

# EX Series

# CMOS Camera

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## Instruction Manual

Model  
B/W Camera : EX670AMG-X

Thank you for purchasing our product.  
Before using this CMOS camera, please read through this instruction manual carefully in order to use this product correctly and safely.  
After reading, keep this instruction manual handy so that you can refer to, whenever you need it.

## Toshiba Teli Corporation

Information contained in this document is subject to change without prior notice.

Standard name might be trade mark of each company.

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# Safety Precautions

Before using this product, read these safety precautions carefully. Important information is shown in this Instruction Manual to protect users from bodily injuries and property damages, and to enable them to use the product safely and correctly.

Please be sure to thoroughly understand the meanings of the following signs and symbols before reading the main text that follow, and observe the instructions given herein.

[Definition of Safety Signs]

Safety Signs	Description
 WARNING	Indicates a potentially hazardous situation that may result in death or serious injury (*1) in the event of improper handling.
 CAUTION	Indicates a potentially hazardous situation that may result in light to moderate injuries (*2) or only in property damage (*3) in the event of improper handling.

Notes \*1: "Serious injury" refers to cases of loss of eyesight, wounds, burns (high or low temperature), electric shock, broken bones, poisoning, etc., which leave after-effects or which require hospitalization or a long period of outpatient treatment of cure.

\*2: "Light to moderate injuries" refers to injuries, burns, electric shock etc. that do not require hospitalization or long-term treatment.

\*3: "Property damage" refers to cases of extensive damage involving damage to buildings, equipment, farm animals, pet animals and other belongings.

[Explanation of Safety Symbols]

Safety Symbols	Description
 PROHIBITED	This sign indicates <b>PROHIBITION</b> (Do not). The content of prohibition is shown by a picture or words beside the symbol.
 MANDATORY	This sign indicates <b>MANDATORY ACTION</b> (You are required to do). The content of action is shown by a picture or words beside the symbol.

# General Handling

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## **WARNING**

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Unplug

- **Stop operation immediately when any abnormality or defect occurs.**

If abnormal conditions are present, such as smoke, a burning smell, ingress of water or foreign matter, or if the equipment is dropped or malfunctions, fire or electric shock may result.

Be always sure to disconnect the power cable from the wall socket at once and contact your dealer.



Do not get wet

- **Do not use the equipment in locations subject to water splashes.**

Otherwise, fire or electric shock may result.



Never pull apart

- **Do not disassemble, repair, or modify the equipment.**

Otherwise, fire or electric shock may result.

For internal repair, inspection, or cleaning, contact your sales representative.



Avoid

- **Do not place anything on the equipment.**

If metallic objects, liquid, or other foreign matter enters the equipment, fire or electric shock may result.



Avoid

- **Do not install the equipment in an unstable or inclined location or locations subject to vibration or impact.**

Otherwise, the equipment may topple over and cause personal injury.



Do not touch

- **During an electrical storm, do not touch the power cable and the connection cable.**

Otherwise, an electric shock may result.



Instruction

- **Use the specified voltage.**

Use of an unspecified voltage may result in fire or electric shock.



Avoid

- **Do not be handled roughly, damaged, fabricated, bent forcefully, pulled, twisted, bundled, placed under heavy objects or heated the power cable and the connection cable.**

Otherwise, fire or electric shock may result.

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## CAUTION

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Instruction

- **Observe the following when installing the equipment:**

- Do not cover the equipment with a cloth, etc.
- Do not place the equipment in a narrow location where heat is likely to accumulate. Otherwise, heat will accumulate inside the equipment, possibly resulting in a fire.



Avoid

- **Do not place the equipment in locations subject to high moisture, oil fumes, steam, or dust.**

Otherwise, fire or electric shock may result.



Avoid

- **Do not install the equipment in locations exposed to direct sunlight or humidity.**

Otherwise, the internal temperature of the equipment will rise, which may cause a fire.



Instruction

- **Use only specified the power cable and the connection cables.**

Otherwise, fire or electric shock may result.



Avoid

- **Do not give strong impact against the equipment.**

It may cause the trouble.



Instruction

- **When performing connection, turn off power.**

When connecting the power cable and the connection cable, turn off the equipment power.

Otherwise, fire or electric shock may result.



Avoid

- **Do not expose its camera head to any intensive light (such as direct sunlight).**

Otherwise, its inner image pickup device might get damaged.



Avoid

- **Avoid short-circuiting signal output.**

Otherwise, a malfunction may occur.



Avoid

- **Avoid giving a strong shock against the camera body.**

It might cause a breakdown or damage. If your camera is used in a system where its connector is subjected to strong repetitive shocks, its connector is possible to break down. If you intend to use your camera in such a situation, if possible, bundle and fix a cable in the place near the camera, and do not transmit a shock to the connector.



Instruction

- **Contact your sales representative to request periodic inspection and cleaning (every approx five years).**

Accumulation of dust inside the equipment may result in fire or electric shock.

For inspection and cleaning costs, contact your sales representative.

# CASES FOR INDEMNITY (LIMITED WARRANTY)

We shall be exempted from taking responsibility and held harmless for damage or losses incurred by the user in the following cases.

- In the case damage or losses are caused by natural disasters, such as an earthquake and thunder, fire, or other acts of God, acts by a third party, deliberate or accidental misuse by the user, or use under extreme operating conditions.
- In the case of indirect, additional, consequential damages (loss of business interests, suspension of business activities) are incurred as result of malfunction or non-function of the equipment, we shall be exempted from responsibility for such damages.
- In the case damage or losses are caused by failure to observe the information contained in the instructions in this instruction manual and specifications.
- In the case damage or losses are caused by use contrary to the instructions in this instruction manual and specifications.
- In the case damage or losses are caused by malfunction or other problems resulting from unintended use of equipment or software etc. that are not specified.
- In the case damage or losses are caused by repair or modification conducted by the customer or any unauthorized third party (such as an unauthorized service representative).
- Expenses we bear on this product shall be limited to the individual price of the product.
- The item that is not described in specifications of this product is out of the guarantee.
- The case of damages or losses which are caused by incorrect connection of the cable is out of the guarantee.

# RESTRICTION FOR USE

- Should the equipment be used in the following conditions or environments, give consideration to safety measures and inform us of such usage:
  1. Use of the equipment in the conditions or environment contrary to those specified, or use outdoors.
  2. Use of the equipment in applications expected to cause potential hazard to people or property, which require special safety measures to be adopted.
  
- This product can be used under diverse operating conditions. Determination of applicability of equipment or devices concerned shall be determined after analysis or testing as necessary by the designer of such equipment or devices, or personnel related to the specifications. Such designer or personnel shall assure the performance and safety of the equipment or devices.
  
- This product is not designed or manufactured to be used for control of equipment directly concerned with human life (\*1) or equipment relating to maintenance of public services/functions involving factors of safety (\*2). Therefore, the product shall not be used for such applications.
  - (\*1): Equipment directly concerned with human life refers to.
    - Medical equipment such as life-support systems, equipment for operating theaters.
    - Exhaust control equipment for exhaust gases such as toxic fumes or smoke.
    - Equipment mandatory to be installed by various laws and regulations such as the Fire Act or Building Standard Law
    - Equipment related to the above
  - (\*2): Equipment relating to maintenance of public services/functions involving factors of safety refers to.
    - Traffic control systems for air transportation, railways, roads, or marine transportation
    - Equipment for nuclear power generation
    - Equipment related to the above

# Notes on using this product

- Handle carefully

Do not drop the equipment or allow it to be subject to strong impact or vibration, as such action may cause malfunctions. Further, do not damage the connection cable, since this may cause wire breakage.

- Camera installation

When handling the camera in moving, operation setting with strong impacts and extreme vibrations may cause malfunctions. Make sure carefully in the camera installation and operation setting.

- Environmental operating conditions

Do not use the product in locations where the ambient temperature or humidity exceeds the specifications. Otherwise, image quality may be degraded or internal components may be adversely affected. In particular, do not use the product in areas exposed to direct sunlight. Moreover, during shooting under high temperatures, vertical stripes or white spots (noise) may be produced, depending on the subject or camera conditions (such as increased gain). However, such phenomena are not malfunctions.

- Check a combination with the lens

Depending on the lens and lighting you use, an image is reflected as a ghost in the imaging area. However, this is not because of a fault of the camera.

In addition, depending on the lens you use, the performance of the camera may not be brought out fully due to deterioration in resolution and brightness in the peripheral area, aberration and others.

Be sure to check a combination with the camera by using the lens and lighting you actually use.

When installing a lens in the camera, you can use an optional mount adapter. When attaching a mount adapter or a lens to the camera, make sure carefully that they are not tilted.

- Mounting to pedestal

When mounting this product to a pedestal, make sure carefully that lens doesn't touch with the pedestal.

- Do not expose the camera's image-pickup-plane to sunlight or other intense light directly

Its inner CMOS sensor might be damaged.

- Occurrence of moiré

If you shoot thin stripe patterns, moiré patterns (interference fringes) may appear. This is not a malfunction.

- Occurrence of noise on the screen

If an intense magnetic or electromagnetic field is generated near the camera or connection cable, noise may be generated on the screen. If this occurs, move the camera or the cable.

- Handling of the protective cap

If the camera is not in use, attach the lens cap to the camera to protect the image pickup surface.

- If the equipment is not to be used for a long duration

Turn off power to the camera for safety.

- Maintenance

Turn off power to the equipment and wipe it with a dry cloth.

If it becomes severely contaminated, gently wipe the affected areas with a soft cloth dampened with diluted neutral detergent. Never use alcohol, benzene, thinner, or other chemicals because such chemicals may damage or discolor the paint and indications.

