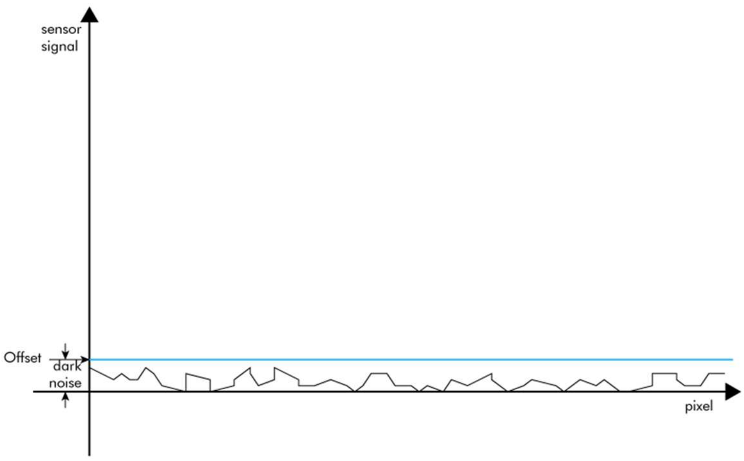


Figure 13: Illustration of dark noise cut off by the offset

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 (see tap balancing).

6.1.11 Gain

Setting gain above 0 dB (default) is a 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. Increasing gain will increase noise as well.

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

Figure 14: Table of dB and corresponding ISO value

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.

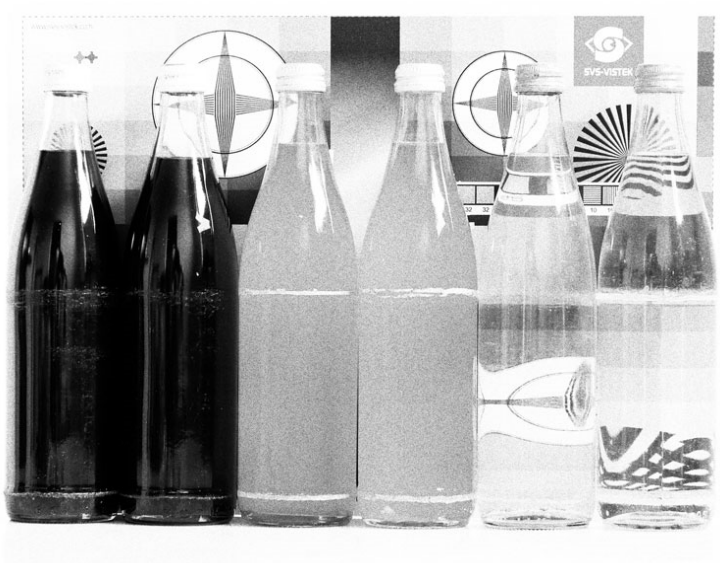


Figure 15: noise caused by too much gain

Auto Gain

For automatic adjustment of Gain please refer to Auto Luminance.

When using autogain with steps of gain the non-continous gain adjustment might be visible in final image. Depending on your application it might be preferrable to use fixed gain values instead and modify exposure with exposure time.

6.1.12 Flip Image

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 4: original image

Figure 5: horizontal flip

Figure 6: vertical flip

6.1.13 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.

On CMOS sensors, binning will not affect image quality. In any case, binning will reduce the amount of pixel data to be transferred.

Vertical Binning

Accumulates vertical pixels.

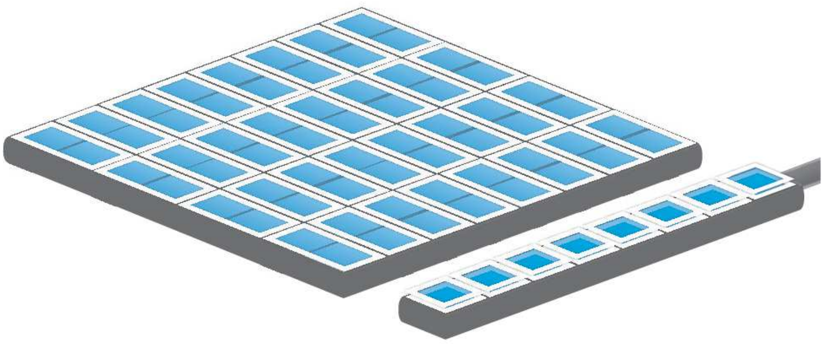


Figure 16: Vertical binning

Horizontal Binning

Accumulates horizontal pixels.

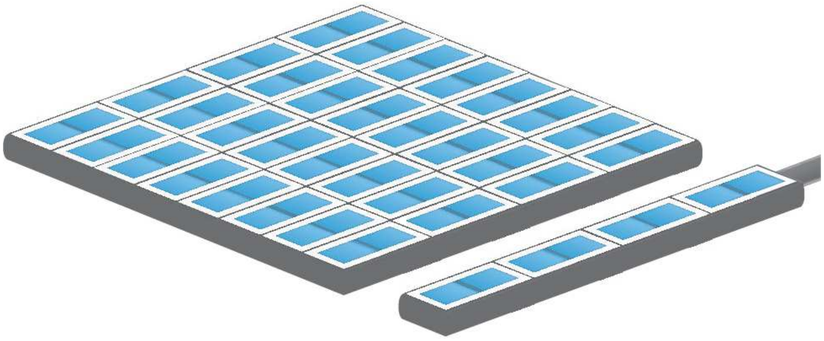


Figure 17: Illustration of horizontal binning

2×2 Binning

A combination of horizontal and vertical binning.

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

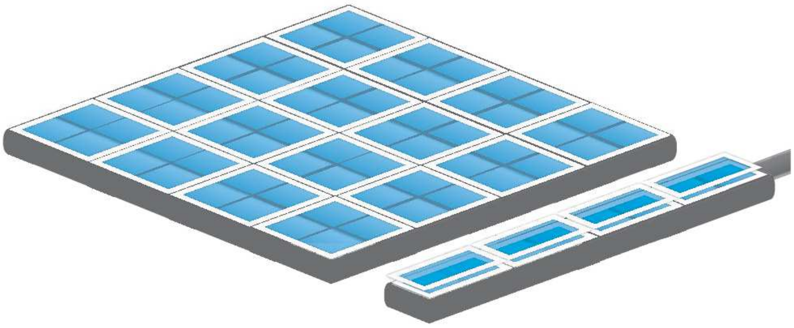


Figure 18: Illustration of 2x2 binning

6.1.14 Decimation

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

Refer to AOI for reducing data rate by reducing the region you are interested in.

Figure 19: Horizontal decimation

Figure 20: 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.

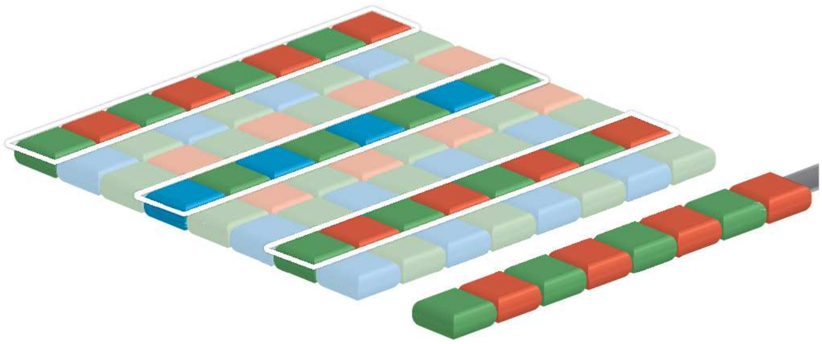


Figure 21: Decimation on color sensors

6.1.15 Burst Mode

The hardware interface (GigE, USB3 etc) of your camera very often will limit the maximum framerate of the camera to the maximum framerate of the interface of the camera. Inside the camera, the sensor speed (internal framerate) might be higher than the external interface's speed (e.g. GigE).

In triggered mode though, trigger frequency might be higher than the external interface's speed. The triggered images will stay in the internal memory buffer and will be delivered one after the other with interface speed. If trigger frequency is higher than interface max fps frequency, more and more images will stick in the internal image buffer. As soon as the buffer is filled up, frames will be dropped.

This internal-save-images and deliver-later thing is called Burst Mode.

Due to internal restriction in the image request process of the camera, on USB cameras the maximum sensor speed is limited to the maximum interface speed. This means the maximum trigger frequency cannot be higher than camera freerun frequency. The image buffer will protect against breaking datarates of the USB line, though.

Usage of Burst Mode

Burst Mode has 2 main purposes:

- If transfer speed breaks down (e.g. Ethernet transfer rate due to high network load), tolerate low speed transfer for a short time and deliver frames later on (buffering low speed interface performance for a short time)
- For several frames (up to full internal memory) images can be taken with higher frame rate than camera specs are suggesting (as soon as there is enough time later on to deliver the images) (not applicable to USB cameras)

Please note, as soon as the internal memory buffer is filled up, frames will be dropped. Due to this reason, SVS-Vistek camers provide up to 512MB image buffer memory.

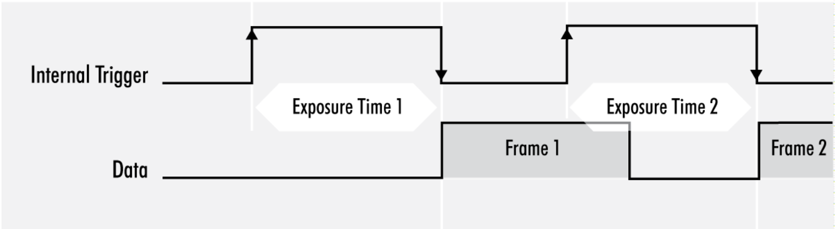
6.2 Camera Features

6.2.1 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.

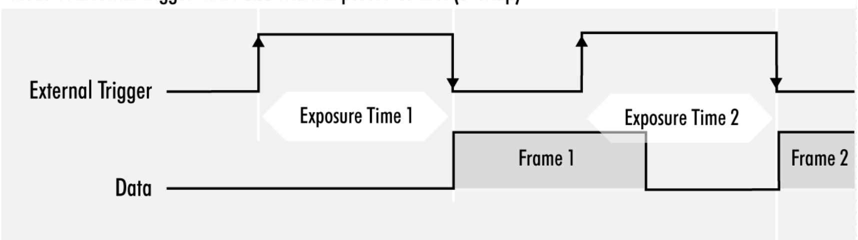
NOTICE

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

Triggered Mode (pulse width)

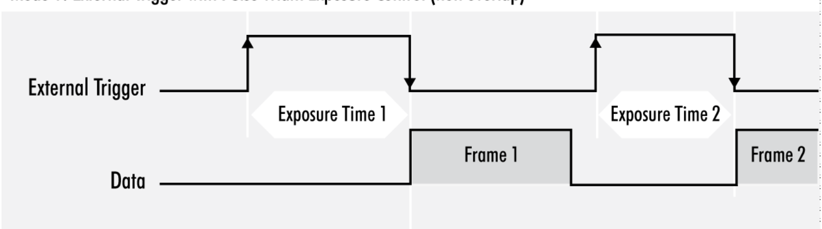
External trigger and pulse-width controlled exposure time. In this mode the camera is waiting for an external trigger, which starts integration and readout. Exposure time can be varied using the length of the trigger pulse (rising edge starts integration time, falling edge terminates the integration 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).

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

External Trigger (Exposure Time)

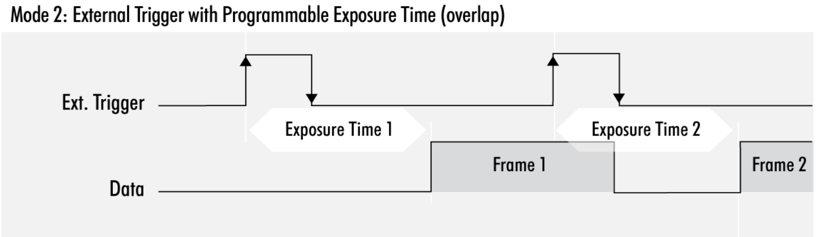
External trigger with programmable exposure time. In this mode the camera is waiting for an external trigger pulse that starts integration, whereas exposure time is programmable via the serial interface and calculated by the internal microcontroller of the camera.

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).

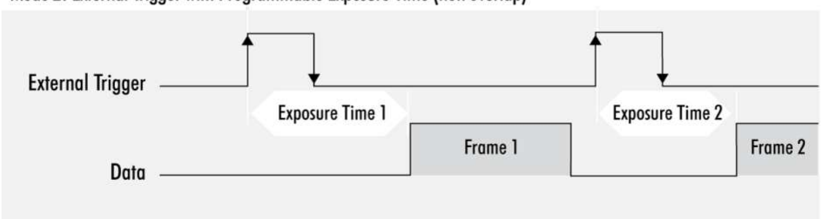
Exposure time of the next image can overlap with the frame readout of the current image (trigger pulse occurs when FVAL is high). When this happens, the start of exposure time is synchronized to the negative edge of the LVAL signal (see figure)

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)

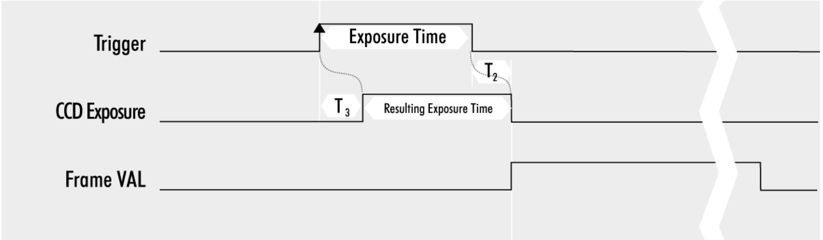


Exposure time can be changed during operation. No frame is distorted during switching time. If the configuration is saved to the EEPROM, the set exposure time will remain also when power is removed.

Detailed Info of External Trigger Mode

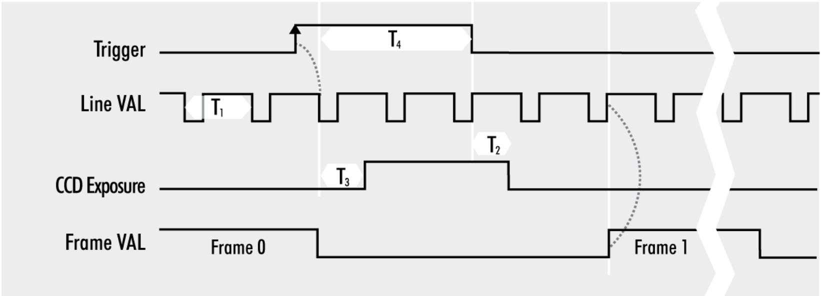
Dagrams below are aquivalent for CCD and CMOS technique.

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



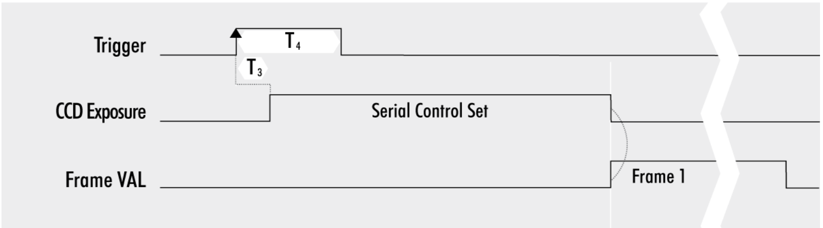
T_1: Line Duration T_2: Transfer Delay T_3: Exposure Delay T_4: min. Trigger Pulse Width

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



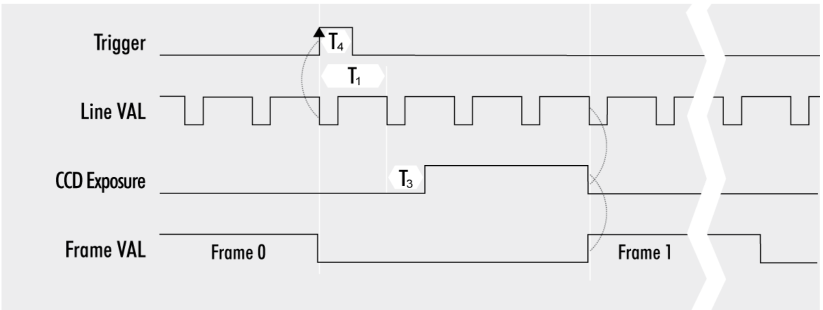
T_1: Line Duration T_2: Transfer Delay T_3: Exposure Delay T_4: min. Trigger Pulse Width

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

6.2.2 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 steps. In this example, the transfer rate is 66.7 MHz, thus resulting in steps 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

6.2.3 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)

6.2.4 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.

