Baumer
Passion for Sensors

Operating Manual

VAX(.2) Smart Cameras
(Embedded Processing)

List of contents

1   About this document

1.1   Purpose

This operating manual (subsequently referred to as *manual*) allows the safe and efficient handling of the product .

The manual does not provide instructions on operating the machine in which the product is integrated. Information on this is found in the operating manual of the machine.

The manual is a constituent part of the product. It must be kept in the immediate vicinity of the product and must be accessible to personnel at all times.

Personnel must have carefully read and understood this manual before beginning any work. The basic prerequisite for safe working is compliance with all safety instructions and handling instructions given in this manual.

In addition, the local occupational health and safety regulations and general safety regulations apply.

The illustrations in this manual are examples only. Deviations are at the discretion of Baumer at all times.

1.2   Warnings in this manual

Warnings draw attention to potential personal injury or material damage. The warnings in this manual indicate different hazard levels:

Symbol	Warning term	Explanation
⚠️	DANGER	Indicates an imminent potential danger with high risk of death or serious personal injury if not being avoided.
	WARNING	Indicates potential danger with medium risk of death or (serious) personal injury if not being avoided.
	CAUTION	Indicates a danger with low risk, which could lead to light or medium injury if not avoided.
	NOTE	Indicates a warning of material damage.
💡	INFO	Indicates practical information and tips that enable optimal use of the devices.

1.3   Labels in this manual

Identifier	Usage	Example
Dialog element	Indicates dialog elements.	Click the *OK* button.
Unique name	Indicates the names of products, files, etc.	*Internet Explorer* is not supported in any version.
`Code`	Indicates entries.	Enter the following IP address: `192.168.0.250`

1.4   Liability limitation

All information and notes in this manual have been compiled in accordance with the applicable standards and regulations, the state of the art, and our many years of knowledge and experience.

The manufacturer accepts no liability for damage due to the following reasons:

- Non-observance of the manual
- Improper use
- Use of unqualified personnel
- Unauthorized conversions

The obligations agreed in the delivery contract, the general terms and conditions and the delivery conditions of the manufacturer and its suppliers, as well as the legal regulations valid at the time of conclusion of the contract apply.

1.5   Copyright

Any duplication or reprinting of this documentation, in whole or in part, and the reproduction of the illustrations even in modified form is permitted only with the written approval of Baumer. The information in this document is subject to change without notice.

2   General information

Commissioning

Assembly, installation, and calibration of this product may only be performed by a specialist.

Installation

Only use the fasteners and fastener accessories intended for this product for installation. Outputs not in use must not be wired. Unused wires of cable outputs must be insulated. Do not go below the permissible cable bending radii. Disconnect the system from power before the product is electrically connected. Use shielded cables to prevent electro-magnetic interference. If the customer assembles plug connections on shielded cables, then EMC-version plug connections should be used and the cable shield must be connected to the plug housing across a large surface area.

Disposal (environmental protection)

Used electrical and electronic devices may not be disposed of in household waste. The product contains valuable raw materials that can be recycled. Therefore dispose of this product at the appropriate collection point. For additional information visit www.baumer.com.

3   Description

3.1   Intended use

The Baumer AX Smart Camera is a user programmable, Linux based, all-in-one image processing system for many different applications.

It has a compact housing suitable for industrial use and is designed exclusively for indoor use. The use in wet locations is permissible under consideration of the IP protection class.

3.2   Conception
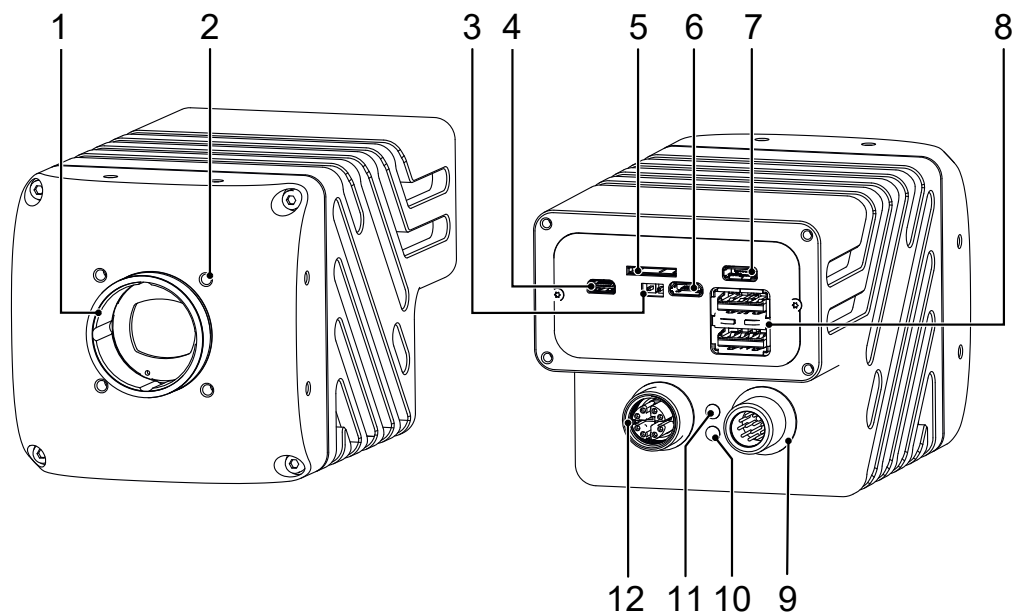
1	Lens mount (C-mount)	2	4 x Tube adapter / front mounting threads
3	Recovery mode jumper	4	Micro HDMI
5	Slot for micro SD card	6	Debug UART
7	Recovery mode (Micro USB)	8	2 x USB3.0 (Type A)
9	Power supply / Digital-IO / RS232	10	Status LED
11	Ethernet LED	12	Gigabit Ethernet Port

3.2.1 Schematic view

3.3 LED signaling
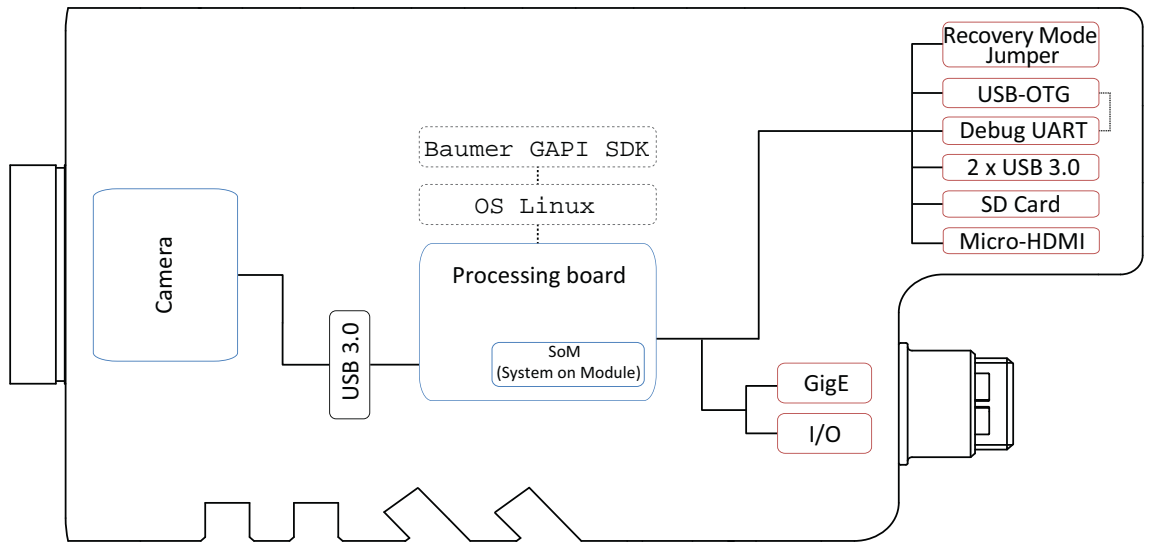
GigE LED (1)   Camera LED (2)
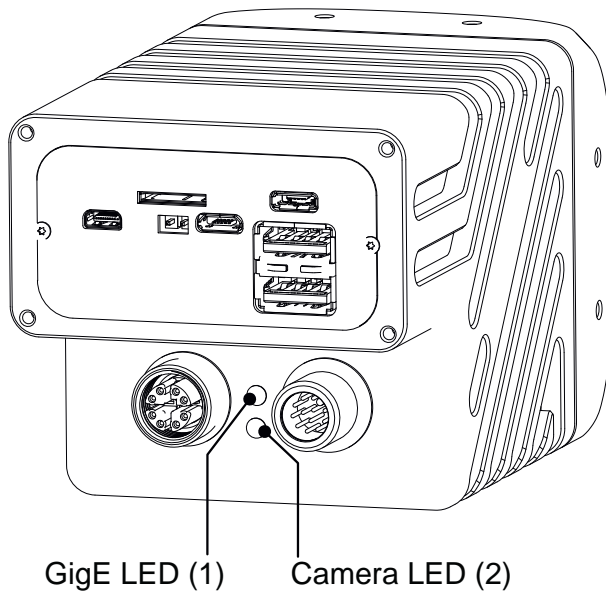
Description	Signal	Meaning
GigE LED (1)	green continuous	Link active
	orange flash	Data traffic
Camera LED (2)	off	Power off / Booting error
	green continuous	Power on

3.4 Camera models

Camera type	System on Module (SoM)	Sensor Size	Resolution (Width × Height)	Full Frames [max. fps]
Monochrome				
VAX(.2)-32M.I.NVN	NVIDIA® Jetson Nano™	1/1.8"	2048 x 1536	55.5
VAX(.2)-50M.I.NVX	NVIDIA® Jetson Xavier NX™	2/3"	2448 x 2048	73
Color				
VAX(.2)-32C.I.NVN	NVIDIA® Jetson Nano™	1/1.8"	2048 x 1536	55.5
VAX(.2)-50C.I.NVX	NVIDIA® Jetson Xavier NX™	2/3"	2448 x 2048	73
VAX-50C.I.NX16	NVIDIA® Jetson Xavier NX™ 16 GB	2/3"	2448 x 2048	73

3.5 Dimensional drawing
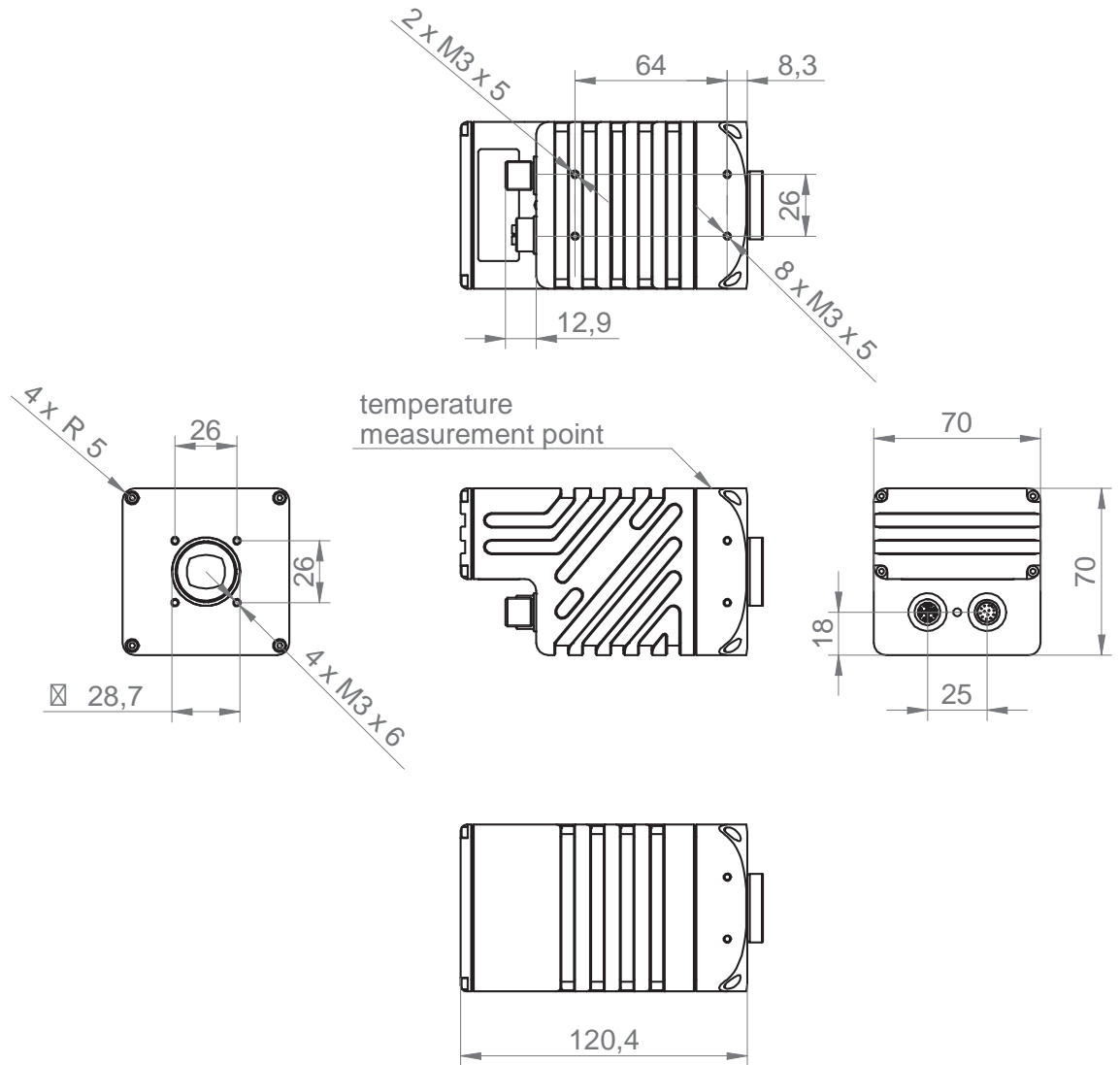
Ill. 1: Dimensional drawing - VAX(.2)

4   Transport and storage

4.1   Transport

> **NOTICE**
>
> **Material damage due to improper transport.**
>
> a) Ensure maximum diligence when unloading the delivered packages as well as when transporting them inside the company.
>
> b) Note the information and symbols on the packaging.
>
> c) Only remove packaging immediately before mounting.

4.2   Delivery inspection

Upon receipt immediately inspect the delivery for completeness and transport damage.

Claim any defect as soon as it is detected. Damages can only be claimed within the applicable claims deadlines.

In case of externally visible transport damage, proceed as follows:

Instruction:

a) Do not accept the delivery or only with reservations.

b) Note the scope of the damage on the transport documents or the delivery slip of the carrier.

c) Initiate the claim.

5 Installation

5.1 Environmental requirements

Storage temperature	-10 °C (+14 °F) … +70 °C (+158 °F)
Humidity	10 % ... 90 % non condensing

5.2 Mechanical Tests

Baumer cameras are tested towards the following standards to ensure industrial suitability.

Test environment	Standard	Parameter	
Vibration, sinusoidal	IEC 60068-2-6	Continuous oscillation	10-2000 Hz
		Amplitude underneath crossover frequencies	0,75 mm
		Acceleration	1 g
		Test duration	150 min (axis) 450 min (total)
Vibration, broad band	IEC 60068-2-64	Frequency range	10-2000 Hz
		Acceleration	10 g
		Test duration	5 h (axis) 15 h (total)
Shock	IEC 60068-2-27	Pulse Time	11 ms / 6 ms
		Beschleunigung	50 g / 100 g
Shocks	IEC60068-2-29	Pulse Time	2 ms
		Acceleration	100 g

5.3   Emergency shutdown at Overtemperature

To prevent the hardware from damage by high temperature, the camera features emergency shutdown. Feature *DeviceTemperatureStatusTransitionSelector* (Category: *DeviceControl*) is for selection of different temperature thresholds:

- *NormalToHigh*: freely programmable value
- *HighToExeeded*: fixed value (if exceeded, the sensor for image acquisition is switched off)
- *ExeededToNormal*: freely programmable, temperature for error-free reactivation

Feature *DeviceTemperatureStatusTransition* is for setting the temperatures for the programmed transition temperatures.

The event *EventDeviceTemperatureStatusChanged* is always generated when *DeviceTemperatureStatus* changes.

If temperature rises above the value set at *HighToExeeded*, function *DeviceTemperatureExceeded* is set to *True* followed by sensor switchoff to reduce power consumption; LED status indicator is red static. This usually will reduce temperature. Further rising temperature inside the camera due to ambient temperature may damage the hardware.

For further use, disconnect the camera from power supply after cool down or execute *DeviceReset*.

The sufficient cooling is recognizable when the event *DeviceTemperatureStatusChanged* (Device Temperature < *ExceededToNormal*) is output.

Temperatures for emergency-off

As soon as the temperature measured at the internal temperature sensor is exceeding the values specified in the table below, function *DeviceTemperatureExceeded* is set to *True* and image acquisition stops.

Camera type	max. temperature (internal sensor)
Monochrome	
VAX(.2)-32M.I.NVN	73 °C (163.4 °F)
VAX(.2)-50M.I.NVX	73 °C (163.4 °F)
Color	
VAX(.2)-32C.I.NVN	73 °C (163.4 °F)
VAX(.2)-50C.I.NVX	73 °C (163.4 °F)
VAX-50C.I.NV16	73 °C (163.4 °F)

5.4 Heat dissipation

NOTICE

Heat accumulation in the device

Heat can damage the device. Ensure adequate heat dissipation. In view of the varied installation options Baumer does not make any recommendation for heat dissipation, but we suggest the following:

a) Any form of convection around device and mounting helps reduce temperature. Prevent any heat accumulation!

b) Mounting combined with forced convection may provide proper heat dissipation.

c) Avoid mounting on stainless steel surfaces. The thermal conductivity of stainless steel is about 10 times worse compared to aluminium.

d) To ensure heat dissipation on both sides, do not install the device at the end of a profile (larger surface for increased temperature reduction)!

e) Do not operate other devices close to the camera. Any waste heat might further heat up the camera.

The cooling requirements of the AX Smart Cameras differ widely depending on the computing power required for the application.

Generally, it is always a good idea to mount the AX Smart Camera on a large aluminum profile or similar mounting point to aid heat dissipation.
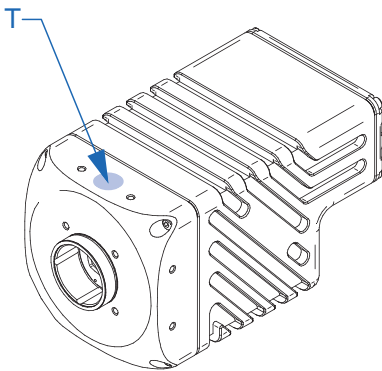
Camera type	Max. Temperature (T = Measurement Point)
Monochrome	
VAX(.2)-32M.I.NVN	65 °C (149 °F)
VAX(.2)-50M.I.NVX	60 °C (140 °F)
Color	
VAX(.2)-32C.I.NVN	65 °C (149 °F)
VAX(.2)-50C.I.NVX	60 °C (140 °F)
VAX-50C.I.NX16	60 °C (140 °F)

Maximum ambient temperature depending on use case

Camera type	Use case	mounted (45 x 90 mm aluminum profile)	not mounted
VAX(.2)-32M.I.NVN VAX(.2)-32C.I.NVN	Full power usage (CPU, GPU & Camera @ 100%)	53 °C (124.7 °F)	40 °C (104 °F)
	Typical power usage (running a typical DNN & Camera)	56 °C (132.8 °F)	46 °C (114.8 °F)
VAX(.2)-50M.I.NVX VAX(.2)-50C.I.NVX VAX-50C.I.NX16	Full power usage (CPU, GPU & Camera @ 100%)	44 °C (111.2 °F)	27 °C (80.6 °F)
	Typical power usage (running a typical DNN & Camera)	52 °C (125.6 °F)	42 °C (107.6 °F)

The integrated NVIDIA® Jetson™ SoM comes with an integrated active thermal management system. If temperatures exceed set boundaries the CPU and/or GPU Cores will reduce their maximum clock frequency as required.

The NVIDIA® tool tegrastats can help monitor temperature and clock rates.

5.5   Lens mount

Avoid contamination of the sensor and the lens by dust and airborne particles when mounting the lens to the device!

Therefore the following points are very important:
- Install the camera in an environment that is as dust free as possible!
- Keep the lens mount covered if no lens is attached
- Hold the camera downwards with unprotected sensor.
- Avoid contact with any optical surface of the camera!

5.6   Filter exchange

Color cameras integrate a filter. This filter may limit the sensor use in certain applications.

To replace the filter, proceed as follows.

NOTICE

Dust-contaminated optical surfaces
Prevent filter, sensor and lens from contamination by dust and suspended matter!
Any filter exchange only in a dust-free room and using clean tools!
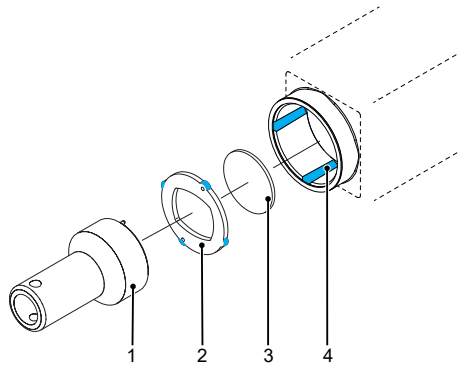
1	Assembly tool	2	Filter support
3	Filter	4	Guide grooves

Instruction:

a) Place the mounting tool (1) into the sensor opening. Place both front pins into the holes provided at the filter support (2).

b) Turn filter support (2) until the lugs can be seen in the guide grooves (4).

c) Remove the filter support (2).

d) Carefully remove the filter (3). When doing so, do not touch the sensor!

e) Insert a new filter into the sensor opening.

f) Replace the filter support (2).

g) Turn the filter support (2) until the lugs are no longer visible in the guide grooves (4).

5.7 Modular tube system (please order separately)

Specific camera models allow for varied *modular tube systems* as lens protection.

Instruction:

a) Mount the *Modular Tube System* as shown in the illustration below.

b) Baumer recommends ELKALUB GLS 867 grease for easier installation of the sealing rings (5).

c) Tighten the screws (3) with a torque wrench to 0.9 Nm.

d) If you need more space for a lens, use a corresponding distance ring (2).
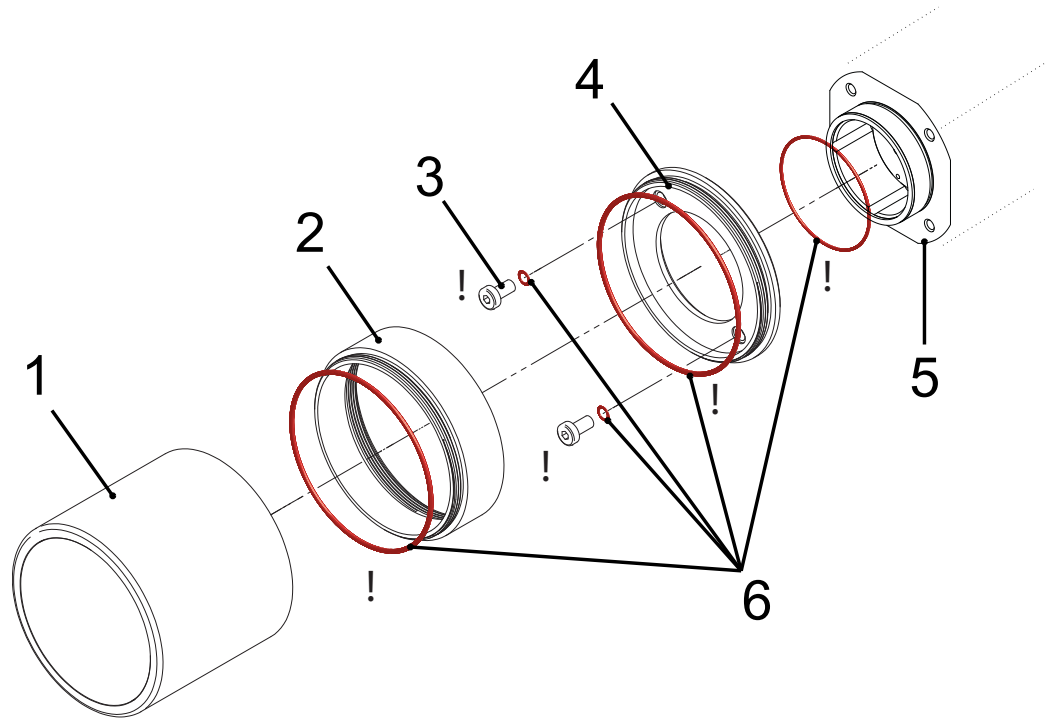
1	Tube	2	Spacer
3	Screw	4	Tube adapter
5	Camera	6	Sealings

Tube adapter

M 47

A-A

Ø 49,5

3,25

2,75

2,5

M47 x 0,75

3

5,25

Art. No.: 11185373

M 62

A-A 3,25

Ø 65

2,75

2,5

M62 x 0,75

3

5,25
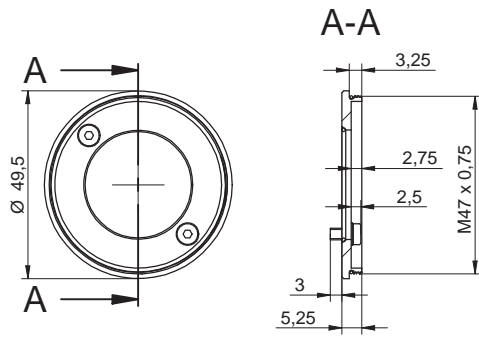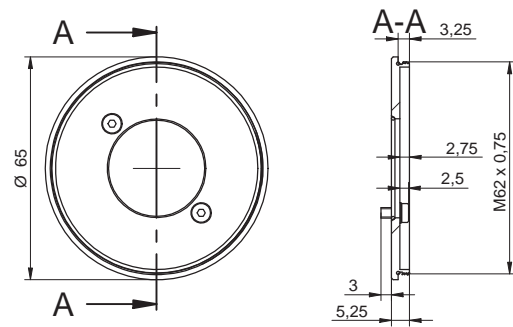
Art. No.: 11185377

M 92

A-A

Ø 95

3,25

2,75

2

M92 x 0,75

3,5

5,25
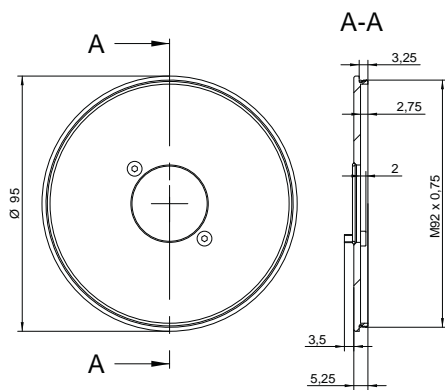
Art. No.: 11704311

Spacer

M 47

Art. No.: 11185372
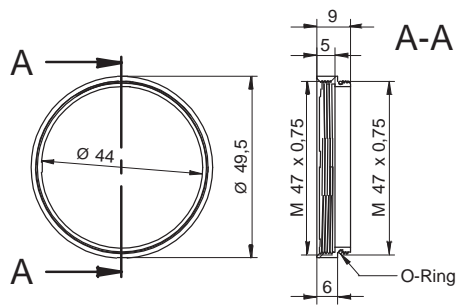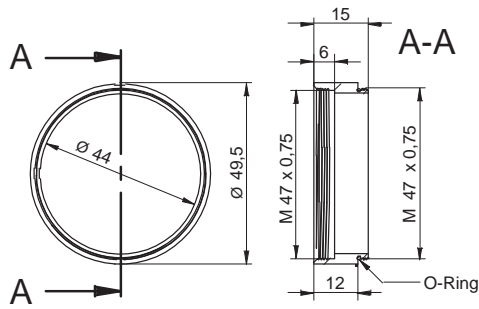
Art. No.: 11185371