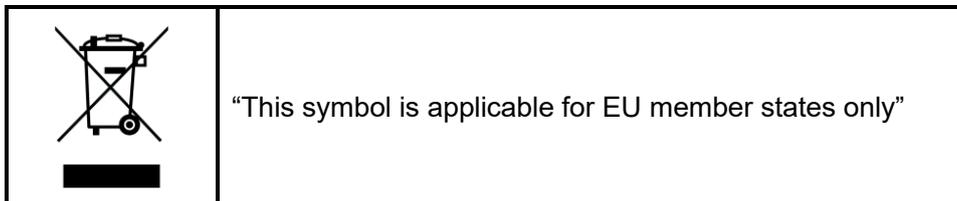
If the image pickup surface becomes dusty, contaminated, or scratched, consult your sales representative.

- Disposal

When disposing of the camera, it may be necessary to disassemble it into separate parts, in accordance with the laws and regulations of your country and/or municipality concerning environmental contamination.

**Following information is only for EU-member states:**

The use of the symbol indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. For more detailed information about the take-back and recycling of this product, please contact your supplier where you purchased the product.



This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communication.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

**[Phenomena specific to CMOS sensor]**

- **Defective pixels**

A CMOS image sensor is composed of photo sensor pixels in a square grid array. Due to the characteristics of CMOS image sensors, over- or under-driving of the pixels results in temporary white or black areas (as if these are noises) appearing on the screen. This phenomenon which is not a defect is exacerbated under higher temperatures and long exposure time.

- **Image shading**

The brightness of the upper part of the screen may be different from that of the lower part. Note that this is a characteristic of a CMOS image sensor and is not a fault.



中华人民共和国  
环保使用期限

环保使用期限标识，是根据电子信息产品污染控制管理办法以及，电子信息产品污染控制标识要求(SJ/T11364-2014)、电子信息产品环保使用期限通则，制定的适用于中国境内销售的电子信息产品的标识。

电子信息产品只要按照安全及使用说明内容，正常使用情况下，从生产月期算起，在此期限内，产品中含有的有毒有害物质不致发生外泄或突变，不致对环境造成严重污染或对其人身、财产造成严重损害。

产品正常使用后，要废弃在环保使用年限内或者刚到年限的产品时，请根据国家标准采取适当的方法进行处置。

另外，此期限不同于质量/功能的保证期限。

The Mark and Information are applicable for People's Republic of China only.

<产品中有毒有害物质或元素的名称及含量>

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
相机本体	×	○	○	○	○	○

本表格依据SJ/T 11364的规定编制

○：表示该有毒有害物质在该部件所有均质材料中的含量均在电子信息产品中有毒有害物质的限量要求标准规定的限量要求(GB/T26572)以下

×：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出电子信息产品中有毒有害物质的限量要求标准规定的限量要求(GB/T26572)

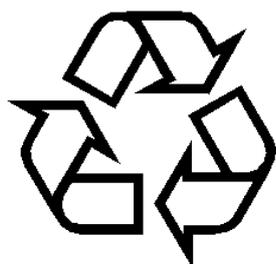
This information is applicable for People's Republic of China only.

リサイクルに関する情報 (包装物)

有关再利用的信息 (包装物)

Information on recycling of wrapping composition

箱 / 箱子 / Box



段ボール  
瓦楞纸板  
Corrugated cardboard

内部緩衝材料・袋

内部缓冲材料・袋

Internal buffer materials・Bag



PE-LD

# Specifications

## Overview

EX670AMG-X is an integrated-(one-body)-type camera that adopts a global shutter CMOS sensor which is a 67M B&W type 1.8 (APS-C) sensor. For video output and camera control, CoaXPress standard is adopted for high transfer rate, and it is easy to integrate into industrial equipment.

## Features

- High frame rate  
Supporting high frame rate of 67 M pixels 64.5 fps by outputting images with 4 lanes at CXP-12 (12.5Gbps) speeds.
- Global shutter  
As it employs a global electronic shutter similar to a CCD image sensor, clear images of even fast-moving object are obtainable with less blur.
- CoaXPress  
Video output and camera control are performed via CoaXPress standard version 2.0. Data transfer is up to 50Gbps (12.5Gbps x 4) that enables to output uncompressed video data at high frame rate.
- GenICam  
This product is based on GenICam (Generic Interface for Cameras).
- IIDC2 Digital Camera Control Specification Ver.1.1.0  
This product is based on IIDC2 Digital Camera Control Specification Ver.1.1.0.

- Random Trigger Shutter

The Random Trigger Shutter function provides images in any timing by input of an external trigger signal. Trigger control from PC is available as well.

- Scalable

Selectable video output area. This mode achieves higher frame rate by reducing vertical output area. And reduces occupied data rate of CoaXPress transmission bandwidth by reducing horizontal output area.

- Binning

Pixel data is combined by vertical and horizontal. It achieves high frame rate.

- Dust-proof Glass

Dust-proof Glass is built in default.

# Configuration

The system configuration of this camera series is as follows;

This camera has no accessories, please prepare other equipment separately.

- Mount adapter (\*1)

Model name: EXA-F

F-mount adapter for EX series

Model name: EXA-M42\*\*

M42-mount adapter for EX series

Suffix [\*\*] represents flange back in millimeters

- Mounting plate (\*1)

Model name: CPTEx

Mounting plate for EX series

Attach this mounting plate to the underside of the camera if fixing to a tripod.

- CoaXPress Cable (\*2):

This cable is used to connect the camera to host PC. Please select a CoaXPress cable with Micro BNC connector for the camera. When connecting four CoaXPress cables, please use the same item (manufacturer, model name, cable length).

- CoaXPress frame grabber (\*2):

This is the interface card to connect to the camera. Usually this card is installed to expansion slot of PC etc.

- Round connector Cable:

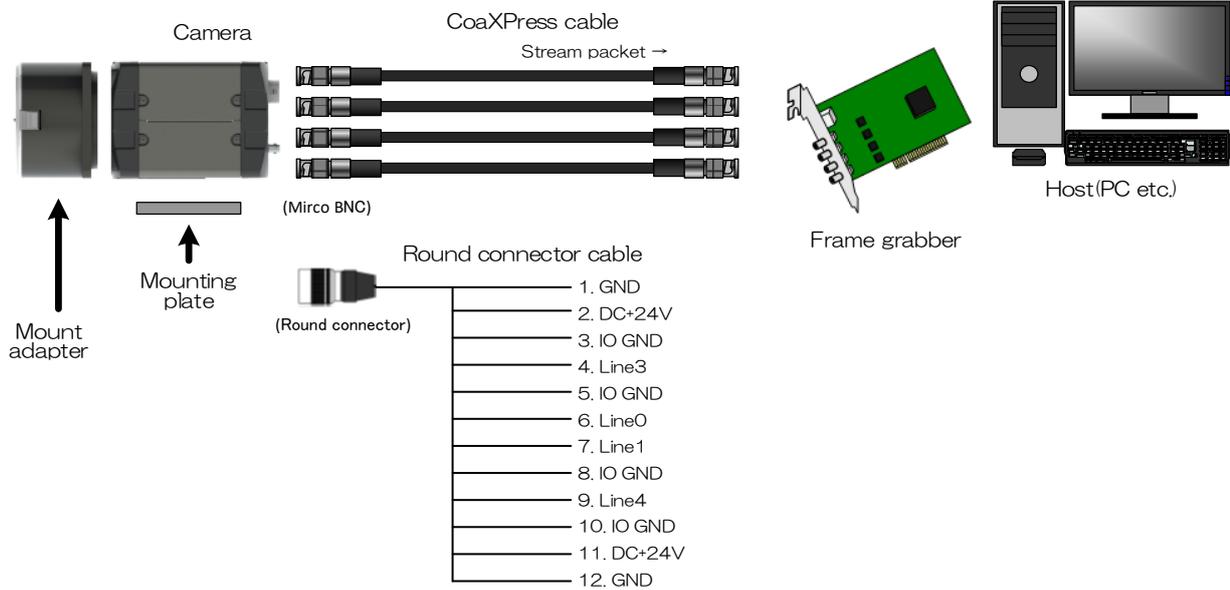
For external power supply, trigger input and GPIO signal, a round connector cable is required.

We recommend using shielded cable for noise suppression depending on the operating environment.

\*1: Optional part. Contact your sales representative for details of option units.

\*2: Commercial items.

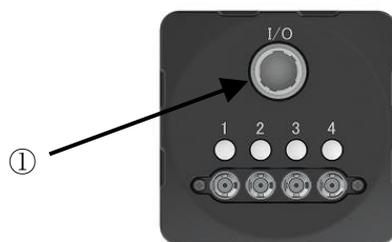
# Connection



## Notes on Connection:

- Please confirm the power supply of the camera off when plugging in or pulling out the I/O Connector. It causes the breakdown.
- If your camera is used in a system where its connectors are subjected to strong repetitive shocks, secure the camera cable as close as possible to the camera body for avoid physical shock to the camera connector.
- In the case that electric-wire of cable is long or thin, input and output voltage may not satisfy specifications of the camera or your system by voltage drop. Please confirm wires' specifications before use them.
- When connecting four CoaXPres cables for image transfer with four lanes, please use the same item (manufacturer, model name, cable length).
- Packet loss may occur due to an electrical characteristic of the transmission line. Please check with the combination of CoaXPress cable and CoaXPress frame grabber.