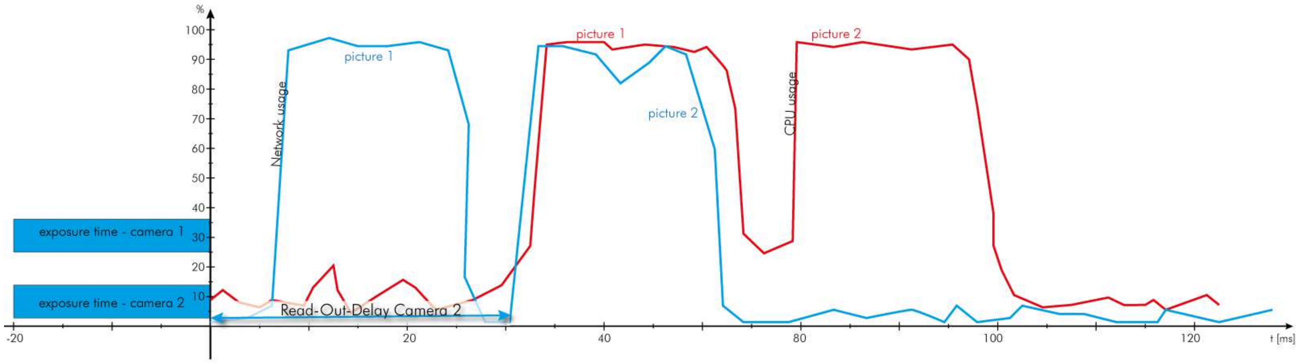


Figure 22: Illustration of physical data stream in time

6.2.5 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]

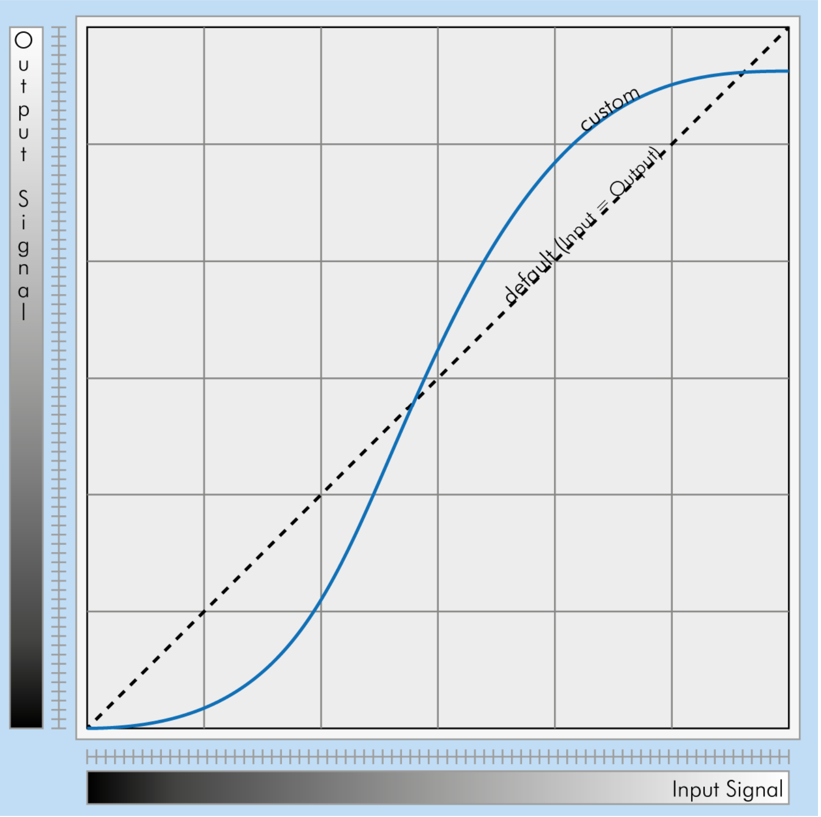


Figure 23: Custom LUT adding contrast to the midtones

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

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

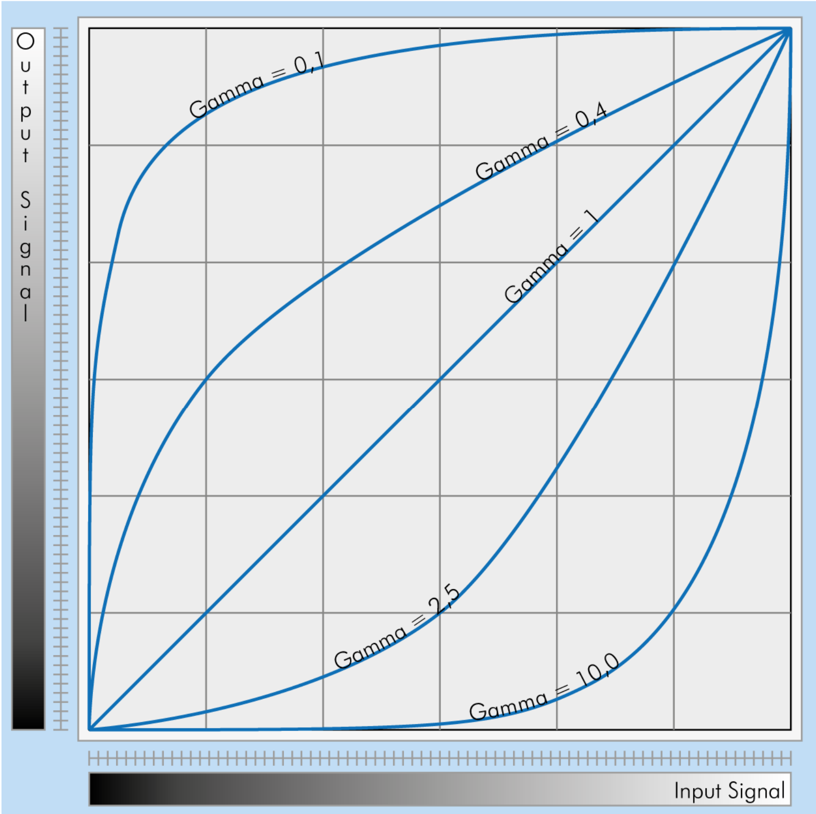


Figure 24: Several gamma curves comparable to a LUT

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..

6.2.6 ROI / AOI

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

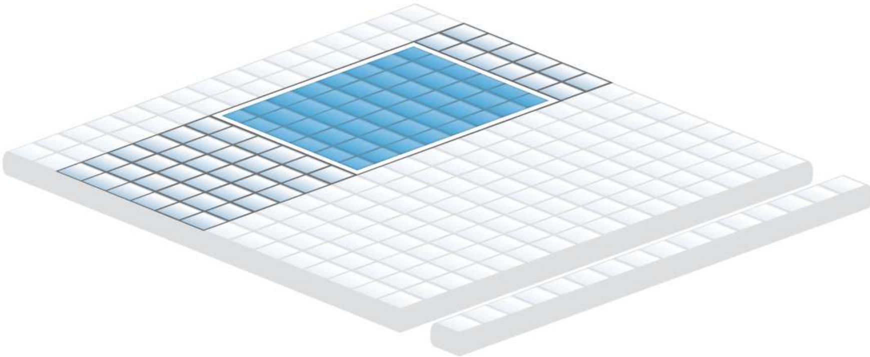


Figure 25: AOI on a CCD sensor

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.

6.2.7 PIV

By using PIV mode on CCD sensor cameras it is possible to capture 2 images within extremely short time.

Based on the “interline transfer” of CCD sensors, in the PIV mode the first picture is transferred to the vertical shift register, while the second picture is taken. The readout of picture 1 will take place during the second exposure time.

So the time between 2 images can be shortened to transfer time only – contact us (@ SVS-VISTEK.com) for camera and sensor specific minimum transfer time/duration.

„Triggered with external exposure“ (via pulse width of the Exsync signal) or alternatively „triggered with internal exposure“(set via internal microcontroller). This is useful for ”particle image velocimetry” (PIV).

The first exposure starts approx. 5 µs after the camera has detected the rising edge of Exsync.

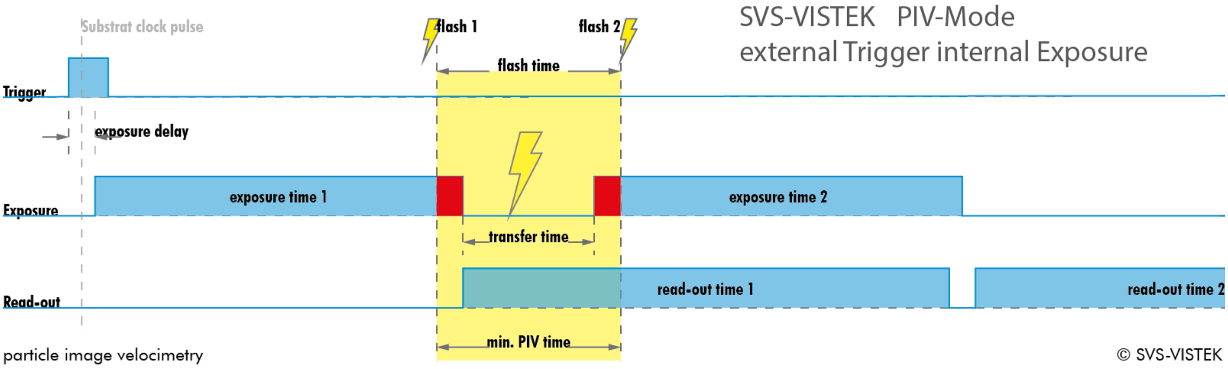


Figure 26: PIV mode

The read-out time 1 and the exposure time 2 start both directly after the image transfer of image 1. The exposure time 2 ends when the read-out of image 1 has finished. After the read out of image 1 is done, image 2 is transferred and read out. The readout time of each camera is sensor dependent. Please contact the SVS-Vistek support team for details on sensor readout timing.

During the read out of the 2nd image the camera cannot take images until the next Exsync signal (rising edge) arrives and initiates the next exposure cycle.

Without PIV-Mode enabled, all camera modes like “free running “or “triggered with internal exposure control“ function as described.

6.3 I/O Features

6.3.1 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.

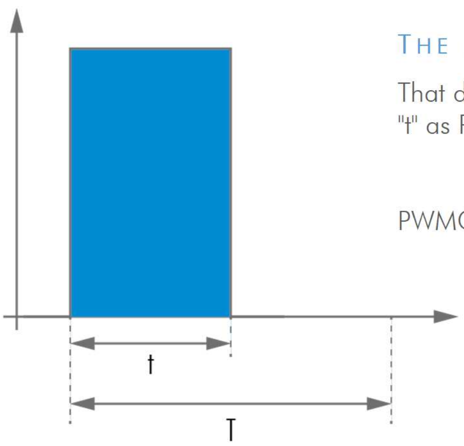
Implementation of PWM

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

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

Duty cyle "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:

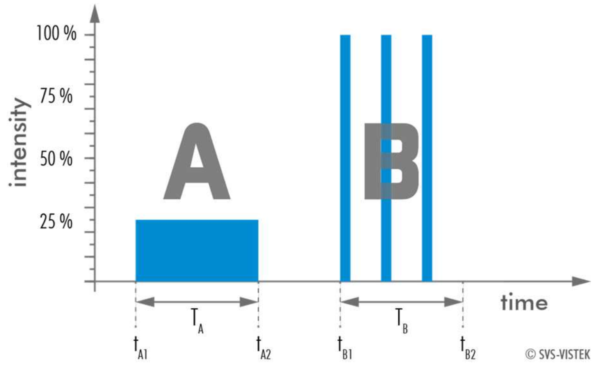


Figure 27: 25% PWM load

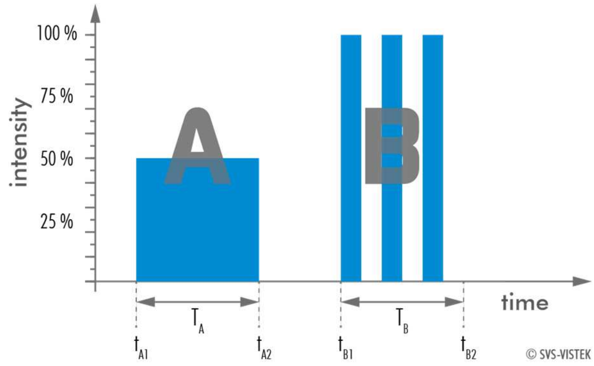


Figure 28: 50% PWM load

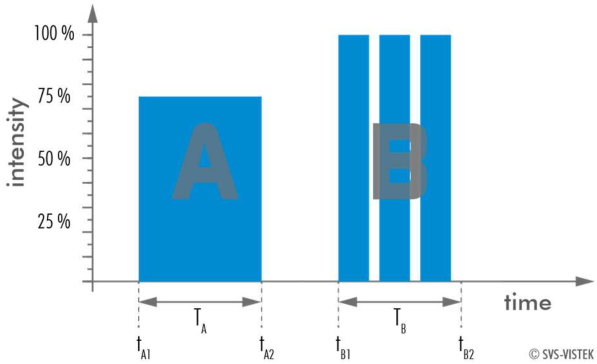


Figure 29: 75% PWM load

The integrals over both periods T_A and T_A are equal.

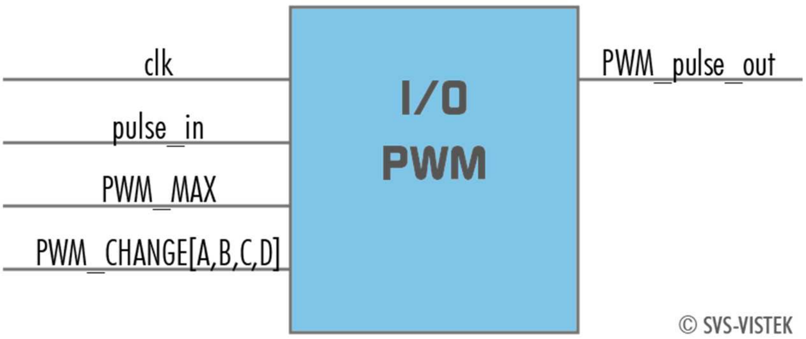
$$\int_{t_{A1}}^{t_{A2}} \mathbf{A} = \int_{t_{B1}}^{t_{B2}} \mathbf{B}$$

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:



6.3.2 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.

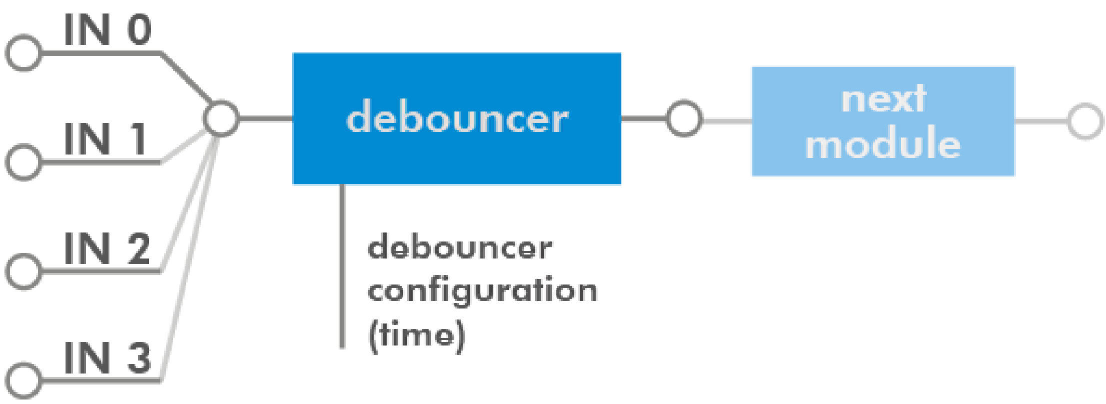


Figure 30: "IN0" connected to "debouncer"

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.

LineSelector	translation
Line0	Output0
Line1	Output1
Line2	Output2
Line3	Output3
Line3	Output4
Line5	Uart In
Line6	Trigger
Line7	Sequencer
Line8	Debouncer
Line9	Prescaler
Line10	Input0
Line11	Input1
Line12	Input2
Line13	Input3
Line14	Input4
Line15	LogicA
Line16	LogicB
Line17	LensTXD
Line18	Pulse0
Line19	Pulse1
Line20	Pulse2
Line21	Pulse3
Line22	Uart2 In

Note:

If you connect the camera with a non-SVS-Vistek GigEVision client, you might not see the clearnames of the lines, but only line numbers. In this case, use this list of line names

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

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

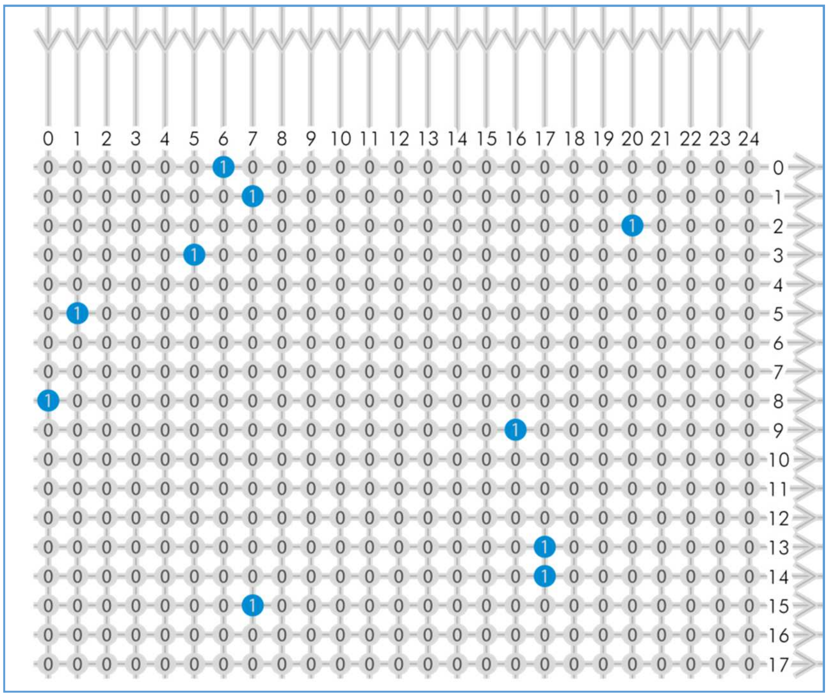
* refer to pinout or specifications

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.

6.3.3 Strobe Control

The SVCam 4I/O concept contains an integrated strobe controller. Its controls are integrated into the GenICam tree. With LED lights attached to the outputs, this enables the user to control the light without external devices. Being controlled via GenICam, any GenICam-compliant 3rd party software is able to control the light as well. Depending on the camera model, up to 4 (see specifications) independent channels are supported with a peak current of max 3 Amps.