Art. No.: 11211571

M 62

Art. No.: 11185376
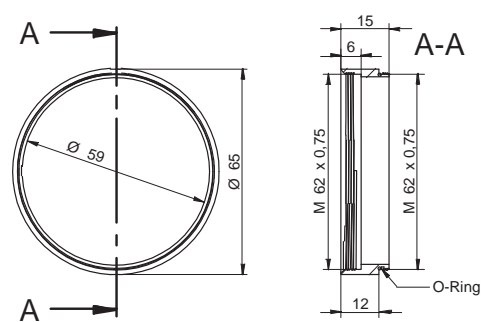
Art. No.: 11185375

Art. No.: 11198906

M 92

A-A

Ø 89
Ø 95

9
4.8

M92 x 0.75
M92 x 0.75

O-Ring
6

Art. No.: 11704395

A-A

Ø 89
Ø 95

15
7.25

M92 x 0.75
M 92 x 0.75

O-Ring
12

Art. No.: 11704397

A-A

Ø 89
Ø 95

39
7.25

M 92 x 0.75
M 92 x 0.75

O-Ring
36
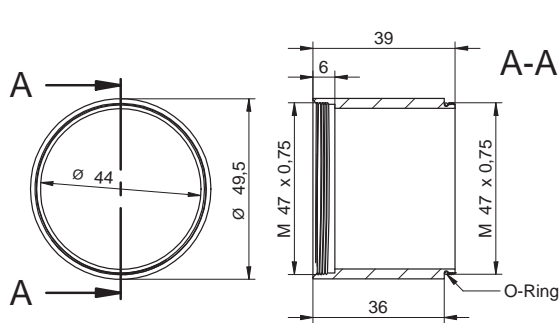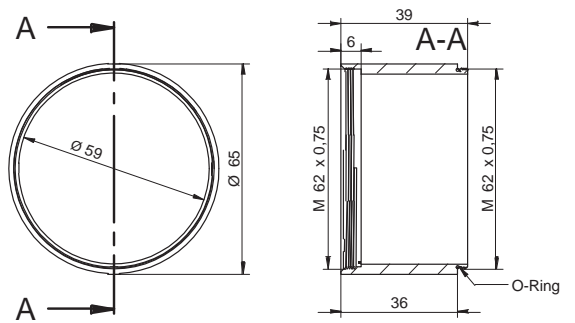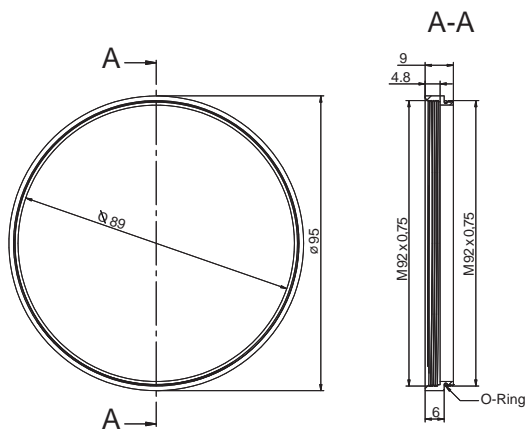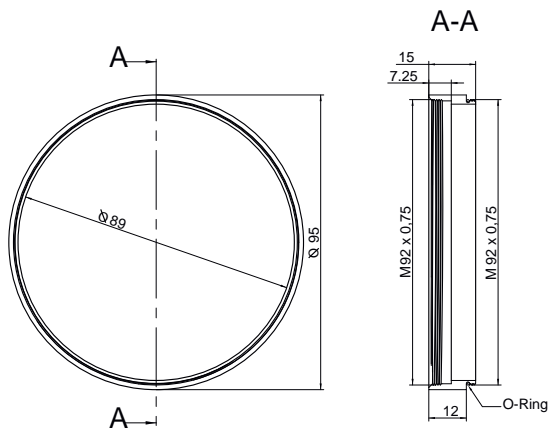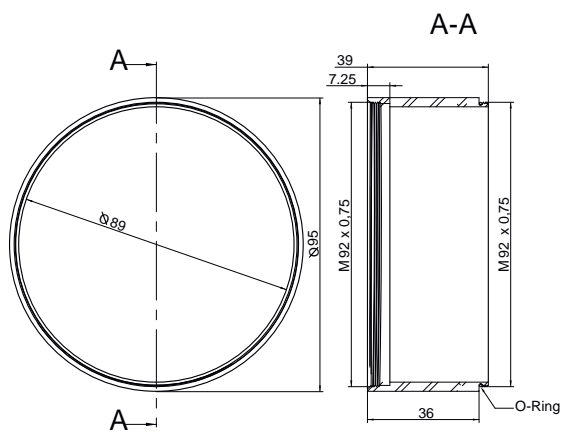
Art. No.: 11704394

Tube

M 47

A → ⌀ 49,5

A-A

M47 x 0,75 | ⌀ 46 | ⌀ 38,1

4 | 40,5 | 44
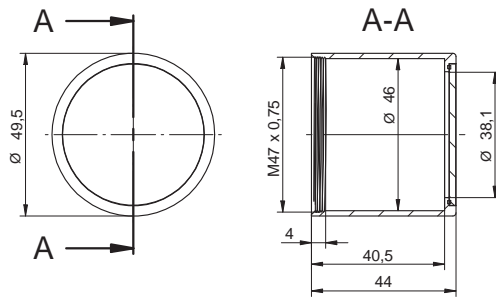
Art. No.: 11185370 (Cover Glass: Acryl)

Art. No.: 11195425 (Cover Glass: restistant laminated safety cover glass)

M 62

A → ⌀ 65

A-A

M62 x 0,75 | ⌀ 61 | ⌀ 50,2

4 | 54,5 | 58
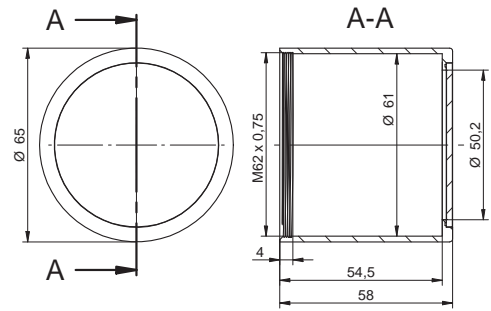
Art. No.: 11185374 (Cover Glass: Acryl)

Art. No.: 11195426 (Cover Glass: restistant laminated safety cover glass)

M 92

A → ⌀ 95

A-A

M92 x 0,75 | ⌀ 91 | ⌀ 83,1

5 | 66,5 | 70
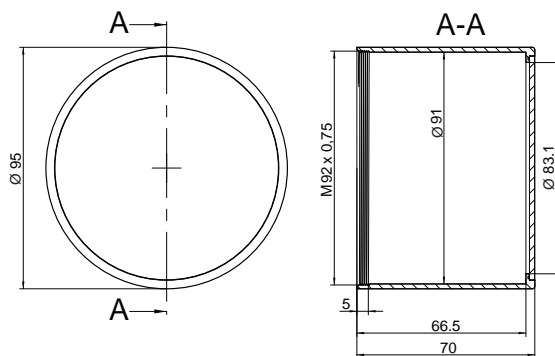
Art. No.: 11704312 / Cover glass: PMMA (Acryl)

Tube: inner dimensions

M 47

35 | ⌀ 46 | ⌀ 38,2 | 44

M 62

49 | ⌀ 61 | ⌀ 50,2 | 58
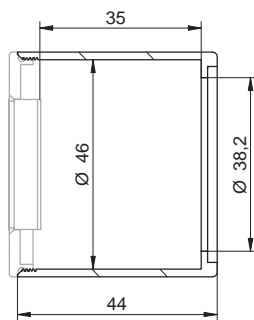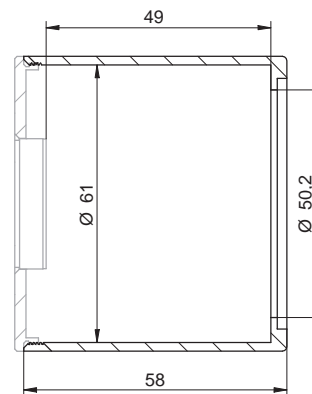
M 92
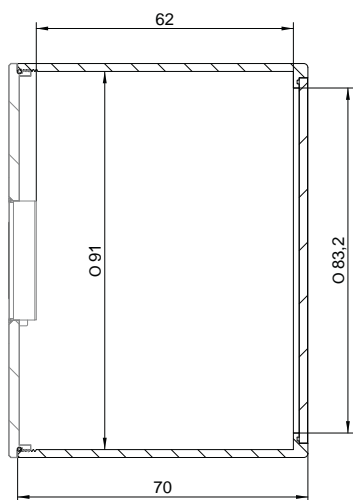
6 Optical specification

6.1 Sensor position accuracy

The typical accuracy by assumption of the root mean square value is displayed in the figure and the table(s) below.
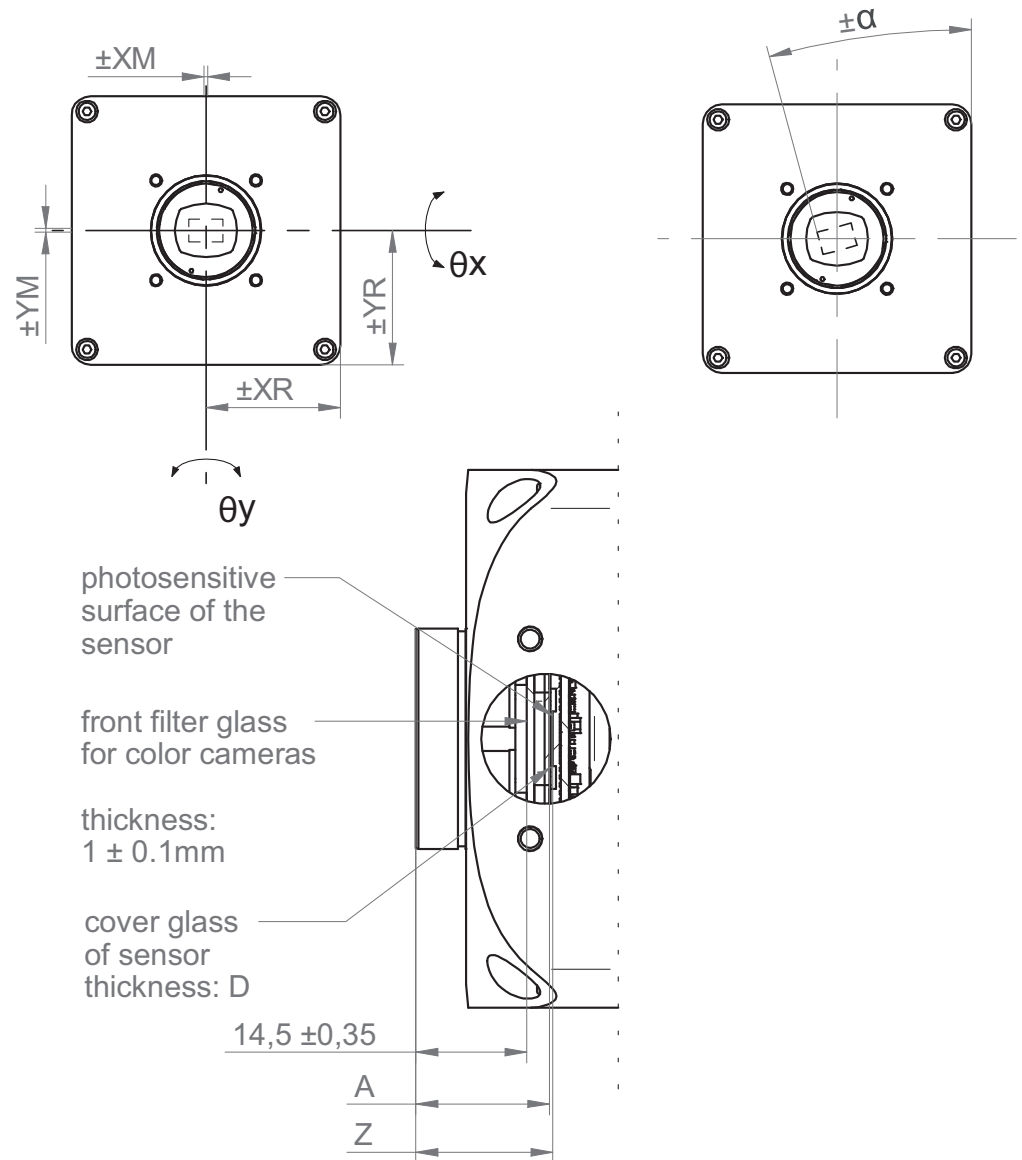
Camera type	± x_M [mm]	± y_M [mm]	± x_R [mm]	± Y_R [mm]	z^{***}_{typ} [mm]	± α_{typ} [°]	A*** [mm]	D** [mm]
VAX(.2)-32*	0.17	0.17	0.17	0.17	17.63 ± 0.070	0.6	16.5	0.70
VAX(.2)-50*	0.17	0.17	0.17	0.17	17.63 ± 0.070	0.6	16.5	0.70

Typical precision by assumption of the average square root value

* C or M

**; Dimension D specified in the table was taken from the manufacturer datasheet

*** For color, add 0.35 mm to the nominal value.

6.2   Spectral sensitivity

The spectral sensitivity characteristics for cameras of this series are displayed in the following graphs. The characteristic curves for the sensors do not take the characteristics of lenses and light sources without filters into consideration.

Values relating to the respective technical data sheets.

Filter glasses / Cover glasses
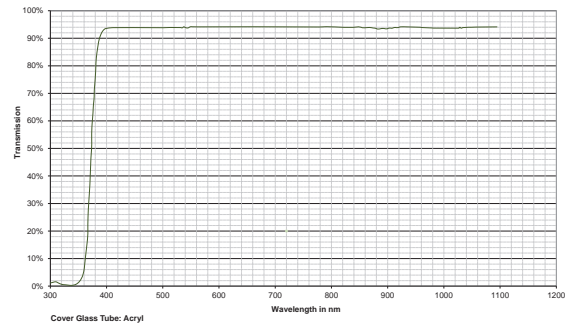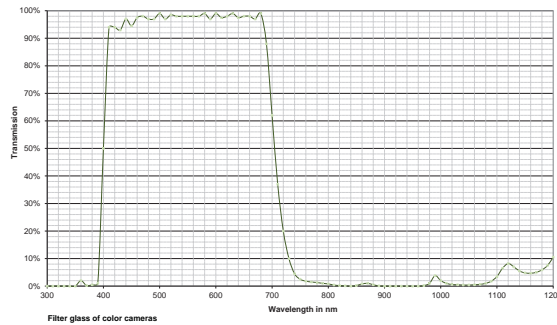
Filter glass color camera
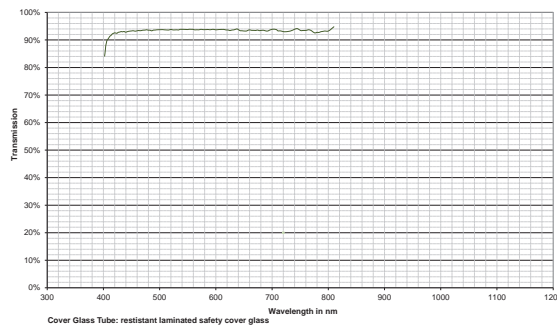
Filter glass Tube Acryl

Filter glass Tube laminated safety glass

Cameras

Sony® IMX 265 mono
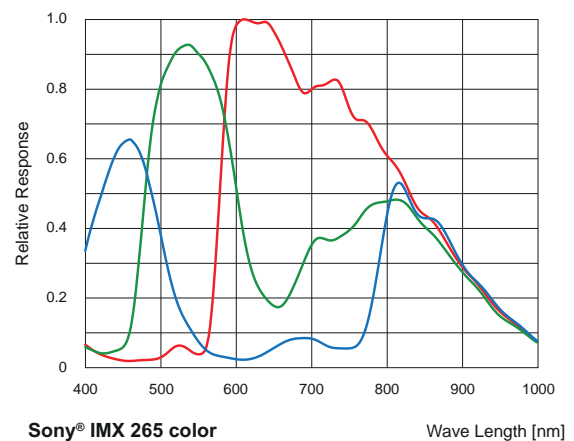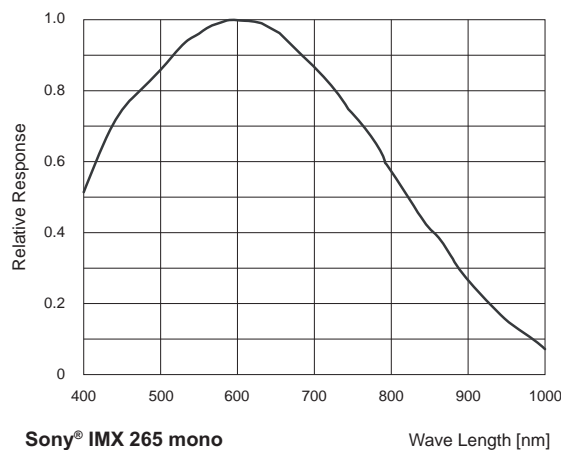
Spectral sensitivity VAX(.2)-32M (IMX265)

Sony® IMX 265 color

Spectral sensitivity VAX(.2)-32C (IMX265)

Sony® IMX 250 mono   Wave Length [nm]
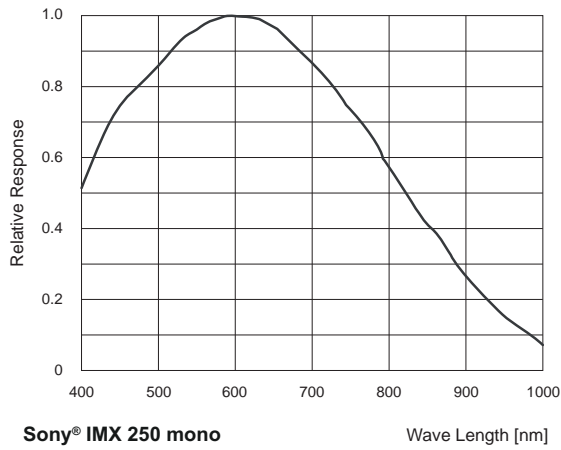
Spectral sensitivity VAX(.2)-50M (IMX250)

Sony® IMX 250 color   Wave Length [nm]
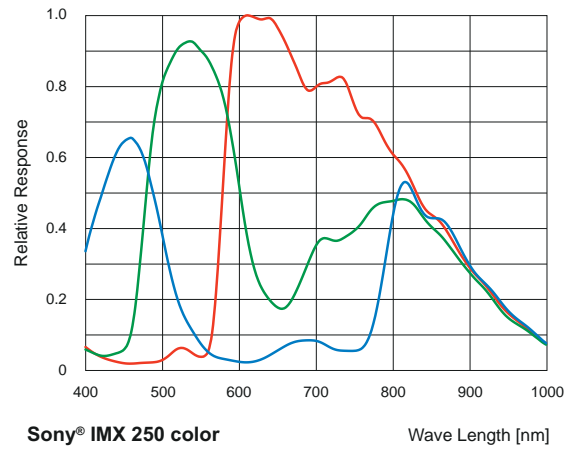
Spectral sensitivity VAX(.2)-50C (IMX250)

7 Electrical installation

7.1 General instructions for electric installation

NOTICE

Device damage due to faulty power supply.

The device can be damaged due to faulty power supply.

  a) Operate the device only with protected low voltage and safe electrical isolation of protection class III.

NOTICE

Device damage or unintended operation due to work on live parts.

Any wiring work on live parts may lead to unintentional operation.

  a) Prior to performing any wiring work disconnect power supply.

  b) Only connect or disconnect any terminals when not live.

7.2 Wiring (example)

What is included:

- The AX Smart Camera
  - Cover
  - UMO/UM2 jumper
  - M12 dust cover
  - C-Mount dust cover
- preinstalled OS and software

What is not included:

To use the AX Smart Camera further components are required:

- 24 V Power Supply (min. 25 W)
- M12 power / GPIO cable
- suitable C-Mount lens

To access all features of the AX Smart Cameras we recommend also following:

- USB keyboard and mouse
- HDMI monitor
- Micro HDMI adapter
- M12 X-Coded Ethernet cable
- a computer with internet connection is required for flashing the device
- USB Type A to micro B cable

Baumer provides a large variety of optional accessories which are tested to work with AX Smart Cameras:
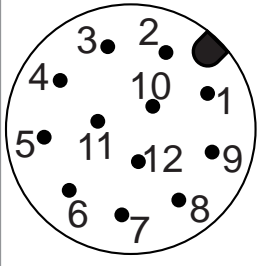
- IP67 Tubing System for lens protection
- larger end-lid to cover USB-License-Dongles or small USB Sticks
- Mounting Plate with tripod-thread
- M12 process and Ethernet cables with a variety of specifications and length
- various C-Mount lenses
- various lighting options
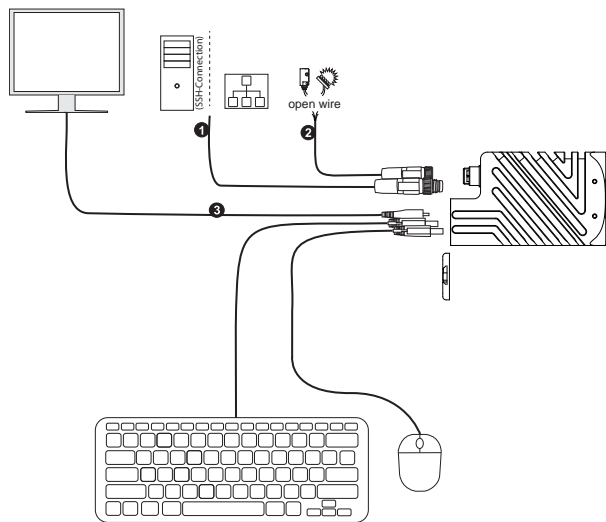
1	Ethernet cable (SSH-Connection / Network)	3	HDMI cable
2	Cable for power supply, Digital-IO		

7.3 Pin assignment

Power supply / Digital IO

1	Power Vcc (24 V ± 20 %)	7	OUT3
2	GND (Power)	8	RS232 TxD
3	IN1 (Camera Line 1)	9	OUT4
4	OUT1 (Camera Line 2)	10	RS232 RxD
5	IN2	11	GND (IO)
6	OUT2	12	Power (IO)

Core colors (cable not included in delivery)

1	BN – Brown	2	BU – Blue
3	WH – White	4	GN – Green
5	PK – Pink	6	YE – Yellow
7	BK – Black	8	GY – Grey
9	RD – Red	10	VT – Violet
11	GY-PK – Grey Pink	12	RD-BU – Red Blue

Ethernet interface

1	MX1+	2	MX1-
3	MX2+	4	MX2-
5	MX4+	6	MX4-
7	MX3-	8	MX3+

⚠ **DANGER**

Moisture intrusion at the port

In order to achieve the mentioned IP protection level and to prevent danger by electric shock, the unused port must be sealed with a protective cap.

7.4   Power supply

Class 2 per NEC / Protection Class III

The device is intended to be supplied from an isolated Limited Energy Source per UL61010-1, 3rd ed cl. 9.4 or Limited Power Source per UL60950-1 or Class 2 per NEC.

> ⚠ **DANGER**
>
> **Use in wet environments requiring IP67 protection**
> Risk of electric shock. Electric shock can be fatal or cause serious injury.
>
> a) Use is only permitted under consideration of pollution degree 2 and overvoltage category 2.
>
> b) The M12 connectors must comply with the IEC 61076-2-101 standard.
>
> c) The dielectric strength and withstand voltage for the plug / socket combination must be checked according to DIN EN 60664-1:2008-01 for 60 V.

Power Vcc	24 V (± 20 %)
Power IO	12 V (- 20 %) ... 48 V (+ 10 %)

7.5   Digital-IO

The *System on Modules* of the AX Smart cameras differ in the internal wiring of the digital IO
(Out 2). For more information please see the following wiring diagrams.