# Connector Pin Assignment



Rear View

## 1. I/O Connector (Round Connector)

Connector (Camera side)

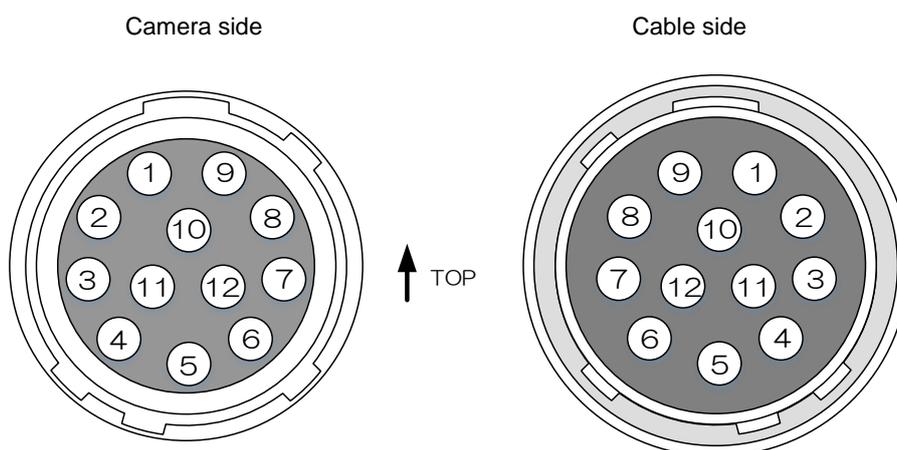
HR10A-10R-12P(73) (HIROSE ELECTRIC CO., LTD.) or equivalent

Plug (Cable side)

HR10A-10R-12S(73) (HIROSE ELECTRIC CO., LTD.) or equivalent

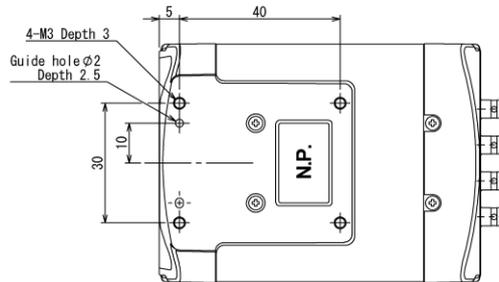
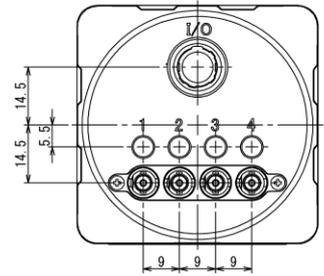
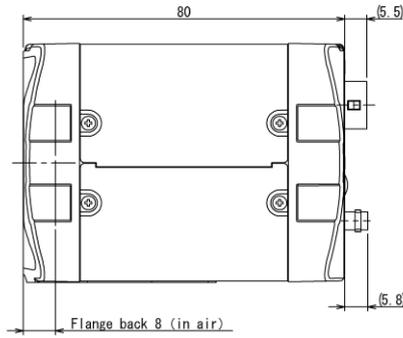
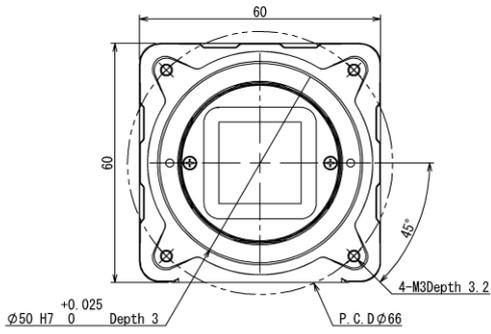
\* Matching connector is not an accessory of this product.

### Pin assignment



Pin No.	I/O	Signal	Function
1	-	GND	Ground
2	I	DC+24V	Power Input
3	-	IO GND	GPIO Ground
4	O	Line3	GPIO Output
5	-	IO GND	GPIO Ground
6	I	Line0	GPIO Input
7	I	Line1	GPIO Input
8	-	IO GND	GPIO Ground
9	O	Line4	GPIO Output
10	-	IO GND	GPIO Ground
11	I	DC+24V	Power Input
12	-	GND	Ground

# Outline Drawing



## Specification

### Main material

Mount, Rear panel: Aluminum die-cast  
Cover: Aluminum alloy

### Processing

Mount, Rear panel: Painting (Black)  
Cover: Anodic oxide coating (Gray)

# General Specifications

- B/W model

Model Name	EX670AMG-X
Optical part	Optical glass
Imager	CMOS image sensor
Number of Video out pixels (H) × (V)	8192 x 8192
Optical Size	APS-C
Scanning area (diagonal)[mm]	28.96
Pixel size (H) × (V)[μm]	2.5 × 2.5
Scan method	Progressive
Electronic shutter method	Global shutter
Aspect ratio	1 : 1
Sensitivity	2500lx, F8, 1/66.7s
Minimum illuminance	1lx (F1.4, Gain +36dB, Video Level 50%)
Power supply	PoCXP (Power over CoaXPress) Or DC+24V (DC+18.5 to +26.0V) ripple 50 mV(p-p) or less
Power consumption (*1)	13W
Interface	CoaXPress
Transmission speed	12.5Gbps (CXP-12) x 4 lanes 12.5Gbps (CXP-12) x 1 lane 6.25Gbps (CXP-6) x 4 lanes 6.25Gbps (CXP-6) x 1 lane
Protocol	CoaXPress 2.0
Image format	Mono8, Mono10p, Mono12p
Maximum Frame rate (*1)	
Mono8	64.5 fps
Mono10p	31.6 fps
Mono12p	31.6 fps
Dimensions	60 mm(W) x 60 mm (H) x 80 mm (D) (Not including protrusion)
Mass	approx. 280g
Lens mount	Mount less
Flange back	8mm
Camera body grounding: insulation status	Conductive between circuit GND and camera body

(\*1) Condition: All pixel readout, 4 lanes at CXP-12 (12.5Gbps) speed

**Notes on combination of lens:**

- Depending on the lens you use, the performance of the camera may not be brought out fully due to the deterioration in resolution and brightness in the peripheral area, occurrence of a ghost, aberration and others. When you check the combination between the lens and camera, be sure to use the lens you actually use.
- When installing a lens in the camera, you can use an optional mount adapter. When attaching a mount adapter or a lens to the camera, make sure carefully that they are not tilted.

# LED Status

Camera state	Lamp indication
No power	Off
Link detection in progress	Fast flash green (ON:20ms, OFF:60ms)
Connection Error	Flash alternate red / green
SuperSpeed connected, but no data being transferred	Flash green (ON: 200ms, OFF: 800ms)
SuperSpeed connected, waiting for trigger	Flash orange (ON: 200ms, OFF: 800ms)
Data being transferred	Fast flash green (ON:60ms, OFF:20ms)
Error during data transfer	Solid Red (Time period: 500ms)
Stand-by	Super slow flash orange (ON:200ms, OFF: 2800ms)

# I/O Specification

- Signal Specification

- Line0, 1 (Round connector: Pin 6, 7)

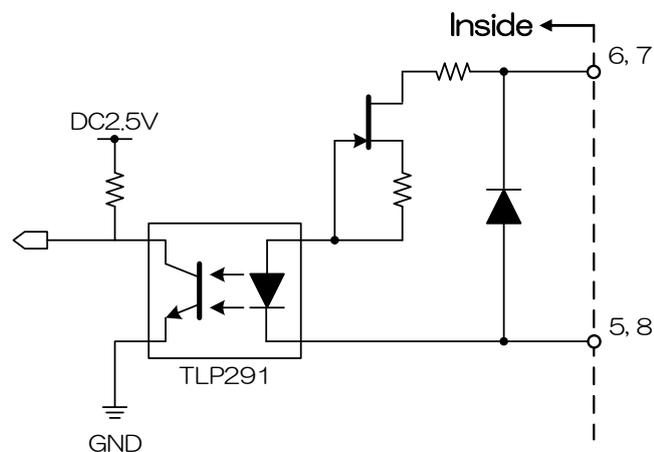
- Input / Output specification : Input only

- Level : Low 0 ~ 0.5V, High 3.3 ~ 24.0V

- Polarity : High active / Low active (initial factory setting: Low active)

- Pulse Width : Minimum 200 $\mu$ s

- Input circuit diagram



## **Notes of external trigger signal:**

Depending on cable length, cable kinds and input current of trigger input line, Random Trigger Shutter operation may not satisfy timing specification or camera may not receive EXT\_TRIG signal. Please confirm it before use.