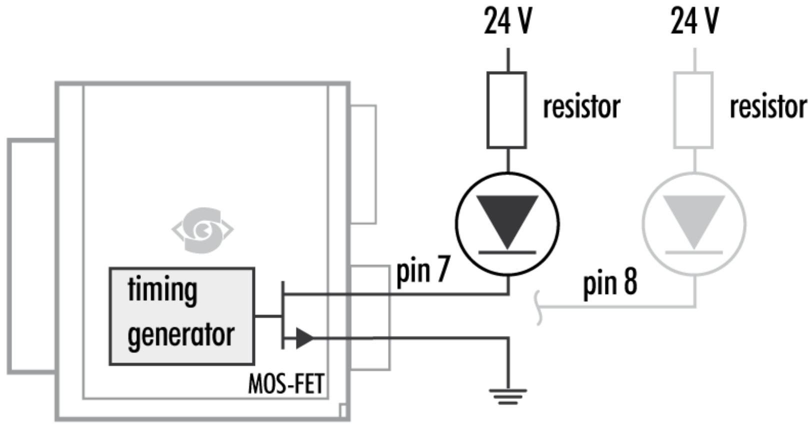


Figure 31: Attach LED lights to camera outputs. For detailed connector pin out refer to Connectors

USE RIGHT DIMENSION OF RESISTOR!

To avoid destruction of your LED light, make sure to use the right dimension of shunt resistor. If not done so, LEDs and/or Camera might be damaged.

Calculate LED shunt resistors

Shunt resistors are used to limit the LED current. Make sure, neither shunt nor LED are run above specs.

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

Most LED lights can cope with currents higher than specs. This gives you higher light output when light is ON. Please refer to your LED specs if LED overdrive is permitted.

By controlling the duty cycle the intensity of light and current can be controlled. See sequencer example how to adjust the values in the GenICam tree for strobe control.

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 translates to "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 when driving LEDs with current higher than spec

Strobe vocabulary

For an example how to enable and adjust the integrated strobe controller refer to sequencer. Times and frequencies are set in tics. 1 tic = 15ns.

Exposure Delay

A tic value, representing the time between the (logical) positive edge of trigger pulse and start of integration time.

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 tics. 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.

6.3.4 Sequencer

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

Values to set	Description
Sequencer interval	Duration of the interval
Exposure start	Exposure delay after interval start

Exposure stop	Exposure stop related to interval Start
Strobe start	Strobe delay after interval start
Strobe stop	Strobe stop related to interval Start
PWM frequency	Basic duty cycle (1 / Hz) for PWM
PWM change	Demodulation results

In the current GenICam implementation, all values have to be entered in tic values.

1 tic = 15 ns

Every adjustment (times, frequencies) has to be recalculated into tics and done in tics. See the example below.

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

For physical input and output connections refer to pinout or specifications or see example below. After trigger signal all programmed intervals will start. Up to 16 intervals can be programmed.

Sequencer settings can be saved to camera EEPROM.

Example

For demonstration, imagine following task to be done:

Scenario

An object should be inspected with a monochrome camera. For accentuating different aspects of the image, 4 images should be taken in a row with 4 different colours of light: Red, Green, Blue, White. White light should be generated from the RGB lights being activated at the same time. Basis is a dark environment without other light sources.

Camera wiring

- 3 LED lights are physically connected to the camera on out 0-2 (red, green, blue)
- Out 3 is not used

I/O matrix

- 4 images to be taken (RGBW) result in 4 sequences
- RGB PWM change with different intensities (duty cycle) taking care for differences in spectral response of the camera sensor
- PWM change 0-2 is connected to out 0-2
- Seq pulse A is driving the exposure (trigger)
- Seq pulse B is driving the strobe
- Seq pulse B in WHITE sequence is reduced down to 33% as light intensities of 3 lights (RGB) will add up

Notes

- Different exposure / strobe timings are used for illustration. In most cases they will show values same as exposure
- The resulting exposure time shows the period of sensor light exposure. (''masking'' of exposure time by creating strobe light impulses shorter than exposure time). This value is not adjustable at the camera
- PWM change is shown with reduced height for demonstrating reduced intensity. In reality though, PWM change will be full

height (full voltage, shunt resistor might be necessary) with the adjusted duty cycle

- Use a PWM frequency high enough not to interfere with your timings (here: 1000 Hz)

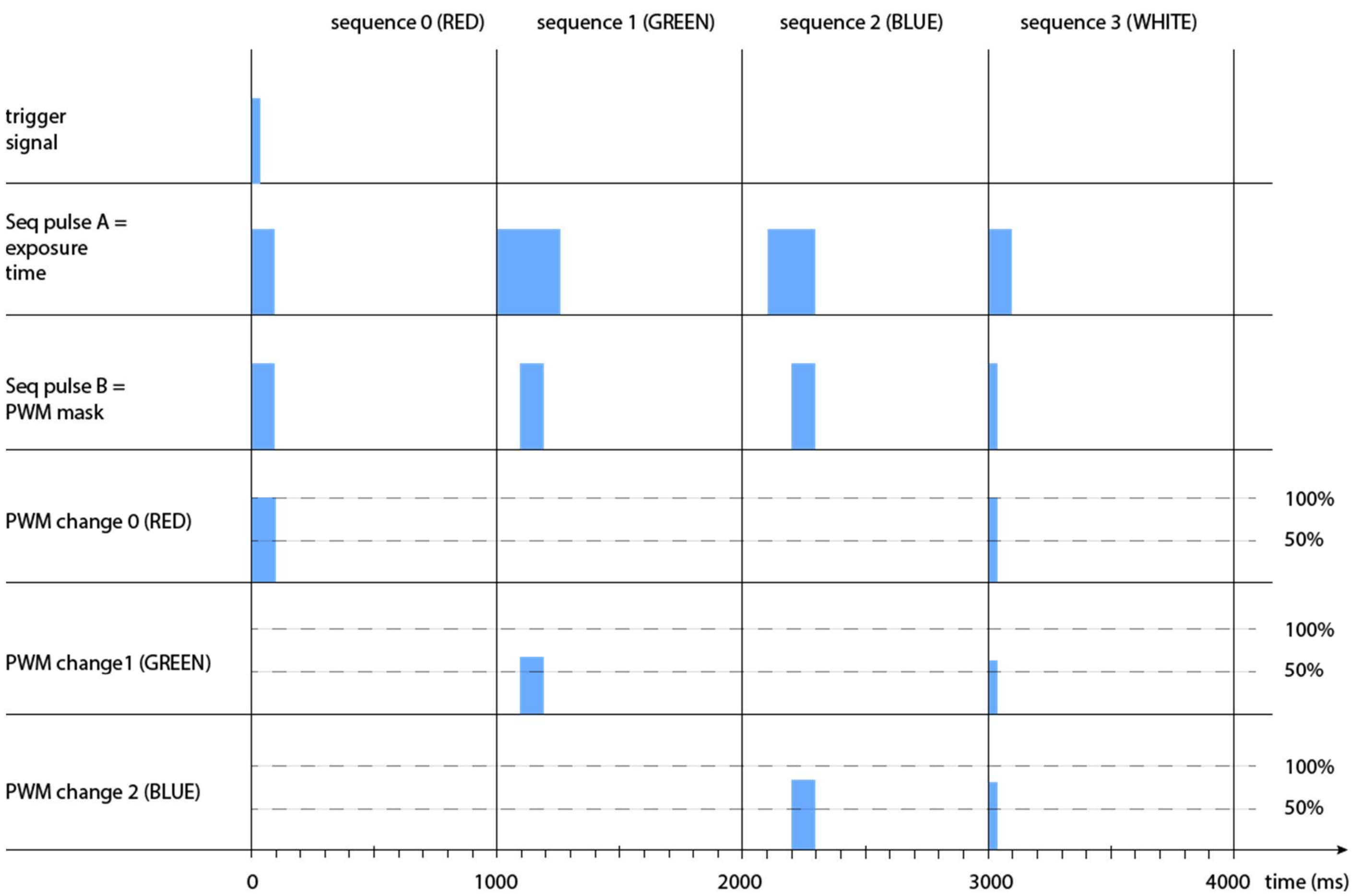
Scenario values	Interval 0 (RED)	Interval 1 (GREEN)	Interval 2 (BLUE)	Interval 3 (WHITE)
Sequencer Interval	1000 ms	1000 ms	1000 ms	1000 ms
Seq pulse A start	0 ms	0 ms	100 ms	0 ms
Seq pulse A stop	100 ms	300 ms	300 ms	100 ms
Seq pulse B start	0 ms	100 ms	200 ms	0 ms
Seq pulse B stop	100 ms	200 ms	300 ms	33 ms
PWM Frequency f	1000 Hz	1000 Hz	1000 Hz	1000 Hz
PWM change 0 (RED)	100%	0%	0%	100%
PWM change 1 (GREEN)	0%	70%	0%	70%
PWM change 2 (BLUE)	0%	0%	80%	80%
PWM change 3	-	-	-	-

As being said before, all these values have to be entered into the camera's GenICam tree as tic values.

The timing values translate like this into tics:

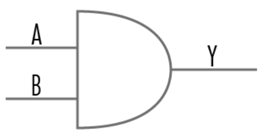
Values to set in GenICam properties	Interval 0 (RED)	Interval 1 (GREEN)	Interval 2 (BLUE)	Interval 3 (WHITE)
Sequencer Interval	66666667 tic (1000 ms)	66666667 tic (1000 ms)	66666667 tic (1000 ms)	66666667 tic (1000 ms)
Seq pulse A start	0 tic (0 ms)	0 tic (0 ms)	6666667 tic (100 ms)	0 tic (0 ms)
Seq pulse A stop	6666667 tic (100 ms)	20000000 tic (300 ms)	20000000 tic (300 ms)	6666667 tic (100 ms)
Seq pulse B start	0 tic (0 ms)	6666667 tic (100 ms)	13333333 tic (200 ms)	0 tic (0 ms)
Seq pulse B stop	6666667 tic (100 ms)	13333333 tic (200 ms)	20000000 tic (300 ms)	2200000 tic (33 ms)
Effective exposure time	100 ms	100 ms	100 ms	33 ms
PWM Frequency f	66667 tic (1000 Hz)	66667 tic (1000 Hz)	66667 tic (1000 Hz)	66667 tic (1000 Hz)
PWM change 0 (RED)	66667 tic (100% of 1000 Hz)	0 tic	0 tic	66667 tic (100% of 1000 Hz)
PWM change 1 (GREEN)	0 tic	46667 tic (70% of 1000 Hz)	0 tic	46667 tic (70% of 1000 Hz)
PWM change 2 (BLUE)	0 tic	0 tic	53333 tic (80% of 1000 Hz)	53333 tic (80% of 1000 Hz)
PWM change 3	-	-	-	-

In a timings diagram, the sequence values above will look like this:



6.3.5 PLC/Logical Operation on Inputs

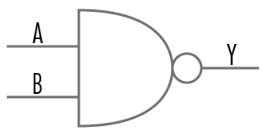
The logic input combines trigger signals with Boolean algorithms. The camera provides AND, NAND, OR, NOR as below. You might connect 2 signals on the logic input. The result can be connected to a camera trigger signal or it may be source for the next logical operation with another input. It is possible to connect it to an OUT line as well.



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



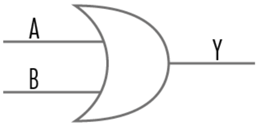
NAND

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

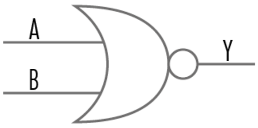


OR

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

6.3.6 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).

Table 2: serial interface parameter – RS-232 and RS-422

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

RS-232

It is splitted into 2 lines 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 transportis asynchronous. Synchronization is implemented by fist and last bit of a package. Therefore 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)

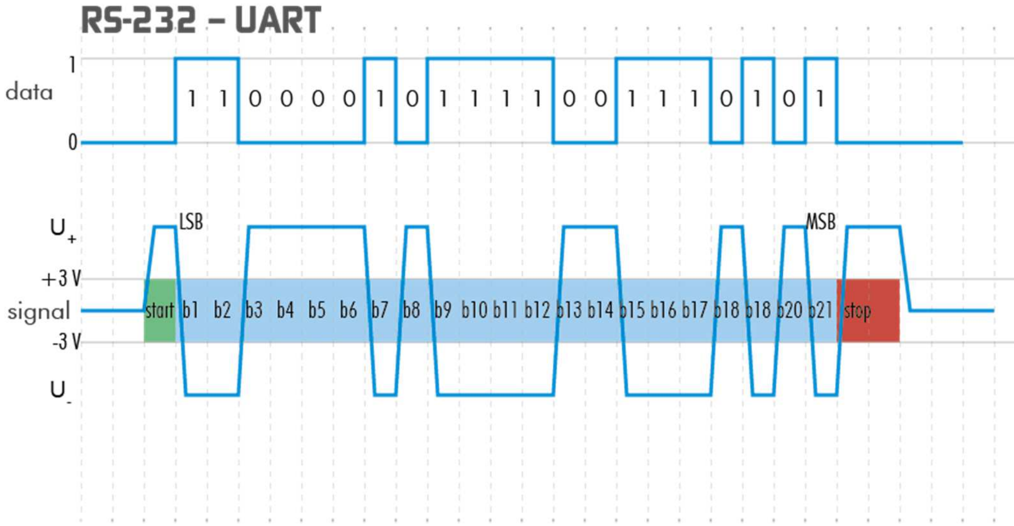


Figure 32: UART encoding of a data stream

RS-422

RS-422 is a differential low voltage communication standard.