NVIDIA® Jetson Nano™

Camera Type	System on Module(SoM)
Monochrome	
VAX(.2)-32M.I.NVN	NVIDIA® Jetson Nano™
Color	
VAX(.2)-32C.I.NVN	NVIDIA® Jetson Nano™
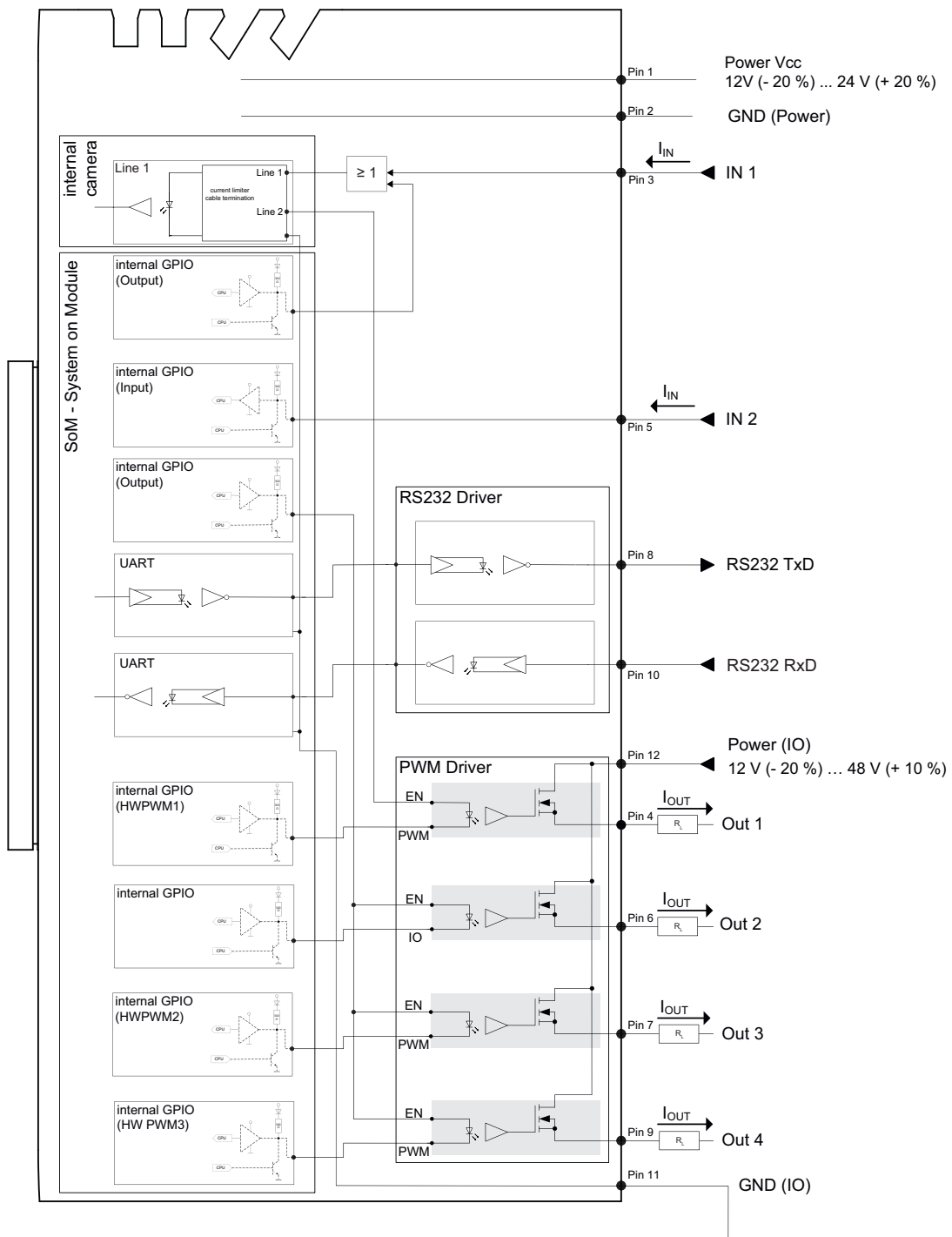
NVIDIA®Jetson Xavier NX™

Camera Type	System on Module(SoM)
Monochrome	
VAX(.2)-50M.I.NVX	NVIDIA® Jetson Xavier NX™
Color	
VAX(.2)-50C.I.NVX	NVIDIA® Jetson Xavier NX™
VAX-50C.I.NX16	NVIDIA® Jetson Xavier NX™
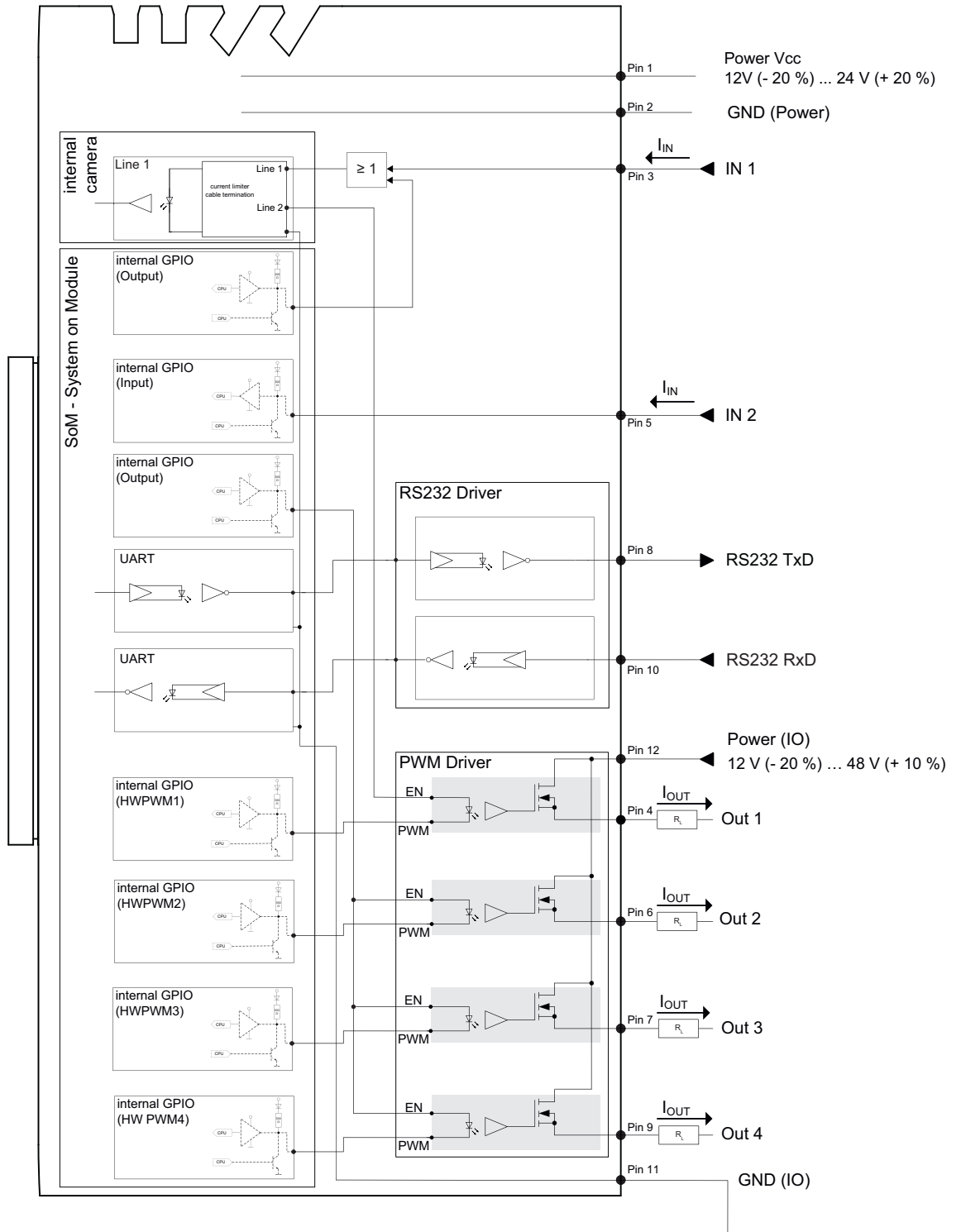
8 Maintenance

The sensor is maintenance-free. No special preventive maintenance is required. Regular cleaning and visual inspection of the plug connections are recommended.

8.1 Cleaning

Due to its compact design, the device is characterized by almost maintenance-free operation. When used for the intended purpose, it is possible that the device may need to be cleaned from time to time. Very clean optical surfaces (cover glass) are required for the consistent and reproducible operation of the device.

The device requires cleaning if the captured frames resemble the following example. In order to test the camera, capture a homogenous image (test target could be a white sheet of paper).

Filter / Cover glass sensor

NOTICE

Cleaning with compressed air

Compressed air may force dust into the camera.

Never use compressed air to clean the filter / cover glass!

Use a soft, lint free cloth dampened with a small amount of pure methanol for cleaning.

Housing

NOTICE

Cleaning with volatile solvents

Volatile solvents can damage the surface of the camera.

Never use volatile solvents (benzene, thinner) for cleaning!

Use a soft, dry cloth to clean the surface of the camera housing. To remove persistent stains, use a soft cloth dampened with a small quantity of neutral detergent. Then wipe dry

---

Tube cover glass

For cleaning, use a soft, lint-free cloth to clean the surface of the tube cover glass with a gentle pressure, without scratching.

To clean stubborn dirt, commonly available window cleaning agent is recommended.

- Ensure that no residues of the cleaning agent or scratches remain on the glass. These can permanently damage the reproducibility of the results from the device.
- As so many cleaning agents are available, we hope you understand that we cannot test every single one. Resistance to cleaning agents and areas of use depends upon the specific application.
- Cleaning agents must be tested on an discreet area of the device under application conditions to evaluate if they are suitable.

Camera materials

Components, parts	Material
Camera support	Aluminum (anodized)
Housing center	Aluminum (anodized)
M12 interfaces	Copper-zinc alloy (CuZN, nickel-plated)
Fiber-optics (LED)	Polycarbonate
Cover	Aluminum (anodized)
Screws	galvanized steel / stainless steel
Label	Foil composite with aluminum
Seals (not openly accessible)	Gomastit 400

9 Troubleshooting

9.1 Support

In case of any questions please contact our Technical & Application Support Center.

Worldwide

Baumer Optronic GmbH

Badstrasse 30

DE - 01454 Radeberg

www.baumer.com

Tel.: +49 (0)3528 4386 845

support.cameras@baumer.com

9.2 Accessories

You can find accessories at the website at:

https://www.baumer.com

10   Software

10.1   Installed OS and software

The AX Smart Camera System image is based on Ubuntu® extended with NVIDIA® L4T (Linux® for Tegra®). It includes Linux®, boot loader, NVIDIA® drivers, flash utilities, root file system based on Ubuntu® and everything else required for the Jetson™ platform.

This image uses LXDE as desktop environment for minimum disk and memory footprint. Additionally, you'll find the Baumer tools to work with the integrated camera:

- *Baumer GAPI* & NeoAPI SDK's for C++ and Python™
- Baumer *Camera Explorer*
- Baumer IO-libs (to control the Digital IO)
- Baumer Code Examples
- additional technical documentation

You are free to install any further packages or components you might require. This is best done using the Linux® `apt-get` command. This also allows you to replace any of our default packages with the ones you prefer.

☀ INFO
Risk of data loss

Do not disconnect the AX Smart Camera after change of data from the power supply! Shut down the camera via the operating system or perform a restart via the operating system.

In both cases, the camera is restarted. When the operating system has been loaded, you can disconnect the camera from the power supply.

10.2   Getting started

The AX Smart Cameras can be used similar to a standard Linux PC. That means, that once you connect keyboard, mouse, monitor and a suitable power supply, you can work on it directly. This is the easiest way to get familiar with the AX Smart Cameras.

However, to be more productive, most people will choose to do actual software development on their PC and use a cross compile workflow to create software which can then be transferred and run on the AX Smart Camera.

☀ INFO
Risk of inaccessible hardware

You have the freedom to do anything on the file system. This includes operations which can render the hardware inaccessible. This case might require reflashing the original software as described.

10.3   Setup assistant

The AX Smart Camera will start to boot into the Linux® operating system as soon as a power supply is connected.

When first starting the AX Smart Camera you will be presented with the initial setup assistant. This assistant will guide you through the few necessary steps to set up the AX Smart Camera for further usage. All of the chosen settings can be changed later on.

INFO

System Configuration Wizard starts during initial startup. If no HDMI cable is connected, the system expects input via the DEBUG UART interface.

INFO

The most critical step is the setup of the root user and password. Please ensure that you document this user name and password securely. Without that user / password you will not be able to access the camera!

Only a complete flashing of the operating system will help in this case, which destroys all data and configuration on the camera.

Instruction:

  a) Connect all cables.

  b) Activate the power supply.

     ✓ The operating system boots and the System Configuration Wizard is started.

  c) Follow the instructions of the System Configuration Wizard. The System Configuration Wizard will guide you through the few necessary steps to set up the camera for further usage. All of the chosen settings can be changed later on.

     ✓ The desktop is loaded. **The setup is not yet complete!**

  d) Shut down the camera via the operating system or perform a restart via the operating system. In both cases, the camera is restarted. **When the operating system has been loaded, you can disconnect the camera from the power supply.**

Result:

  ✓ The system is set up with your settings.

10.4   First log-in

Once you finished the setup assistant, you can log-in with your chosen user name and password.

After your successful log-in, you will be presented with the *lxde* desktop. Obviously, you are free to install an alternative desktop if required.

In the start menu in the lower left hand corner you find the usual standards like a file manager (*PCManFM*), editor (*Leafpad*) and terminal (*LXTerminal*).

INFO

The file system is read-only when you start the AX Smart Camera! It only appears to be writable through an overlay file system. Please read the further information about working with an overlay file system.

10.5 Check the version of the system image

Baumer will periodically release bugfixes and updates for the system image. Those will be available from the baumer website: https://www.baumer.com/ax-software

You can check the file `/etc/vax_release` which contains the current version number. If the image on the website is newer, you can update the image as described in the chapter

Steps to flash the camera's operating system [▶ 47].

10.6 The Smart Camera and Baumer software

Pre-installed on the AX Smart Camera is the Baumer *Camera Explorer* which you can run from the start menu. Once the *Camera Explorer* is started you should see a first image from the integrated camera.

The *Camera Explorer* allows you to configure all the settings of the integrated camera and display or record images from the integrated camera. The *Camera Explorer* is also a good tool to fix any minor problems which might arise.

Also pre-installed are the Baumer neoAPI and GAPI camera SDK's. Those are used to configure the integrated camera and retrieve images.

The neoAPI is a modern API for GenICam™ compatible cameras, such as the Baumer cameras. It hides much of the complexity typically associated with handling GenICam™ cameras to reduce code complexity and required time for development. The Baumer neoAPI is available for Python™ and C++.

The Baumer GAPI API is the more traditional API which gives you more flexibility for advanced use cases. The Baumer GAPI is only available for C++.

The provided documentation and examples for each API will help you walk the first steps.

Baumer neoAPI Python™ documentation:	`/opt/baumer-neoapi-x.x.x-py/docs/`
Baumer neoAPI Python™ examples:	`/opt/baumer-neoapi-x.x.x-py/examples/`
Baumer neoAPI C++ documentation:	`/opt/baumer-neoapi-x.x.x-cpp/docs/`
Baumer neoAPI C++ examples:	`/opt/baumer-neoapi-x.x.x-cpp/examples/`
Baumer GAPI C++ documentation:	`/opt/baumer-gapi-x.x.x/docs/`
Baumer GAPI C++ examples:	`/opt/baumer-gapi-x.x.x/examples/`
Baumer *Camera Explorer*:	`/opt/baumer-camera-explorer/bin/`

`x` = version number

10.7   Change network settings

Another common task is to change the default network settings to suit your application. All settings should be configured with the network manager which can also configured on terminal using `nmcli`.

For example to configure the first ethernet connection to use static ip call:

`nmcli c modify Wired\ Connection\ 1 ipv4.addresses "169.254.1.10/16" ipv4.method manual`. This settings are applied after setting the connection up again using: `nmcli c up Wired\ Connection\ 1`

A simple call to `nmcli` will show you now all available connections and their settings.

Please see the available online documentation for the Gnome Network manager for further details.

10.8   Connect via SSH

After running the setup assistant you can connect to your AX Smart Camera remotely using `ssh` and login with the password you have chosen during the setup.

Connect over Ethernet

For that you have to connect the M12 Ethernet Connector of the AX Smart Camera to a local switch or directly to your working PC.

You need to know the IP of the AX Smart Camera in the network.

`ssh <login>@<ip-adress>`

If you prefer, you can also use ssh keys to login without password prompt.

Connect over USB-OTG

If you connect the AX Smart Camera using a USB cable on the USB recovery connector to your PC, a simulated network should show up. This network has the IP-address `192.168.55.1`.

`ssh <login>@192.168.55.1`

10.9   The Read-only file system

For an industrial capable system it is very important, that the system will start up reliably even after a unplanned power loss. However due to the way flash memory is handled, write operations to the file system can corrupt important files or data during power loss.

To protect the file system in such events, the AX Smart Camera file system provides two partitions, `/` and `/home`. The `/` partition mounts in Read-only, while `/home` mounts write. This way it is ensured there is no writing into the flash memory during operation. Reading of both partitions is safe.

Persistent data such as configuration should be stored on the `/` partition. Operational data should use the `/home` partition. Make sure that this data is backed up regularly to prevent data loss. Should `/etc/fstab` require modification, e.g. when permanently adding an SD card, you will find the fstab-template files for ro- and rw-mode in `/opt/baumer-vax/ro`. Only change the fstab-files in this directory. fstab in `/etc` is replaced when changing write mode.

10.9.1   Changing the home partition size

The default partition size of `/home` is 500 MB. Though the size can be changed, it is recommended to maintain the default size.

Prior to changing the home partition, please verify the following:

- all static data such as applications, neural networks etc. are outside the home partition
- whether working on ramdisk or SD card is feasible

If the above points are met, the, the home partition can be enlarged. Setting the change is by flashing only. To increase the size, call up the flash script of the required size in MegaBytes `./flash.sh -h=1500` as described in chapter *Steps to flash the camera's operating system [▷ 47]*.

10.9.2   Start with writable partition (/)

For software installation or copying programs or data to the AX Smart Camera, the camera must be booted using a writable `/ partition`. For doing so, execute script `/opt/baumer-vax/ro/configure-rw-boot.sh` with root rights, then reboot.

To permanently disable Read-only mode, execute script with the first argument `permanent`. Calling the script again without `permanently` will enable Read-only mode after the second restart.

INFO

Permanently disabling Read-only mode in production environments is not recommended due to the risk that devices will no longer be operational after a power failure.

10.10   Install / uninstall software packages

Many different software packages are available for the AX Smart Camera through the Ubuntu® and NVIDIA® repositories and can be installed as required. To access this repositories the Linux® standard tool `apt-get` is used.

The `apt-get` command allows you to search, install and remove packages and handles depencies for you.

You can also add your own repositories to the `/etc/apt/sources.list` to install your own software or copy software manually.

If you are not familiar with `apt-get`, please visit one of the many tutorials available online.

10.11   Add / change / delete services

The AX Smart Camera uses the Linux® `system.d` supervisor. This supervisor can be used to start additional provided services or help create your own.

The Debian® online documentation for `system.d` might help you to get started.

10.12   Using the Inputs, Power Outputs and RS232

To control the power-outputs or read the value of inputs the AX Smart Camera provide the `vax_io` libraries for C and Python™. To trigger the internal camera or to use its flashes, the IOs must also be initialized on the VAX Smart Camera via the `vax_io` libraries.

This libraries are located at `/opt/baumer-vax/vax_io`.

Please see the included documentation there for details how to use them.

10.13   Use debug UART

If no display is connected to the AX Smart Camera, you may use *Debug UART* for camera control. When you connect *Debug UART* to your PC, a serial device is created that you can access with a terminal emulator such as *minicom* or *hterm*. Set the speed to 115200 (8n1) baud for this connection. Once connection has been established you should be prompted to login.

10.14   The Cross-Compile Tool Chain

A cross-compiling workflow is in most cases the only effective way to write software for an embedded system like the AX Smart Cameras. To simplify getting started we provide a helper script to configure the cross compile tool-chain and an example.

Condition:
  ⇨ For this example you'll need a Linux based x86_64 system as your development PC.

Instruction:
a) Establish a SSH connection to your AX Smart Camera over USB-OTG or Ethernet.
b) Copy the helper script to your development system `scp <login>@<ip-address>:/opt/ baumer-vax/cross-toolchain/init-cross-dev.sh`
c) Dependencies could show up, please install these.
d) Executing the helper script will create the development environment at your current working directory `init-cross-dev.sh -l=<login>@<ip-address>`
   ✓ As default the example will compile against a SSH mounted AX Smart Camera file system. **If you turn the device off, the compile will fail!**
e) To allow builds with an unpowered AX Smart Camera omit the option `-o` to create a reduced system root `init-cross-dev.sh -l=<login>@<ip-address> -o`
f) To build the example call `make -C build`
g) Copy the binary with `scp build/bin/* <login>@<ip-address>:` and execute it on the AX Smart Camera.

10.15 Steps to flash the camera's operating system

Baumer provides downloads of the system image for the AX Smart Cameras on the Baumer website. Please check there for the most current image.

If your AX Smart Camera is not accessible, e.g. because you can't remember your root password, you can flash the original image provided by Baumer to regain access.

INFO
Flashing a new image will delete all files and data. Please backup everything required as there is no way back!

INFO
Only flash images from Baumer and pick the right version for your Baumer AX Smart Camera. Do not attempt to flash the original NVIDIA® image, those will not work!

INFO
Be sure to perform all steps as described! If the AX Smart Camera is disconnected from the power supply prematurely, the update will fail!

Steps to flash the AX Smart Camera

Condition:

⇨ Linux based host PC

⇨ USB-A to Micro USB cable (USB-OTG, most Micro USB phone charging cables will work)

⇨ UMO/UM2 jumper

⇨ Power supply

⇨ Monitor, keyboard, mouse

Instruction:

a) Download the current image for your specific AX Smart Camera from our website here: https://www.baumer.com/ax-software

b) Unzip the file to a convenient location on the host PC.

c) Switch off the AX Smart Camera power supply.

d) Insert the jumper onto the pins at the back (Recovery mode jumper) of the AX Smart Camera.

e) Connect the host PC to the Recovery Mode port of the AX Smart Camera.

f) Switch the power supply of the AX Smart Camera back on.
   ✓ The camera should be connected as a slave device (can be checked with `lsusb - a` on the host)

g) Change to the folder where you extracted the image on the host PC.

h) Connect monitor, keyboard and mouse to the AX Smart Camera.

i) Run `./flash.sh` on the host PC.

j) Wait until finished, this takes some time.
   ✓ The following message appears: *"*** The target t186ref has been flashed successfully. *** Reset the board to boot from internal eMMC"*. **The flashing is not yet complete!**

k) Remove USB-cable and jumper from the AX Smart Camera.

l) Run the setup assistant and wait until the desktop is loaded.

m) Shut down the camera via the operating system or perform a restart via the operating system. In both cases, the camera is restarted. **When the operating system has been loaded, you can disconnect the camera from the power supply.**

Result:

✓ Now the AX Smart Camera is usable again.

10.16   Dumb creation

The flash can be extracted, for example to create Recovery-Images from the used development device. For doing so, proceed as described in chapter *Steps to flash the camera's operating system [▶ 47]*, but call `flash.sh` with argument `-d`. This will read Flash into the `system.img` and `home.img` files out of the software package directory.

Please note that this will require up to ~35 GB of free disk space on Hostsystem. For using Images again, copy the files to the `nx/nano` folder in the software package.

10.17   Software development the AX Smart Camera

First steps are accessible in folder *examples* under: `/opt/baumer-vax/examples`.

11   GenICam Camera Features

A GenICam™-compliant XML-description file presents the camera's Features. The following chapter describes all included and accessible functions. Most of the camera's functions are standardized in *GenICam™ SFNC* and must use the name defined in there. Particular Features, which cannot be assigned to an existing *GenICam™ SFNC* name come as vendor-specific in the "Custom" namespace.

The Features are clustered in categories according to their function. The software uses them to present the functions more clearly.

You can see your camera's Features functionalities in *Feature Tree* (1) of the *Camera Explorer*. Please refer to the appropriate documentation.
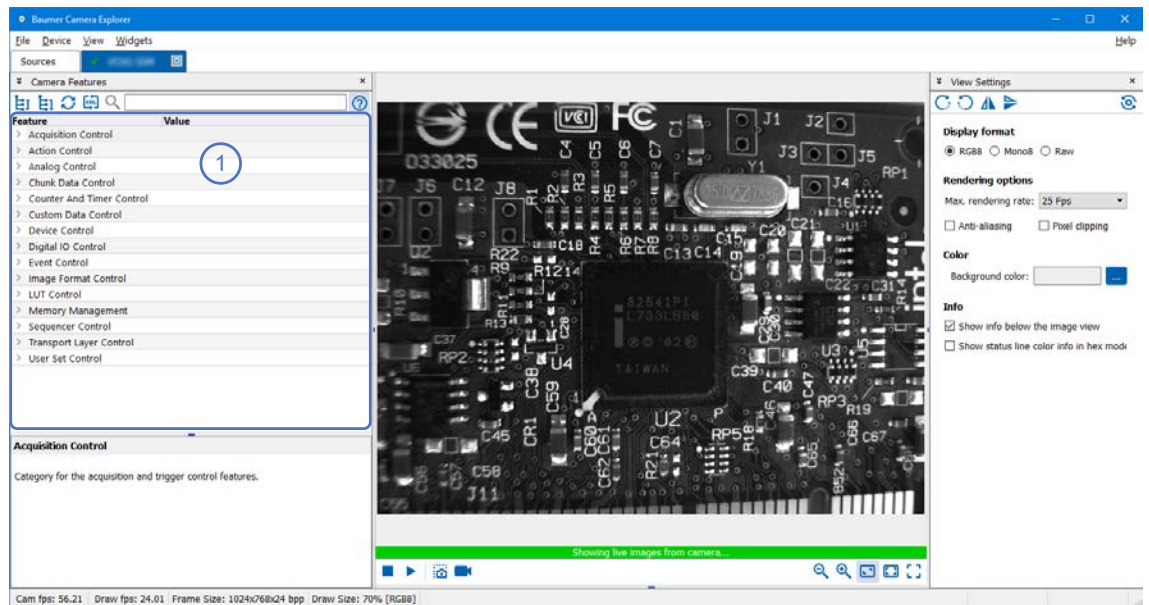
11.1   Category: AcquisitionControl

This chapter describes all features related to image acquisition, including the trigger and exposure control.

11.1.1   AcquisitionAbort

The abort of the image acquisition is a special case, where the ongoing acquisition is stopped. If an exposure is running, the exposure is aborted immediately and the image is not read out.

Name	AcquisitionAbort
Category	AcquisitionControl
Interface	ICommand
Access	Write only
Unit	-
Values	-

11.1.2   AcquisitionFrameCount

Number of frames to acquire in MultiFrame Acquisition mode.

Name	AcquisitionFrameCount
Category	AcquisitionControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	1 - 65535 (Increment: 1)

11.1.3   AcquisitionFrameRate

Controls the acquisition rate (in Hertz) at which the frames are captured.

Name	AcquisitionFrameRate
Category	AcquisitionControl
Interface	IFloat
Access	Read / Write
Unit	Hz
Values	depends on camera

11.1.4   AcquisitionFrameRateEnable

Enables the acquisition at the framerate specified by AcquisitionFrameRate.

Name	AcquisitionFrameRateEnable
Category	AcquisitionControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On) false = 0 (Off)

11.1.5   AcquisitionMode

Sets the acquisition mode of the device. It defines mainly the number of frames to capture during an acquisition and the way the acquisition stops.

INFO

The camera must be stopped before this feature can be edited.

Name	AcquisitionMode	
Category	AcquisitionControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Continuous	Without external events, image acquisition continues until stop by command *AcquisitionStop*.
	MultiFrame	In this mode a predefined number of frames will be captured after *AcquisitionStart*. The *AcquisitionFrameCount* controls the number of captured frames. Next acquisition stops automatically.
	SingleFrame	In this mode the camera will acquire another image after *AcquisitionStart*. Next acquisition stops.

11.1.6   AcquisitionStart

Once image acquisition has started, the camera processes the images in three steps:

1. Determining the current set of image parameters
2. Sensor exposure
3. Readout from the sensor

This process is then repeated until the camera is stopped.

Name	AcquisitionStart
Category	AcquisitionControl
Interface	ICommand
Access	Write only
Unit	-
Values	-

11.1.7   AcquisitionStatus

Reads the state of the internal acquisition signal selected using AcquisitionStatusSelector.

Name	AcquisitionStatus
Category	AcquisitionControl
Interface	IBoolean
Access	Read only
Unit	-
Values	true = 1 (On)

	false = 0 (Off)

11.1.8 AcquisitionStatusSelector

Selects the internal acquisition signal to be read by *AcquisitionStatus*.

Name	AcquisitionStatusSelector	
Category	AcquisitionControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Acquisition Active	Device is currently doing an acquisition of one or many frames.
	Acquisition Trigger Wait	Camera awaits *Trigger* to acquire a single or several images.

11.1.9 AcquisitionStop

Stops the acquisition of the device at the end of the current frame.

Name	AcquisitionStop
Category	AcquisitionControl
Interface	ICommand
Access	Write only
Unit	-
Values	-

11.1.10 ExposureAuto

Sets exposure mode to automatic if *ExposureMode = Timed*. The exact algorithm used for implementation is device-specific.

Name	ExposureAuto	
Category	AcquisitionControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Continuous	The camera is continuously adapting the exposure time for maximized dynamic range.
	Off	Exposure duration is user controlled using ExposureTime.
	Once	Exposure time is adapted once. Once it has converged, it returns to the Off state.

11.1.11   ExposureMode

Sets the operation mode of the Exposure.