- Line3, 4 (Round connector: Pin 4, 9)

Input / Output specification : Output only

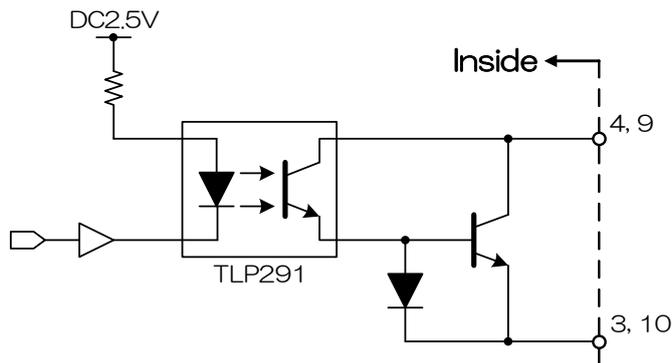
Output Circuit : Open Collector

Maximum Current : 50mA (input current)

Polarity : High active / Low active (initial factory setting: Low active)

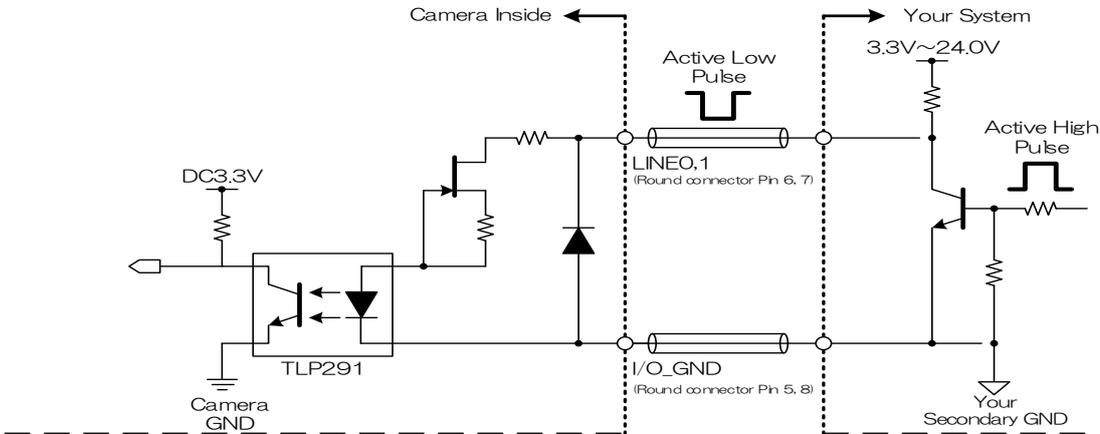
Output signal : Off / UserOutput / Timer0Active / AcquisitionActive / FrameTriggerWait  
(LineSource) FrameActive / FrameTransferActive / ExposureActive

Output circuit diagram

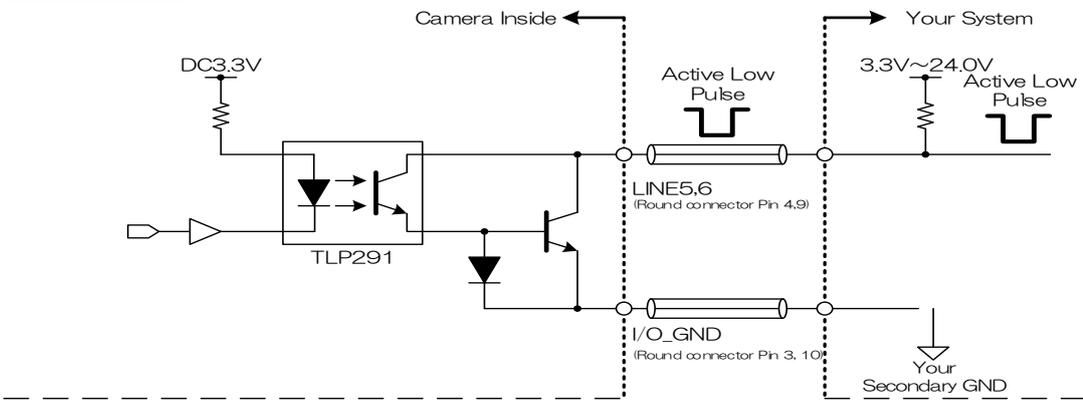


• External trigger input/output recommended circuit

GPIO Input



GPIO Output

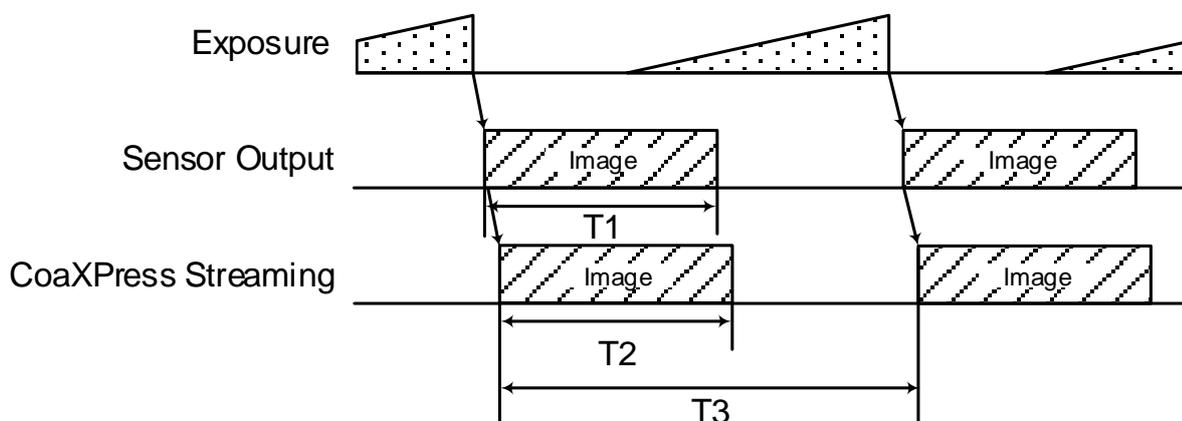


\*Camera GND (e-CON connector Pin 1, 12) and I/O\_GND (Round connector Pin 3, 5, 8 ,10) are mutually isolated. It is also possible to connect them to common GND of your system.

# Timing Specification

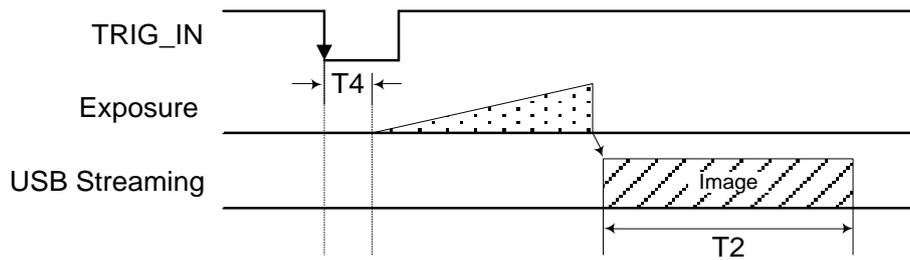
Image data outputs are transferred according to CoaXPress standard. Timing numerical value below is described by absolute prerequisite that camera can use transmission band without restriction. When there is any limitation on the transmission band, the value described below is not guaranteed.

- In Manual Shutter mode (at all pixels readout)

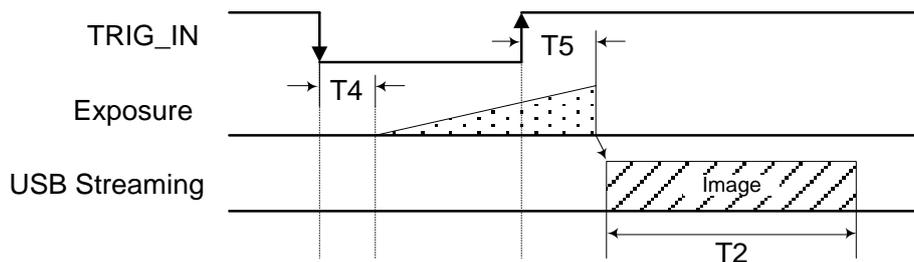


Model Name	Transmission speed	Format	T1 [ms]	T2 [ms]	T3 [s]
EX670AMG-X	CXP-12 x 4 lanes	Mono8	15.4	15.4	1/(Frame Rate setting)
		Mono10p	31.4	31.4	
		Mono12p	31.4	31.4	
	CXP-12 x 1 lane	Mono8	62.6	62.6	
		Mono10p	77.2	77.2	
		Mono12p	94.0	94.0	
	CXP-6 x 4 lanes	Mono8	31.4	31.4	
		Mono10p	39.6	39.6	
		Mono12p	48.0	48.0	
	CXP-6 x 1 lane	Mono8	123.0	123.0	

● In Random Trigger Shutter mode



Edge mode / Bulk mode (at all pixels readout)



Level mode (at all pixels readout)

Model Name	TRIG IN	Polarity	Transmission speed	Format	T4 [μs]	T5 [μs]
EX670AMG-X	Line0 Line1	Active Low Active High	CXP-12 x 4 lanes	Mono8	10.2	14.8
				Mono10p	10.4	15.0
				Mono12p	10.4	15.0
			CXP-12 x 1 lane	Mono8	18.0	22.6
				Mono10p	21.6	26.2
				Mono12p	25.7	30.3
			CXP-6 x 4 lanes	Mono8	10.4	15.0
				Mono10p	12.4	17.0
				Mono12p	14.5	19.1
CXP-6 x 1 lane	Mono8	32.8	37.4			

\* The value of T2 is the same as the value of normal shutter mode. T4 and T5 are typical value.

\* In case that the Trigger mode is Level mode, exposure time is longer than trigger signal width due to the CMOS sensor specifications.

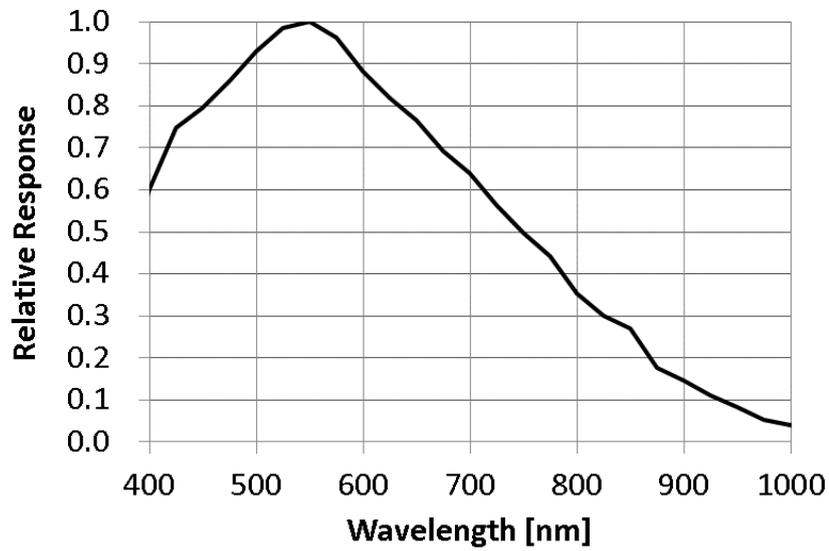
**Notes of random trigger shutter mode:**

- In the period when FRAME\_TRIGGER\_WAIT (refer to GPIO output signals) signal is inactive, user must not input external trigger signal to this camera.
- Starting exposure during cmos sensor readout is possible in random trigger shutter mode, but completion of the exposure is not possible. In this case, its trigger operation will be ignored.
- When the interval of the input trigger signal is extremely short, or when the trigger signal is noisy, there is a possibility of causing the malfunction. In this case, please input a proper trigger signal.