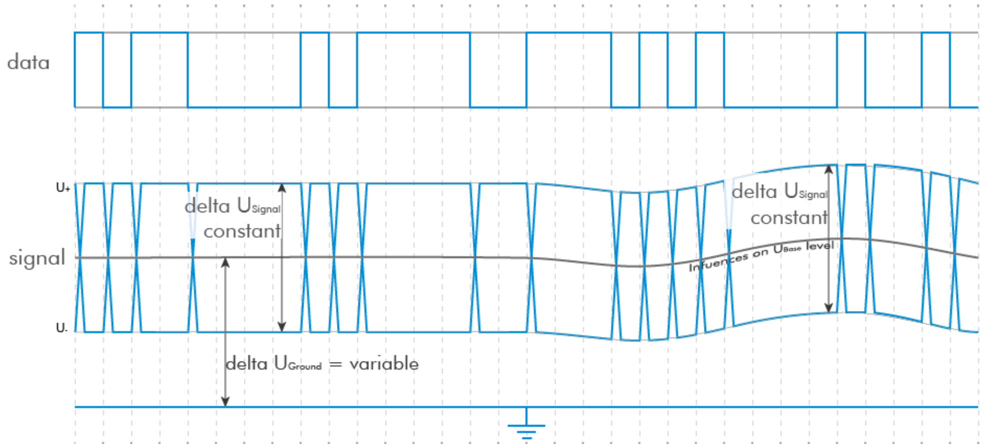


Figure 33: LVDS signal – no return to zero volt

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

6.3.7 Trigger-Edge Sensitivity

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

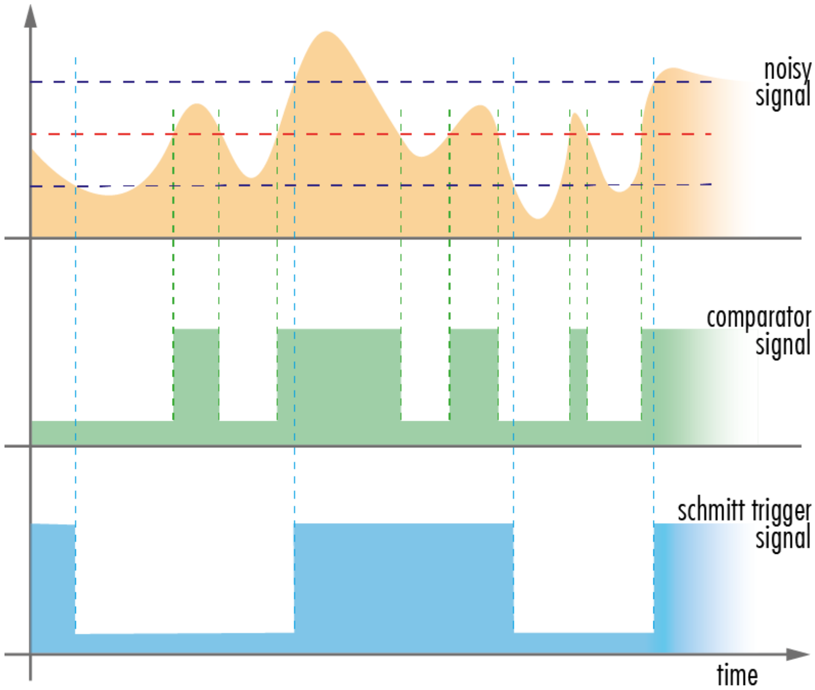


Figure 7: Schmitt trigger noise suppression

6.3.8 Debouncing Trigger Signals

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

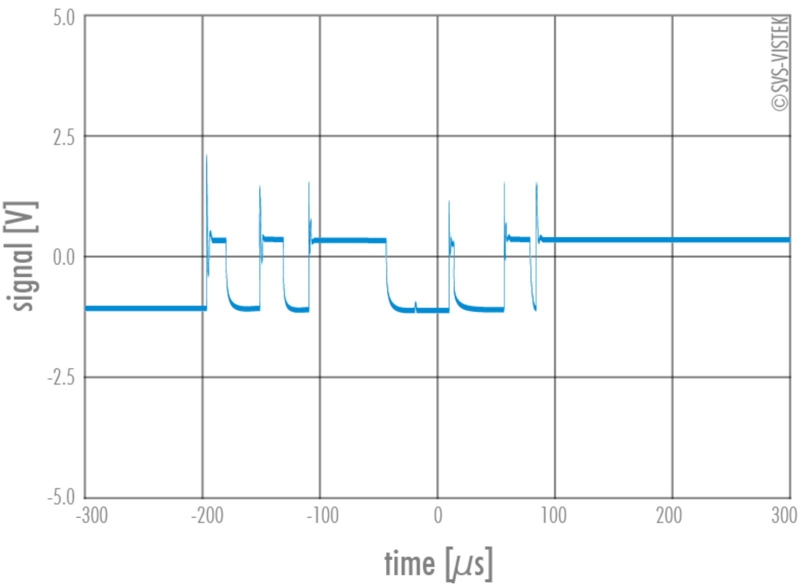


Figure 34: bounces or glitches caused by a switch

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

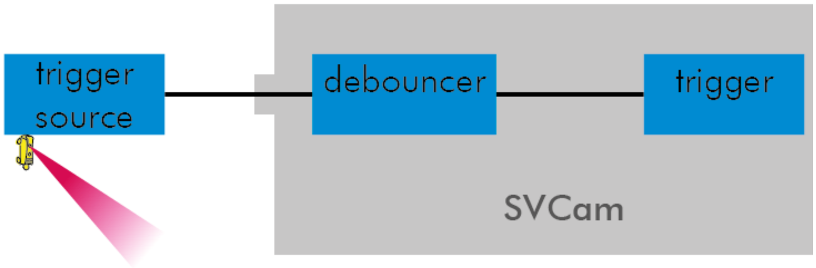


Figure 35: debouncer between the trigger source and trigger

The Debouncer module

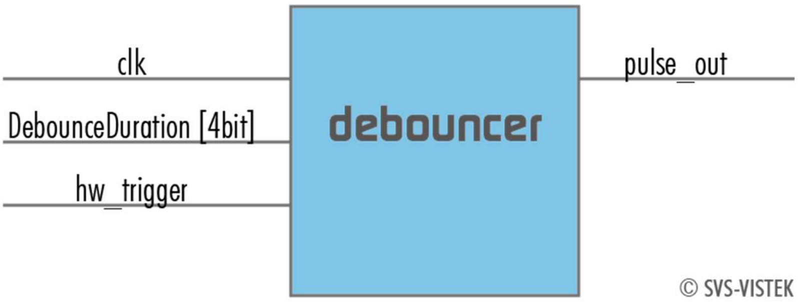


Figure 36: Illustration of the debouncer module

6.3.9 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)

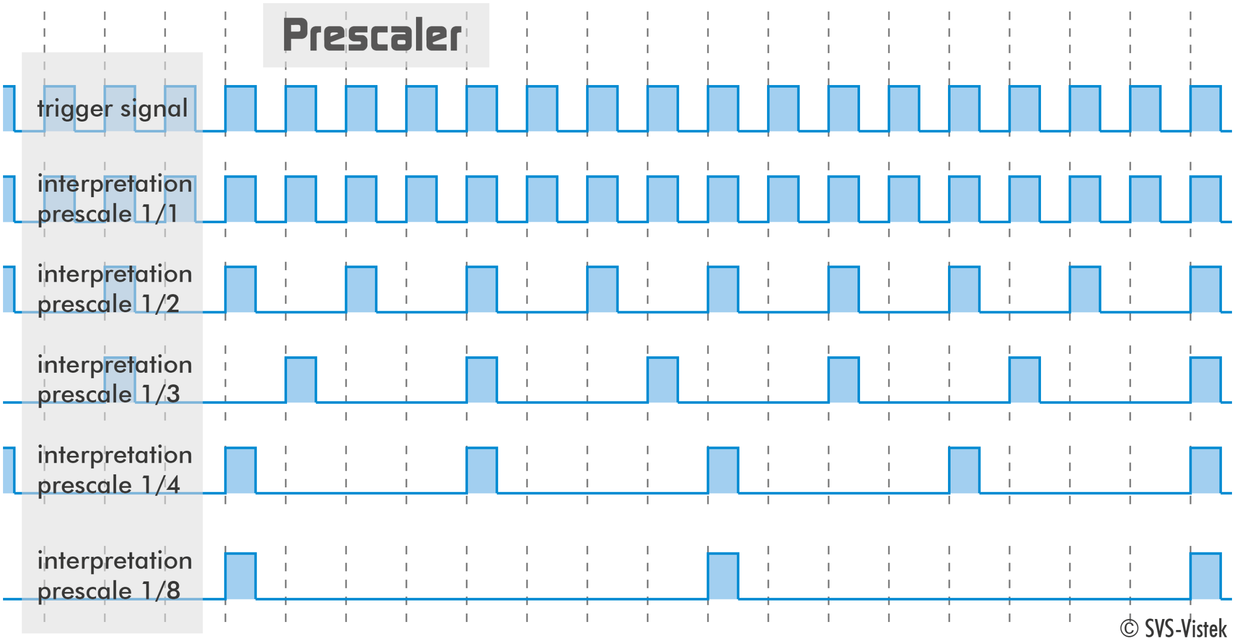


Figure 37: Prescale values

The prescale module

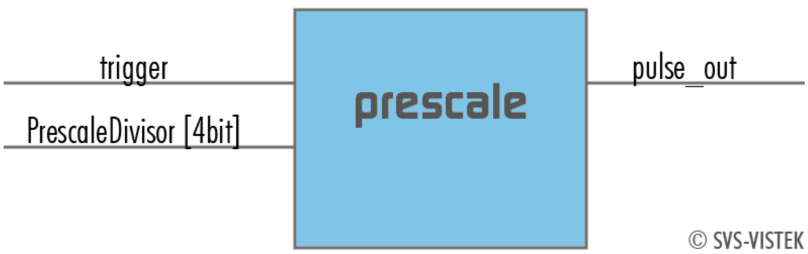


Figure 38: Illustration of the prescale module

6.4 IR Cut Filter

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

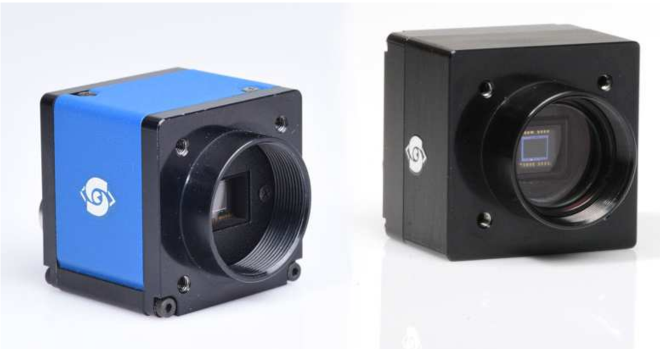
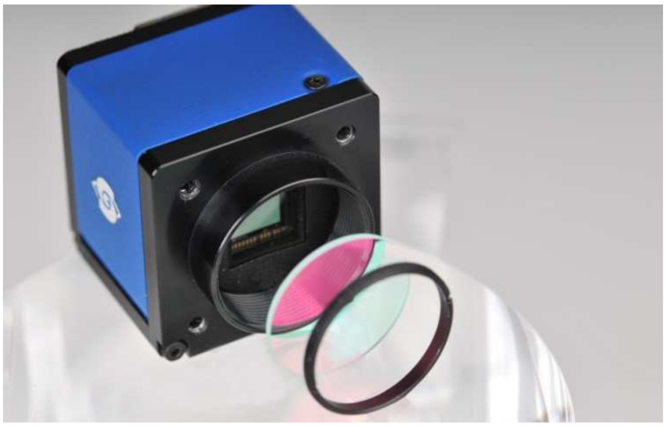


Figure 39: ECO with IR cut filter

In addition filters raise the protection class of the camera by protecting the sensor and camera internals from environmental influences. IP67 models do have 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)



All kinds 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.

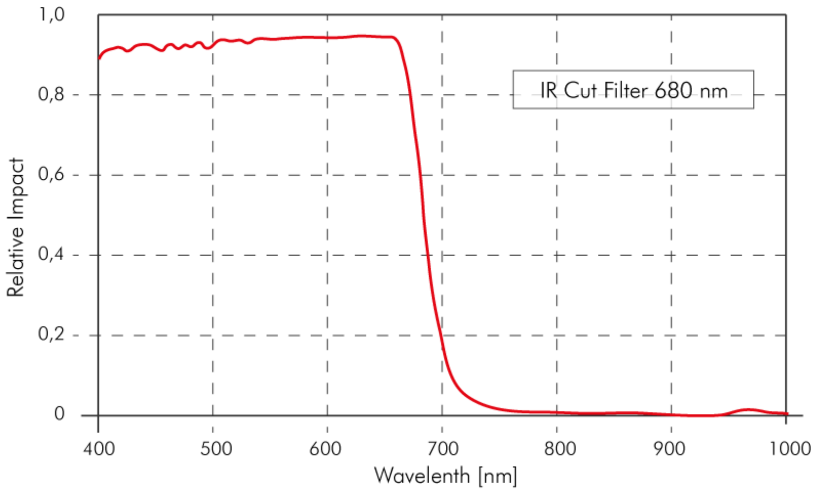


Figure 40: IR cut filter light transmission

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.

7 Specifications

All specifications can be viewed as well on our website, www.svs-vistek.com. We are proud to have ongoing development on our cameras, so specs might change and new features being added.

7.1 eco204*VGE

Model	eco204MVGE	eco204CVGE
family	ECO	ECO
active pixel w x h	1024 x 776	1024 x 776
max. frame rate	47 fps	47 fps
chroma	mono	color
interface	GigE Vision	GigE Vision

sensor name	ICX204AL	ICX204AK
sensor manufacturer	Sony	Sony
sensor architecture	Area CCD	Area CCD
shutter type	global	global
equivalent format	1/3"	1/3"
diagonal	6.0 mm	6.0 mm
pixel w x h	4.65x4.65 µm	4.65x4.65 µm
optic sensor w x h	5.8x4.92 mm	5.8x4.92 mm
exposure time	16 µs / 60s	16 µs / 60s
max. gain	18 dB	18 dB
dynamic range	54 dB environment dependant	54 dB environment dependant
S/N Ratio		

frame buffer	64MB RAM 8MB Flash	64MB RAM 8MB Flash
CL_geometry	-	-
frequency select	-	-
exp. time adjustment	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / -	x / x / -
packed readout	-	-
max binning h / v	2 / 2	2 / 2
LUT	12to8(1)	12to8(1)
ROI	1	1
white balancing	-	manual
tap balancing	-	-
gain	auto;manual	auto;manual
black level	manual	manual
PIV	x	x
readout control	manual;delayed	manual;delayed
flat field correction	-	-
shading correction	-	-
defect pixel correction	-	-
image flip	horizontal;vertical	horizontal;vertical

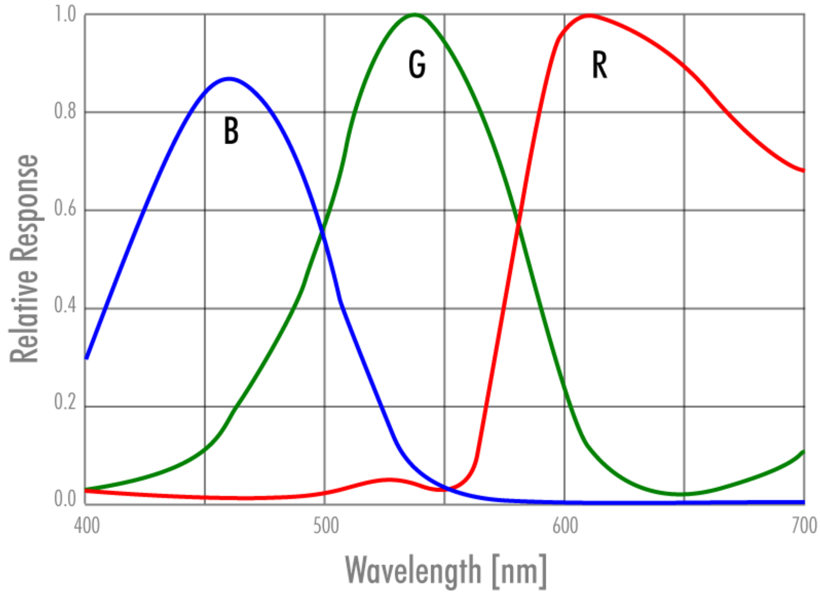
trigger int / ext / soft	x / x / x	x / x / x

trigger edge high / low	x / x	x / x
sequencer	-	-
PWM power out	-	-
trigger IN TTL-24 V	2	2
outputs open drain	2	2
optical in / out	- / -	- / -
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power supply	10...25 V	10...25 V

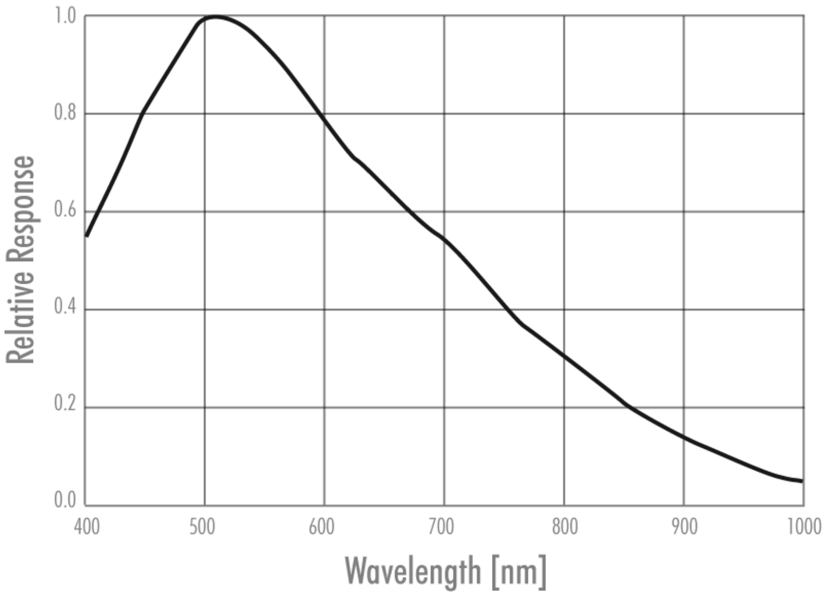
lens mount	CS-Mount	CS-Mount
dynamic lens control	-	-
size w / h / d (1)	38x38x33 mm	38x38x33 mm
weight	85 g	85 g
protection class	IP40	IP40
power consumption	4.5 W	4.5 W
ambient temperature	-10...45°C	-10...45°C
humidity non-condensing	10…90 %	10…90 %
status	production	production

(1) please refer to drawings

Spectral Sensitivity Characteristics ICX204AK



Spectral Sensitivity Characteristics ICX204AL



7.2 eco267*VGE

Model	eco267MVGE	eco267CVGE
family	ECO	ECO
active pixel w x h	1392 x 1040	1392 x 1040
max. frame rate	25 fps	25 fps
chroma	mono	color
interface	GigE Vision	GigE Vision

sensor name	ICX267AL	ICX267AK
sensor manufacturer	Sony	Sony
sensor architecture	Area CCD	Area CCD
shutter type	global	global
equivalent format	1/2"	1/2"
diagonal	7.9 mm	7.9 mm
pixel w x h	4.65x4.65 µm	4.65x4.65 µm
optic sensor w x h	7.6x6.2 mm	7.6x6.2 mm
exposure time	39 µs / 60s	39 µs / 60s
max. gain	18 dB	18 dB
dynamic range	56 dB environment dependant	56 dB environment dependant
S/N Ratio		

frame buffer	64MB RAM 8MB Flash	64MB RAM 8MB Flash
CL_geometry	-	-
frequency select	-	-
exp. time adjustment	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / -	x / x / -
packed readout	-	-
max binning h / v	2 / 2	2 / 2
LUT	12to8(1)	12to8(1)
ROI	1	1
white balancing	-	manual
tap balancing	-	-
gain	auto;manual	auto;manual
black level	manual	manual
PIV	x	x
readout control	manual;delayed	manual;delayed
flat field correction	-	-
shading correction	-	-
defect pixel correction	-	-
image flip	horizontal;vertical	horizontal;vertical

trigger int / ext / soft	x / x / x	x / x / x
trigger edge high / low	x / x	x / x
sequencer	-	-
PWM power out	-	-
trigger IN TTL-24 V	2	2
outputs open drain	2	2