Name	ExposureMode	
Category	AcquisitionControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Timed	Time-controlled exposure. The exposure duration time is set using the *ExposureTime* or *ExposureAuto* features and the exposure starts with the *FrameStart* or *LineStart*.

11.1.12   ExposureTime

On exposure of the sensor, the inclination of photons produces a charge separation on the semiconductors of the pixels. This results in a voltage difference, which is used for signal extraction.
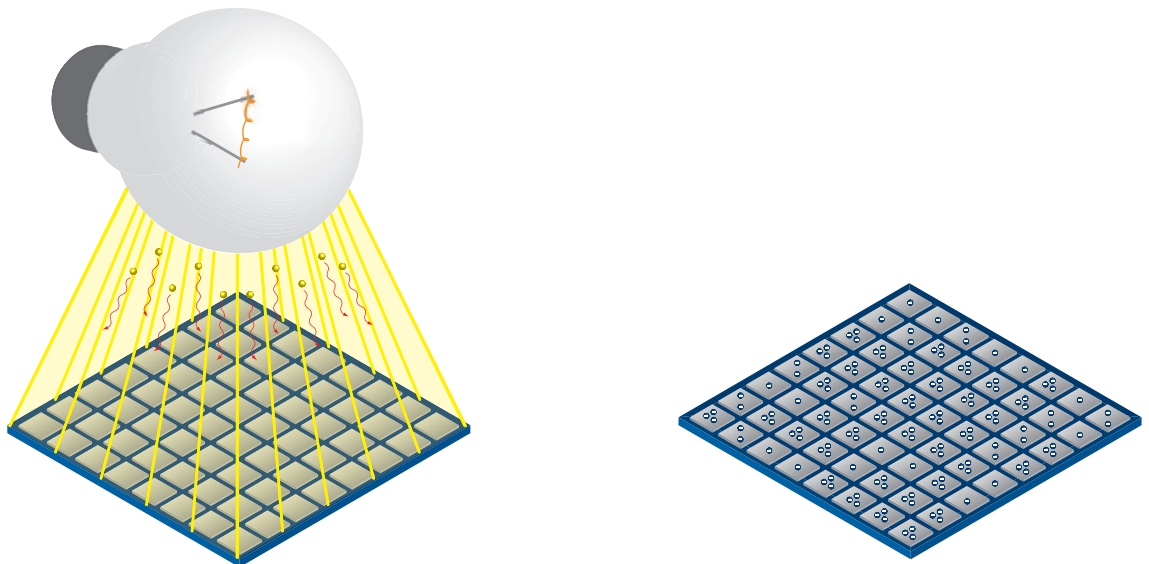
The signal strength is influenced by the incoming amount of photons. It can be increased by increasing the exposure time (texposure).

Name	ExposureTime
Category	AcquisitionControl
Interface	IFloat
Access	Read / Write
Unit	µs
Values	see table(s) below

INFO

Sequencer will not be accessible if function *ShortExposureTimeEnable* is enabled.

VAX(.2)

Camera type	texposure min [µsec]	texposure max [sec]
Monochrome		
VAX(.2)-32M.I.NVN	1	60
VAX(.2)-50M.I.NVX	1	60
Color		
VAX(.2)-32C.I.NVN	1	60
VAX(.2)-50C.I.NVX	1	60
VAX-50C.I.NX16	1	60

11.1.13   ReadoutMode

Specifies the operation mode of the readout for the acquisition.

Image acquisition consists of two separate procedures carried out in succession.

Exposing the pixels on the photosensitive surface of the sensor is only the first part of the image acquisition process. Once this first step is completed, the pixels are read out.

The exposure time (*texposure*) can be adjusted by the user, however, the time needed for the readout (*treadout*) is determined by the particular sensor and image format in use.

Depending on mode and the combination of exposure and reading times, the cameras can operate in *Sequential* or *Overlapped*:

Overlapped	Sequential
In this operation mode, an image is being exposed whilst Frame (n) is being read.	Here, the time intervals are long enough for the exposure and readout to be processed successively.
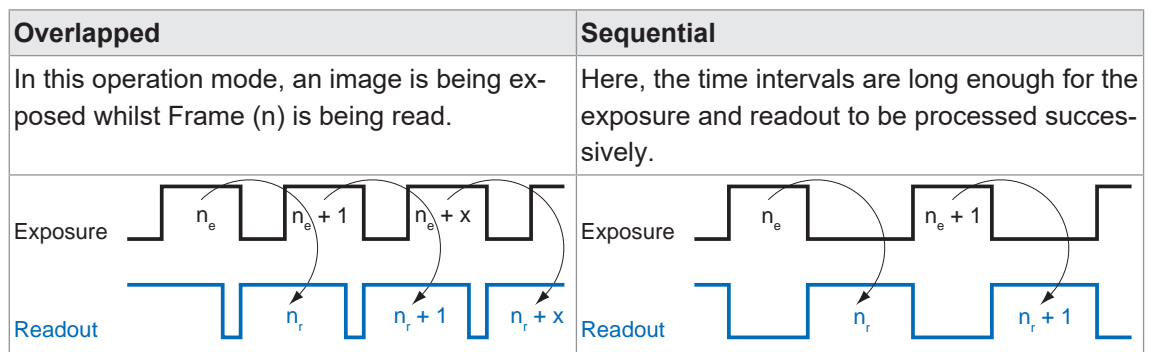
Name	ReadoutMode	
Category	AcquisitionControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Overlapped	Overlapped ReadoutMode.
	Sequential	Sequential ReadoutMode.

11.1.14   ShortExposureTimeEnable

Controls if short exposure time should be supported.

INFO

Sequencer will not be accessible if function *ShortExposureTimeEnable* is enabled.

Name	ShortExposureTimeEnable
Category	AcquisitionControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On) false = 0 (Off)

11.1.15   TriggerActivation

Specifies the activation mode of the trigger.

Name	TriggerActivation	
Category	AcquisitionControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	FallingEdge	*Trigger* valid at falling edge of source signal.
	RisingEdge	*Trigger* valid at rising edge of source signal.

11.1.16   TriggerDelay

Specifies the delay in microseconds (µs) to apply after the trigger reception before activating it.

Name	TriggerDelay
Category	AcquisitionControl
Interface	IEnumeration
Access	Read / Write
Unit	µs
Values	0 - 2,000,000.000000 (Increment: 1.00)

11.1.17   TriggerMode

Controls if the selected *Trigger* is active.

Name	TriggerMode	
Category	AcquisitionControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Off	Disables selected *Trigger*.
	On	Enables selected *Trigger*.

11.1.18   TriggerOverlap

Specifies the type trigger overlap permitted with the previous frame.

Name	TriggerOverlap	
Category	AcquisitionControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Read Out	*Trigger* is adopted immediately after exposure time.

11.1.19   TriggerSelector

Selects the type of trigger to configure.

Name	TriggerSelector	
Category	AcquisitionControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Frame Start	Selects the type of trigger to configure.

11.1.20   TriggerSoftware

Generates an internal trigger. TriggerSource must be set to Software.

Name	TriggerSoftware
Category	AcquisitionControl
Interface	ICommand
Access	Write only
Unit	-
Values	-

11.1.21   TriggerSource

Specifies the internal signal or physical input Line to use as the trigger source. The selected trigger must have its *TriggerMode* set to *On*.

Name	TriggerSource
Category	AcquisitionControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	see table(s) below

VAX(.2)

TriggerSource	VAX(.2)
All	■
Line0	■
Line1	■
Line2	■
Line3	■
Off	■
Software	■

11.2   Category: AnalogControl

Features in this chapter describes how to influence the analog features of an image, such as Gain, BlackLevel and Gamma.

11.2.1   BalanceWhiteAuto (color cameras only)

Controls the mode for automatic white balancing between the color channels. The white balancing ratios are automatically adjusted.

Name	BalanceWhiteAuto	
Category	AnalogControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Continuous	White balancing is constantly adjusted by the device.
	Off	White balancing is off.
	Once	White balancing is automatically adjusted once by the device. Once converged, it automatically returns to the *Off* state. The levelling can take several images.
		When images are acquired in *TriggerMode*, the white balance affects on the next acquired image.

11.2.2   **BlackLevel**

Controls the analog black level as an absolute physical value. This represents a offset applied to the video signal.

Name	BlackLevel
Category	AnalogControl
Interface	IFloat
Access	Read / Write
Unit	-
Values	see table(s) below

VAX(.2)

Camera type	BlackLevel
Monochrome	
VAX(.2)-32M.I.NVN	0 ... 255 DN12
VAX(.2)-50M.I.NVX	0 ... 255 DN12
Color	
VAX(.2)-32C.I.NVN	0 ... 255 DN12
VAX(.2)-50C.I.NVX	0 ... 255 DN12
VAX-50C.I.NX16	0 ... 255 DN12

11.2.3 **BlackLevelSelector**

Selects which Black Level is controlled by the various Black Level features.

Name	BlackLevelSelector	
Category	AnalogControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	All	Black Level will be applied to all channels.

11.2.4 **Gain**

Motion blur is unacceptable in high quality image acquisition. Exposure times are therefore limited. However, this results in low output signals from the camera and dark images. To solve this issue, the signals can be amplified by a user-defined gain factor within the camera.

INFO

Increasing the *Gain* will increase image noise.

Name	Gain
Category	AnalogControl
Interface	IFloat
Access	Read / Write
Unit	-
Values	see table(s) below

VAX(.2)

Camera type	Gain [dB]
Monochrome	
VAX(.2)-32M.I.NVN	0 ... 48
VAX(.2)-50M.I.NVX	0 ... 48
Color	
VAX(.2)-32C.I.NVN	0 ... 48
VAX(.2)-50C.I.NVX	0 ... 48
VAX-50C.I.NX16	0 ... 48

11.2.5   **GainAuto**

Sets the automatic gain control (AGC) mode. The exact algorithm used to implement AGC is device-specific.

Name	GainAuto	
Category	AnalogControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Continuous	Gain is constantly adjusted by the device.
	Off	Gain is User controlled using Gain.
	Once	Gain is automatically adjusted once by the device. Once it has converged, it automatically returns to the Off state. The levelling can take several images.

11.2.6   **GainSelector**

Selects which gain is controlled by the various gain feature.

Name	GainAuto	
Category	AnalogControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	All	All Gain will be applied to all channels.
	Blue	Gain will be applied to the blue channel. (color cameras only)
	Green Blue	GreenBlue Gain will be applied to the green blue channel. (color cameras only)
	Green Red	Gain will be applied to the green red channel. (color cameras only)
	Red	Gain will be applied to the red channel. (color cameras only)

11.2.7   **Gamma**

This function compensates any nonlinearity in human eye light perception.

For this correction, the corrected pixel intensity (Y') is calculated from the original intensity of the sensor's pixel ($Y_{original}$) and correction factor ɣ using the following formula (in oversimplified version): $Y' = Y^{ɣ}_{original}$
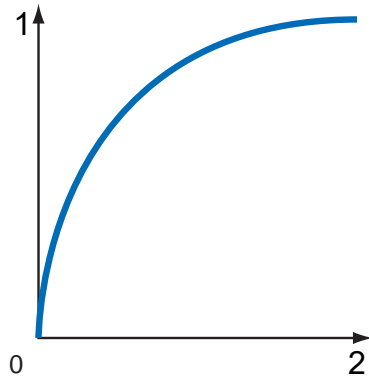
Ill. 2: Non-linear-perception of the human eye

1	Perception of brightness	2	Energy of light

The values of the calculated intensities are entered in Look-Up-Table. This will overwrite any existing values in LUT.

💡 **INFO**

If function *LUT* is disabled by software, the gamma correction function is disabled as well.

💡 **INFO**

Setting the gamma value at simultaneous image acquisition may cause visual effects in cameras with long readout time, since access to *LUT* is not locked against the pixel stream.

This behavior can be avoided by camera stop prior to the setting (*AcquisitionStop*).

Name	Gamma
Category	AnalogControl
Interface	IFloat
Access	Read / Write
Unit	-
Values	0.1 - 2.0 (Increment: 0.10)

11.3   Category: AutoFeatureControl

Category containing the functions for automatic adjustment.

General Information

Various auto functions are available to affect the automatic adjustment of image brightness.
Two methods are described below.

BrightAutoPriority = ExposureAuto		
	1	<u>Example 1</u> For image 1, it will suffice increasing brightness using *ExposureTime* to achieve the value of *BrightnessAutoNominalValue*.
	2	<u>Example 2</u> For image 2, increasing brightness using *ExposureTime* will not suffice to achieve the value of *BrightnessAutoNominalValue*. Therefore, *Gain* is increased after reaching *ExposureAutoMaxValue*.

BrightAutoPriority = GainAuto		
	1	<u>Example 1</u> For image 1, it will suffice increasing brightness using *Gain* to achieve the value in *BrightnessAutoNominalValue*.
	2	<u>Example 2</u> For image 2, increasing brightness using *Gain* will not suffice to achieve the value in *BrightnessAutoNominalValue*. Therefore, *ExposureTime* is increased after reaching *ExposureAutoMaxValue*.

AutoFeature ROI – General Information

Function *AutoFeature Region of Interest (ROI)* is used to define a so-called Region of Interest ROI. The *ROI* is a defined range of sensor pixels.

This function is used if only the image data (e.g. brightness) of a particular region of the image is of interest. The calculated corrections will be applied to the entire image.

AutoFeature ROI is specified by four values:

- *AutoFeatureOffsetX* - x-coordinate of the first relevant pixel
- *AutoFeatureOffsetY* - y-coordinate of the first relevant pixel
- *AutoFeatureWidth* – horizontal size of the region
- *AutoFeatureHeight* – vertical size of the region

AutoFeature ROI in full frame
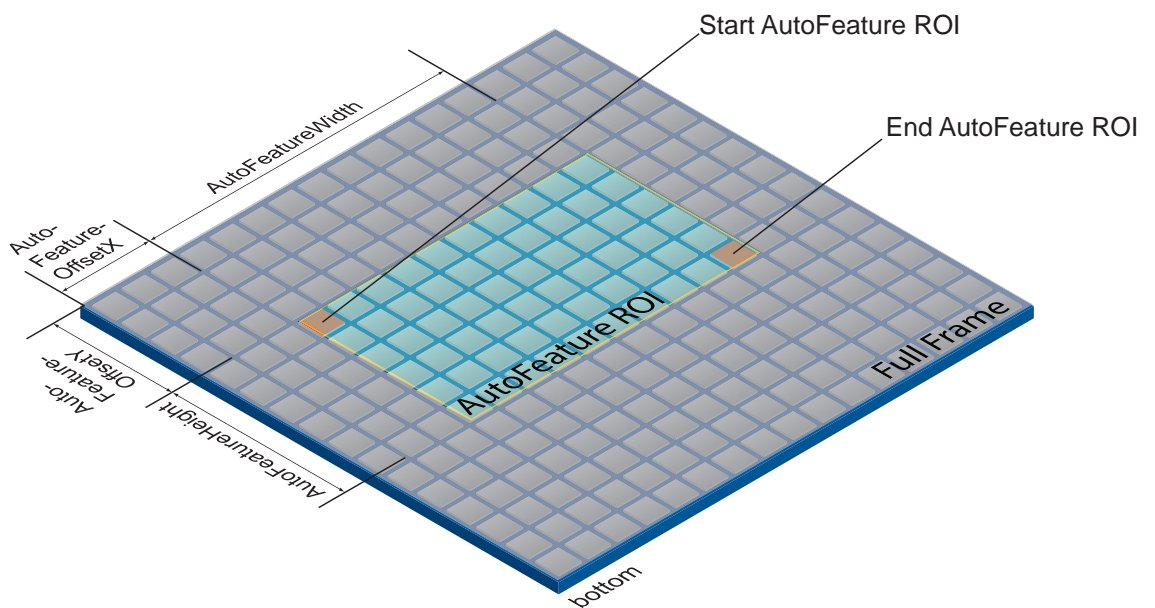
AutoFeature ROI in an ROI

INFO

AutoFeature ROI can be set in *ROI* (*Category: ImageFormatControl*). The settings permitted for *AutoFeature ROI* are adjusted accordingly.

Starting point for *AutoFeatureOffsetX* and *AutoFeatureOffsetY* is defined by *ROI* (*Category: ImageFormatControl)*.
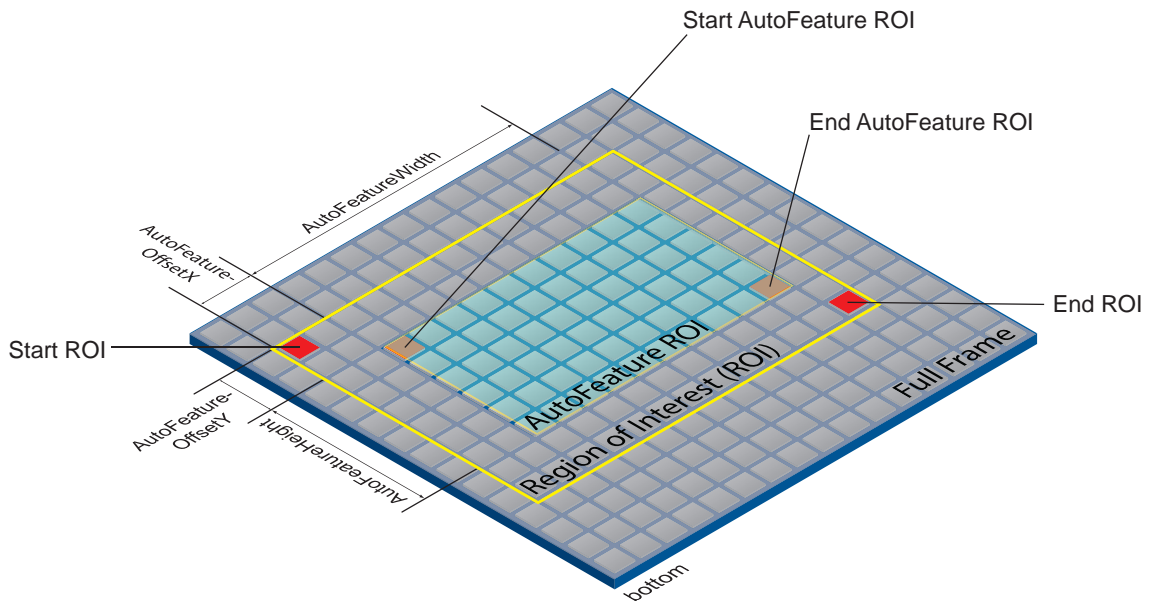
11.3.1   AutoFeatureHeight

Height of the selected Auto Feature Region (in pixels).
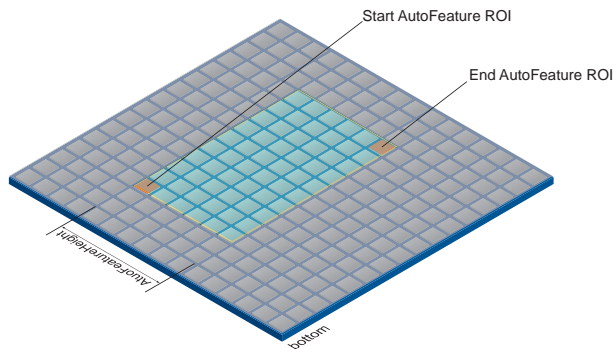
Name	AutoFeatureHeight
Category	AutoFeatureControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	*Height [▶ 116]*

11.3.2   AutoFeatureOffsetX

Horizontal offset from the origin to the Auto Feature Region (in pixels).
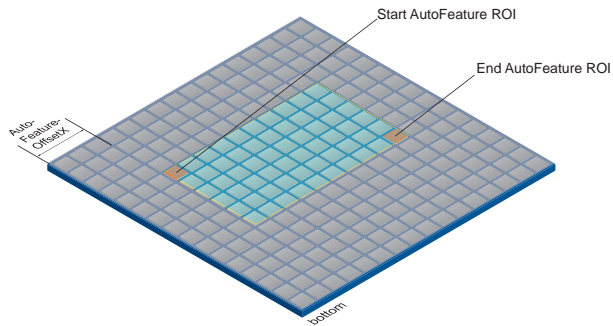
Name	AutoFeatureOffsetX
Category	AutoFeatureControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 - depends on *AutoFeatureWidth*

11.3.3   AutoFeatureOffsetY

Vertical offset from the origin to the Auto Feature Region (in pixels).
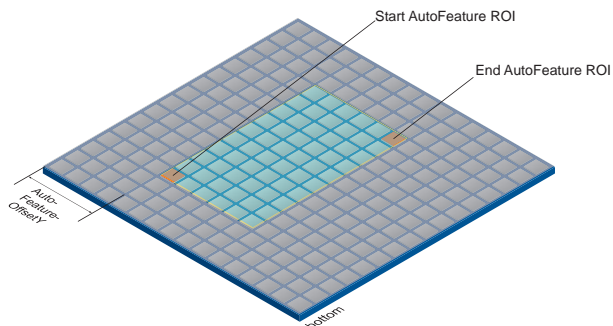
Name	AutoFeatureOffsetX
Category	AutoFeatureControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 - depends on *AutoFeatureHeight*

11.3.4   AutoFeatureRegionMode

Controls the mode for the selected area (*AutoFeature ROI*).

> ☀ **INFO**
>
> The camera must be stopped before this feature can be edited.

Name	AutoFeatureRegionMode	
Category	AutoFeatureControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Off	All settings of the selected *AutoFeature ROI* are automatically the same as the selected *AutoFeatureRegionReference*.
	On	The settings of the selected *AutoFeature ROI* are user defined. The *AutoFeature* is only accessible if the *AutoFeature ROI* is within the *AutoFeatureregionReference* of the *AutoFeature*.

11.3.5   AutoFeatureRegionReference

Defines *Reference ROI*. *Auto Feature Region* is part of this region, every *Auto Feature Region* will refer to the *Reference Region*.

Name	AutoFeatureRegionReference	
Category	AutoFeatureControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Region0	The selected *Auto Feature Region* refers to *Region 0*.

11.3.6   AutoFeatureRegionSelector

Selects which *Region of Interest* to be controlled. Function *RegionSelector* enables devices capable of extracting multiple ROI from a frame out of an image, to configure the functions of those individual regions independently.

Name	AutoFeatureRegionSelector	
Category	AutoFeatureControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	BalanceWhiteAuto	Selected functions will control the region for *BalanceWhiteAuto* and *ColorTransformationAuto* algorithm.
	BrightnessAuto	Selected functions will control the region for *GainAuto* and *ExposureAuto* algorithm.

11.3.7   AutoFeatureWidth

Width of the selected Auto Feature Region (in pixels).
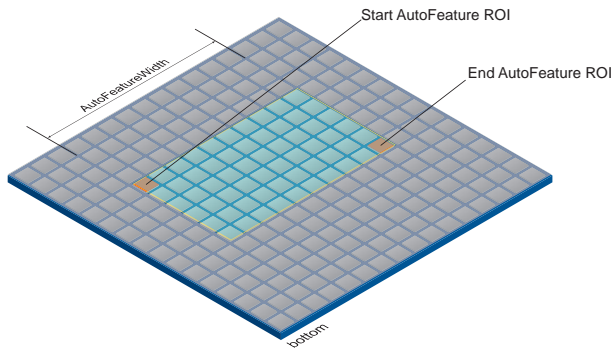
Name	AutoFeatureWidth
Category	AutoFeatureControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	*Width [▷ 124]*

11.3.8   BalanceWhiteAutoStatus

Status of *BalanceWhiteAuto*.

Name	BalanceWhiteAutoStatus	
Category	AutoFeatureControl	
Interface	IEnumeration	
Access	Read only	
Unit	-	
Values	ColorGainsTooHigh	The *BalanceWhiteAuto* calculation failed since at least one of the calculated color gains exceeds the maximum value.
	Initial	*BalanceWhiteAuto* has never been started.
	Start	*BalanceWhiteAuto* is waiting for statistics data.
	Success	The last *BalanceWhiteAuto* calculation was successful.
	Underrun	The *BalanceWhiteAuto* calculation failed since at least one color-channel shows invalid statistic data.

11.3.9   BrightnessAutoNominalValue

Sets the nominal value for brightness in percent of full scale. It will be adjusted according to parameterization in *BrightnessAutoPriority*.

Name	BrightnessAutoNominalValue
Category	AutoFeatureControl
Interface	IFloat
Access	Read / Write
Unit	-
Values	5 - 95 (Increment: 1)

11.3.10   **BrightnessAutoPriority**

The function set the highest priority auto function to adjust the brightness.

INFO

Provided *BrightnessAutoPriority* is set to *GainAuto*, image brightness can be increased by a higher value in *Gain*. Though this can cause image noise, but the Framerate will not be reduced.

BrightAutoPriority = ExposureAuto		
BrightnessAutoPriority = Exposure	1	**Example 1** For image 1, increasing brightness using *ExposureTime* will suffice to achieve the value in *BrightnessAutoNominalValue*.
	2	**Example 2** For image 2, increasing brightness using *ExposureTime* will not suffice to achieve the value in *BrightnessAutoNominalValue*. Therefore,*Gain* is increased after reaching *ExposureAutoMaxValue*.

BrightAutoPriority = GainAuto		
BrightnessAutoPriority = Exposure	1	**Example 1** For image 1, increasing brightness using *Gain* will suffice to achieve the value in *BrightnessAutoNominalValue*.
	2	**Example 2** For image 2, increasing brightness using *Gain* will not suffice to achieve the value in *BrightnessAutoNominalValue*. Therefore,*ExposureTime* is increased after reaching *ExposureAutoMaxValue*.

Name	BrightnessAutoPriority	
Category	AutoFeatureControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	ExposureAuto	*ExposureAuto* has highest priority and will be modified first.
	GainAuto	*GainAuto* has highest priority and will be modified first.

11.3.11   ExposureAutoMaxValue

Maximal value of *ExposureTime* calculable by exposure auto algorithm.

Name	ExposureAutoMaxValue
Category	AutoFeatureControl
Interface	IFloat
Access	Read / Write
Unit	µs
Values	*ExposureTime [▶ 53]*

11.3.12   ExposureAutoMinValue

Minimal value of *ExposureTime* calculable by exposure auto algorithm.

INFO

Enabled *ShortExposureTimeEnable* will be ignored.

Name	ExposureAutoMinValue
Category	AutoFeatureControl
Interface	IFloat
Access	Read / Write
Unit	µs
Values	*ExposureTime [▶ 53]*

11.3.13   GainAutoMaxValue

Maximal value of *Gain* calculable by gain auto algorithm.

Name	GainAutoMaxValue
Category	AutoFeatureControl
Interface	IFloat
Access	Read / Write
Unit	-
Values	*Gain [▶ 61]*

11.3.14   GainAutoMinValue

Minimal value of *Gain* calculable by gain auto algorithm.

Name	GainAutoMinValue
Category	AutoFeatureControl
Interface	IFloat
Access	Read / Write
Unit	-
Values	*Gain [▶ 61]*

11.4 Category: ChunkDataControl

Chunk is camera-generated data packet which is integrated into the *Payload* every image with m *Chunk* ode being enabled. This integrated data packet contains different image settings. Baumer GAPI can read out *Chunk (Image Info Header)*.