# Typical Spectral Response

\* The lens characteristics and light source characteristics is not reflected in table.

- EX670AMG-X



# Operating Ambient Conditions

- Ambient conditions

- Operating Assurance

Temperature: 0°C to +40°C, Camera housing temperature: less than 60 °C

Humidity: 10% to 90% (no condensation)

- Storage Assurance

Temperature: -20°C to +60°C

Humidity: 90% or less (no condensation)

**Notes on Heat Radiation:**

The temperature of camera housing must be kept less than 60 °C.

Please provide sufficient heat radiation depending on your installation.

● EMC Conditions

- EMI (Electro-Magnetic Interference): EN61000-6-4  
FCC Part 15 Subpart B Class A
- EMS (Electro-Magnetic Susceptibility): EN61000-6-2

**Notes on Conformity of the EMC:**

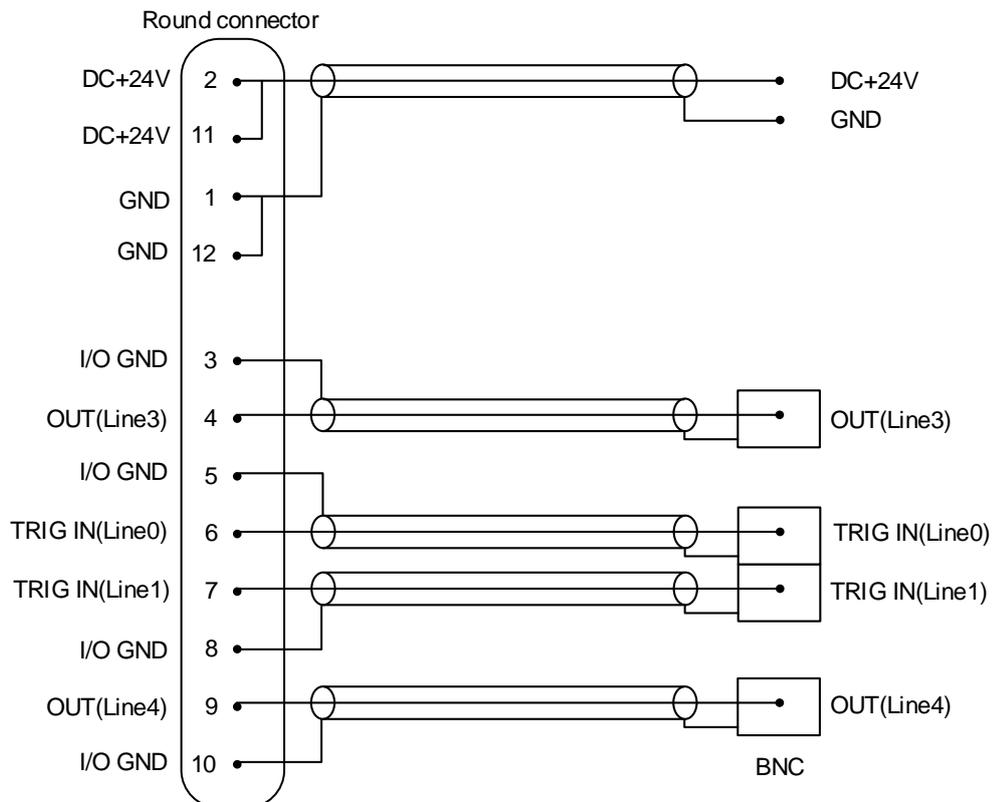
The adaptability of the safety standard of this camera is assured in the condition of combination with the following parts:

- CoaXPress Cable CP12-24CHF-HH-HH-0050-00K(SQLP) (HIRALAWA HEWTECH CORP.)
- Round connector Cable 3.0m, Shield cable (Fabricated parts)  
or CPRC3700-02 (Toshiba Teli Corporation)

Parts:

- Round connector HR10A-7P-6S(73) (HIROSE ELECTRIC CO., LTD.)
- Shielded wire UL1533 (AWG28) (Hitachi Cable, Ltd.)

Connection (Round connector Cable):



\*Please confirm the EMC adaptability when it combines with parts other than them.

# Functions

This section introduces standard functions. EX series provides following functions.

Category	Function	
DeviceControl	DeviceControl	Device information
ImageFormatControl	ImageFormatSelector	Image format selection
	Scalable	Scalable control
	Binning	Binning control
	Reverse	Image flip
	PixelFormat	Pixel format selection
	TestPattern	Test pattern control
AcquisitionControl	AcquisitionControl	Image stream start / stop
	TriggerControl	Trigger control
	ExposureControl	Exposure time control
DigitalIOControl	DigitalIOControl	GPIO signal control
	AntiGlitch	Anti Glitch
	AntiChattering	Anti Chattering
CounterAndTimerControl	TimerControl	Timer0Active signal control
AnalogControl	Gain	Gain control
	BlackLevel	Black level control
LUTControl	LUTControl	LUT control
UserSetControl	UserSetControl	Load / Save user setting
EventControl	EventControl	Event packet control
DPCControl	DPCControl	Defect pixel correction control
SequentialShutterControl	SequentialShutterControl	Sequential shutter control
TransportLayerControl	PayloadSize	Payload Size
	DeviceTapGeometry	Device Tap Geometry setting
	StreamType	Stream Type setting
	CxpLinkConfiguration	Link Configuration

# DeviceControl

Registers of this category provide various information of the camera.

## ● GenICam Node

Register	GenICam Interface	Length Byte / [bit]	Access	Description
DeviceVendorName	String	16	R	Same as ManufactureName in Bootstrap Registers ex. Toshiba-Teli
DeviceModelName	String	16	R	Same as ModelName in Bootstrap Registers ex. EX670AMG
DeviceManufactureInfo	String	16	R	Same as ManufacturerInfo in Bootstrap Registers ex. 67M APS-C B&W
DeviceVersion	String	16	R	Same as DeviceVersion in Bootstrap Registers
DeviceID	String	16	R	Same as SerialNumber in Bootstrap Registers ex. 1.0.0
DeviceUserID	String	16	R/W	Sets User-programmable device identifier
DeviceReset	Command	[0]	W	[1] Resets the device.

## **GenICam API**

Control DeviceControl using GenICam API.

### ◆ DeviceReset

Camera executes its reset operation by DeviceReset command.

- Plug-and-play happens, camera handles used in the application become invalid.
- The application is required to close and re-open the camera.

# ImageFormatControl

Node of this category is related to image format control.

## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
ImageFormatSelector	IEnumeration	4	R/W	Selects an image format.

## GenICam API

Control ImageFormat using GenICam API.

### ◆ ImageFormatSelector

Select an image format by 'ImageFormatSelector'.

Integer value and string value of Enumeration are as follows;

Integer	String	Discription
0(*)	Format0	Scalable Mode
1	Format1	Binning Mode

\* initial factory setting

## ● Note

Changing 'ImageFormatSelector' register value is invalid during image stream data output.

# Scalable

Scalable is to read out arbitrary area of the image. Only single rectangle is selectable. Concave or convex shape is impossible. The number of selectable window is only one.

To understand limited settings, refer to the following information.

- Window size:  $\{A + 128 \times m (H)\} \times \{B + 4 \times n (V)\}$

A, B = minimum unit size

m, n = integer

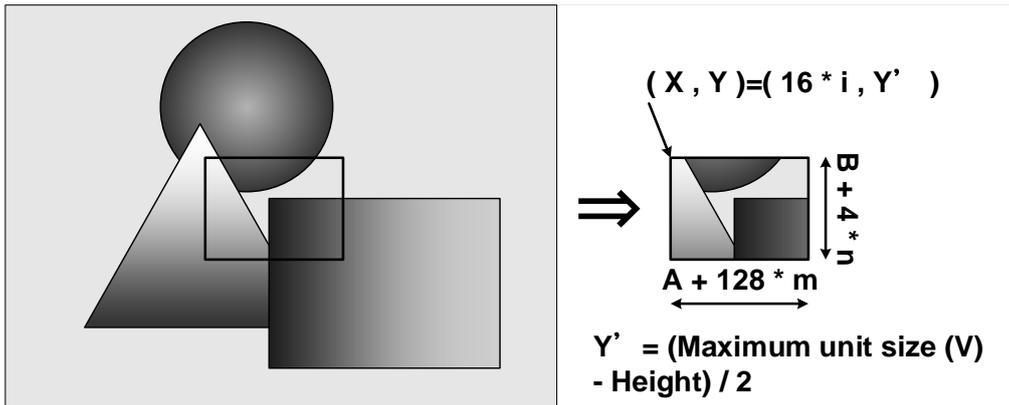
The window size is equal or less than maximum image size.

- Start address:  $\{16 \times i (H)\} , \{Y' (V)\}$

i = integer

The window size is equal or less than maximum image size.