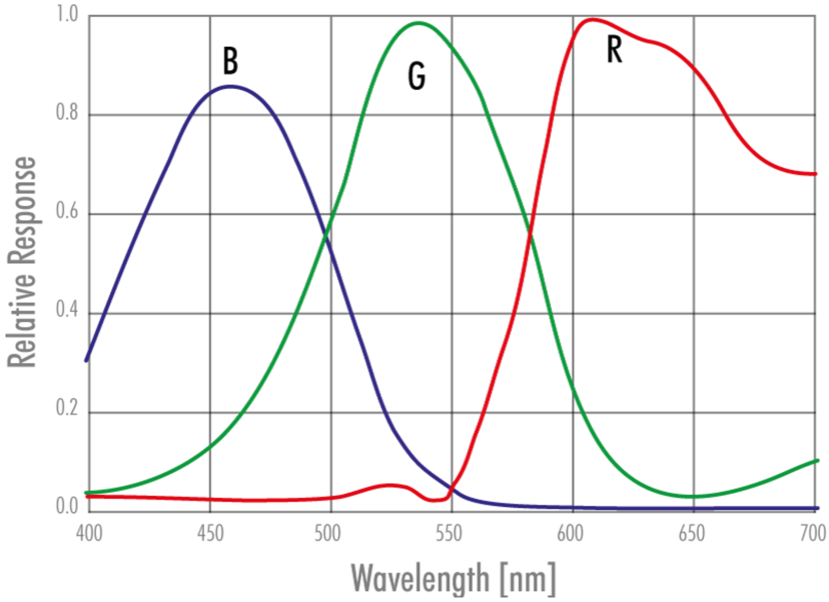
optical in / out	- / -	- / -
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power supply	10...25 V	10...25 V

lens mount	CS-Mount	CS-Mount
dynamic lens control	-	-
size w / h / d (1)	38x38x33 mm	38x38x33 mm
weight	85 g	85 g
protection class	IP40	IP40
power consumption	4.5 W	4.5 W
ambient temperature	-10...45°C	-10...45°C
humidity non-condensing	10…90 %	10…90 %
status	production	production

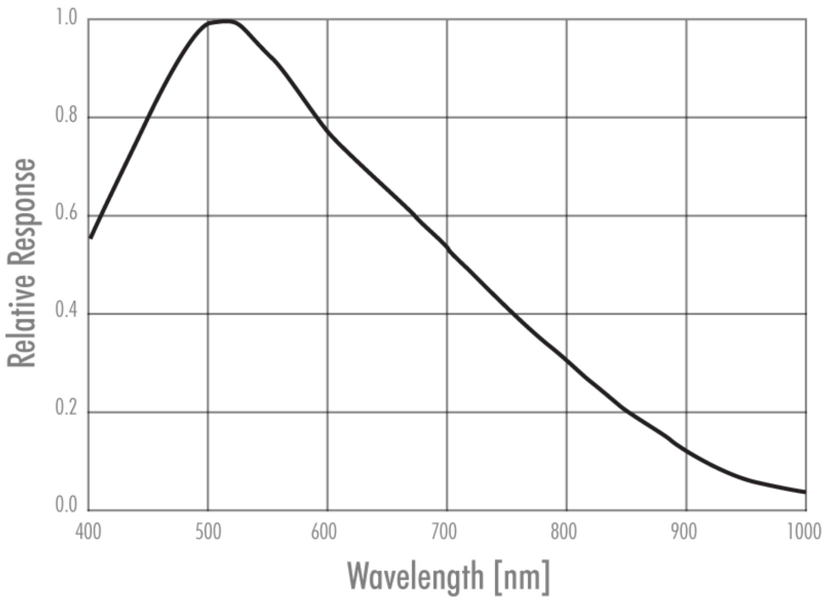
(1) please refer to drawings

 July 25, 2018 July 25, 2018

Spectral Sensitivity Characteristics ICX267AQ



Spectral Sensitivity Characteristics ICX267AL



7.3 eco274*VGE

Model	eco274MVGE	eco274CVGE
family	ECO	ECO
active pixel w x h	1600 x 1236	1600 x 1236
max. frame rate	26.5 fps	26.5 fps
chroma	mono	color
interface	GigE Vision	GigE Vision

sensor name	ICX274AL	ICX274AQ
sensor manufacturer	Sony	Sony
sensor architecture	Area CCD	Area CCD
shutter type	global	global
equivalent format	1/1.8"	1/1.8"
diagonal	8.8 mm	8.8 mm
pixel w x h	4.4x4.4 µm	4.4x4.4 µm
optic sensor w x h	8.5x6.8 mm	8.5x6.8 mm
exposure time	20 µs / 60s	20 µs / 60s
max. gain	18 dB	18 dB
dynamic range	54 dB environment dependant	54 dB environment dependant
S/N Ratio		

frame buffer	64MB RAM 8MB Flash	64MB RAM 8MB Flash
CL_geometry	-	-
frequency select	-	-
exp. time adjustment	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / -	x / x / -
packed readout	-	-
max binning h / v	2 / 2	2 / 2
LUT	12to8(1)	12to8(1)
ROI	1	1
white balancing	-	manual
tap balancing	-	-
gain	auto;manual	auto;manual
black level	manual	manual
PIV	x	x
readout control	manual;delayed	manual;delayed
flat field correction	-	-
shading correction	-	-
defect pixel correction	-	-
image flip	horizontal;vertical	horizontal;vertical

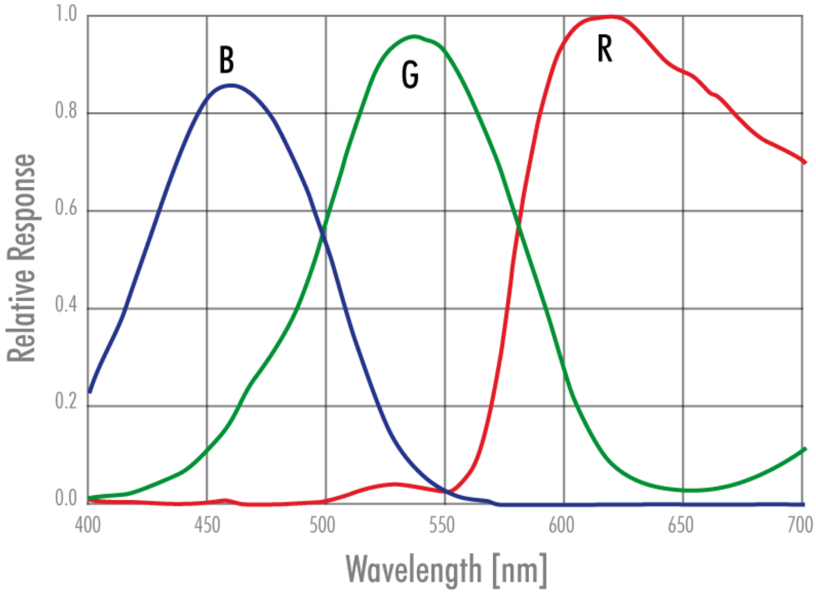
trigger int / ext / soft	x / x / x	x / x / x
trigger edge high / low	x / x	x / x
sequencer	-	-
PWM power out	-	-
trigger IN TTL-24 V	2	2
outputs open drain	2	2

optical in / out	- / -	- / -
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power supply	10...25 V	10...25 V

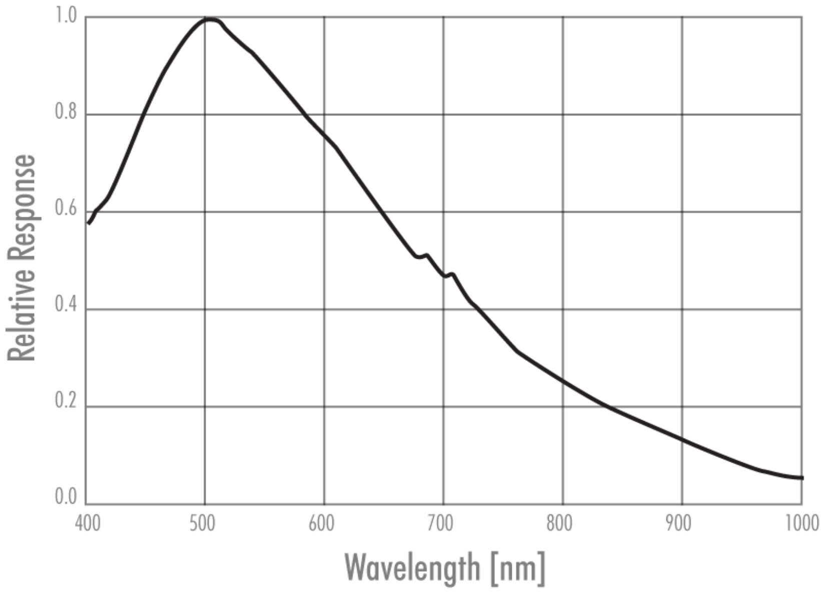
lens mount	CS-Mount	CS-Mount
dynamic lens control	-	-
size w / h / d (1)	38x38x33 mm	38x38x33 mm
weight	85 g	85 g
protection class	IP40	IP40
power consumption	4.5 W	4.5 W
ambient temperature	-10...45°C	-10...45°C
humidity non-condensing	10…90 %	10…90 %
status	production	production

(1) please refer to drawings

Spectral Sensitivity Characteristics ICX274AQ



Spectral Sensitivity Characteristics ICX274AL



7.4 eco285*VGE

Model	eco285MVGE	eco285CVGE
family	ECO	ECO
active pixel w x h	1392 x 1040	1392 x 1040
max. frame rate	34 fps	34 fps
chroma	mono	color
interface	GigE Vision	GigE Vision

sensor name	ICX285AL	ICX285AQ
sensor manufacturer	Sony	Sony
sensor architecture	Area CCD	Area CCD
shutter type	global	global
equivalent format	2/3"	2/3"
diagonal	11.0 mm	11.0 mm
pixel w x h	6.45x6.45 µm	6.45x6.45 µm
optic sensor w x h	10.2x8.3 mm	10.2x8.3 mm
exposure time	20 µs / 60s	12 µs / 60s
max. gain	18 dB	18 dB
dynamic range	56 dB environment dependant	56 dB environment dependant
S/N Ratio		

frame buffer	64MB RAM 8MB Flash	64MB RAM 8MB Flash
CL_geometry	-	-
frequency select	-	-
exp. time adjustment	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / -	x / x / -
packed readout	-	-
max binning h / v	2 / 2	2 / 2
LUT	12to8(1)	12to8(1)
ROI	1	1
white balancing	-	manual
tap balancing	-	-
gain	auto;manual	auto;manual
black level	manual	manual
PIV	x	x
readout control	manual;delayed	manual;delayed
flat field correction	-	-
shading correction	-	-
defect pixel correction	-	-
image flip	horizontal;vertical	horizontal;vertical

trigger int / ext / soft	x / x / x	x / x / x
trigger edge high / low	x / x	x / x
sequencer	-	-
PWM power out	-	-
trigger IN TTL-24 V	2	2
outputs open drain	2	2

optical in / out	- / -	- / -
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power supply	10...25 V	10...25 V

lens mount	C-Mount	C-Mount
dynamic lens control	-	-
size w / h / d (1)	38x38x34 mm	38x38x34 mm
weight	90 g	90 g
protection class	IP40	IP40
power consumption	4.5 W	4.5 W
ambient temperature	-10...45°C	-10...45°C
humidity non-condensing	10…90 %	10…90 %
status	production	production

(1) please refer to drawings

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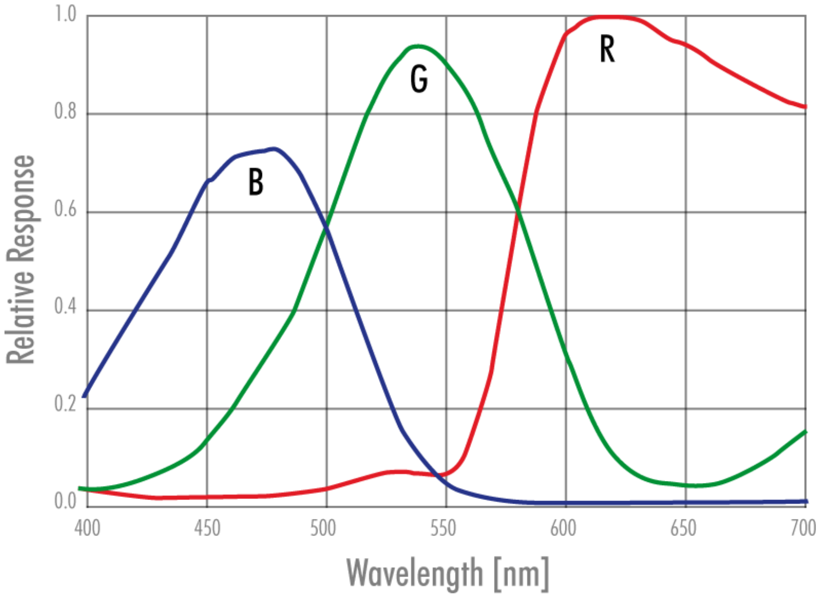
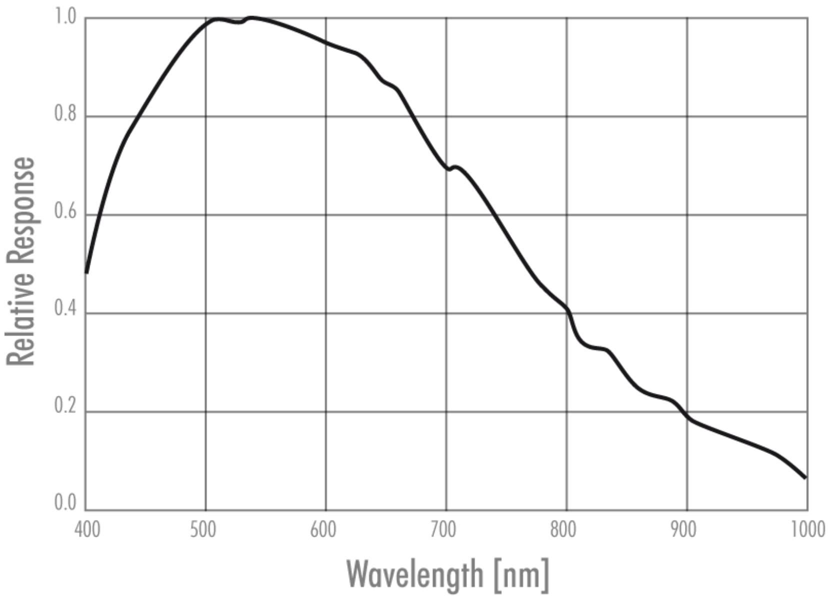
Spectral Sensitivity Characteristics ICX285AQ



Spectral Sensitivity Characteristics ICX285AL



7.5 eco414*VGE

Model	eco414MVGE	eco414CVGE
family	ECO	ECO
active pixel w x h	656 x 492	656 x 492
max. frame rate	125 fps	125 fps
chroma	mono	color
interface	GigE Vision	GigE Vision

sensor name	ICX414AL	ICX414AQ
sensor manufacturer	Sony	Sony
sensor architecture	Area CCD	Area CCD
shutter type	global	global
equivalent format	1/2"	1/2"
diagonal	7.9 mm	7.9 mm
pixel w x h	9.9x9.9 µm	9.9x9.9 µm
optic sensor w x h	7.48x6.15 mm	7.48x6.15 mm
exposure time	21 µs / 60s	21 µs / 60s
max. gain	30 dB	30 dB
dynamic range	58 dB environment dependant	58 dB environment dependant
S/N Ratio		

frame buffer	64MB RAM 8MB Flash	64MB RAM 8MB Flash
CL_geometry	-	-
frequency select	-	-
exp. time adjustment	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / -	x / x / -
packed readout	-	-
max binning h / v	2 / 2	2 / 2
LUT	12to8(1)	12to8(1)
ROI	1	1
white balancing	-	manual
tap balancing	-	-
gain	auto;manual	auto;manual
black level	manual	manual
PIV	x	x
readout control	manual;delayed	manual;delayed
flat field correction	-	-
shading correction	-	-
defect pixel correction	-	-
image flip	horizontal;vertical	horizontal;vertical

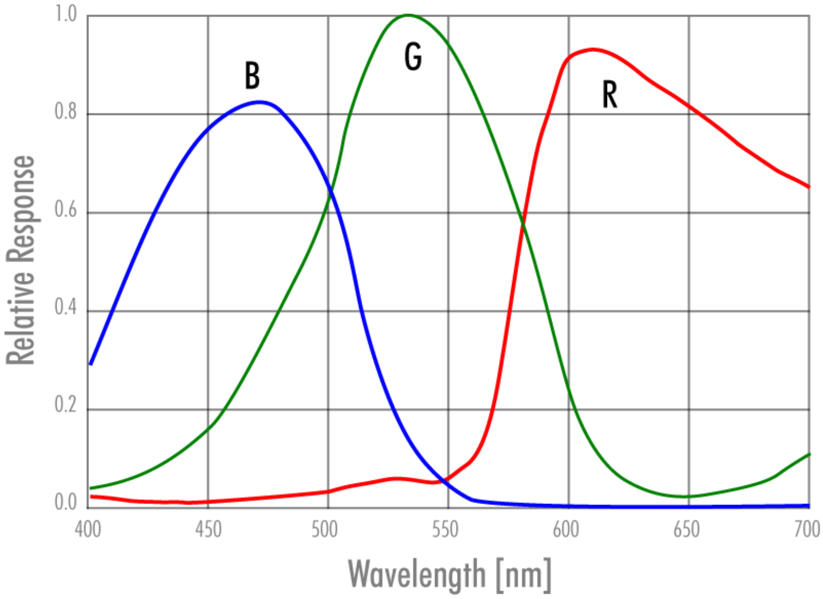
trigger int / ext / soft	x / x / x	x / x / x
trigger edge high / low	x / x	x / x
sequencer	-	-
PWM power out	-	-
trigger IN TTL-24 V	2	2
outputs open drain	2	2

optical in / out	- / -	- / -
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power supply	10...25 V	10...25 V