There are three modes:

Image Data

Only image data is transferred, no *Chunk* data.
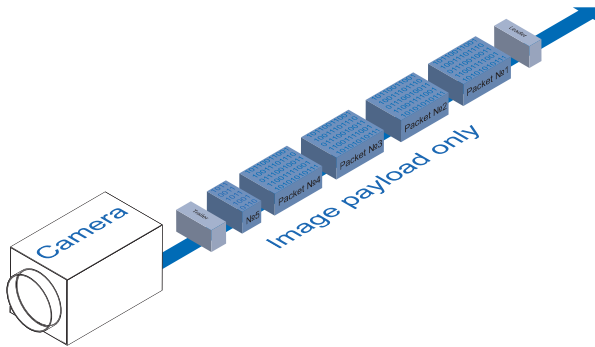
Chunk

Only *Chunk* data are transferred, no image data.
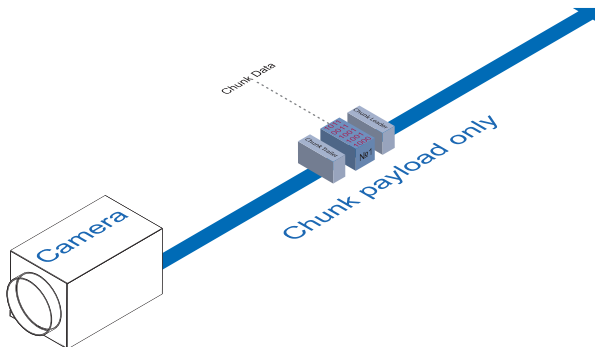
Extended Chunk

Chunk and image data are transmitted. The *Chunk* data are included in the last data packet.
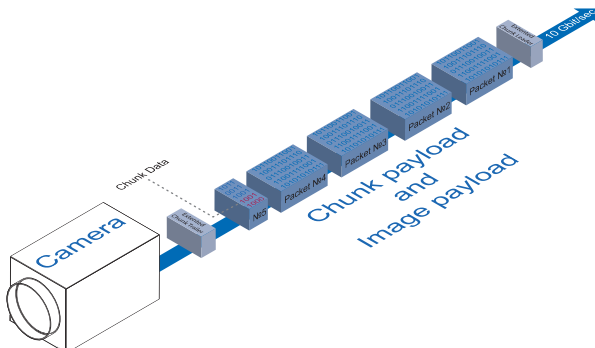
11.4.1 ChunkEnable

Enables the inclusion of the selected *Chunk* data in the *Payload* of the image.

INFO

The camera must be stopped before this feature can be edited.

INFO

Use *ChunkSelector* to select the required *Chunk*.

Name	ChunkEnable
Category	ChunkDataControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.4.2 ChunkModeActive

Enables data inclusion of *Chunk* into *Payload* of the image.

INFO

The camera must be stopped before this feature can be edited.

Name	ChunkModeActive
Category	ChunkDataControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.4.3 ChunkSelector

Selects which *Chunk* to enable or control.

Name	ChunkSelector
Category	ChunkDataControl
Interface	IEnumeration
Access	Read only
Unit	-
Values	see table(s) below

VAX(.2)

Values (Features)	
Binning (BinningHorizontal, BinningHorizontalMode, BinningSelector, BinningVertical, BinningVerticalMode)	ImageControl (BrightnessCorrection, DefectPixelCorrection, LUTSelector, LUTEnable, ReverseX, ReverseY)
BlackLevel	LineStatusAll
CounterValue	OffsetX
DeviceTemperature	OffsetY
ExposureTime	PixelFormat
FrameID	SequencerSetActive
Gain	Timestamp
Height	Width
Image	

11.5 Category: ColorTransformationControl (color cameras only)

Category that contains the color transformation control functions.

The color processing is realized by 4 modules.

White balance
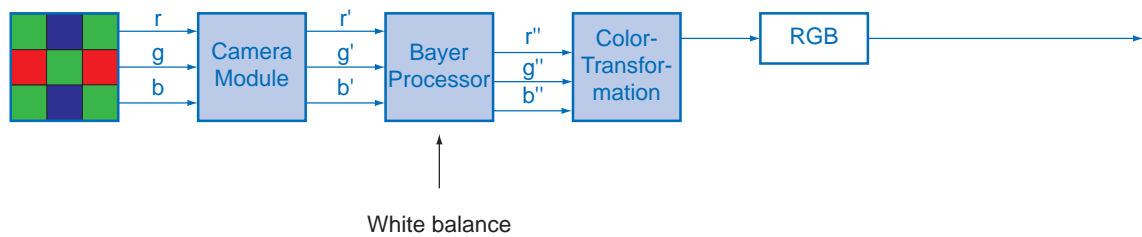
The sensor color signals r (red), g (green) and b (blue) are amplified in total and digitized within the Camera Module.

Within the *Bayer Processor*, the raw signals r', g' and b' are amplified by color-channel- specific factors. Next is interpolating the missing color values which will generate new ones (r'', g'', b'').

Color Transformation is next. Here, the previously generated color signals r'', g'' and b'' are converted to optimized RGB (color adjustment as physical balance of the spectral sensitivities).

11.5.1   ColorTransformationAuto

Controls the mode for automatic adjusting the gains of the active transformation matrix.

INFO

Function *ColorTransformationAuto* can always be enabled which will make the camera calculate appropriate color matrices.

If the range of the estimated illumination to the measured reference illuminations exceeds a certain threshold, a white balance is triggered even if *BalanceWhiteAuto = off*.

However, matrices in image format *RAW* are not applied.

Name	ColorTransformationAuto	
Category	ColorTransformationControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Continuous	Color conversion is constantly adjusted by the camera. *Color Gains* not adjustable.
	Off	Color transformation is user controlled using the various Color transformation functions.
	Once	Color conversion setting is automatically one-time by the camera. Once converged, it automatically returns to the *Off* state. *Color Gains* not adjustable.

11.5.2   ColorTransformationEnable

Activates the selected Color Transformation module.

Name	ColorTransformationEnable
Category	ColorTransformationControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.5.3   ColorTransformationFactoryListSelector

Selects the *OptimizedMatrix* for the desired color temperature. All calculated color values are based on the sRGB color space.

When setting an *OptimizedMatrix*, the *ColorGains* are also set for the white point matching the light.

INFO

We recommend to carry out a white balance after setting a matrix.

Name	ColorTransformationFactoryListSelector
Category	ColorTransformationControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	See table(s) below

VAX(.2)

Values	Description
OptimizedMatrixFor3000K	Matrix is set to color temperature 3000K.
OptimizedMatrixFor5000K	Matrix is set to color temperature 5000K.
OptimizedMatrixFor6500K	Matrix is set to color temperature 6500K.
OptimizedMatrixFor9500K	Matrix is set to color temperature 9500K.

11.5.4   ColorTransformationOutputColorSpace

Output the color space of the camera.

Name	ColorTransformationOutputColorSpace
Category	ColorTransformationControl
Interface	IString
Access	Read only
Unit	-
Values	Color space

11.5.5   ColorTransformationResetToFactoryList

Resets *ColorTransformation* to the selected *ColorTransformationFactoryList*.

Name	ColorTransformationResetToFactoryList
Category	ColorTransformationEnable
Interface	ICommand
Access	Write
Unit	-
Values	-

11.5.6   ColorTransformationValue

Represents the selected *Gain* within the *Transformation matrix*.

Name	ColorTransformationValue
Category	ColorTransformationControl
Interface	IFloat
Access	Read only
Unit	-
Values	-8.0 – 8.0 (Increment: 1.00)

11.5.7   ColorTransformationValueSelector

Selects *Gain* of *Transformation matrix* to be accessed to within the selected *Color Transformation module*.

Name	ColorTransformationValueSelector	
Category	ColorTransformationControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Gain00	
	Gain01	
	Gain02	
	Gain10	
	Gain11	
	Gain12	
	Gain20	
	Gain21	
	Gain22	

11.6   Category: CounterAndTimerControl

This chapter lists all features that relates to control and monitoring of Counters and Timers.

11.6.1   CounterDuration

Sets the time (or number) of events prior to generating event *CounterEnd*.

Counter reaching the *CounterDuration* value will output a *CounterEnd* event, the *CounterActive* signal is enabled and *Counter* stops counting until new trigger or explicit reset by *CounterReset*.

Name	CounterDuration
Category	CounterAndTimerControl
Interface	IString
Access	Read / Write
Unit	-
Values	0 ... 65535 (Increment: 1)

11.6.2   CounterEventActivation

Selects the activation mode for the *Event Source* signal.

Name	CounterEventActivation	
Category	CounterAndTimerControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	RisingEdge	Counts on the rising edge of the signal.
	FallingEdge	Counts on the falling edge of the signal.
	AnyEdge	Counts on the falling or rising edge of the selected signal.

11.6.3   CounterEventSource

Select the event that will be the source to increase *Counter*.

Name	CounterEventSource
Category	CounterAndTimerControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	see table(s) below

VAX(.2)

CounterEventSource	
Counter1End	Line1
Counter2End	Line2
ExposureActive	FrameTrigger
FrameTransferSkipped	Off
Line0	TriggerSkipped

11.6.4   CounterReset

Executes software reset and start of the selected *Counter*. *Counter* starts counting events immediately after reset unless *Counter Trigger* trigger is active. *CounterReset* is to reset *Counter* independently of *CounterResetSource*. To disable *Counter* temporarily, set *CounterEventSource = Off*.

💡 **INFO**

Note that the value of *Counter* at time of reset is automatically saved and reflects in *CounterValueAtReset*.

Name	CounterReset
Category	CounterAndTimerControl
Interface	ICommand
Access	Write only
Unit	-
Values	-

11.6.5   **CounterResetActivation**

Selects the activation mode of the *CounterResetSource* signal.

Name	CounterResetActivation	
Category	CounterAndTimerControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	RisingEdge	Resets the counter on the rising edge of the signal.
	FallingEdge	Resets the counter on the falling edge of the signal.
	AnyEdge	Resets the counter on the falling or rising edge of the selected signal.

11.6.6   **CounterResetSource**

Selects the signals that will be the source to reset *Counter*.

Name	CounterResetSource
Category	CounterAndTimerControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	see table(s) below

VAX(.2)

CounterResetSource	
Counter1End	Line1
Counter2End	Line2
ExposureActive	FrameTrigger
FrameTransferSkipped	Off
Line0	

11.6.7   **CounterSelector**

Selects which *Counter* to configure.

Name	CounterSelector	
Category	CounterAndTimerControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Counter1	Selects Counter 1.
	Counter2	Selects Counter 2.

11.6.8   **CounterValue**

Reads or writes the current value of the selected *Counter*. Writing to *CounterValue* is typically used to define the start value.

Name	CounterValue
Category	CounterAndTimerControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... 65535 (Increment: 1)

11.6.9   **CounterValueAtReset**

Reads the value of the selected *Counter* when being reset by trigger or explicit *CounterReset* command.

It represents the last *Counter* value saved before *Counter* reset.

Name	CounterValueAtReset
Category	CounterAndTimerControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 65535 (Increment: 1)

11.6.10   **FrameCounter**

FrameCounter is part of *Chunk (Baumer Image Info Header)* and added to every frame if *Chunk Mode* is enabled. It is generated by the hardware and can be used to verify that each of the camera's images is transmitted to the PC and received in the right order.

FrameCounter can be set to a defined value by writing it into the *FrameCounter*.

Name	FrameCounter
Category	CounterAndTimerControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... 4294967295 (Increment: 1)

11.6.11   TimerDelay

Defines the delay time (in microseconds) to be applied at trigger reception prior to starting the *Timer*.

Name	TimerDelay
Category	CounterAndTimerControl
Interface	IFloat
Access	Read / Write
Unit	μs
Values	0 ... 2,000,000.000000 (Increment: 1.00)

11.6.12   TimerDuration

Defines the time (in microseconds) of the *Timer* pulse.

Name	TimerDuration
Category	CounterAndTimerControl
Interface	IFloat
Access	Read / Write
Unit	μs
Values	10.000000 ... 2,000,000.000000 (Increment: 1.00)

11.6.13   TimerSelector

Selects which *Timer* to configure.

Name	TimerSelector	
Category	CounterAndTimerControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Timerx	Selects Timer x.

11.6.14   TimerTriggerActivation

Selects the trigger activation mode to start the *Timer*.

Name	TimerTriggerActivation	
Category	CounterAndTimerControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	RisingEdge	Starts counting on the rising edge of the selected trigger signal.
	FallingEdge	Starts counting on the falling edge of the selected trigger signal.
	AnyEdge	Starts counting on the falling or rising edge of the selected trigger signal.

11.6.15   TimerTriggerSource

Selects the trigger source to start the *Timer*.

Name	TimerTriggerSource
Category	CounterAndTimerControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	see table(s) below

VAX(.2)

TimerTriggerSource	
ExposureEnd	Line1
ExposureStart	Off
FrameTransferSkipped	TriggerSkipped
Line0	

11.7   Category: CustomDataControl

The category contains the custom data specific features.

11.7.1   CustomData

The feature holds one byte of custom special data.

Name	CustomData
Category	CustomDataControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0x0 ... 0xFF (Increment: 1)

11.7.2   CustomDataConfiguration

Controls whether the configuration mode for user-defined data is enabled.

Name	CustomDataConfiguration	
Category	CustomDataControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Off	Disables configuration mode for user-defined data.
	On	Enables configuration mode for user-defined data.

11.7.3   CustomDataSelector

The feature selects the index of the custom data byte array.

Name	CustomData
Category	CustomDataControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... 127 (Increment: 1)

11.8   Category: DeviceControl

Category for device information and control.

11.8.1   DeviceCharacterSet

Character set used by the strings of the device`s bootstrap registers.

Name	DeviceCharacterSet	
Category	DeviceControl	
Interface	IEnumeration	
Access	Read only	
Unit	-	
Values	ASCII	Device use ASCII character set.
	UTF16	Device use UTF16 character set.
	UTF8	Device use UTF8 character set.

11.8.2   DeviceEventChannelCount

Indicates the number of camera-supported *Event Channel*.

Name	DeviceEventChannelCount
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 4294967295 (Increment: 1)

11.8.3   DeviceFamilyName

Identifier of the product family of the device.

Name	DeviceFamilyName
Category	DeviceControl
Interface	IString
Access	Read only
Unit	-
Values	device family name

11.8.4   DeviceFirmwareVersion

Version of the firmware in the device.

Name	DeviceFirmwareVersion
Category	DeviceControl
Interface	IString
Access	Read only
Unit	-
Values	e.g. CID:000057/PID:11194280

11.8.5   DeviceGenCPVersionMajor

Major version of the GenCP protocol supported by the device.

Name	DeviceGenCPVersionMajor
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 65535 (Increment: 1)

11.8.6   DeviceGenCPVersionMinor

Minor version of the GenCP protocol supported by the device.

Name	DeviceGenCPVersionMinor
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 65535 (Increment: 1)

11.8.7   DeviceLinkSelector

Selects which Link of the device to control.

Generally, a device has only one Link that can be composed of one or many connections. But if there are many, this selector can be used to target a particular Link of the device with certain functions.

Name	DeviceLinkSelector
Category	DeviceControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	≥ 0

11.8.8   DeviceLinkSpeed

Indicates the speed of transmission negotiated on the specified link.

Name	DeviceLinkSpeed
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	Bps
Values	≥ 0

11.8.9   DeviceLinkThroughputLimit

Limits the maximum bandwidth of the data that will be streamed out by the device on the selected Link. If necessary, delays will be uniformly inserted between transport layer packets in order to control the peak bandwidth.

Name	DeviceLinkThroughputLimit	
Category	DeviceControl	
Interface	IInteger	
Access	Read / Write	
Unit	-	
Values	GigE:	1.250.000 ... 1.250.000.000 (Increment: 12.500.000)
	5GigE:	1.250.000 ... 6.250.000.000 (Increment: 12.500.000)
	10GigE:	1.250.000 ... 1.250.000.0000 (Increment: 12.500.000)
	USB3:	1.000.000 ... 4.000.000.000 (Increment: 1000000)

11.8.10   DeviceManufacturerInfo

Manufacturer information about the device.

The content might look as follows:

Firmware (F) / FPGA (C) / BL3-Version (BL)

Name	DeviceManufacturerInfo
Category	DeviceControl
Interface	IString
Access	Read only
Unit	-
Values	e. g. F:00007F9A/C:0180802D/BL3.8:00000081

11.8.11   DeviceModelName

Model name of the device.

Name	DeviceModelName
Category	DeviceControl
Interface	IString
Access	Read only
Unit	-
Values	Model name of the device.

11.8.12   DeviceRegistersEndiannes

Endianess of the register of the device.

Name	DeviceRegisterEndiannes	
Category	DeviceControl	
Interface	IEnumeration	
Access	Read only	
Unit	-	
Values	Big	Device registers are big Endian.
	Little	Device registers are little Endian.

11.8.13   **DeviceReset**

Resets the device to its power up state.

INFO

The execution of this feature may take several seconds.

Name	DeviceReset
Category	DeviceControl
Interface	IComand
Access	Write only
Unit	-
Values	-

11.8.14   **DeviceResetToDeliveryState**

By executing this feature, the camera is set to the factory settings.

INFO

The camera-stored settings (e.g. *UserSets*) will be lost.

Name	DeviceResetToDeliveryState
Category	DeviceControl
Interface	IComand
Access	Write only
Unit	-
Values	-

11.8.15   **DeviceSFNCVersionMajor**

Primary version of *Standard Features Naming Convention* used to create the device GenICam XML(**X**.x.x).

Name	DeviceSFNCVersionMajor
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 9223372036854775807 (Increment: 1)

11.8.16   DeviceSFNCVersionMinor

Minor version of *Standard Features Naming Convention* used to create the device *GenICam XML*(x.**X**.x.).

Name	DeviceSFNCVersionMinor
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 9223372036854775807 (Increment: 1)

11.8.17   DeviceSFNCVersionSubMinor

Sub version of *Standard Features Naming Convention*, used to create the device *GenICam XML*(x.x.**X**).

Name	DeviceSFNCVersionSubMinor
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 9223372036854775807 (Increment: 1)

11.8.18   DeviceScanType

Scan type of the sensor of the device.

Name	DeviceScanType	
Category	DeviceControl	
Interface	IEnumeration	
Access	Read only	
Unit	-	
Values	Areascan	2D Sensor.

11.8.19   DeviceSensorType

This feature specifies the type of the sensor.

Name	DeviceSensorType	
Category	DeviceControl	
Interface	IEnumeration	
Access	Read only	
Unit	-	
Values	CCD	CCD sensor.
	CMOS	CMOS sensor.

11.8.20   DeviceSerialNumber

Device`s serial number. This string is a unique identifier of the device.

Name	DeviceSerialNumber
Category	DeviceControl
Interface	IString
Access	Read only
Unit	-
Values	e.g. 1117281217

11.8.21   DeviceStreamChannelCount

Indicates the number of streaming channels supported by the device.

Name	DeviceStreamChannelCount
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 4294967295 (Increment: 1)

11.8.22   DeviceStreamChannelEndianness

Endianness of multi-byte pixel data for this stream.

Name	DeviceStreamChannelEndianness	
Category	DeviceControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Big	Endianness of multi-byte pixel data for this stream is big Endian.
	Little	Endianness of multi-byte pixel data for this stream is little Endian.

11.8.23   DeviceStreamChannelSelector

Selects which *Stream Channel* to control.

Name	DeviceStreamChannelSelector
Category	DeviceControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	≥ 0

11.8.24 DeviceStreamChannelType

Reports the type of the *Stream Channel*.

Name	DeviceStreamChannelType	
Category	DeviceControl	
Interface	IEnumeration	
Access	Read only	
Unit	-	
Values	Receiver	Data stream receiver channel.
	Transmitter	Data stream transmitter channel.

11.8.25 DeviceTLType

Transport Type of the device.

Name	DeviceTLType	
Category	DeviceControl	
Interface	IEnumeration	
Access	Read only	
Unit	-	
Values	GigEVision	GigE Vision.
	USB3Vision	USB3 Vision.
	CameraLink	Camera Link.

11.8.26 DeviceTLVersionMajor

Major version of the Transport Layer (GigE Vision® version) of the device.

Name	DeviceTLVersionMajor
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	-
Values	≥ 0 (**X**.x.x.)

11.8.27 DeviceTLVersionMinor

Minor version of the Transport Layer (GigE Vision® version) of the device.

Name	DeviceTLVersionMinor
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	-
Values	≥ 0 (x.**X**.x.)

11.8.28   **DeviceTLVersionSubMinor**

Minor version of the Transport Layer (GigE Vision® version) of the device.

Name	DeviceTLVersionSubMinor
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	-
Values	≥ 0 (x.x.**X**)

11.8.29   **DeviceTemperature**

Device temperature in degrees Celsius (°C). Measured at the location selected by *DeviceTemperatureSelector*.

Name	DeviceTemperature
Category	DeviceControl
Interface	IFloat
Access	Read only
Unit	°C
Values	Device specific (e.g. -127.0 ... 127.0)

11.8.30   **DeviceTemperatureExceeded**

Returns if the device operates in critical temperature range.

Name	DeviceTemperatureExceeded
Category	DeviceControl
Interface	IBoolean
Access	Read only
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.8.31   **DeviceTemperatureSelector**

Selects the temperature measuring point.

Name	DeviceTemperatureSelector	
Category	DeviceControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	InHouse	Temperature inside the camera housing.

11.8.32   DeviceTemperatureStatus

Returns the current temperature status of the device.

Name	DeviceTemperatureStatus	
Category	DeviceControl	
Interface	IEnumeration	
Access	Read only	
Unit	-	
Values	Exceeded	Device operates in critical temperature range.
	High	Device operates in increased temperature range.
	Normal	Device operates in normal temperature range.

11.8.33   DeviceTemperatureStatusTransition

Temperature threshold for selected status transition (*DeviceTemperatureStatusTransitionSelector*) in degrees Celsius (°C).

Name	DeviceTemperatureStatusTransition
Category	DeviceControl
Interface	IInteger
Access	Read / Write
Unit	°C
Values	-126.0 ... 72.0

11.8.34   DeviceTemperatureStatusTransitionSelector

Defines the temperature transition to be controlled by the *DeviceTemperatureStatusTransition* function.

Name	DeviceTemperatureStatusTransitionSelector	
Category	DeviceControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	ExceededToNormal	Temperature threshold for transition when going back from status *Exceeded* to *Normal*.
	HighToExceeded	Temperature threshold for transition from status *High* to status *Exceeded*.
	NormalToHigh	Temperature threshold for transition from status *Normal* to status *High*.

11.8.35   DeviceType

Returns the device type.

Name	DeviceType	
Category	DeviceControl	
Interface	IEnumeration	
Access	Read ony	
Unit	-	
Values	Transmitter	Data stream transmitter device.

11.8.36   DeviceUserID

User-programmable device identifier.

Name	DeviceUserID
Category	DeviceControl
Interface	IString
Access	Read / Write
Unit	-
Values	GiGE: 16Byte
	USB: 64Byte
	e.g. "Camera 1

11.8.37   DeviceVendorName

Name of the manufacturer of the device.

Name	DeviceVendorName
Category	DeviceControl
Interface	IString
Access	Read only
Unit	-
Values	Manufacturer name.

11.8.38   DeviceVersion

Version of the device.

Name	DeviceVersion
Category	DeviceControl
Interface	IString
Access	Read only
Unit	-
Values	e.g. R2.0.0

11.8.39   ReadOutTime

Readout time of one image from the sensor in µs, with the current image settings.

INFO

ReadOutTime depends on:
- *OffsetY*
- *Height*
- *PixelFormat*
- *SensorBinning*

Name	ReadOutTime
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	µs
Values	0 ... 65535 (Increment: 1)

11.8.40   TimestampLatch

Saves current timestamp into *TimestampLatchValue*.

Name	TimestampLatch
Category	DeviceControl
Interface	ICommand
Access	Write only
Unit	-
Values	-

11.8.41   TimestampLatchValue

Returns the saved value of counter *Timestamp*.

Name	TimestampLatchValue
Category	DeviceControl
Interface	IInteger
Access	Read only
Unit	ns
Values	0 ... 9223372036854775807 (Increment: 8 (GigE) / 10 (USB))

11.8.42   **USB2SupportEnable (USB cameras only)**

Enable or disable the streaming support for USB 2.0.

INFO

VAX Smart Camera

Internal camera connection is via USB3. For this reason, this feature is of no relevance.

NOTICE

Activation of the image transmission with USB2 connection

If the camera is connected to an USB 2.0 port image transmission is disabled by default. The camera consumes more than 2.5W which is the maximum allowed by the USB 2.0 specification. But there is a possibility to activate the image transmission at your own risk!

This activation could damage your computer´s hardware!

Steps to enable image transmission

Instruction:

a) Open the camera in *Camera Explorer*.

b) Select profile *GenICam Guru* (only *Camera Explorer* < v3.0).

c) Enable the feature *USB2SupportEnable* in category *DeviceControl*.

d) Disconnect the data connection of the camera to the USB 2.0 port.

e) Connect the data connection of the camera to the USB 2.0 port.

Result:

✓ Images will be transmitted via the USB 2.0 port.

Name	USB2SupportEnable
Category	DeviceControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.9   Category: DigitalIOControl

Category that contains the digital input and output control functions.

INFO

Functional range of the VAX

Unlike other Baumer cameras,*Baumer Camera Explorer* does not provide the full function range
of this category.

See the description of the Baumer `IO_lib` (Python™ and C++ Libraries) for more information
about usage the I/Os.

Trigger – General Information

Trigger signals are used to synchronize the camera exposure and a machine cycle or, in case
of a software trigger, to take images at predefined time intervals. Different trigger sources can
be used here.

A Trigger delay
B Exposure time
C Readout time
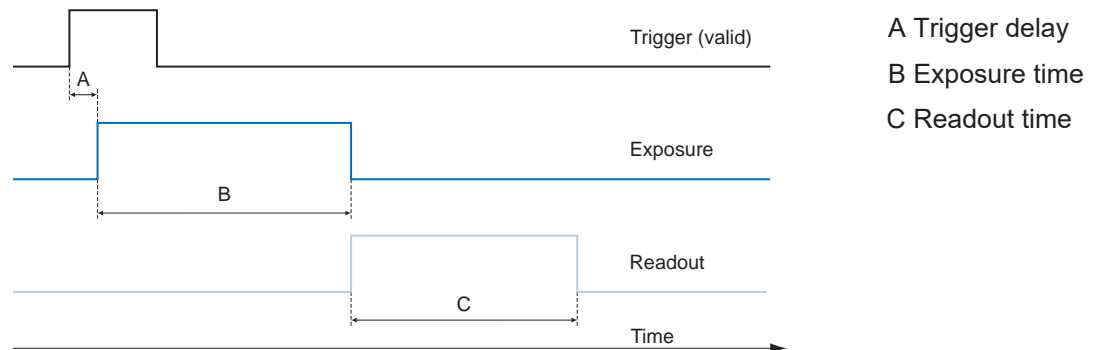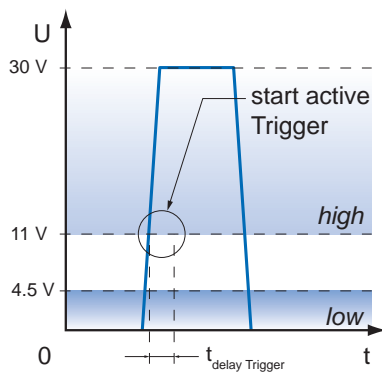
Trigger delay – General Information

The trigger delay (*TriggerDelay*) is a flexible user-defined delay between the given trigger im-
pulse and the image capture. The delay time can be set between 0 µs and 2.0 s in increments
of 1 µs. Where there are multiple triggers during the delay, the triggers will also be stored and
delayed. The buffer is able to store up to 512 trigger signals during the delay.