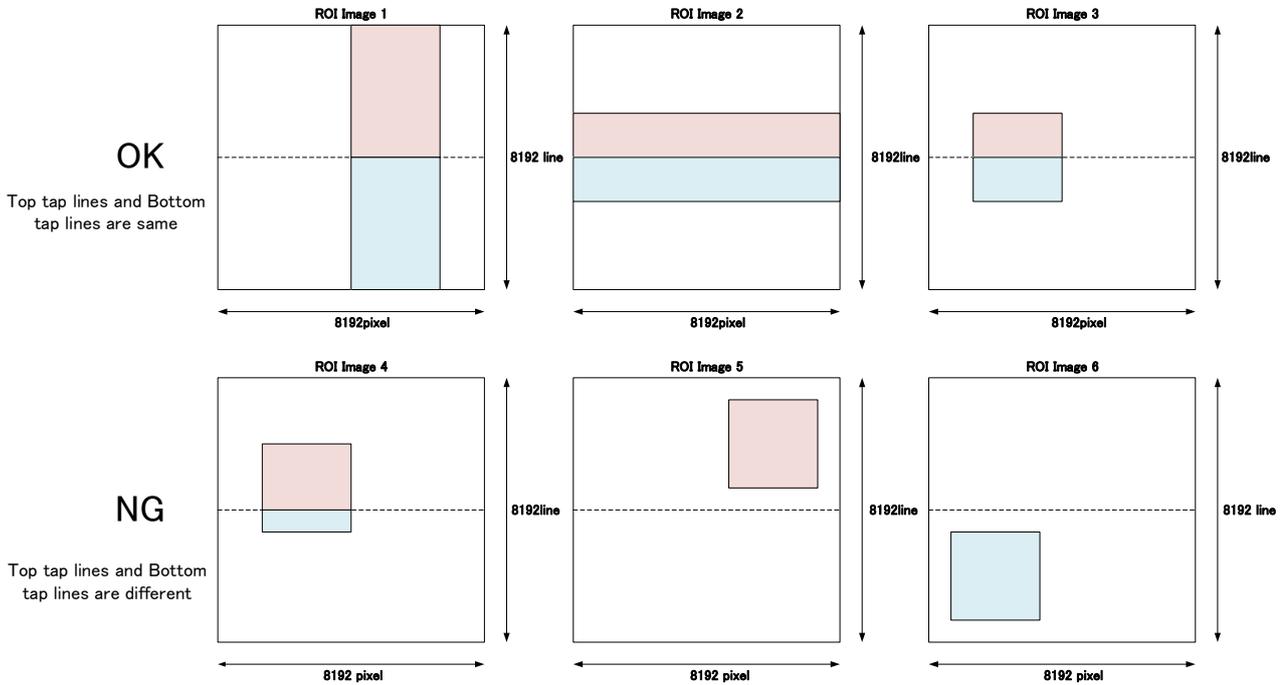
Y' is automatically updated after setting Height.



- Available settings for scalable

This camera adapts a CMOS sensor which outputs images from two taps (top tap and bottom tap).

For that reason, it has limited settings for scalable. Refer to the following figures as an example.



In the scalable mode, camera reads out only necessary area at the normal speed and reads out other area at high speed. The trigger interval can be shorter when the vertical height size is small.

## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
Width	Integer	4	R/W	Sets width (in pixels) of the image data.
Height	Integer	4	R/W	Sets Height (in pixels) of the image data.
OffsetX	Integer	4	R/W	Sets horizontal offset (in pixels) from the origin to the region of interest.
OffsetY	Integer	4	R	Sets vertical offset (in pixels) from the origin to the region of interest.

### GenICam API

Control Scalable using GenICam API.

If you're going to reduce width size, set Width, first. Then set OffsetX.

If you're going to increase width size, set OffsetX, first. Then set Width.

If you're going to change height size, set Height. OffsetY is read-only, it cannot be manually changed. (It is automatically updated.)

### ◆ Minimum/Maximum Value

Scalable	EX670AMG-X
OffsetX unit size	16
OffsetY unit size	OffsetY is automatically updated
Width unit size	128
Height unit size	4
Minimum unit size	128 x 64
Maximum unit size(*)	8192 x 8192

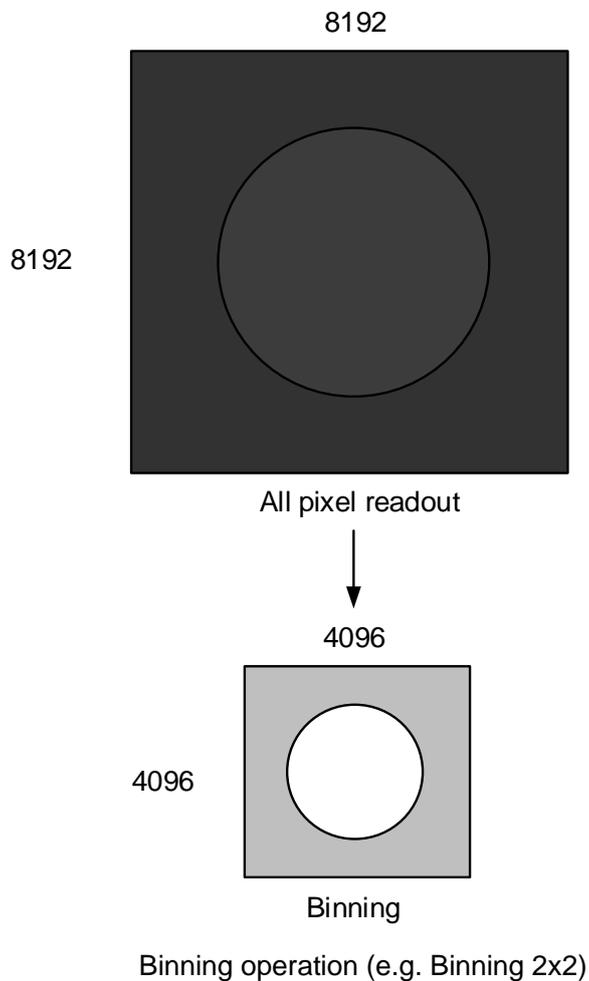
\* initial factory setting

## ● Note

Changing "Width", "Height", "OffsetX", "OffsetY" register value is invalid during image stream data output.

# Binning

In the binning mode, a pixel is added with the neighboring pixel(s) and the sensitivity of the image increases. In addition, transmission bandwidth occupation can decrease.



● **GenICam Node**

Name	Interface	Length Byte / [bit]	Access	Description
BinningHorizontal	Integer	4	R/W	Sets the Binning Horizontal.
BinningVertical	Integer	4	R/W	Sets the Binning Vertical.

**GenICam API**

Control Binning using GenICam API.

Set BinningHorizontal or BinningVertical.

◆ **BinningHorizontal/BinningVertical (Available setting)**

		BinningHorizontal	
		1	2
BinningVertical	1	✓ *	✓
	2	✓	✓

\* initial factory setting

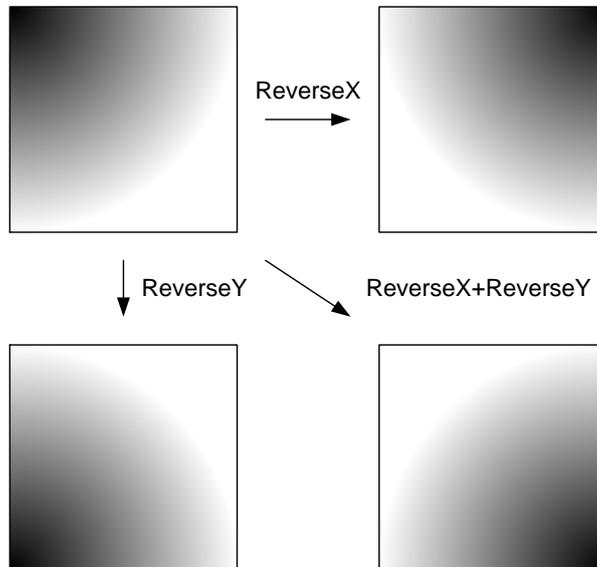
● **Note**

Binning is disabled when the camera is running in Scalable mode.

Changing “BinningHorizontal” or “BinningVertical” is invalid during image stream data output.

# Reverse

Reverse function flips image in horizontal and/or vertical direction..



## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
ReverseX	IBoolean	4	R/W	Sets the Reverse Horizontal.
ReverseY	IBoolean	4	R/W	Sets the Reverse Vertical.

### GenICam API

Control Reverse using GenICam API.

#### ◆ ReverseX/ReverseY

Sets the Reverse Horizontal by 'ReverseX'.

Sets the Reverse Vertical by 'ReverseY'.

Node type of ReverseX and ReverseY is Boolean, its setting value is assigned as follows;

Boolean	説明
FALSE (*)	Reverse OFF
TRUE	Reverse ON

\* initial factory setting

#### ● Note

- Changing 'ReverseX', 'ReverseY' register value is invalid during image stream data output.

# PixelFormat

Select a pixel format of image stream data.

## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
PixelCoding	IEnumeration	4	R/W	Selects a pixel coding.
PixelSize	IEnumeration	4	R/W	Selects a bit size of image pixel.
PixelFormat	IEnumeration	4	R/W	Selects a pixel format. PixelFormat is conformed to AIA Pixel Format Naming Convention.

### **GenICam API**

Control PixelFormat using GenICam API.

#### ◆ PixelCoding/PixelSize

To determine PixelFormat combination of 'PixelCoding' and 'PixelSize' register.