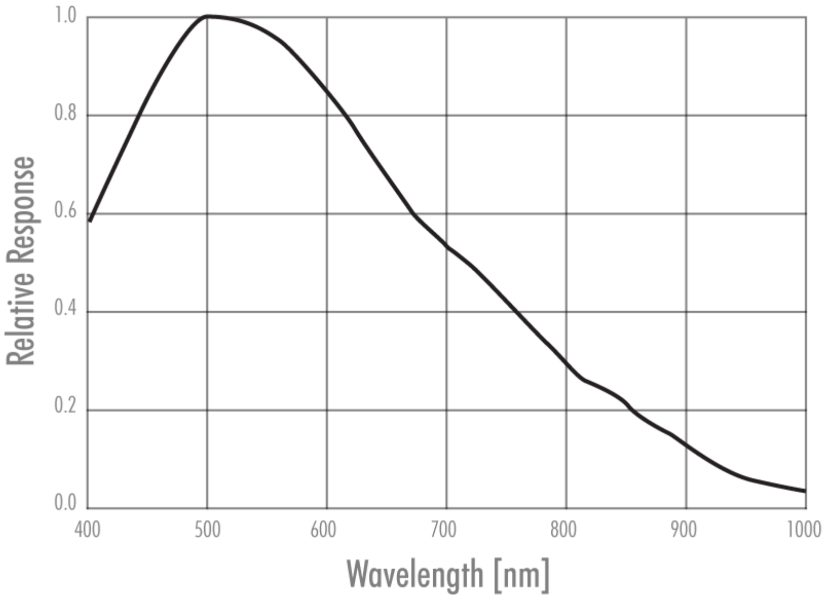
lens mount	CS-Mount	CS-Mount
dynamic lens control	-	-
size w / h / d (1)	38x38x33 mm	38x38x33 mm
weight	85 g	85 g
protection class	IP40	IP40
power consumption	4.5 W	4.5 W
ambient temperature	-10...45°C	-10...45°C
humidity non-condensing	10…90 %	10…90 %
status	production	production

(1) please refer to drawings

Spectral Sensitivity Characteristics ICX414AQ



Spectral Sensitivity Characteristics ICX414AL



7.6 eco415*VGE

Model	eco415MVGE	eco415CVGE
family	ECO	ECO
active pixel w x h	780 x 580	780 x 580
max. frame rate	86 fps	86 fps
chroma	mono	color
interface	GigE Vision	GigE Vision

sensor name	ICX415AL	ICX415AQ
sensor manufacturer	Sony	Sony
sensor architecture	Area CCD	Area CCD
shutter type	global	global
equivalent format	1/2"	1/2"
diagonal	8.0 mm	8.0 mm
pixel w x h	8.3x8.3 µm	8.3x8.3 µm
optic sensor w x h	7.48x6.15 mm	7.48x6.15 mm
exposure time	21 µs / 60s	21 µs / 60s
max. gain	24 dB	24 dB
dynamic range	58 dB environment dependant	58 dB environment dependant
S/N Ratio		

frame buffer	64MB RAM 8MB Flash	64MB RAM 8MB Flash
CL_geometry	-	-
frequency select	-	-
exp. time adjustment	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / -	x / x / -
packed readout	-	-
max binning h / v	2 / 2	2 / 2
LUT	12to8(1)	12to8(1)
ROI	1	1
white balancing	-	manual
tap balancing	-	-
gain	auto;manual	auto;manual
black level	manual	manual
PIV	x	x
readout control	manual;delayed	manual;delayed
flat field correction	-	-
shading correction	-	-
defect pixel correction	-	-
image flip	horizontal;vertical	horizontal;vertical

trigger int / ext / soft	x / x / x	x / x / x
trigger edge high / low	x / x	x / x
sequencer	-	-
PWM power out	-	-
trigger IN TTL-24 V	2	2
outputs open drain	2	2

optical in / out	- / -	- / -
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power supply	10...25 V	10...25 V

lens mount	CS-Mount	CS-Mount
dynamic lens control	-	-
size w / h / d (1)	38x38x33 mm	38x38x33 mm
weight	85 g	85 g
protection class	IP40	IP40
power consumption	4.5 W	4.5 W
ambient temperature	-10...45°C	-10...45°C
humidity non-condensing	10…90 %	10…90 %
status	production	production

(1) please refer to drawings

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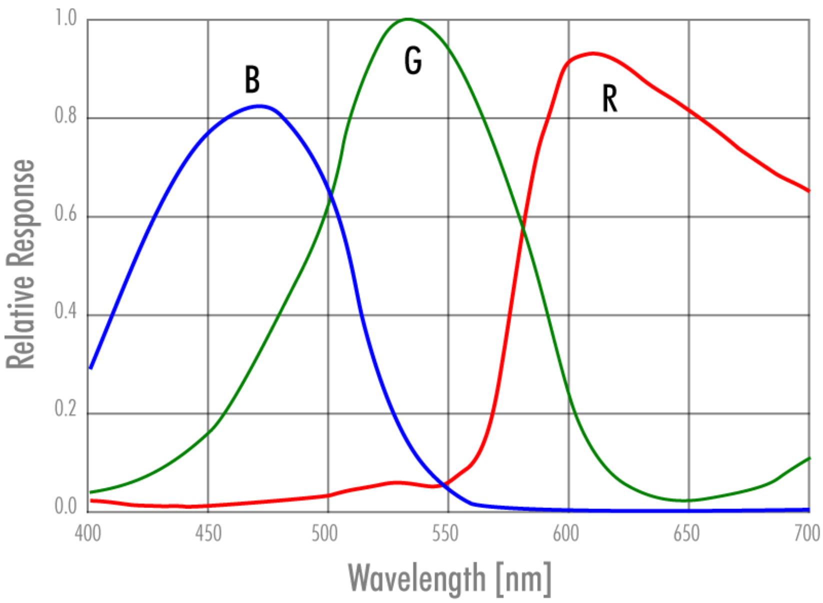
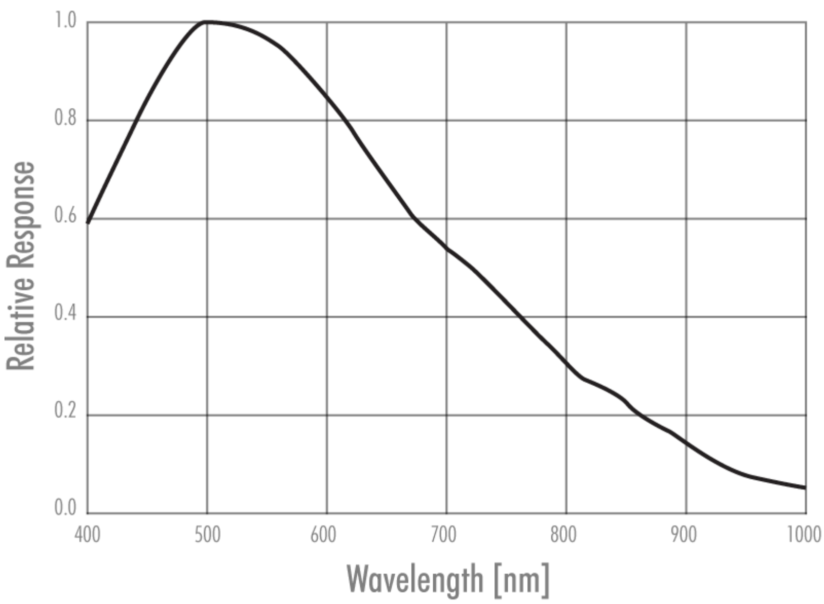
Spectral Sensitivity Characteristics ICX415AQ



Spectral Sensitivity Characteristics ICX415AL



7.7 eco424*VGE

Model	eco424MVGE	eco424CVGE
family	ECO	ECO
active pixel w x h	656 x 492	656 x 492
max. frame rate	124 fps	124 fps
chroma	mono	color
interface	GigE Vision	GigE Vision

sensor name	ICX424AL	ICX424AQ
sensor manufacturer	Sony	Sony
sensor architecture	Area CCD	Area CCD
shutter type	global	global
equivalent format	1/3"	1/3"
diagonal	5.9 mm	5.9 mm
pixel w x h	7.4x7.4 µm	7.4x7.4 µm
optic sensor w x h	5.79x4.89 mm	5.79x4.89 mm
exposure time	3 µs / 60s	3 µs / 60s
max. gain	30 dB	30 dB
dynamic range	56 dB environment dependant	56 dB environment dependant
S/N Ratio		

frame buffer	64MB RAM 8MB Flash	64MB RAM 8MB Flash
CL_geometry	-	-
frequency select	-	-
exp. time adjustment	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / -	x / x / -
packed readout	-	-
max binning h / v	2 / 2	2 / 2
LUT	12to8(1)	12to8(1)
ROI	1	1
white balancing	-	manual
tap balancing	-	-
gain	auto;manual	auto;manual
black level	manual	manual
PIV	x	x
readout control	manual;delayed	manual;delayed
flat field correction	-	-
shading correction	-	-
defect pixel correction	-	-
image flip	horizontal;vertical	horizontal;vertical

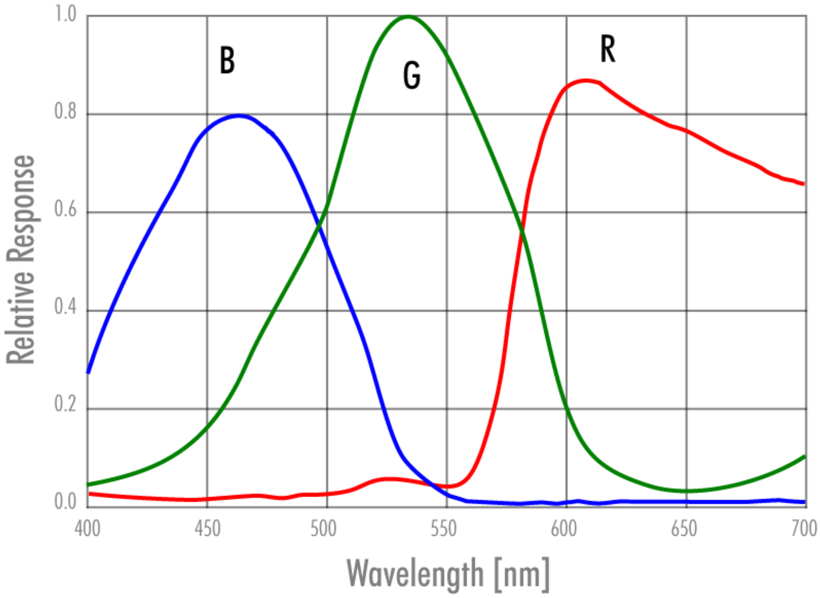
trigger int / ext / soft	x / x / x	x / x / x
trigger edge high / low	x / x	x / x
sequencer	-	-
PWM power out	-	-
trigger IN TTL-24 V	2	2
outputs open drain	2	2

optical in / out	- / -	- / -
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power supply	10...25 V	10...25 V

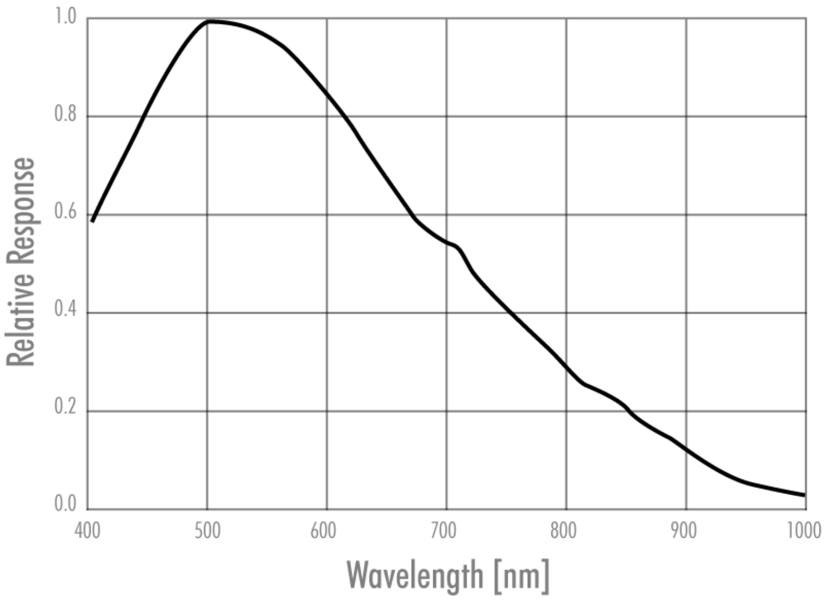
lens mount	CS-Mount	CS-Mount
dynamic lens control	-	-
size w / h / d (1)	38x38x33 mm	38x38x33 mm
weight	85 g	85 g
protection class	IP40	IP40
power consumption	4.5 W	4.5 W
ambient temperature	-10...45°C	-10...45°C
humidity non-condensing	10…90 %	10…90 %
status	production	production

(1) please refer to drawings

Spectral Sensitivity Characteristics ICX424AQ



Spectral Sensitivity Characteristics ICX424AL



7.8 eco445*VGE

Model	eco445MVGE	eco445CVGE
family	ECO	ECO
active pixel w x h	1296 x 964	1296 x 964
max. frame rate	30 fps	30 fps
chroma	mono	color
interface	GigE Vision	GigE Vision

sensor name	ICX445ALA	ICX445AQA
sensor manufacturer	Sony	Sony
sensor architecture	Area CCD	Area CCD
shutter type	global	global
equivalent format	1/3"	1/3"
diagonal	6.0 mm	6.0 mm
pixel w x h	3.75x3.75 µm	3.75x3.75 µm
optic sensor w x h	6.26x5.01 mm	6.26x5.01 mm
exposure time	12 µs / 60s	12 µs / 60s
max. gain	18 dB	18 dB
dynamic range	56 dB environment dependant	56 dB environment dependant
S/N Ratio		

frame buffer	64MB RAM 8MB Flash	64MB RAM 8MB Flash
CL_geometry	-	-
frequency select	-	-
exp. time adjustment	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / -	x / x / -
packed readout	-	-
max binning h / v	2 / 2	2 / 2
LUT	12to8(1)	12to8(1)
ROI	1	1
white balancing	-	manual
tap balancing	-	-
gain	auto;manual	auto;manual
black level	manual	manual
PIV	x	x
readout control	manual;delayed	manual;delayed
flat field correction	-	-
shading correction	-	-
defect pixel correction	-	-
image flip	horizontal;vertical	horizontal;vertical

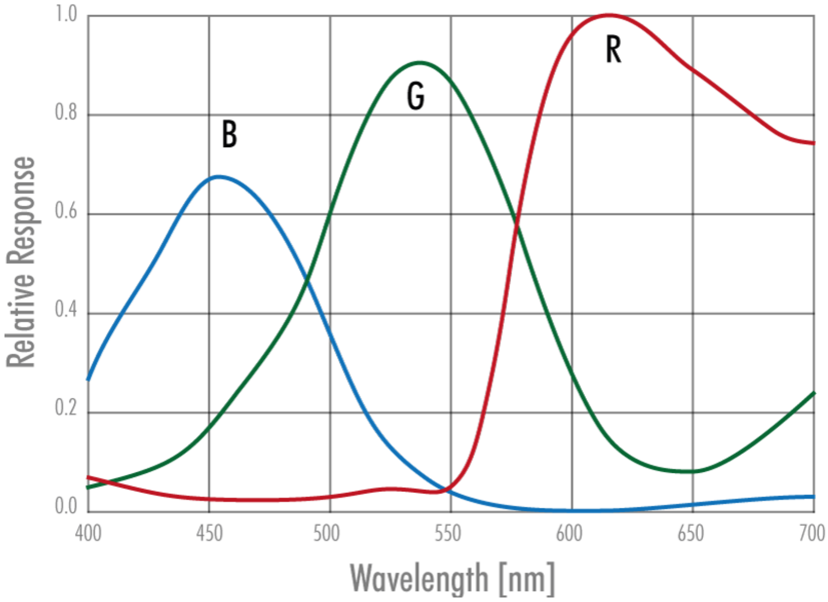
trigger int / ext / soft	x / x / x	x / x / x
trigger edge high / low	x / x	x / x
sequencer	-	-
PWM power out	-	-
trigger IN TTL-24 V	2	2
outputs open drain	2	2

optical in / out	- / -	- / -
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power supply	10...25 V	10...25 V

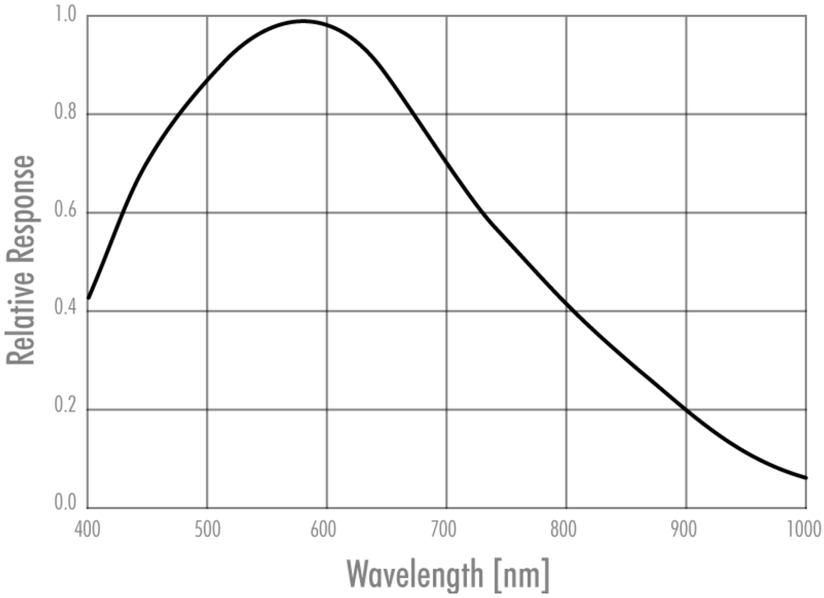
lens mount	CS-Mount	CS-Mount
dynamic lens control	-	-
size w / h / d (1)	38x38x33 mm	38x38x33 mm
weight	85 g	85 g
protection class	IP40	IP40
power consumption	4.5 W	4.5 W
ambient temperature	-10...45°C	-10...45°C
humidity non-condensing	10…90 %	10…90 %
status	production	production