Your benefits:

- No need for an external trigger sensor to be perfectly aligned
- Different objects can be captured without hardware changes

Trigger Source (examples of possible trigger sources)
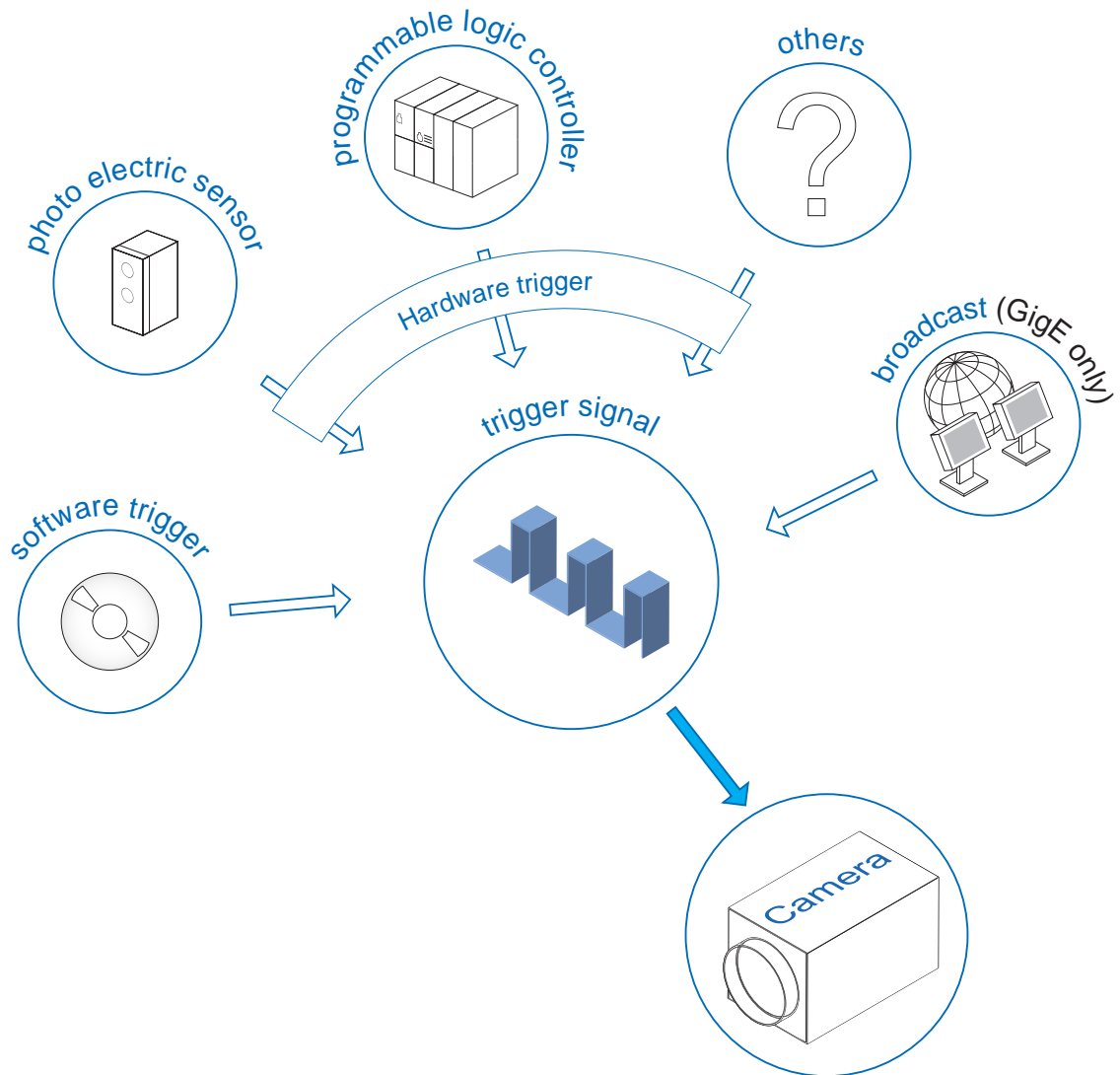
Each trigger source must be activated separately. When the trigger mode (*TriggerMode*) is activated, the hardware trigger is activated by default.

Debouncer (*LineDebouncerHighTimeAbs* / *LineDebouncerLowTimeAbs*)

The basic idea behind this functions was to separate interfering signals (short peaks) from valid square wave signals, which can be important in industrial environments. Debounce will filter invalid signals while others exceeding the user-defined time *tDebounceHigh* will be recognized and transferred to the camera to induce a trigger.

Second test time *tDebounceLow* was realized to detect valid signals and filter any jitter. The point in time is user-defined. If the signal value falls to state *low* and does not rise within *tDebounceLow*, this is recognized as the end of the signal.

INFO

Please note that the edges of valid trigger signals are shifted by *tDebounceHigh* and *tDebounceLow*!

Depending on these two points in time, the trigger signal can be temporally extended or compressed.

Δt_x - high time of the signal
$t_{DebounceHigh}$ - user-defined debouncer delay for state high
$t_{DebounceLow}$ - user-defined debouncer delay for state low
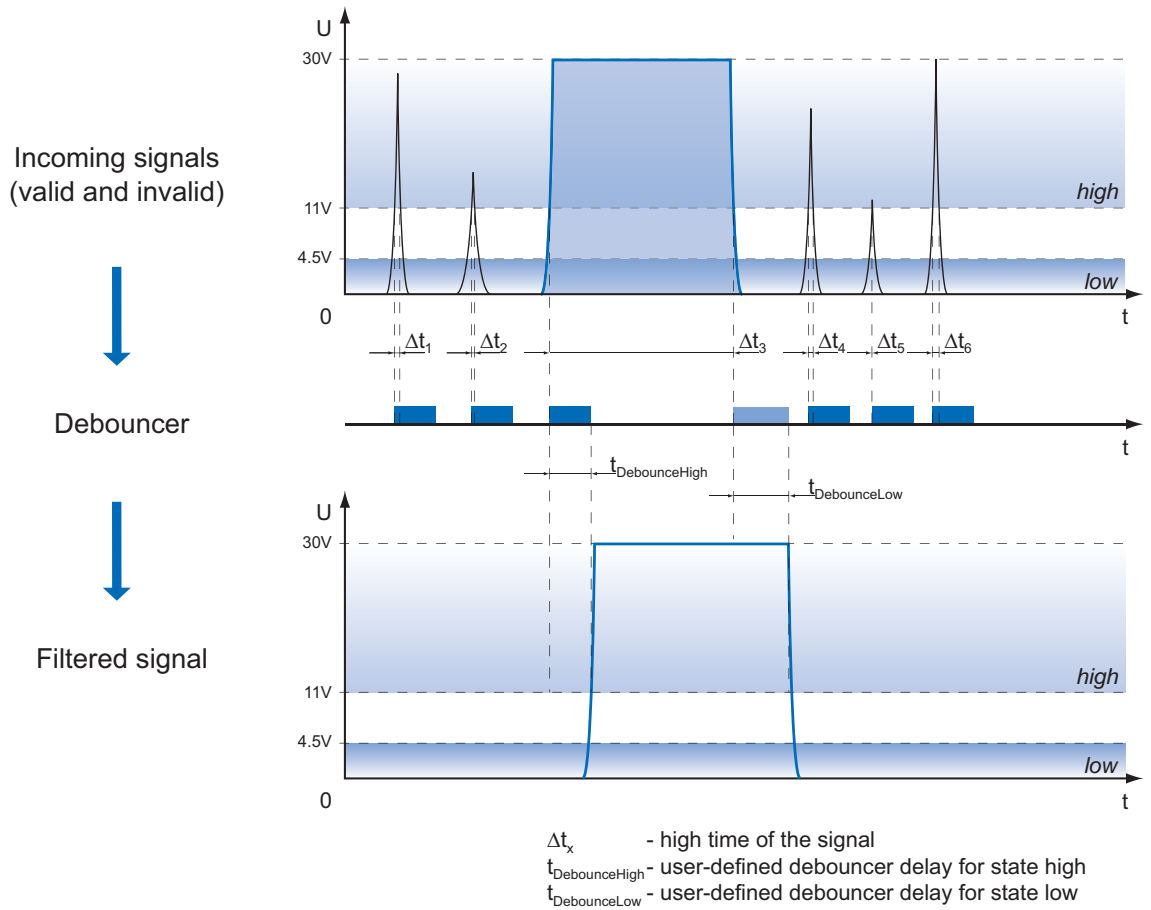
11.9.1   LineDebouncerHighTimeAbs

Defines the absolute value of the selected line debounce time in microseconds for switching from *low* to *high*.

Name	LineDebouncerHighTimeAbs
Category	DigitalIOControl
Interface	IFloat
Access	Read / Write
Unit	µs
Values	0.000000 - 5,000.000000 (Increment: 1.00)

11.9.2   LineDebouncerLowTimeAbs

Sets the absolute value of the selected line debounce time in microseconds for switching from *high* to *low*.

Name	LineDebouncerLowTimeAbs
Category	DigitalIOControl
Interface	IFloat
Access	Read / Write
Unit	µs
Values	0.000000 - 5,000.000000 (Increment: 1.00)

11.9.3   LineInverter

Controls signal inversion of the selected line *Input* or *Output*.

Name	LineInverter
Category	DigitalIOControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On) false = 0 (Off)

11.9.4   LineMode

Controls if the physical Line is used to input or output a signal.

Name	LineMode	
Category	DigitalIOControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Input	The selected physical line is used to input an electrical signal.
	Output	The selected physical line is used to output an electrical signal.

11.9.5   LineSelector

Selects the physical line (or pin) of the external device connector to configure.

Name	LineSelector
Category	DigitalIOControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	see table(s) below

VAX(.2)

INFO
Line0 and *Line3* can be selected but have no function.

Linesource
Line1
Line2

11.9.6   LineSource

Selects which internal signals are output at the selected *Line*.

Input

The defined signals will have no direct effect, but can be analyzed and processed on the software side and used for controlling the camera.
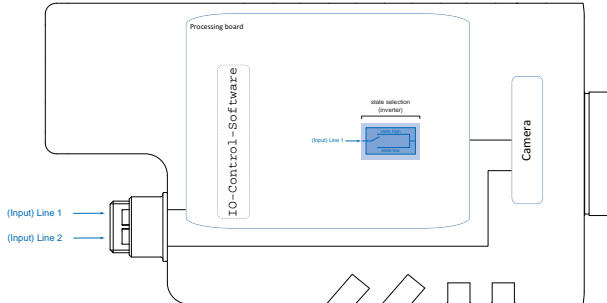
Output

Selects which internal signal to output on the selected Line.

With this feature, Baumer gives you the option to wire the output to internal signals that are controlled on the software side.
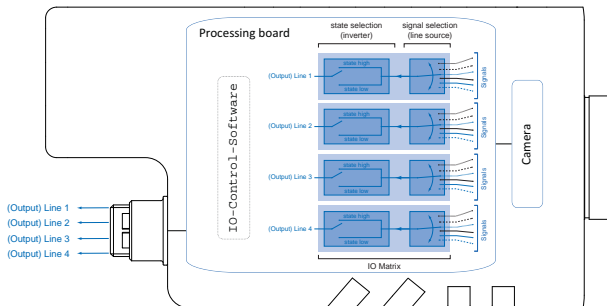
Name	LineSource
Category	DigitalIOControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	see table(s) below

VAX(.2)

LineSource (Signals)	
ExposureActive	A Frame (or Line) is currently being exposed by the device.
Off	Line Output disabled.
Line 0	Device is currently waiting for signal on *Line 0*.
Line 1	Device is currently waiting for signal on *Line 1*.
ReadoutActive	Camera is currently reading out a frame.
Timer1Active	Selected *Timer* is active.
TriggerReady	Device is ready for trigger.

LineSource (Signals)	
UserOutput1	Output state of the selected User Output Bit defined by its current *UserOutputValue*.
UserOutput2	Output state of the selected User Output Bit defined by its current *UserOutputValue*.
UserOutput3	Output state of the selected User Output Bit defined by its current *UserOutputValue*.
UserOutput4	Output state of the selected User Output Bit defined by its current *UserOutputValue*.

11.9.7   LineStatus

Returns the current status of the selected *Input* or *Output*.

Name	LineStatus
Category	DigitalIOControl
Interface	IBoolean
Access	Read only
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.9.8   LineStatusAll

Returns the current status of all available Line signals at time of polling in a single bitfield.

Name	LineStatusAll
Category	DigitalIOControl
Interface	IInteger
Access	Read only
Unit	-
Values	Devices-Specific (HexNumber)

11.9.9   UserOutputSelector

Selects which bit of the User Output register will be set by UserOutputValue.

Name	UserOutputSelector	
Category	DigitalIOControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	UserOutput1	Selects the bit 0 of the User Output register.
	UserOutput2	Selects the bit 1 of the User Output register.
	UserOutput3	Selects the bit 2 of the User Output register.
	UserOutput4	Selects the bit 3 of the User Output register.

11.9.10   UserOutputValue

Sets the value of the bit selected by *UserOutputSelector*.

Name	UserOutputValue
Category	DigitalIOControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.9.11   UserOutputValueAll

Sets the values of all bits under the *User Output* register.

Name	UserOutputValueAll
Category	DigitalIOControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 4294967295 (Increment: 1)

11.10   Category: EventControl

This chapter describes how to control the *Events* generation for host application. *Event* is a message sent to the host application to notify the presence of an internal event.

General Information

The asynchronous message channel is described in the GigE Vision standard® and can option-ally be used to signal events. Every *Event* is assigned a timestamp (64 bits) with the exact point in time the event has occurred. Every *Event* can be separately enabled and disabled (*EventSelector*).

Event: EventLost

Event is output if a selected *Event* was lost. The cause may be too many *Events* having oc-curred.

Event: TriggerReady

Event signal whether the camera is able of processing incoming trigger signals or not.
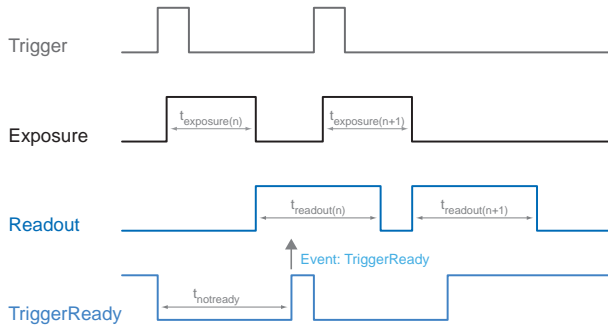
Event: TriggerSkipped

If the camera is unable to process incoming trigger signals, meaning camera trigger should be within the *tnotready* interval , these trigger signals are skipped. This will be indicated to the user by event *TriggerSkipped*..
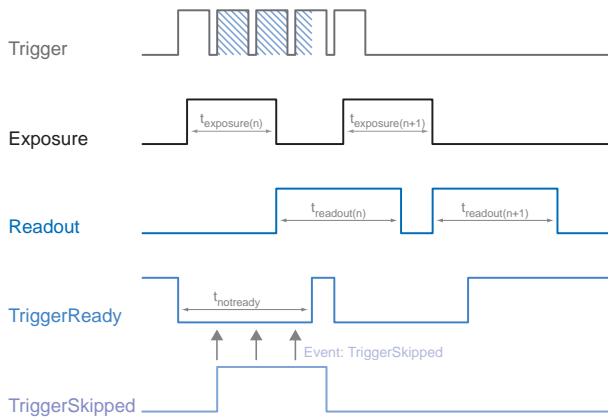
Event: TriggerOverlapped

This *Event* is active as long as the sensor is under exposure with parallel read out, i.e. camera operation utilizes *Overlapped*.

A valid trigger signal event outside a sensor readout operation will change the *TriggerOverlapped* signal to *Low*.
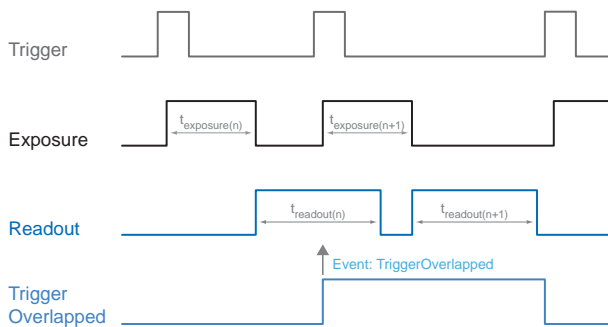
Event: ReadoutActive

While the sensor is read out, the camera signals this by means of *ReadoutActive*.
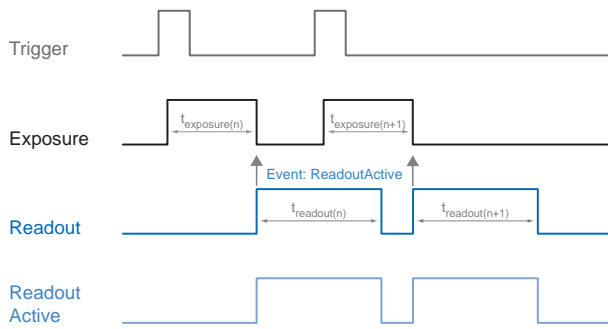
Event: TransferBufferFull

Event is only output at *TriggerMode*. It signals that no buffer is available.
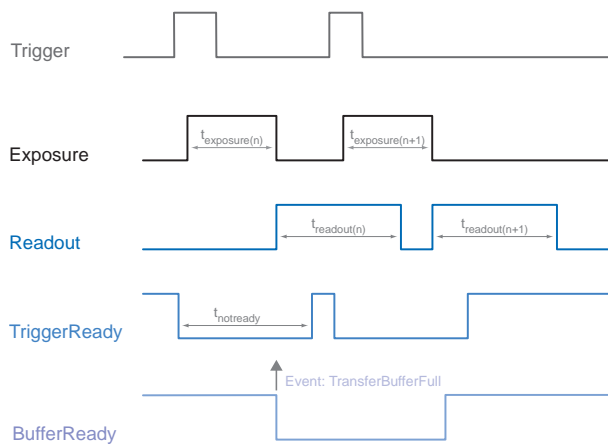
Event: TransferBufferReady

Event is only output at *TriggerMode*. Signals buffer availability.
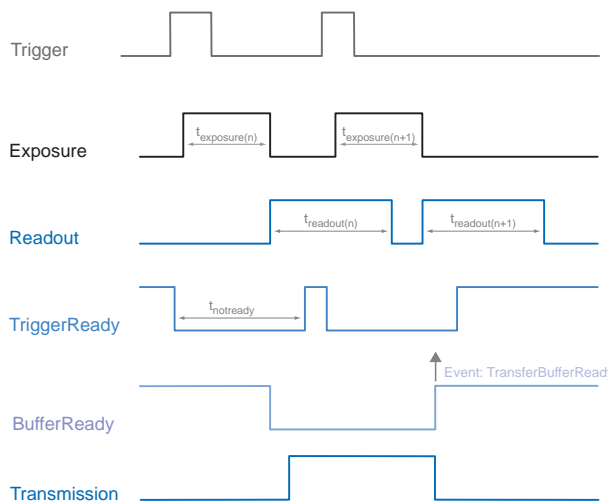
Event: DeviceTemperaturStatusChanged

To prevent the hardware from damage by high temperature, the camera features emergency shutdown. Feature *DeviceTemperatureStatusTransitionSelector* (Category: *DeviceControl*) is for selection of different temperature thresholds:

- *NormalToHigh*: freely programmable value
- *HighToExeeded*: fixed value (if exceeded, the sensor for image acquisition is switched off)
- *ExeededToNormal*: freely programmable, temperature for error-free reactivation

Feature *DeviceTemperatureStatusTransition* is for setting the temperatures for the programmed transition temperatures.

The event *EventDeviceTemperatureStatusChanged* is always generated when *DeviceTemperatureStatus* changes.

If temperature rises above the value set at *HighToExeeded*, function *DeviceTemperatureExceeded* is set to *True* followed by sensor switchoff to reduce power consumption; LED status indicator is red static. This usually will reduce temperature. Further rising temperature inside the camera due to ambient temperature may damage the hardware.

For further use, disconnect the camera from power supply after cool down or execute *DeviceReset*.

The sufficient cooling is recognizable when the event *DeviceTemperatureStatusChanged* (Device Temperature < *ExceededToNormal*) is output.

11.10.1   EventNotification

Activate or deactivate the notification to the host application of the occurrence of the selected *Event*.

Name	EventNotification	
Category	EventControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Off	Selected reporting disabled via *Event*.
	On	Selected reporting enabled via *Event*.

11.10.2   EventSelector

Selects which *Event* is to be reported to the host application.

Name	EventSelector
Category	EventControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	see table(s) below

VAX(.2)

Events
DeviceTemperatureStatusChanged
EventLost
ExposureEnd
ExposureStart
FrameEnd
FrameStart
FrameTranferSkipped
Line0..3 FallingEdge
Line0..3 RisingEdge
TransferBufferFull
TransferBufferReady
TriggerOverlapped
TriggerReady
TriggerSkipped

11.10.3   LostEventCounter

Counts lost Events.

Name	LostEventCounter
Category	EventControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 9223372036854775807 (Increment: 1)

11.11   Category: ImageFormatControl

This chapter describes how to influence and determine the image format control features.

General Information - Region of Interest (OffsetX / OffsetY / Width / Height)

Function *Region of Interest (ROI)* is used to predefine a so-called *Region of Interest*. This *ROI* is a defined range of sensor pixels. At image acquisition, only this pixel-specific information is transferred to PC. Not all of the lines on the sensor are read out, which therefore decreases the readout time (*treadout*). This allows for increased frame rates.

This function is used if only a particular region in the field of view is of interest. Further it will reduce resolution.

The ROI is specified by four values:

- *OffsetX* - x-coordinate of the first relevant pixel
- *OffsetY* - y-coordinate of the first relevant pixel
- *Width* - horizontal ROI size
- *Height* - vertical ROI size
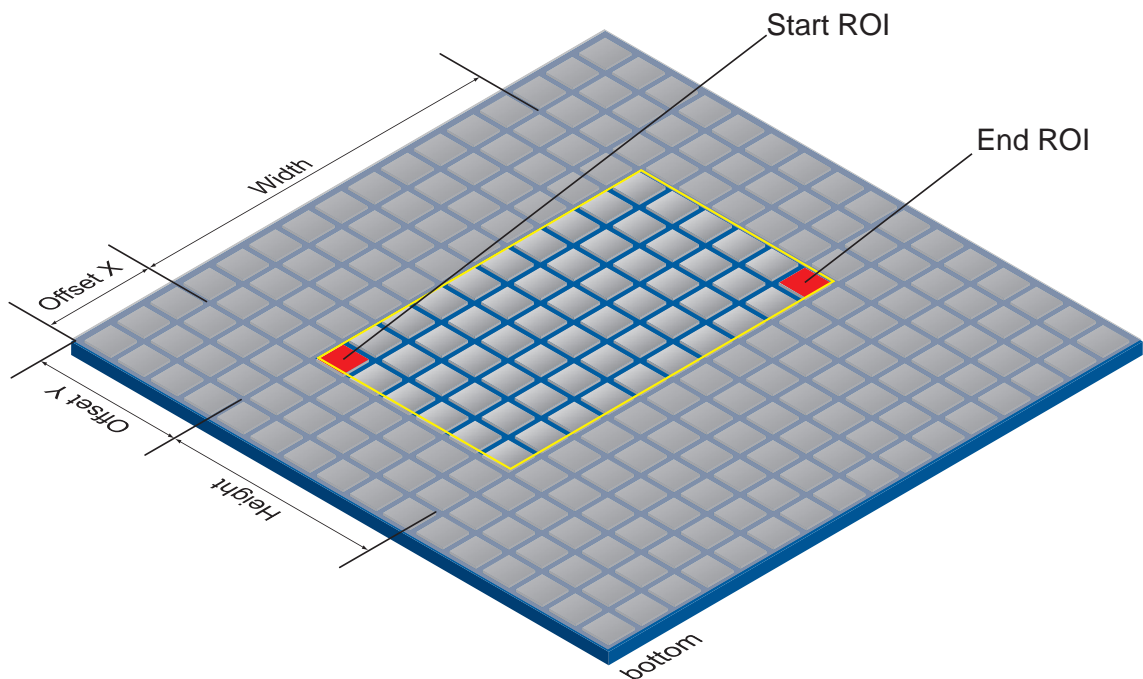
ROI Readout

In the illustration below, the readout time would be cut down to 40% of full frame readout.

Readout lines

bottom
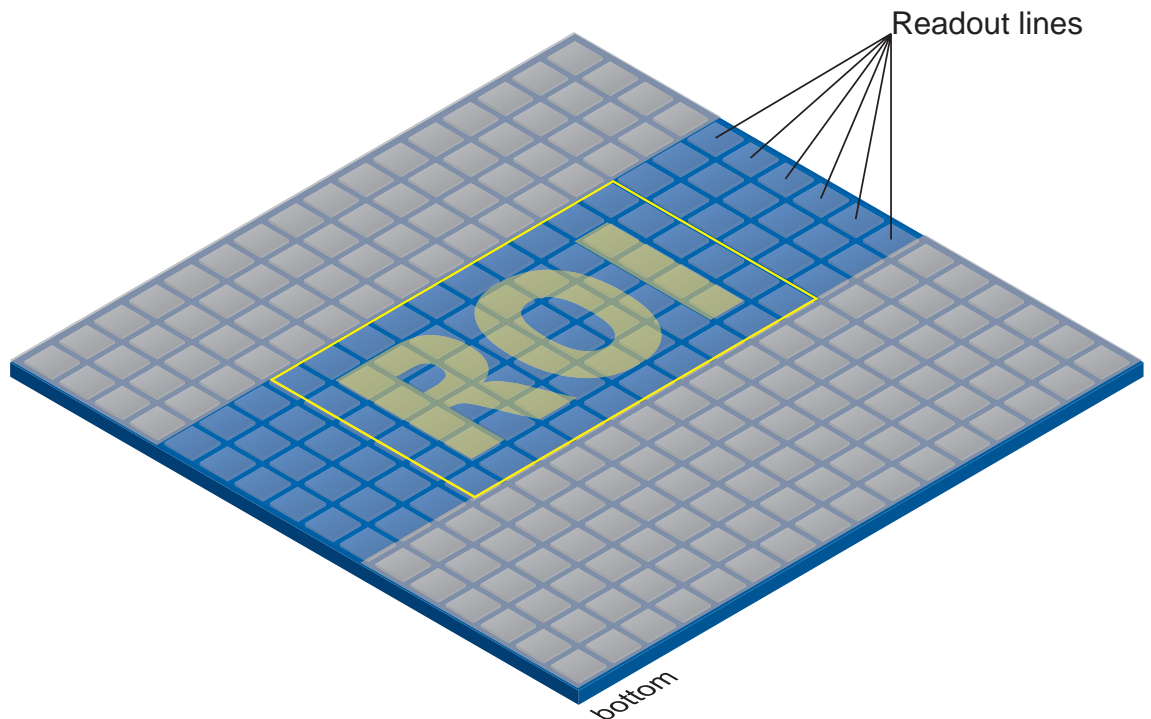
General Information - Binning (BinningHorizontal / BinningVertical)

On digital cameras, you can find several operations for progressing sensitivity. One of them is the so-called *Binning*. It clusters the charge carriers of neighboring pixels. This method implicates higher sensitivity and reduced resolution. Higher sensitivity allows for shorter exposure times.