1. Select a pixel coding. ('PixelCoding').

Integer value and string value of Enumeration are as follows;

Integer	String
0 (*)	Mono
2	MonoPacked

\* initial factory setting

2. Select a bit size of image pixel ('PixelSize').

Integer value and string value of Enumeration are as follows;

Integer	String	Discription
8 (*)	Bpp8	8 bit per pixel
10	Bpp10	10 bit per pixel
12	Bpp12	12 bit per pixel

\* initial factory setting

#### ◆ PixelFormat

Select a pixel format. ('PixelFormat').

Integer value and string value of Enumeration are as follows;

Integer	String	Discription
1 (*)	Mono8	Mono 8 bit
6	Mono10p	Mono 10 bit packed
7	Mono12p	Mono 12 bit packed

\* initial factory setting

#### ● Note

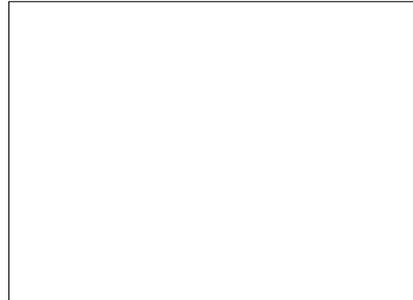
Changing 'PixelFormat' register value is invalid during image stream data output.

# TestPattern

DDU series supports test pattern data output. Camera provides following Test patterns;



Black



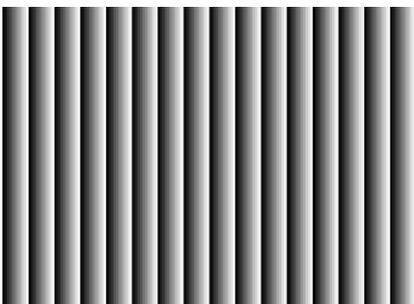
White



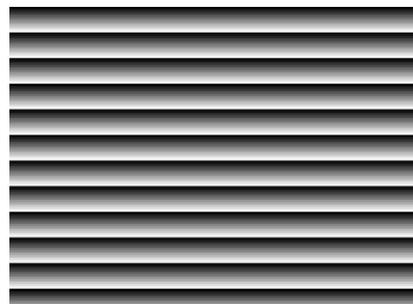
GreyA



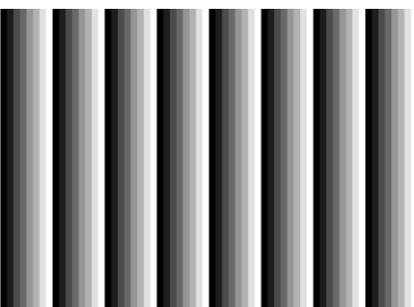
GreyB



GreyHorizontalRamp



GreyVerticalRamp



GreyScale

## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
TestPattern	IEnumeration	4	R/W	Selects a Test pattern.

### GenICam API

Control TestPattern using GenICam API.

#### ◆ TestPattern

Select a test pattern.

Integer value and string value of Enumeration are as follows;

Integer	String	Function
0 (*)	Off (*)	Test pattern disable(Normal data output)
1	Black	All pixel = 0 LSB
2	White	All pixel = 255 @Mono8
3	GreyA	All pixel = 170 @Mono8
4	GreyB	All pixel = 85 @Mono8
5	GreyHorizontalRamp	Horizontal Ramp
6	GreyVerticalRamp	Vertical Ramp
7	GreyScale	Grey scale

\* initial factory setting

# AcquisitionControl

AcquisitionControl features are related to image acquisition.

Camera starts image stream output by receiving AcquisitionStart command.

Camera stops image stream output by receiving AcquisitionStop command.

There are some registers that require camera to stop image stream output to change values.

Acquisition frame rate is variable. Maximum acquisition frame rate depends on camera operation mode.  
(scalable, pixel format, etc.)

## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
AcquisitionMode	IEnumeration	4	R/W	Selects an acquisition mode.
AcquisitionStart	ICommand	4	W	Executes the image stream output start.
AcquisitionStop	ICommand	4	W	Executes the image stream output stop.
AcquisitionAbort	ICommand	4	W	Executes the image stream output abort.
AcquisitionFrameCount	Integer	4	R/W	Sets the number of frames to transfer in MultiFrame/ImageBuffer mode.
AcquisitionFrameRateEnable	IEnumeration	4	R/W	Selects an AcquisitionFrameRate setting priority.
AcquisitionFrameRate	IFloat	4	R/W	Sets frame rate of image stream.
AcquisitionFrameIntervalControl	IEnumeration	4	R/W	Selects an AcquisitionFrameInterval setting priority.
AcquisitionFrameInterval	IFloat	4	R/W	Sets frame interval of image stream.

### **GenICam API**

This API controls AcquisitionControl using GenICam.

1. Set the number of frames to transfer in MultiFrame/ImageBuffer mode. (optional)

\*If you want to capture image stream continuously, it's not necessary to set an AcquisitionFrameCount.

2. Select an 'AcquisitionFrameRate' setting priority. (optional)

Set AcquisitionFrameRateControl with IEnumeration node functions.

Integer value and string value of Enumeration are as follows;

Integer	String
0(*)	NoSpecify
1	Manual

\* initial factory setting

3. Set frame rate of image stream. (optional)

Set AcquisitionFrameRate or AcquisitionFrameInterval with IFloat node functions.

'AcquisitionFrameInterval' is a reciprocal of 'AcquisitionFrameRate'.

4. Capture image stream.

◆ **Minimum/Maximum Value**

AcquisitionFrameRate		EX670AMG-X
Minimum	Raw Value	4095
	Absolute (Float) Value	0.062 [fps]
Maximum	Raw Value	Depend on settings of "ImageFormatControl".
	Absolute (Float) Value	
Initial Value	Raw Value	4229005
	Absolute (Float) Value	64.5 [fps]
Fomula		Absolite Value [fps] = Raw Value / 65536

● **Note**

Changing 'AcquisitionFrameRateControl', 'AcquisitionFrameRate', 'AcquisitionFrameIntervalControl', 'AcquisitionFrameInterval' register value is invalid during image stream data output.

When exposure time setting is longer than frame rate setting, camera operation gives priority to exposure time setting.

**Notes on Frame Drops of Image:**

Depends on your PC or interface card configurations, images may not be captured normally (e.g. frame drops may occur). In this case, change to frame rate setting lower.

# TriggerControl

TriggerControl features are related to image acquisition using trigger.

This camera series provides two kinds of exposure synchronization.

1. Normal Shutter mode : Free run operation (internal synchronization)
2. Random Trigger Shutter mode : Synchronized with external trigger input

In Random Trigger Shutter mode, two kinds of trigger input are available.

1. Trigger signal via the I/O connector (HardwareTrigger)
2. Trigger command via software command (SoftwareTrigger)
3. Link trigger via trigger packed (LinkTrigger)

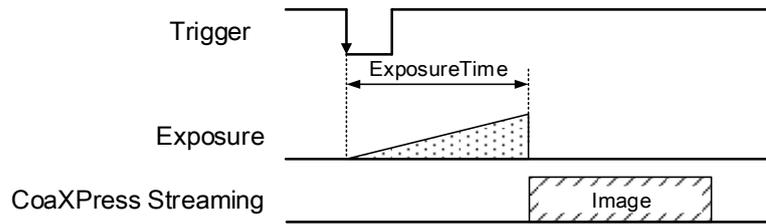
The following table shows the combination of operation mode of this camera series.

Operation Mode		
Trigger Mode	Synchronization	Exposure Control
Normal Shutter mode	Free run	“ExposureTime” register control
Random Trigger Shutter mode	HardwareTrigger (Line0, Line1)	-Edge mode:TriggerSequence0 -Bulk mode:TriggerSequence6 “ExposureTime” register control
		-Level mode:TriggerSequence1 Trigger pulse width control
	SoftwareTrigger (Software)	-Edge mode:TriggerSequence0 -Bulk mode:TriggerSequence6 “ExposureTime” register control
	LinkTrigger (Line2)	-Edge mode:TriggerSequence0 “ExposureTime” register control

\* The camera operation not mentioned above is not supported.

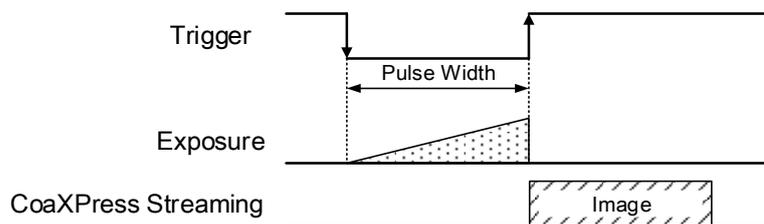
**- Edge mode (TriggerSequence0)**

The exposure time is determined by Exposure Time setting.



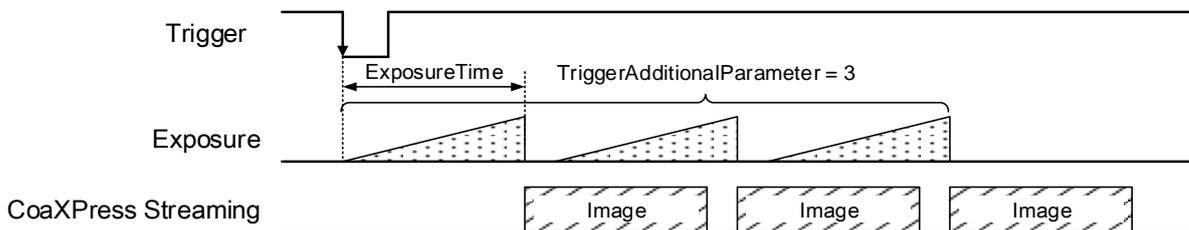
**- Level mode (TriggerSequence1)**

The exposure time is determined by the pulse width of the trigger signal.