(1) please refer to drawings

Spectral Sensitivity Characteristics ICX445AQA



Spectral Sensitivity Characteristics ICX445ALA



7.9 eco618*VGE

Model	eco618MVGE	eco618CVGE
family	ECO	ECO
active pixel w x h	656 x 494	656 x 494
max. frame rate	155 fps	155 fps
chroma	mono	color
interface	GigE Vision	GigE Vision

sensor name	ICX618ALA	ICX618AQA
sensor manufacturer	Sony	Sony
sensor architecture	Area CCD	Area CCD
shutter type	global	global
equivalent format	1/4"	1/4"
diagonal	4.5 mm	4.5 mm
pixel w x h	5.6x5.6 µm	5.6x5.6 µm
optic sensor w x h	4.46x3.8 mm	4.46x3.8 mm
exposure time	65 µs / 60s	65 µs / 60s
max. gain	30 dB	30 dB
dynamic range	58 dB environment dependant	58 dB environment dependant
S/N Ratio		

frame buffer	64MB RAM 8MB Flash	64MB RAM 8MB Flash
CL_geometry	-	-
frequency select	-	-
exp. time adjustment	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / -	x / x / -
packed readout	-	-
max binning h / v	2 / 2	2 / 2
LUT	12to8(1)	12to8(1)
ROI	1	1
white balancing	-	manual
tap balancing	-	-
gain	auto;manual	auto;manual
black level	manual	manual
PIV	x	x
readout control	manual;delayed	manual;delayed
flat field correction	-	-
shading correction	-	-
defect pixel correction	-	-
image flip	horizontal;vertical	horizontal;vertical

trigger int / ext / soft	x / x / x	x / x / x
trigger edge high / low	x / x	x / x
sequencer	-	-
PWM power out	-	-
trigger IN TTL-24 V	2	2
outputs open drain	2	2

optical in / out	- / -	- / -
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power supply	10...25 V	10...25 V

lens mount	CS-Mount	CS-Mount
dynamic lens control	-	-
size w / h / d (1)	38x38x33 mm	38x38x33 mm
weight	85 g	85 g
protection class	IP40	IP40
power consumption	4.5 W	4.5 W
ambient temperature	-10...45°C	-10...45°C
humidity non-condensing	10…90 %	10…90 %
status	production	production

(1) please refer to drawings

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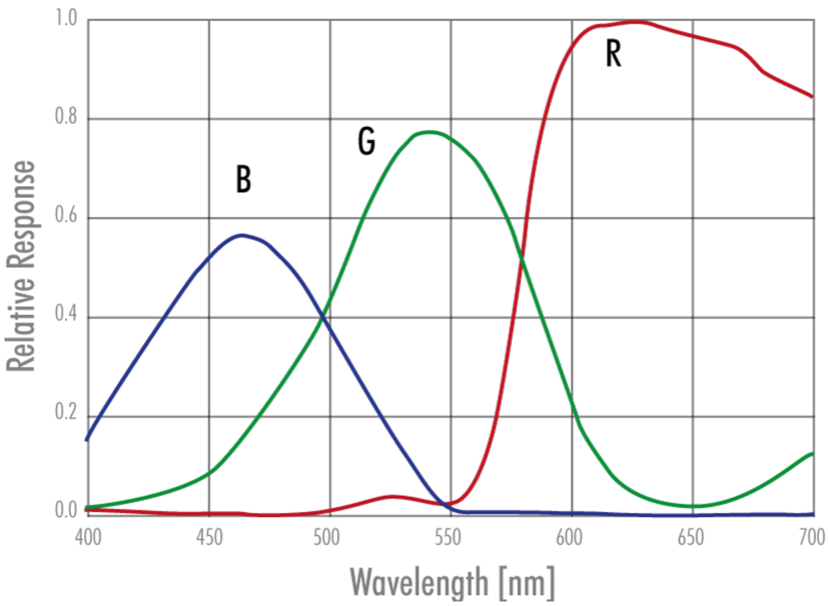
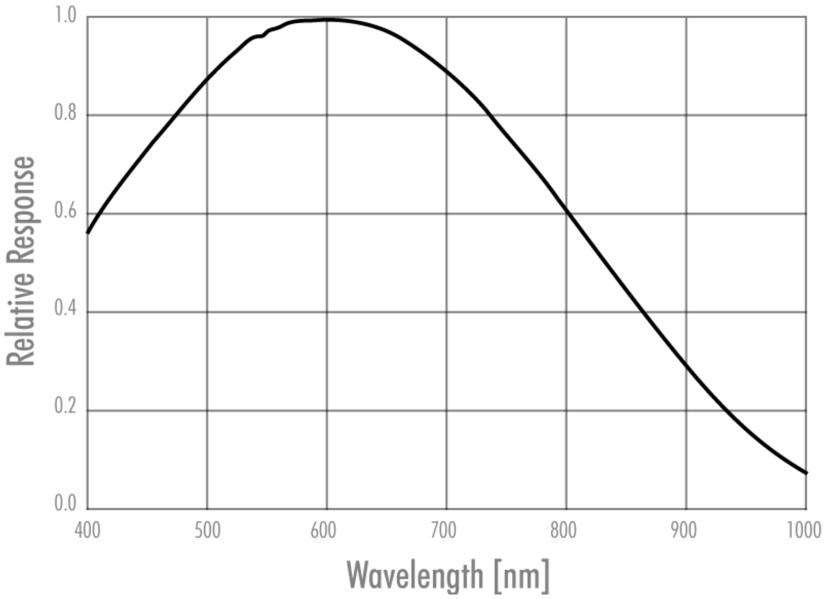
Spectral Sensitivity Characteristics ICX618AQA



Spectral Sensitivity Characteristics ICX618ALA



7.10 eco625*TLGEA

Model	eco625MTLGEA	eco625CTLGEA
family	ECO	ECO
active pixel w x h	2448 x 2050	2448 x 2050
max. frame rate	20 fps	20 fps
chroma	mono	color
interface	GigE Vision	GigE Vision

sensor name	ICX625ALA	ICX625AQA
sensor manufacturer	Sony	Sony
sensor architecture	Area CCD	Area CCD
shutter type	global	global
equivalent format	2/3"	2/3"
diagonal	11.0 mm	11.0 mm
pixel w x h	3.45x3.45 µm	3.45x3.45 µm
optic sensor w x h	9.93x8.7 mm	9.93x8.7 mm
exposure time	7 µs / 60s	7 µs / 60s
max. gain	18 dB	18 dB
dynamic range	54 dB environment dependant	54 dB environment dependant
S/N Ratio		

frame buffer	64MB RAM 8MB Flash	64MB RAM 8MB Flash
CL_geometry	-	-
frequency select	-	-
exp. time adjustment	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / - / -	x / - / -
packed readout	-	-
max binning h / v	2 / 2	2 / 2
LUT	12to8(1)	12to8(1)
ROI	1	1
white balancing	-	auto;manual
tap balancing	manual;auto	manual;auto
gain	auto;manual	auto;manual
black level	manual	manual
PIV	x	x
readout control	manual;delayed	manual;delayed
flat field correction	-	-
shading correction	-	-
defect pixel correction	-	-
image flip	horizontal;vertical	horizontal;vertical

trigger int / ext / soft	x / x / x	x / x / x
trigger edge high / low	x / x	x / x
sequencer	x	x
PWM power out	x	x
trigger IN TTL-24 V	2	2
outputs open drain	2	2

optical in / out	- / -	- / -
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power supply	10...25 V	10...25 V

lens mount	CS-Mount	CS-Mount
dynamic lens control	-	-
size w / h / d (1)	38x38x33 mm	38x38x33 mm
weight	85 g	85 g
protection class	IP40	IP40
power consumption	4.5 W	4.5 W
ambient temperature	-10...45°C	-10...45°C
humidity non-condensing	10…90 %	10…90 %
status	production	production

(1) please refer to drawings

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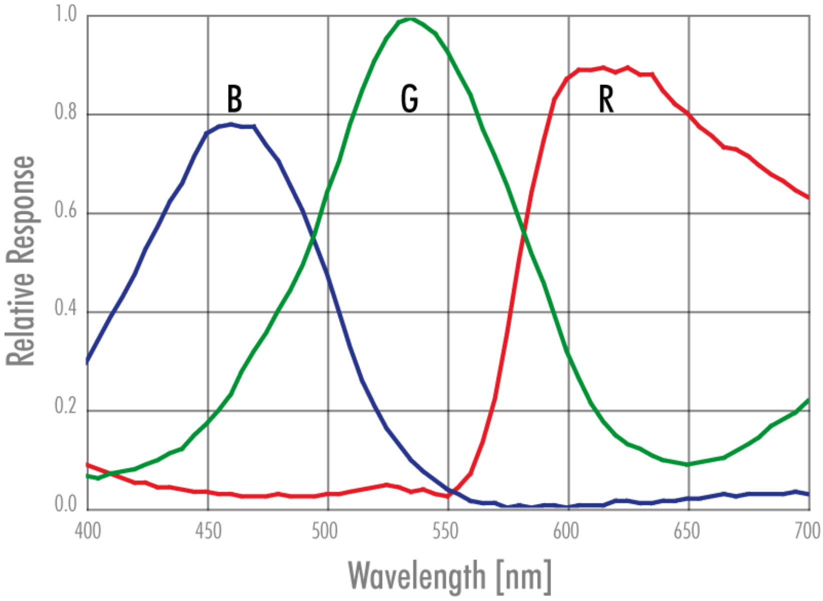
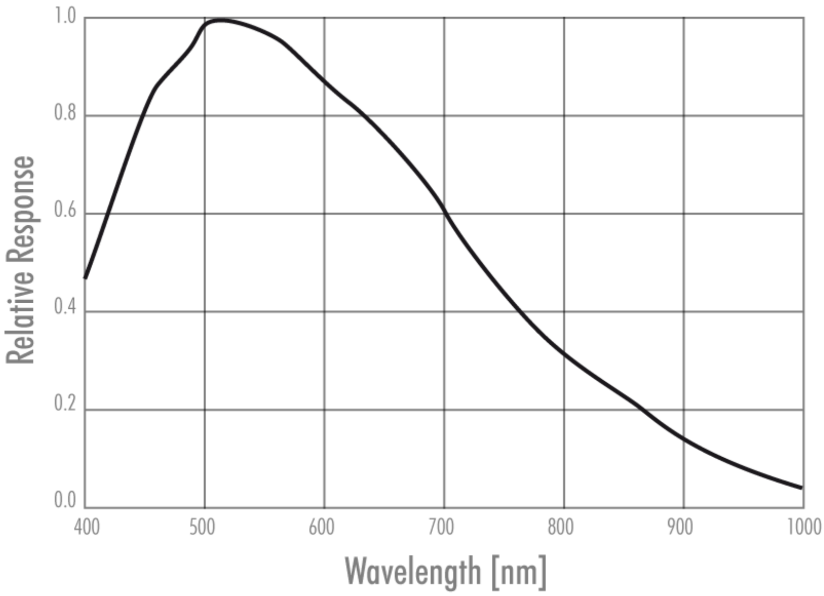
Spectral Sensitivity Characteristics ICX625AQA



Spectral Sensitivity Characteristics ICX625ALA



7.11 eco655*VGE

Model	eco655MVGE	eco655CVGE
family	ECO	ECO
active pixel w x h	2448 x 2050	2448 x 2050
max. frame rate	10 fps	10 fps
chroma	mono	color
interface	GigE Vision	GigE Vision

sensor name	ICX655ALA	ICX655AQA
sensor manufacturer	Sony	Sony
sensor architecture	Area CCD	Area CCD
shutter type	global	global
equivalent format	2/3"	2/3"
diagonal	11.0 mm	11.0 mm
pixel w x h	3.45x3.45 µm	3.45x3.45 µm
optic sensor w x h	9.93x8.7 mm	9.93x8.7 mm
exposure time	7 µs / 60s	7 µs / 60s
max. gain	18 dB	18 dB
dynamic range	58 dB environment dependant	58 dB environment dependant
S/N Ratio		

frame buffer	64MB RAM 8MB Flash	64MB RAM 8MB Flash
CL_geometry	-	-
frequency select	-	-
exp. time adjustment	manual;auto;external	manual;auto;external
px format 8 / 12 / 16	x / x / -	x / x / -
packed readout	-	-
max binning h / v	2 / 2	2 / 2
LUT	12to8(1)	12to8(1)
ROI	1	1
white balancing	-	manual
tap balancing	-	-
gain	auto;manual	auto;manual
black level	manual	manual
PIV	x	x
readout control	manual;delayed	manual;delayed
flat field correction	-	-
shading correction	-	-
defect pixel correction	-	-
image flip	horizontal;vertical	horizontal;vertical

trigger int / ext / soft	x / x / x	x / x / x
trigger edge high / low	x / x	x / x
sequencer	-	-
PWM power out	-	-
trigger IN TTL-24 V	2	2
outputs open drain	2	2

optical in / out	- / -	- / -
RS-232 in / out	1 / 1	1 / 1
RS-422 in / out	1 / 1	1 / 1
power supply	10...25 V	10...25 V

lens mount	CS-Mount	CS-Mount
dynamic lens control	-	-
size w / h / d (1)	38x38x33 mm	38x38x33 mm
weight	85 g	85 g
protection class	IP40	IP40
power consumption	4.5 W	4.5 W
ambient temperature	-10...45°C	-10...45°C
humidity non-condensing	10…90 %	10…90 %
status	production	production

(1) please refer to drawings

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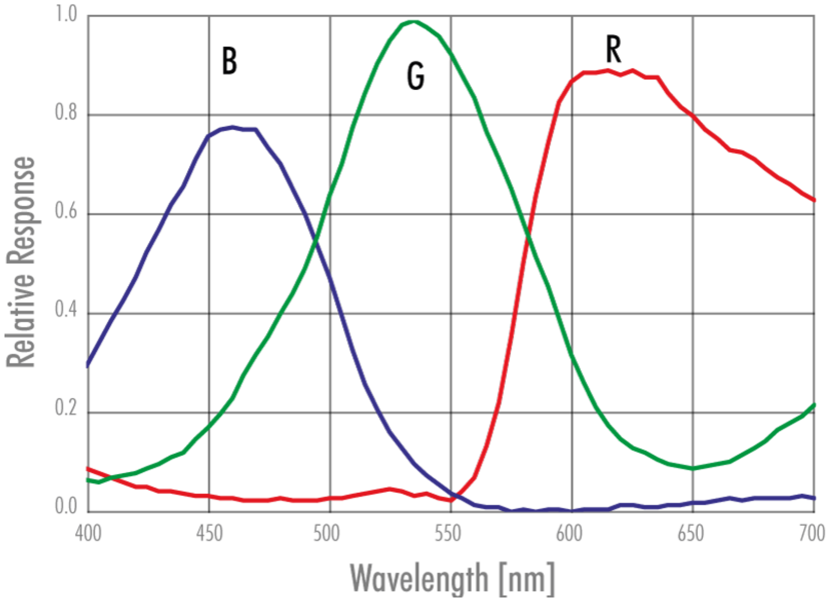
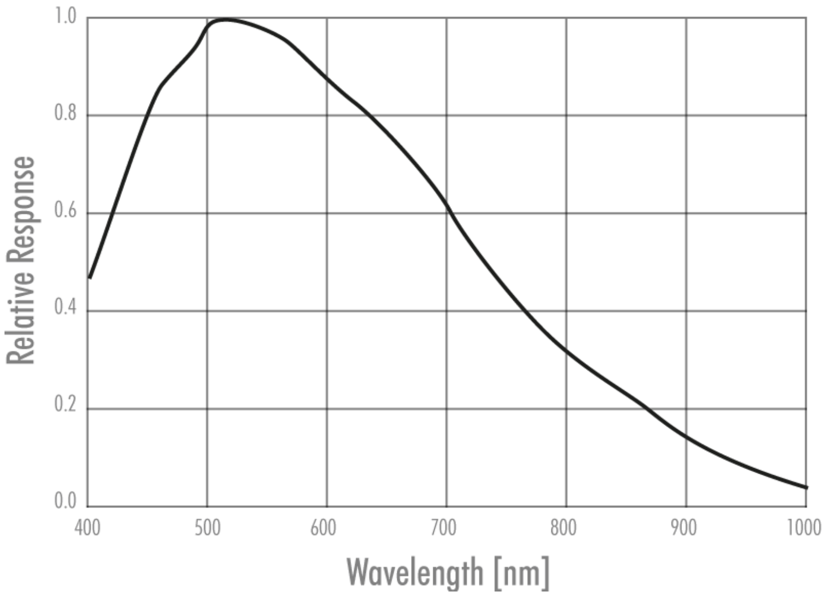
Spectral Sensitivity Characteristics ICX655AQA