Baumer cameras support three *Binning* types - vertical, horizontal and bidirectional.

In unidirectional *Binning*, vertically or horizontally neighboring pixels are clustered and reported to the software as a single "superpixel".

Bidirectional *Binning* clusters, a square of neighboring pixels.

INFO
Deviations in brightness after *Binning* can be corrected with function *Brightness Correction*.

Monochrome Binning

without

Full frame image, no binning of pixels.
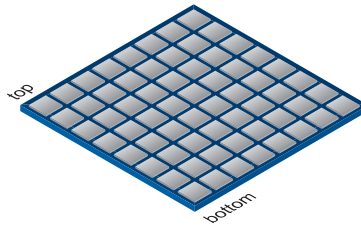
1x2

Vertical binning would produce a vertically compressed image with twice the brightness.
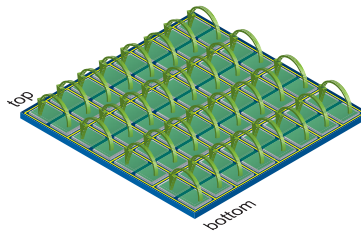
2x1

Horizontal binning would produce a horizontally compressed image with twice the brightness.
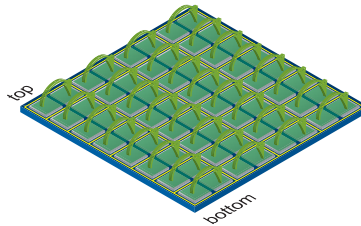
2x2

Bidirectional binning would produce both a horizontally and vertically compressed image with four times the brightness.
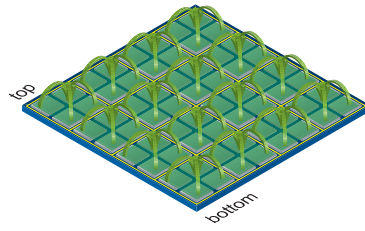
Color Binning

Color Binning is processed by the camera (no higher frame rates) – The sensor does not support this binning option.

Color calculated pixel formats

Pixels which are not in RAW format (e.g. *RGB8*), the three calculated color values (R, G, B) of a pixel will be added those of the related neighbor pixel during binning.

Binning	Illustration
without	
1x2	
2x1	
2x2	
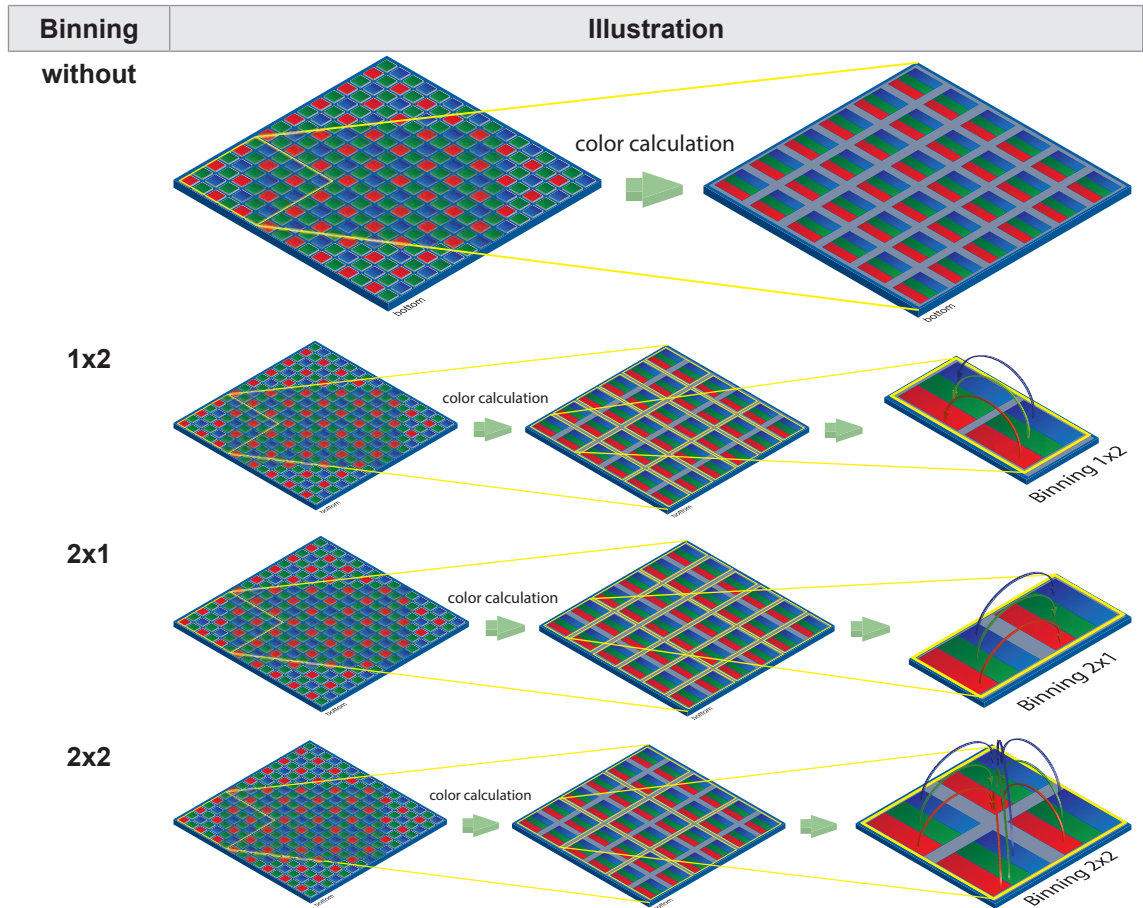
RAW pixel formats

RAW pixel formats (e.g. *BayerRG8*) cluster the color values of neighboring pixels of the same color.

Binning	Illustration
without	
1x2	
2x1	
2x2	
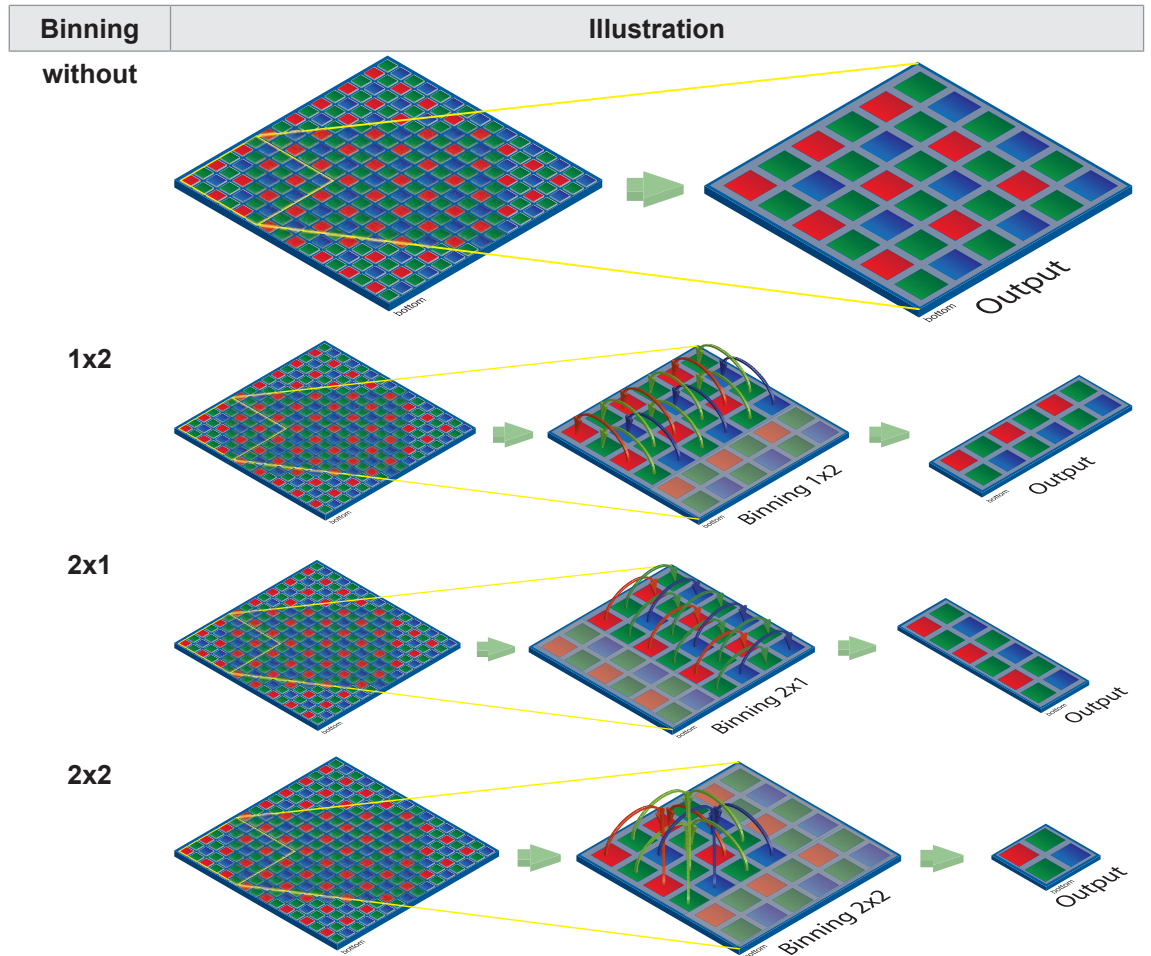
11.11.1   BinningHorizontal

Number of horizontal photo-sensitive cells to combine together. This increases the intensity (or signal to noise ratio) of the pixels and reduces the horizontal resolution (width) of the image.

Name	BinningHorizontal
Category	ImageFormatControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	see table(s) below (Increment: 1)

VAX(.2)

Camera type	BinningSelector [Region0]	BinningSelector [Sensor]
Monochrome		
VAX(.2)-32M.I.NVN	1 ... 2	1 ... 1
VAX(.2)-50M.I.NVX	1 ... 2	1 ... 1

Camera type	BinningSelector [Region0]	BinningSelector [Sensor]
Color		
VAX(.2)-32C.I.NVN	1 ... 2	1 ... 1
VAX(.2)-50C.I.NVX	1 ... 2	1 ... 1
VAX-50C.I.NX16	1 ... 2	1 ... 1

11.11.2   BinningHorizontalMode

Sets the mode to use to combine horizontal pixel together when *BinningHorizontal* is used.

Name	BinningHorizontalMode	
Category	ImageFormatControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Average	The response from the combined cells will be averaged, resulting in increased signal/noise ratio.
	Sum	The response from the combined cells will be added, resulting in increased sensitivity.

11.11.3   BinningSelector

Selects which binning engine is controlled by the *BinningHorizontal* and *BinningVertical* features.

Name	BinningSelector
Category	ImageFormatControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	see table(s) below

Values	Description
Region0	The *Binning* is calculated in the FPGA.
Sensor	*Binning* is calculated in the sensor (only monochrome).

11.11.4   BinningVertical

Number of vertical photo-sensitive cells to combine together. This increases the intensity (or signal to noise ratio) of the pixels and reduces the vertical resolution (height) of the image.

Name	BinningVertical
Category	ImageFormatControl
Interface	IInteger
Access	Read / Write
Unit	-

Values	see table(s) below (Increment: 1)

VAX(.2)

Camera type	BinningSelector [Region0]	BinningSelector [Sensor]
Monochrome		
VAX(.2)-32M.I.NVN	1 ... 2	1 ... 1
VAX(.2)-50M.I.NVX	1 ... 2	1 ... 1
Color		
VAX(.2)-32C.I.NVN	1 ... 2	1 ... 1
VAX(.2)-50C.I.NVX	1 ... 2	1 ... 1
VAX-50C.I.NX16	1 ... 2	1 ... 1

11.11.5   BinningVerticalMode

Sets the mode used to combine vertical pixels when *BinningVertical*l is used.

Name	BinningVerticalMode	
Category	ImageFormatControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Average	The response from the combined cells will be averaged, resulting in increased signal/noise ratio.
	Sum	The response from the combined cells will be added, resulting in increased sensitivity.

11.11.6   ComponentEnable (MP cameras only)

Controls, if streaming of the component selected by feature ComponentSelector is active.

Name	ComponentEnable
Category	ImageFormatControl
Interface	IBoolean
Access	Read only
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.11.7   ComponentSelector (MP cameras only)

Selects, which data acquisition component to use.

Name	ComponentSelctor
Category	ImageFormatControl
Interface	IEnumeration

Access	Read / Write	
Unit	-	
Values	PolarizedRaw	Acquisition of polarized light intensity. The polarizing filters are arranged in a 2-by-2 pattern: 135° and 0° on even lines, 90° and 45° on odd lines. The raw data is unprocessed.

11.11.8   Height

Height of the image provided by the device (in pixels). The selected value changes with the change of *Binning*.

INFO

The sum of *OffsetY* and *Height* must be smaller or equal than *HeightMax*.
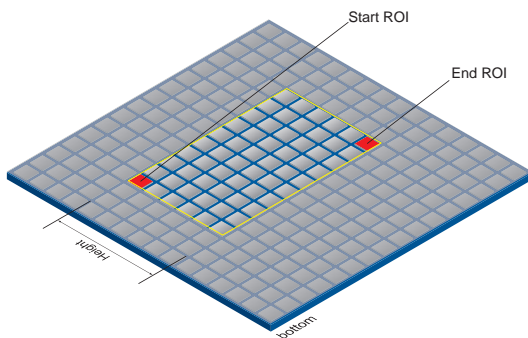
Name	Height
Category	ImageFormatControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	see table(s) below

VAX(.2)

Camera type	Values [Pixel]
Monochrome	
VAX(.2)-32M.I.NVN	1 … 1536 (Increment: 1)
VAX(.2)-50M.I.NVX	1 … 2048 (Increment: 1)
Color	
VAX(.2)-32C.I.NVN	1 … 1536 (Increment: 1)
VAX(.2)-50C.I.NVX	1 … 2048 (Increment: 1)
VAX-50C.I.NX16	1 … 2048 (Increment: 1)

11.11.9   HeightMax

Maximum height of the image (in pixels). This dimension is calculated after *Vertical Binning*, *Decimation* or any other function changing the vertical dimension of the image.

Name	HeightMax
Category	ImageFormatControl

Interface	IInteger
Access	Read only
Unit	-
Values	see table(s) below

VAX(.2)

Camera type	Values [Pixel]
Monochrome	
VAX(.2)-32M.I.NVN	1536
VAX(.2)-50M.I.NVX	2048
Color	
VAX(.2)-32C.I.NVN	1536
VAX(.2)-50C.I.NVX	2048
VAX-50C.I.NX16	2048

11.11.10 OffsetX

Horizontal offset from the origin to the region of interest (in pixels).

INFO

The sum of *OffsetX* and *Width* must be smaller or equal than *WidthMax*.
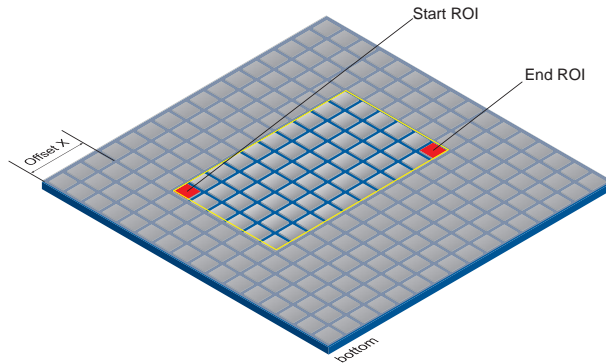
Name	OffsetX
Category	ImageFormatControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 … depends on *Width*

11.11.11 OffsetY

Vertical offset from the origin to the region of interest (in pixels).

INFO

The sum of *OffsetY* and *Height* must be smaller or equal than *HeightMax*.
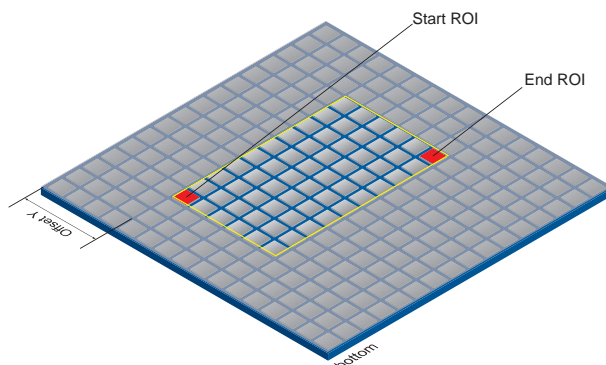
Name	OffsetY
Category	ImageFormatControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 … depends on *Height*

11.11.12   PixelFormat

PixelFormat - General Information

Format of the pixels provided by the device. It represents all the information provided by Pixel-Coding, PixelSize, PixelColorFilter combined in a single feature.

RAW	Raw data format. Here the data stored without processing.
Bayer	Raw data format of color sensors. Color filters are placed on these sensors in a checkerboard pattern, generally in a 50 % green, 25 % red and 25 % blue array.
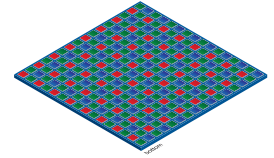
Mono	Monochrome. The color range of monochrome images consists of shades of a single color. Shades of gray as well as black and white are generally considered synonyms for monochrome.
RGB	Color model, in which all detectable colors are defined by three coordinates. Red, Green and Blue.
	The buffer provides the three coordinates in sequence R, G, B.
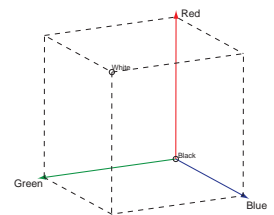
BGR	At BGR the camera interface is mapping in the transmission sequence of the color channels from RGB to BGR.
	This may save processing effort to the computer, since this data can be processed by the graphic card without conversion.

Pixel depth - General Information

In general, pixel depth defines the number of possible different values for each color channel. Typically 8 bits, which means 28 different "colors".

For RGB or BGR these 8 bits per channel equal 24 bits overall.

Transmission of more than 8 bits per pixel requires two bytes - even if data do not completely fill the second byte. To save bandwidth, the Baumer cameras support packed formats. These formats fill any non-used bits of a pixel with the data of the following pixel.

8 bit	Bit string of 8 bits and RGB 8 bits
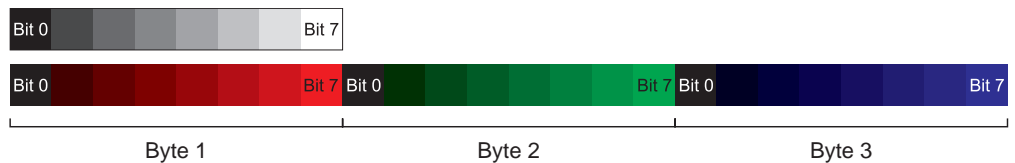
10 bit	Spreading 10 bits over 2 bytes.
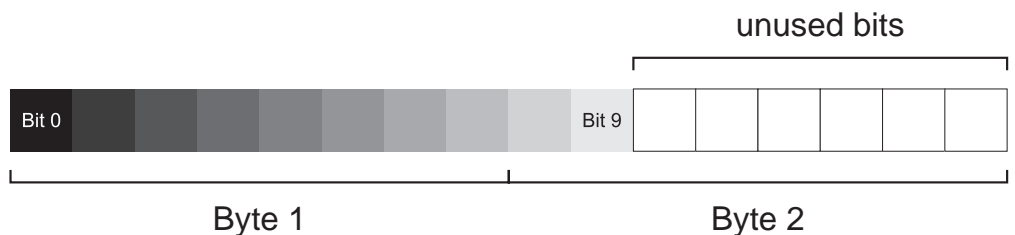
12 bit   Spreading 12 bits over two bytes.

unused bits

| Bit 0 | | | | | | | | | | Bit 11 | | | | |

Byte 1   Byte 2
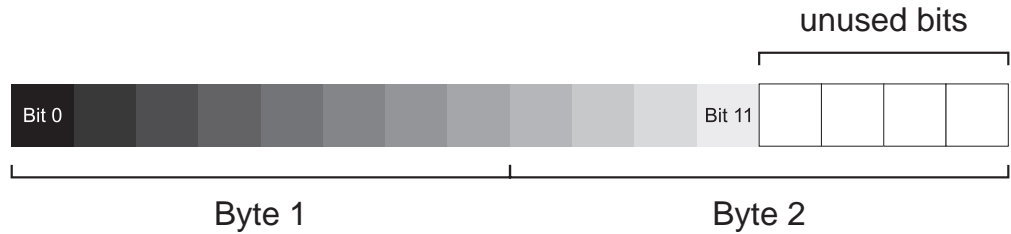
12 bit   Spreading two pixels in 12 bits over three bytes (packed mode).
(Packed)

Pixel 0   Pixel 1

| Bit 4 | Bit 5 | Bit 6 | Bit 7 | Bit 8 | Bit 9 | Bit 10 | Bit 11 | Bit 0 | Bit 1 | Bit 2 | Bit 3 | Bit 0 | Bit 1 | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | Bit 8 | Bit 9 | Bit 10 | Bit 11 |

Byte 1   Byte 2   Byte 3
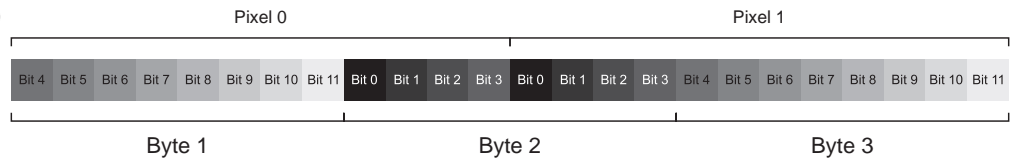
INFO

The camera must be stopped before this feature can be edited.

Name	PixelFormat
Category	ImageFormatControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	see table(s) below

VAX(.2)

Camera type	Mono8	Mono10	Mono12	Mono12p	Bayer RG8	Bayer RG10	Bayer RG12	Bayer G12p	RGB8	BGR8
Monochrome										
VAX(.2)-32M.I.NVN	■	■	■	■	□	□	□	□	□	□
VAX(.2)-50M.I.NVX	■	■	■	■	□	□	□	□	□	□
Color										
VAX-50C.I.NX16	■	■	■	■	■	■	■	■	■	■
VAX(.2)-50C	■	■	■	■	■	■	■	■	■	■
VAX-50C.I.NX16	■	■	■	■	■	■	■	■	■	■

11.11.13   **ReverseX (monochrome cameras/pixel formats only)**

Flips the image in horizontal direction. *Region of Interest* is applied prior to flipping.

INFO

The camera must be stopped before this feature can be edited.

Name	ReverseX
Category	ImageFormatControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.11.14   **ReverseY (monochrome cameras / pixel formats only)**

Flips the image in vertical direction. *Region of Interest* is applied prior to flipping.

INFO

The camera must be stopped before this feature can be edited.

Name	ReverseY
Category	ImageFormatControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.11.15   **SensorHeight**

Effective height of the sensor in pixels.

Name	SensorHeight
Category	ImageFormatControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 65535 (Increment: 1)

11.11.16   SensorName

Product name of the imaging sensor.

Name	SensorName
Category	ImageFormatControl
Interface	IString
Access	Read only
Unit	-
Values	e.g. IMX264

11.11.17   SensorPixelHeight

Physical size (pitch) in the y direction of a photo sensitive pixel unit.

Name	SensorPixelHeight
Category	ImageFormatControl
Interface	IFloat
Access	Read only
Unit	µm
Values	0.000000 ... 255.000000 (Increment: 1)

11.11.18   SensorPixelWidth

Physical size (pitch) in the x direction of a photo sensitive pixel unit.

Name	SensorPixelWidth
Category	ImageFormatControl
Interface	IFloat
Access	Read only
Unit	µm
Values	0.000000 ... 255.000000 (Increment: 1)

11.11.19   SensorShutterMode

Sets the sensor shutter mode of the camera. The sensor shutter mode depends on the *Trigger-Mode*.

Name	SensorShutterMode
Category	ImageFormatControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	See table(s) below

Leica K7

Values	
Global	The shutter opens and closes at the same time for all pixels. All the pixels are exposed for the same length of time at the same time.

11.11.20   SensorWidth

Effective width of the sensor in pixels.

Name	SensorWidth
Category	ImageFormatControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 65535 (Increment: 1)

11.11.21   TestPattern

Selects the type of test pattern that is generated by the device as image source.

Name	TestPattern
Category	ImageFormatControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	see table(s) below

GreyDiagonalRamp	Image is filled diagonally with an image that goes from the darkest possible value to the brightest.
GreyDiagonalRampHorizontalAndVerticalLineMoving	Image is filled diagonally with an image that goes from the darkest possible value to the brightest with moving horizontal and vertical lines.
GreyDiagonalRampHorizontalLineMoving	Image is filled diagonally with an image that goes from the darkest possible value to the brightest with moving horizontal lines.

GreyDiagonalRampVerticalLineMoving	Image is filled diagonally with an image that goes from the darkest possible value to the brightest with moving vertical lines.
GreyHorizontalRamp	Image is filled horizontally with an image that goes from the darkest possible value to the brightest.
GreyHorizontalRampHorizontalAndVerticalLineMoving	Image is filled horizontally with an image that goes from the darkest possible value to the brightest with moving horizontal and vertical lines.
GreyHorizontalRampHorizontalLineMoving	Image is filled horizontally with an image that goes from the darkest possible value to the brightest with moving horizontal lines.
GreyHorizontalRampVerticalLineMoving	Image is filled horizontally with an image that goes from the darkest possible value to the brightest with moving vertical lines.
GreyVerticalRamp	Image is filled vertically with an image that goes from the darkest possible value to the brightest.
GreyVerticalRampHorizontalAndVerticalLineMoving	Image is filled vertically with an image that goes from the darkest possible value to the brightest with moving horizontal and vertical lines.
GreyVerticalRampHorizontalLineMoving	Image is filled vertically with an image that goes from the darkest possible value to the brightest with moving horizontal lines.
GreyVerticalRampVerticalLineMoving	Image is filled vertically with an image that goes from the darkest possible value to the brightest with moving vertical lines.
HorizontalAndVerticalLineMoving	Image is filled with moving horizontal and vertical lines.
HorizontalLineMoving	Image is filled with moving horizontal lines.
Off	Image is coming from the sensor.
VerticalLineMoving	Image is filled with moving vertical lines.

11.11.22   TestPatternGeneratorSelector

Selects which test pattern generator is controlled by function *TestPattern*.

Name	SensorShutterMode	
Category	ImageFormatControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	ImageProcessor	TestPattern function will control the image processor.
	SensorProcessor	TestPattern function will control the sensor processor.

11.11.23   Width

Width of the image provided by the device (in pixels).
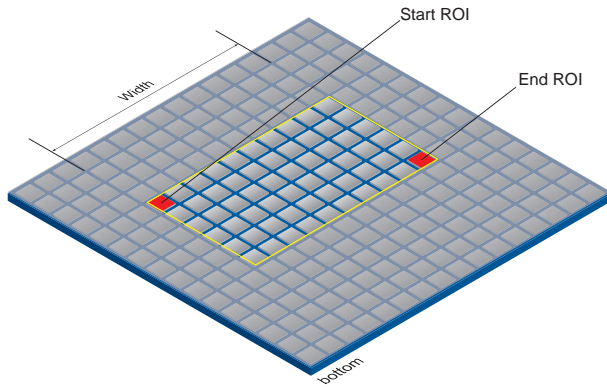
Name	Width
Category	ImageFormatControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	see table(s) below

VAX(.2)

Camera type	Values [Pixel]
Monochrome	
VAX(.2)-32M.I.NVN	16 … 2048 (Increment: 16)
VAX(.2)-50M.I.NVX	16 … 2448 (Increment: 16)
Color	
VAX(.2)-32C.I.NVN	16 … 2048 (Increment: 16)
VAX(.2)-50C.I.NVX	16 … 2448 (Increment: 16)
VAX-50C.I.NX16	16 … 2448 (Increment: 16)

11.11.24   WidthMax

Maximum width of the image (in pixels). Dimension is calculated after *Horizontal Binning*, *Decimation* or having executed any other function that would change the horizontal image dimension.

Name	WidthMax
Category	ImageFormatControl
Interface	IInteger
Access	Read only
Unit	-
Values	see table(s) below

VAX(.2)

Camera type	Values [Pixel]
Monochrome	
VAX(.2)-32M.I.NVN	2048
VAX(.2)-50M.I.NVX	2448
Color	
VAX(.2)-32C.I.NVN	2048
VAX(.2)-50C.I.NVX	2448
VAX-50C.I.NX16	2448

11.12   Category: LUTControl

Functions in this chapter describe the *Look-up table (LUT)* related functions. Particular parameters of the *LUT* functions are saved to the camera. This includes the coordinates of defective pixels so that they can be corrected.

Pixel Correction - General Information

There is a certain probability of abnormal pixels – so-called defect pixels – occurring within sensors from all manufacturers. The charge quantity of these pixels is not linearly dependent on the exposure time.

The occurrence of these defect pixels is unavoidable and intrinsic to the manufacturing and aging process of the sensors.

The operation of the camera is not affected by these pixels. They only appear as brighter (*hot pixel*) or darker (*cold pixel*) spots on the recorded image.
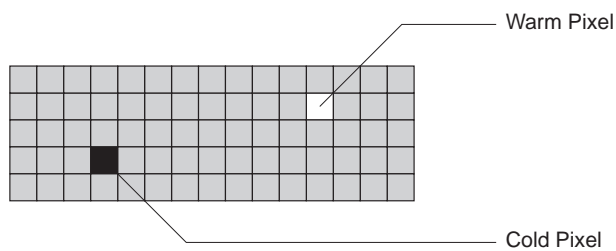
Charge quantity of "hot" and "cold" pixels compared with "normal" pixels:
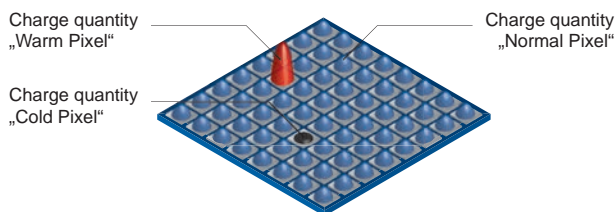
Correction Algorithm (Pixel Correction)

On Baumer cameras the problem of defect pixels is solved as follows:

- Possible defect pixels are identified during the production process of the camera.
- The coordinates of these pixels are stored in the factory settings of the camera.

Once the sensor readout is completed, correction takes place:

- Before any other processing, the values of the neighboring pixels on the left and the right side of the defect pixels, will be read out. (within the same bayer phase for color)
- Then the average value of these 2 pixels is determined to correct the first defect pixel
- Finally, the value of the defect pixel is corrected by using the previously corrected pixel and the pixel of the other side of the defect pixel.

Examples for the correction of defect pixels
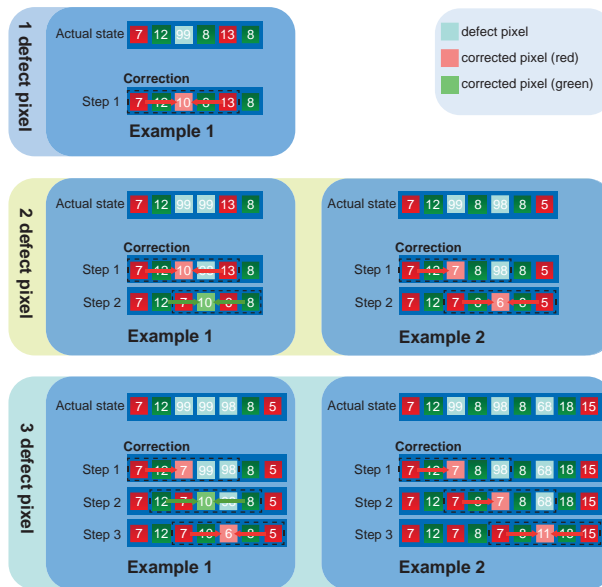
Add Defect Pixel to Defect Pixel List with Baumer Camera Explorer

💡 **INFO**

The addition of defect pixels must be done in full frame (without *Binning* / *Width* / *Height* / *Off-setX* / *OffsetY*), in raw data format and without activated color calculation.

Instruction:

a) Start the *Camera Explorer*. Connect to the camera.

b) Select profile *GenICam Guru* (only *Camera Explorer* < v3.0).

c) Open the category *LUTControl*.

d) Locate an empty *DefectPixelListIndex.*
   (DefectPixelListEntryPosX = 0 | DefectPixelListEntryPosY = 0)

e) Determine the coordinates of the defect pixel. Keep the mouse pointer over the defect pixel. The coordinates of the faulty pixel are provided in the status bar. For your convenience, you can enlarge the image.

f) Enter the determined coordinates for X (*DefectPixelListEntryPosX*) and Y (*DefectPixelListEntryPosY*).

g) Activate the registered *DefectPixelListIndex*.
   DefectPixelListEntryActive = True

h) Stop the camera and start them again to take over the updated coordinates.

Result:

✓ You have added a defective pixel to the defect pixel list.

11.12.1   DefectPixelCorrection

Enable the correction of defect pixels.

Name	DefectPixelCorrection
Category	LUTControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.12.2   DefectPixelListEntryActive

Determines if the pixel correction is active for the selected entry.

Name	DefectPixelListEntryActive
Category	LUTControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.12.3   DefectPixelListEntryPosX

X position of the defect pixel.

Name	DefectPixelListEntryPosX
Category	LUTControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... Resolution of the sensor in X-direction (Increment: 1)

11.12.4   DefectPixelListEntryPosY

Y position of the defect pixel.

Name	DefectPixelListEntryPosY
Category	LUTControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... Resolution of the sensor in Y-direction (Increment: 1)

11.12.5   **DefectPixelListIndex**

Index to the pixel correction list.

Name	DefectPixelListIndex
Category	LUTControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... 511 (Increment: 1)

11.12.6   **DefectPixelListSelector**

Selects which Defect Pixel List to control.

Name	DefectPixelListSelector	
Category	LUTControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Pixel	Selects Defect Pixel List for defect pixels.

11.12.7   **LUTContent**

Describes the content of the selected *LUT*.

Name	LUTContent	
Category	LUTControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Gamma	The content of the selected *LUT* is defined by the parameter in the *Gamma* feature.
	Userdefined LUT	The content of the selected *LUT* is user-defined.

11.12.8 LUTEnable

Enables the selected *LUT*. It contains 2^{12} (4096) values for the available levels. These values can be adjusted by the user.

Color cameras apply *LUT* to all color channels together.

Name	LUTEnable
Category	LUTControl
Interface	IBoolean
Access	Read / Write
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.12.9 LUTIndex

Control index (Offset) of the coefficient to access in the selected *LUT*.

Name	LUTIndex
Category	LUTControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... 4095 (Increment: 1)

11.12.10 LUTSelector

Selects which *LUT* to control.

Name	LUTSelector	
Category	LUTControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Luminance	Select Luminance LUT.

11.12.11 LUTValue

Returns the value at entry *LUTIndex* of the *LUT* selected by *LUTSelector*.

Name	LUTValue
Category	LUTControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 4095 (Increment: 1)

11.13   Category: MemoryManagement

Category containing the memory management functions.

11.13.1   MemoryMaxBlocks

Maximum count of disposal memory blocks.

Name	MemoryMaxBlocks
Category	MemoryManagement
Interface	IInteger
Access	Read only
Unit	-
Values	0 ... 4294967295 (Increment: 1)

11.14   Category: SequencerControl

Category for the *Sequencer* Control functions.

The *Sequencer* enables acquisition of an image series with automated camera re-parameterization based on events and signals. For doing so, the camera parameterization of each step is stored in so called *Sequencer Sets*.

Stringing together a number of these *Sequencer Sets* results in a sequence. The connection of sequences is done by using different paths. Alongside the camera functions the path related functions are also part of a *Sequencer Set*.

Sequencer Sets

Sequencer Sets combine camera features – similar to *User Set* – and *Sequencer* (set and path) related parameters.

Parameterization of several camera functions can be controlled via *Sequencer* and saved to *Sequencer Set*. Information for switching via different paths is also stored.

This camera functions can be:

- *ExposureTime*
- *Gain*
- *Region of Interest (OffsetX / OffsetY / Width / Height)*
- *UserOutput*
- *Counter*
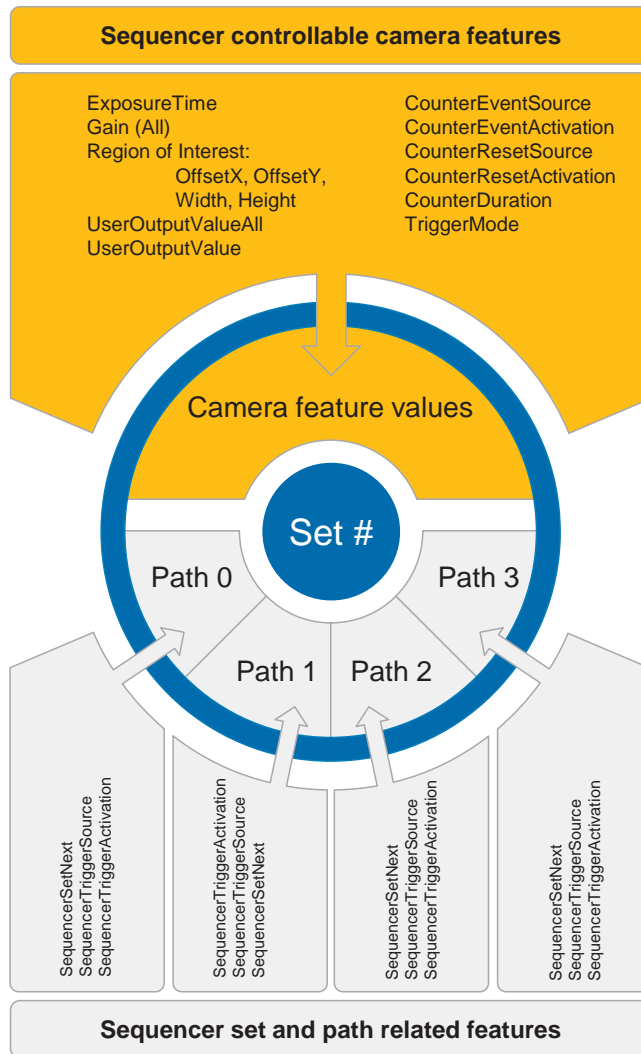
Each path involves:

- the destination for the set switch-over mapped in feature *SequencerSetNext*
- the signal change of state acting as switchover trigger and mapped as *SequencerTrigger-Source*
- the change of state acting as switch-over trigger and mapped as *SequencerTriggerActivation*

Similar to *User Sets* the camera's current parameterization will be overwritten when loading *Sequencer Set* and activating *Sequencer*.

Sequencer configuration

In order to avoid overwriting current camera settings during *Sequencer* configuration, the camera requires reparameterization to *SequencerConfigurationMode*.

If camera is set to *SequencerConfigurationMode*, individual *Sequencer Sets* can be selected via *SequencerSetSelector* for configuration and saved by executing *SequencerSetSave*.

Starting the configured sequence requires switching the *SequencerConfigurationMode = off* to enable *SequencerMode*.

11.14.1 SequencerConfigurationMode

Controls if the *SequencerConfigurationMode* is enabled.

Name	SequencerConfigurationMode	
Category	SequencerControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	On	Enables *SequencerConfigurationMode*.
	Off	Disables *SequencerConfigurationMode*.

11.14.2 SequencerFeatureEnable

Enables the selected feature and make it active in all the *Sequencer Sets*.

Name	SequencerFeatureEnable
Category	SequencerControl
Interface	IBoolean
Access	Read only
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.14.3 SequencerFeatureSelector

Selects the camera features that are controlled by the *Sequencer*.

Name	SequencerFeatureSelector
Category	SequencerControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	see table(s) below

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Values (Features)	
CounterDuration	Height
CounterEventActivation	OffsetX
CounterEventSource	OffsetY
CounterResetActivation	TriggerMode
CounterResetSource	UserOutputValue
ExposureMode	UserOutputValueAll
ExposureTime	Width
Gain	

11.14.4   SequencerMode

Controls if *Sequencer* is enabled.

💡 **INFO**
To use this feature, the features *BalanceWhiteAuto* (color cameras only) and *SequencerConfig-urationMode* must be = *off*.
To write this feature, set *TLParamsLocked = 0*.

Name	SequencerMode	
Category	SequencerControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	On	Enables *Sequencer*.
	Off	Disables *Sequencer*.

11.14.5   SequencerPathSelector

Selects the path that contains the settings coming afterward.

Name	SequencerPathSelector
Category	SequencerControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... 3 (Increment: 1)

11.14.6   SequencerSetActive

Contains the currently active *Sequencer Set*.

Name	SequencerSetActive
Category	SequencerControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... 127 (Increment: 1)

11.14.7   SequencerSetLoad

Loads the *Sequencer Set* selected with *SequencerSetSelector*.

Name	SequencerSetLoad
Category	SequencerControl
Interface	ICommand
Access	Write only
Unit	-
Values	-

11.14.8   SequencerSetNext

Specifies the next *Sequencer Set*.

Name	SequencerSetNext
Category	SequencerControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... 127 (Increment: 1)

11.14.9   SequencerSetSave

Saves the current device state to the *Sequencer Set* selected by the *SequencerSetSelector*.

Name	SequencerSetSave
Category	SequencerControl
Interface	ICommand
Access	Write only
Unit	-
Values	-

11.14.10   SequencerSetSelector

Selects *Sequencer Set* to which related function parameters will apply.

Name	SequencerSetSelector
Category	SequencerControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... 127 (Increment: 1)

11.14.11   SequencerSetStart

Sets the start *Sequencer Set*, which is the first set used.

Name	SequencerSetStart
Category	SequencerControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... 127 (Increment: 1)

11.14.12   SequencerTriggerActivation

Defines the signals edge to trigger *Sequencer*.

Name	SequencerTriggerActivation	
Category	SequencerControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	AnyEdge	Specifies that the trigger is considered valid on the falling or rising edge of the source signal.
	FallingEdge	Specifies that the trigger is considered valid on the falling edge of the source signal.
	LevelHigh	Defines trigger applied as long as source signal is on *high*.
	LevelLow	Defines trigger applied as long as source signal is on *low*.
	RisingEdge	Specifies that the trigger is considered valid on the rising edge of the source signal.

11.14.13   SequencerTriggerSource

Specifies the internal signal or Input to use as trigger source for the Sequencer.

Name	SequencerTriggerSource
Category	SequencerControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	see table(s) below

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INFO

Line2 is selectable, but without function.

Values	
Off	Disabled.
Counter1End	Starts with the reception of *Counter End*.

Values	
Counter2End	Starts with the reception of *Counter End*.
Line1	Specifies *Line1* as external trigger source.
ExposureActive	Starts with the reception of *Exposure Active*.
ReadOutActive	Starts with the reception of *Read Out Active*.
Timer1End	Starts with the reception of *Timer End*.

11.15   Category: TestControl

Category for test control functions.

11.15.1   TestPendingAck

Test of device *PendingAck* function.

Name	TestPendingAck
Category	TestControl
Interface	IInteger
Access	Read / Write
Unit	-
Values	0 ... 4294967295 (Increment: 1)

11.16   Category: TransportLayerControl

This chapter provides the *Transport Layer* control functions.

11.16.1   PayloadSize

Provides the number of bytes transferred for every image or *Chunk* on the Stream Channel with current parameterization. Total size of data payload for a data block.

Name	PayloadSize
Category	TansportLayerControl
Interface	IInteger
Access	Read only
Unit	Byte
Values	0 ... depends on current parameterization (Increment: 1)

11.16.2   Category: TransportLayerControl → USB3Vision

Category that contains the features pertaining to the USB3 Vision transport layer of the device.

INFO

The camera module is internally connected to the Processing Board via USB3.0. Therefore, this category is visible even the smart camera has a GigE port.

11.16.2.1   InterfaceSpeedMode

Show the interface speed mode as string.

Name	InterfaceSpeedMode	
Category	TansportLayerControl → USB3Vision	
Interface	IEnumeration	
Access	Read only	
Unit	-	
Values	FullSpeed	USB operation at 12 Mbps.
	HighSpeed	USB operation at 480 Mbps.
	LowSpeed	USB operation at 1.5 Mbps.
	SuperSpeed	USB operation at 5 Gbps.

11.16.2.2   SIControl

Controls streaming operation.

Name	SIControl	
Category	TansportLayerControl → USB3Vision	
Interface	IEnumeration	
Access	Read only	
Unit	-	
Values	StreamDisabled	Disable Streaming.
	StreamEnabled	Enable Streaming.

11.16.2.3   SIPayloadFinalTransfer1Size

Size of first final Payload Transfer.

Name	SIPayloadFinalTransfer1Size
Category	TansportLayerControl → PtpControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 - 4294967295 (Increment: 1)

11.16.2.4   SIPayloadFinalTransfer2Size

Size of second final Payload Transfer.

Name	SIPayloadFinalTransfer2Size
Category	TansportLayerControl → PtpControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 - 4294967295 (Increment: 1)

11.16.2.5   SIPayloadTransferCount

Expected number of Payload Transfers.

Name	SIPayloadTransferCount
Category	TansportLayerControl → PtpControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 - 4294967295 (Increment: 1)

11.16.2.6   SIPayloadTransferSize

Expected size of a single Payload Transfer.

Name	SIPayloadTransferSize
Category	TansportLayerControl → PtpControl
Interface	IInteger
Access	Read only
Unit	-
Values	0 - 4294967295 (Increment: 1)

11.17   Category: UserSetControl

Category including features for *User Sets* control. It allows loading or saving factory or user-defined settings.

Loading the factory default *User Sets* guarantees a state enabling continuous acquisition start by the mandatory features only.

These *User Sets* are stored to the camera and can be loaded, saved and transferred to other cameras.

11.17.1   UserSetDefault

Four *User Sets* are available for this camera. *User Set 1, User Set 2, User Set 3* are user-specific and can contain user-definable parameters.

The factory settings are stored in the *User Set: Default*. This is the only *User Set* that cannot be edited.

Name	UserSetDefault	
Category	UserSetControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Default	Select the factory predefined *User Set*.
	User Set 1	Select the *User Set 1* (available when saved).
	User Set 2	Select the *User Set 2* (available when saved).
	User Set 3	Select the *User Set 3* (available when saved).

11.17.2   UserSetFeatureEnable

Activates the feature selected with *UserSetFeatureSelector*.

Name	UserSetFeatureEnable
Category	UserSetControl
Interface	IBoolean
Access	Read only
Unit	-
Values	true = 1 (On)
	false = 0 (Off)

11.17.3   UserSetFeatureSelector

Selects which individual feature is to be controlled.

Name	UserSetFeatureSelector
Category	UserSetControl
Interface	IEnumeration
Access	Read / Write
Unit	-
Values	see table(s) below

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Features		
AcquisitionFrameCount	DeviceLinkThroughputLimit	OffsetY
AcquisitionFrameRate	DeviceTemperatureStatus-Transition	PixelFormat
AcquisitionFrameRate-Enable	EventNotification	ReadoutMode
AcquisitionMode	ExposureAuto	ReverseX
AutoFeatureHeight	ExposureAutoMaxValue	ReverseY
AutoFeatureOffsetX	ExposureAutoMinValue	SensorShutterMode
AutoFeatureOffsetY	ExposureMode	SequencerSetNext
AutoFeatureWidth	ExposureTime	SequencerSetStart
BinningHorizontal	FrameCounter	SequencerTrigger-Activation
BinningHorizontalMode	Gain	SequencerTriggerSource
BinningVertical	GainAuto	TestPattern
BinningVerticalMode	GainAutoMaxValue	TimerDelay
BlackLevel	GainAutoMinValue	TimerDuration
BrightnessAutoNominalValue	Gamma	TimerTriggerActivation
BrightnessAutoPriority	Height	TimerTriggerSource
ChunkEnable	LUTContent	TriggerActivation
ChunkModeActive	LUTEnable	TriggerDelay
ColorTransformationAuto	LUTValue	TriggerMode
CounterDuration	LineDebouncerHigh-TimeAbs	TriggerSource
CounterEventActivation	LineDebouncerLow-TimeAbs	UserOutputValue
CounterEventSource	LineInverter	UserOutputValueAll
CounterResetActivation	LineMode	Width
CounterResetSource	LineSource	
DefectPixelCorrection	OffsetX	

11.17.4   UserSetLoad

Loads the *UserSetSelector* specified by *User Set* to the device and activates device.

INFO

The camera must be stopped before this feature can be edited.

Name	UserSetLoad
Category	UserSetControl
Interface	ICommand
Access	Write only
Unit	-
Values	-

11.17.5   UserSetSave

Save the *UserSetSelector* specified by *User Set* to the non-volatile device memory.

INFO

Default settings are stored in *User Set*: *Default*. This is the only *User Set* that cannot be edited. To save the configuration select at *UserSetSelector* (*UserSet1, UserSet2* or *UserSet3*).

Name	UserSetSave
Category	UserSetControl
Interface	ICommand
Access	Write only
Unit	-
Values	-

11.17.6   UserSetSelector

Selects the *User Set* to load, save or configure.

INFO

Default settings are stored in *User Set*: *Default*. This is the only *User Set* that cannot be edited. To save the configuration select at *UserSetSelector* (*UserSet1, UserSet2* or *UserSet3*).

Name	UserSetSelector	
Category	UserSetControl	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Default	Select the factory predefined *User Set*.
	User Set 1	Select the *User Set 1*.
	User Set 2	Select the *User Set 2*.
	User Set 3	Select the *User Set 3*.

11.18 Category: boCalibrationData

Category for functions of calibration data.

INFO

Calibration setting

Calibration is not in the camera and either via *Camera Explorer*. Enter here the category parameters to be determined in the application environment by external software (e.g. *OpenCV*). This calibration data is saved non-volatile to the camera.

For calibration, the camera provides image together with stored calibration data. Calibration must be performed using external software.

11.18.1 boCalibrationAngularAperture

Angular lens aperture as the angular lens size as seen from the focal point in degrees.

Name	boCalibrationAngularAperture
Category	boCalibrationData
Interface	IFloat
Access	Read / Write
Unit	°
Values	0.000000 … 360.000000 (Increment: 1.00)

11.18.2 boCalibrationDataConfigurationMode

Controls whether *boCalibrationDataConfigurationMode* is active.

Name	boCalibrationDataConfigurationMode	
Category	boCalibrationData	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Off	Disables *boCalibrationDataConfigurationMode*.
	On	Enables *boCalibrationDataConfigurationMode*.

11.18.3 boCalibrationDataSave

Save the current calibration data to the non-volatile device memory.

Name	boCalibrationDataSave
Category	boCalibrationData
Interface	ICommand
Access	Write only
Unit	-
Values	-

11.18.4   boCalibrationDataVersion

Version of the optical controller.

Name	boCalibrationDataVersion
Category	boCalibrationData
Interface	IString
Access	Read only
Unit	-
Values	-

11.18.5   boCalibrationFocalLength

Focal length in millimeters (mm).

Name	boCalibrationFocalLength
Category	boCalibrationData
Interface	IFloat
Access	Read / Write
Unit	mm
Values	0.000000 … 4,294,967,296.000000 (Increment: 1.00)

11.18.6   boCalibrationMatrixSelector

Selection of the calibration matrix.

Name	boCalibrationMatrixSelector	
Category	boCalibrationData	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Camera Matrix	Selection of the camera matrix.
	New Camera Matrix	Selection of the camera matrix considering the geometric distortion.

11.18.7   boCalibrationMatrixValue

Selected value of the calibration matrix.

Name	boCalibrationMatrixValue
Category	boCalibrationData
Interface	IFloat
Access	Read only
Unit	-
Values	-3.40282e+38 … 3.40282e+38 (Increment: 1.00)

11.18.8   boCalibrationMatrixValueSelector

Value selector of the calibration matrix.

Name	boCalibrationMatrixValueSelector	
Category	boCalibrationData	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Value 11	Selects the matrix value in row 1 column 1.
	Value 12	Selects the matrix value in row 1 column 2.
	Value 13	Selects the matrix value in row 1 column 3.
	Value 21	Selects the matrix value in row 2 column 1.
	Value 22	Selects the matrix value in row 2 column 2.
	Value 23	Selects the matrix value in row 2 column 3.
	Value 31	Selects the matrix value in row 3 column 1.
	Value 32	Selects the matrix value in row 3 column 2.
	Value 33	Selects the matrix value in row 3 column 3.

11.18.9   boCalibrationVectorSelector

Selects the calibration vector.

Name	boCalibrationVectorSelector	
Category	boCalibrationData	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	rvec	Selects the output rotation vector.
	tvec	Selects the translation vector.

11.18.10   boCalibrationVectorValue

Value of the selected calibration vector.

Name	boCalibrationVectorValue
Category	boCalibrationData
Interface	IFloat
Access	Read only
Unit	-
Values	-3.40282e+38 … 3.40282e+38 (Increment: 1.00)

11.18.11   boCalibrationVectorValueSelector

Selects value selector for calibration vector.

Name	boCalibrationVectorValueSelector	
Category	boCalibrationData	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	Value 1	Selects vector value 1.
	Value 2	Selects vector value 2.
	Value 3	Selects vector value 3.

11.18.12   boGeometryDistortionValue

Selected geometric distortion value.

Name	boGeometryDistortionValue
Category	boCalibrationData
Interface	IFloat
Access	Read only
Unit	-
Values	-3.40282e+38 … 3.40282e+38 (Increment: 1.00)

11.18.13   boGeometryDistortionValueSelector

Selector for geometric distortion.

Name	boGeometryDistortionValueSelector	
Category	boCalibrationData	
Interface	IEnumeration	
Access	Read / Write	
Unit	-	
Values	k1	Selects geometric distortion value k1.
	k2	Selects geometric distortion value k2.
	k3	Selects geometric distortion value k3.
	p1	Selects geometric distortion value p1
	p2	Selects geometric distortion value p2.

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