Spectral Sensitivity Characteristics ICX655ALA



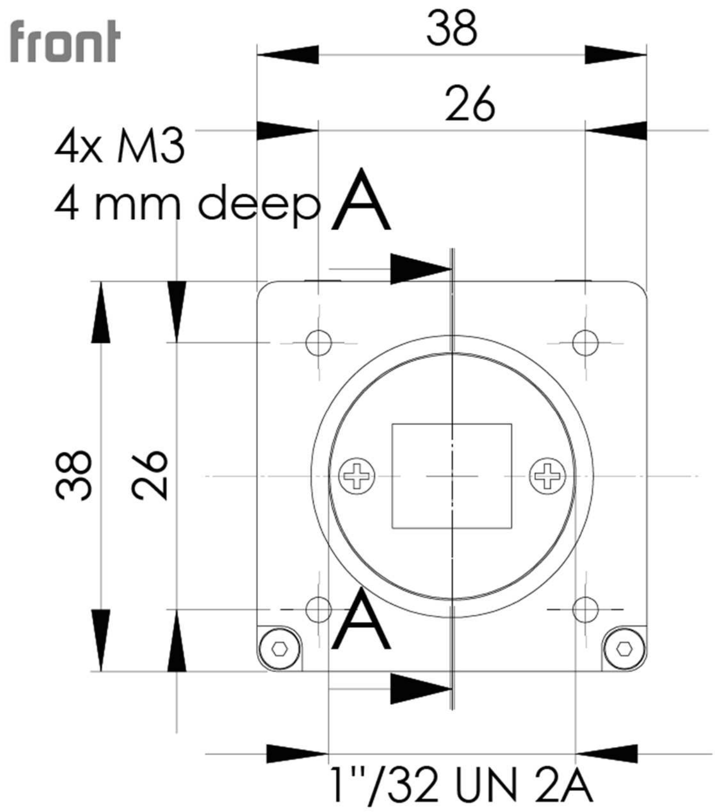
8 Dimensions

All length units in mm.
Find drawings in the web download area at
https://www.svs-vistek.com/en/support/svs-support-download-center.php

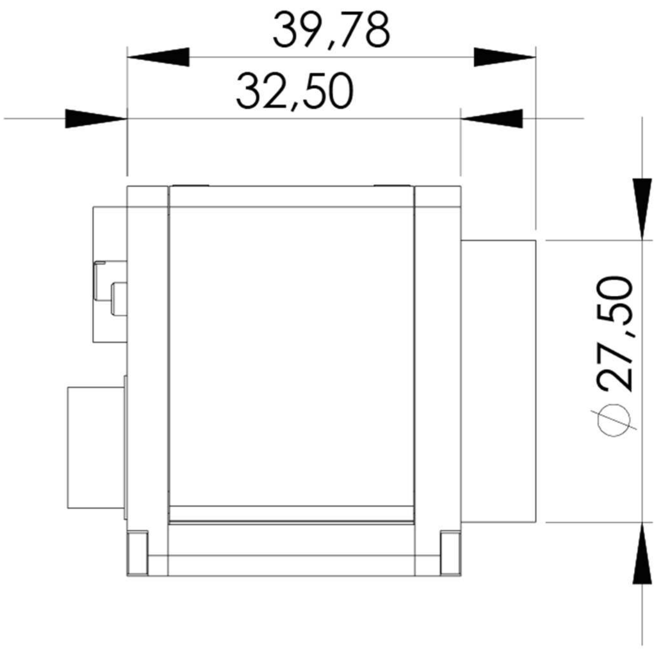
CAD step files available with valid login at SVS-VISTEK.com

8.1 ECO CS-mount

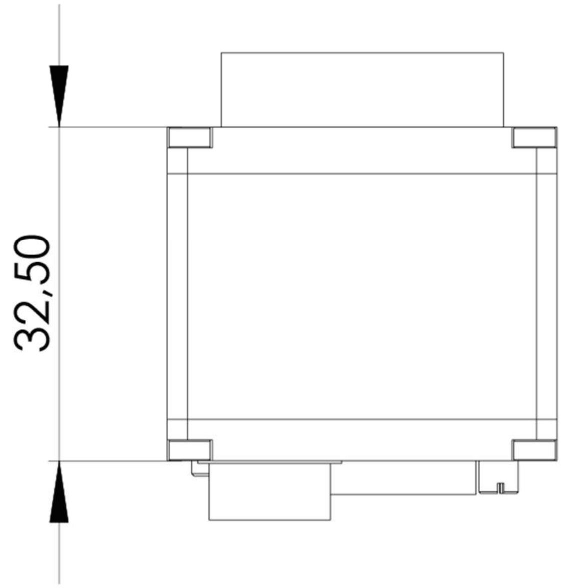
including:
eco204CVGE, eco204CVGE4IO, eco204MVGE, eco204MVGE4IO, eco267CVGE, eco267CVGE4IO, eco267MVGE, eco267MVGE4IO, eco274CVGE, eco274CVGE4IO, eco274MVGE, eco274MVGE4IO, eco414CVGE, eco414CVGE4IO, eco414MVGE, eco414MVGE4IO, eco415CVGE, eco415CVGE4IO, eco415MVGE, eco415MVGE4IO, eco424CVGE, eco424CVGE4IO, eco424MVGE, eco424MVGE4IO, eco445CVGE, eco445CVGE4IO, eco445MVGE, eco445MVGE4IO, eco618CVGE, eco618CVGE4IO, eco618MVGE, eco618MVGE4IO, eco625CTLGEA, eco625CTLGEA4IO, eco625MTLGEA, eco625MTLGEA4IO, eco655CVGE, eco655CVGE4IO, eco655MVGE, eco655MVGE4IO

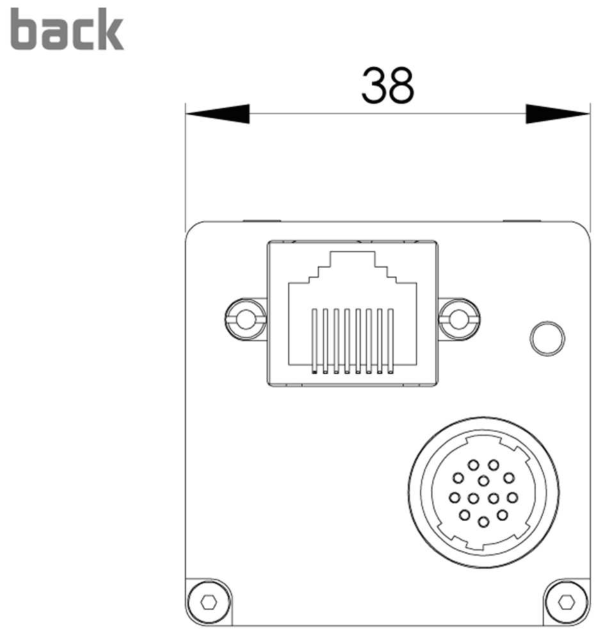


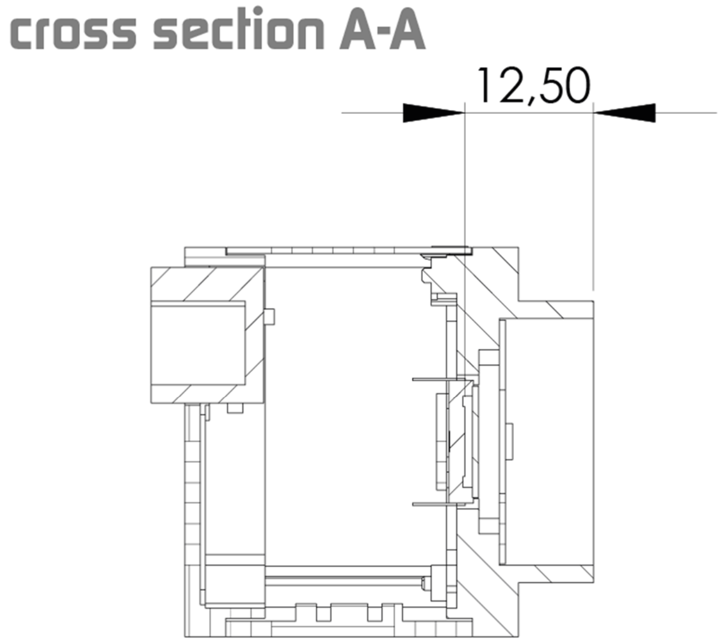
side



bottom



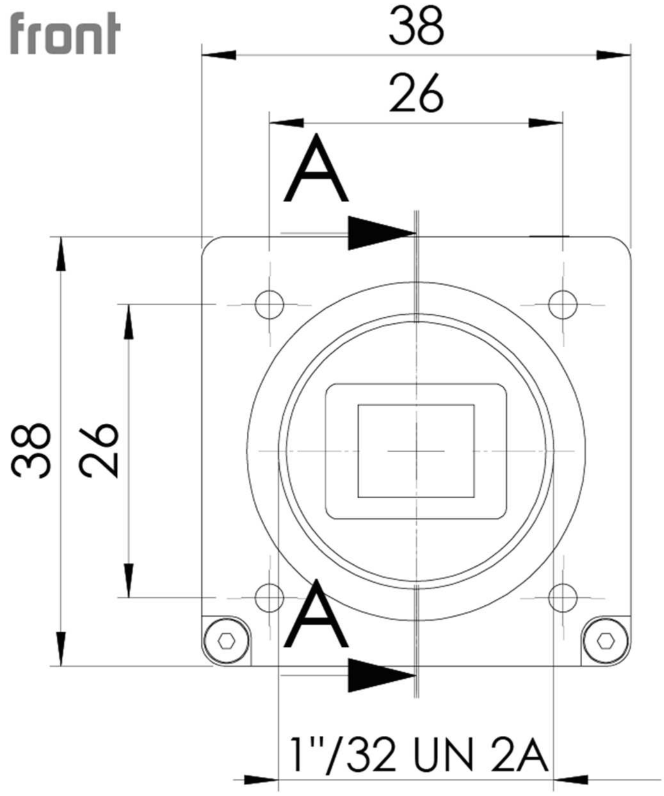




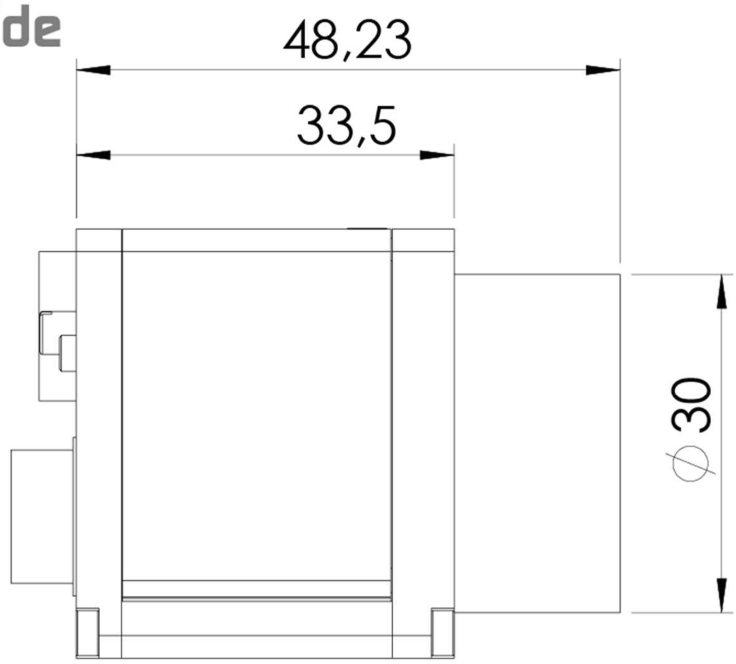
8.2 eco285 C mount

Including:
eco285CVGE, eco285CVGE4IO, eco285MVGE, eco285MVGE4IO

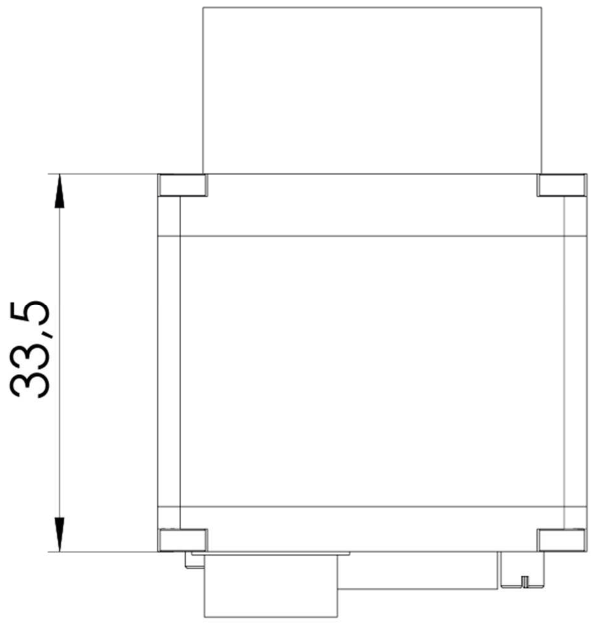
front



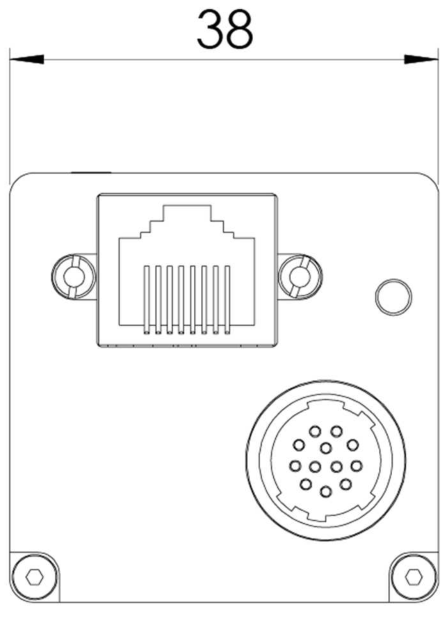
side



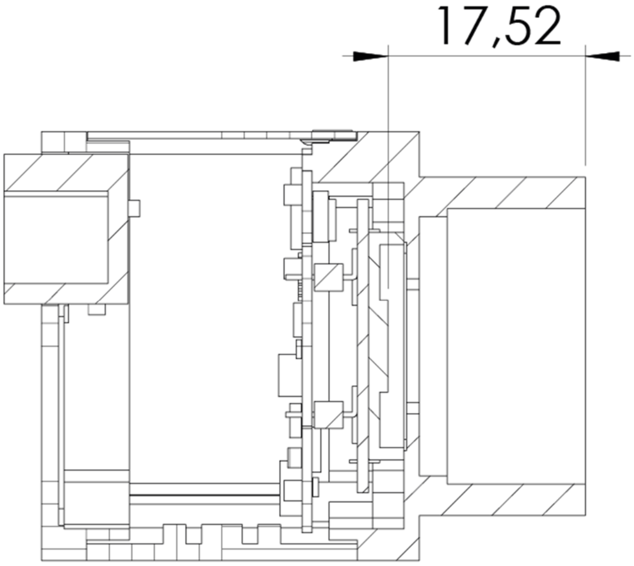
bottom



back



cross section A-A



8.3 C & CS mount

For C & CS mounts, different back focus distances from sensor to lens.

> C-mount: 17,526 mm
> CS-mount: 12,526 mm
> Diameter: 1 inch
> Screw threading: 1/32 inch

CS-mount cameras accept C and CS types of lenses. C-mount lenses require an additional 5mm adapter ring.

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.

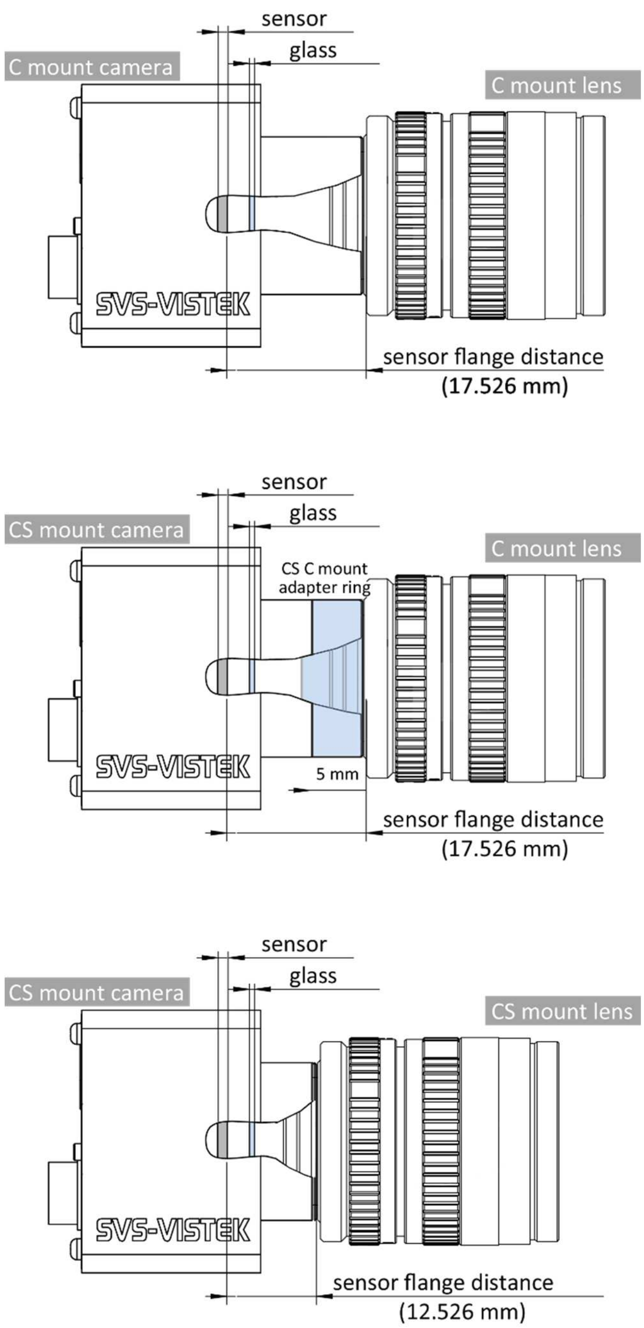


Figure 41: differences of C- & CS-mount

9 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.

10 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.

11 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