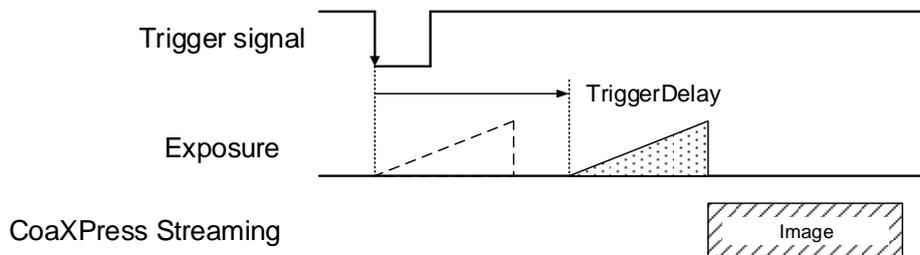
**- Bulk mode (TriggerSequence6)**

Camera exposes and transfers multiple frames by a single trigger.



Trigger sequence

Operation point of HardwareTrigger is at the edge of trigger signal, and active edge polarity is able to change by register setting. And you can add delay time from trigger edge to exposure start by register setting.



Trigger Delay

For details of Random Trigger Shutter operation, please refer to 'Timing' section in 'Specification'.

## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
TriggerMode	IEnumeration	4	R/W	Selects a trigger mode.
TriggerSoftware	ICommand	4	W	Executes software trigger.
TriggerSource	IEnumeration	4	R/W	Selects a trigger source of random trigger shutter.
TriggerActivation	IEnumeration	4	R/W	Selects a trigger activation of hardware trigger.
TriggerDelay	IFloat	4	R/W	Sets a trigger delay.
TriggerSequence	IEnumeration	4	R/W	Selects a trigger sequence of random trigger shutter.
TriggerAdditionalParameter	IInteger	4	R/W	Sets the number of frames to exposure in Bulk mode.

## GenICam API

Control Trigger features using GenICam API.

1. Select a trigger mode by 'TriggerMode'.

Integer value and string value of Enumeration are as follows;

Integer	String	Discription
0(*)	Off	Normal Shutter mode
1	On	Random Trigger Shutter mode

\* initial factory setting

2. Select a trigger sequence of random trigger shutter by 'TriggerSequence'.

Integer value and string value of Enumeration are as follows;

Integer	String	Discription
0(*)	TriggerSequence0	Edge mode
1	TriggerSequence1	Level mode
6	TriggerSequence6	Bulk mode

\* initial factory setting

3. Select a trigger source of random trigger shutter by 'TriggerSource'.

Integer value and string value of Enumeration are as follows;

Integer	String	Discription
0(*)	Line0	HardwareTrigger
1	Line1	HardwareTrigger
2	Line2	LinkTrigger
64	Software	SoftwareTrigger

\* initial factory setting

4. Select a trigger activation of hardware trigger by 'Trigger Activation.

5. Set the number of frames to exposure in Bulk mode by 'TriggerAdditionalParameter'.

6. Set a trigger delay by 'TriggerDelay'.

7. Capture image stream.

To start and stop capturing image is the same way as AcquisitionControl.

8. Execute software trigger in SoftwareTrigger mode by 'TriggerSoftware'.

9. Receive Image

10. Stop and Close image stream.

◆ **Minimum/Maximum Value**

TriggerAdditional Parameter	Raw Value = Absolute (Float) Value
Minimum	0
Maximum	255
Initial Value	0

TriggerDelay	Raw Value	Absolute (Float) Value
Minimum	0	0.0 [us]
Maximum	250000000	2000000.0 [us]
Initial Value	0	0.0 [us]
Formula	Absolute Value [us] = Raw Value / 125	

● **Note**

In SoftwareTrigger operation, the delay time from 'TriggerSoftware' to exposure is not guaranteed.

EX series have different trigger source.

Please refer to 'I/O Specification' section as well.

TriggerSource	Description
Line0 (*)	Round connector : pin 6, Isolation input, High level 3.3 to 24.0V
Line1	Round connector : pin 7, Isolation input, High level 3.3 to 24.0V
Line2	LinkTrigger
SoftwareTrigger	SoftwareTrigger

\* initial factory setting

TriggerDelay is applied to both of HardwareTrigger and SoftwareTrigger.

TriggerAdditionalParameter is only effective in Bulk mode.

# ExposureTime

ExposureTime controls the duration where the image sensor is exposed to light.

This camera series provides three kinds of exposure time control mode.

- NoSpecify : The exposure time is determined by 'AcquisitionFrameRate' register setting value
- Manual : The exposure time is determined by 'ExposureTime' register setting value.

## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
ExposureTime	IFloat	4	R/W	Sets an exposure time.

### GenICam API

Control ExposureTime using GenICam API.

#### ◆ ExposureTime

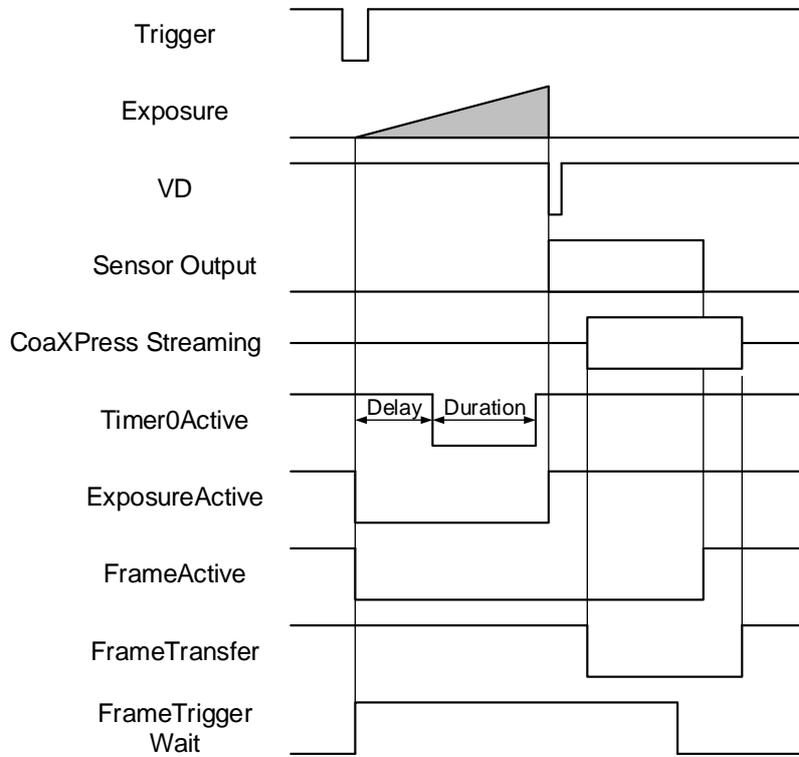
Sets an exposure time by 'ExposureTime'

#### ◆ Minimum/Maximum Value

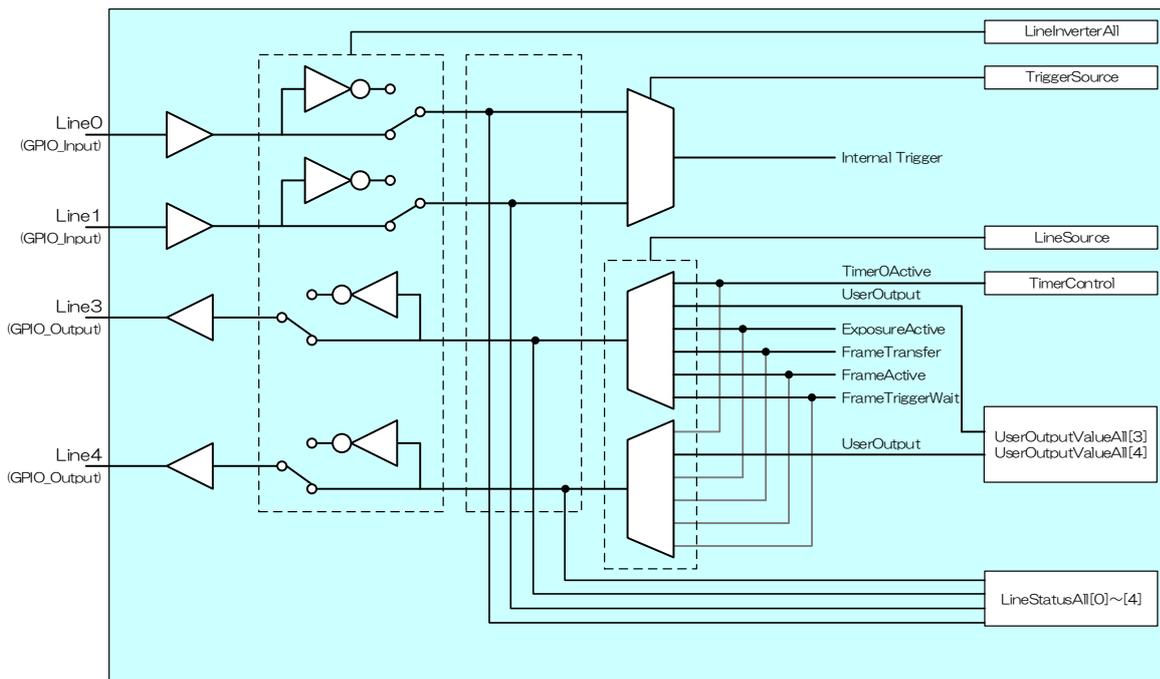
ExposureTime	Raw Value	Absolute (Float) Value
Minimum	1250	10 [us]
Maximum	2000000000	1000000 [us]
Initial Value	1875000	15000.00 [us]
Formula	Absolute Value [us] = Raw Value / 125	

# DigitalIOControl

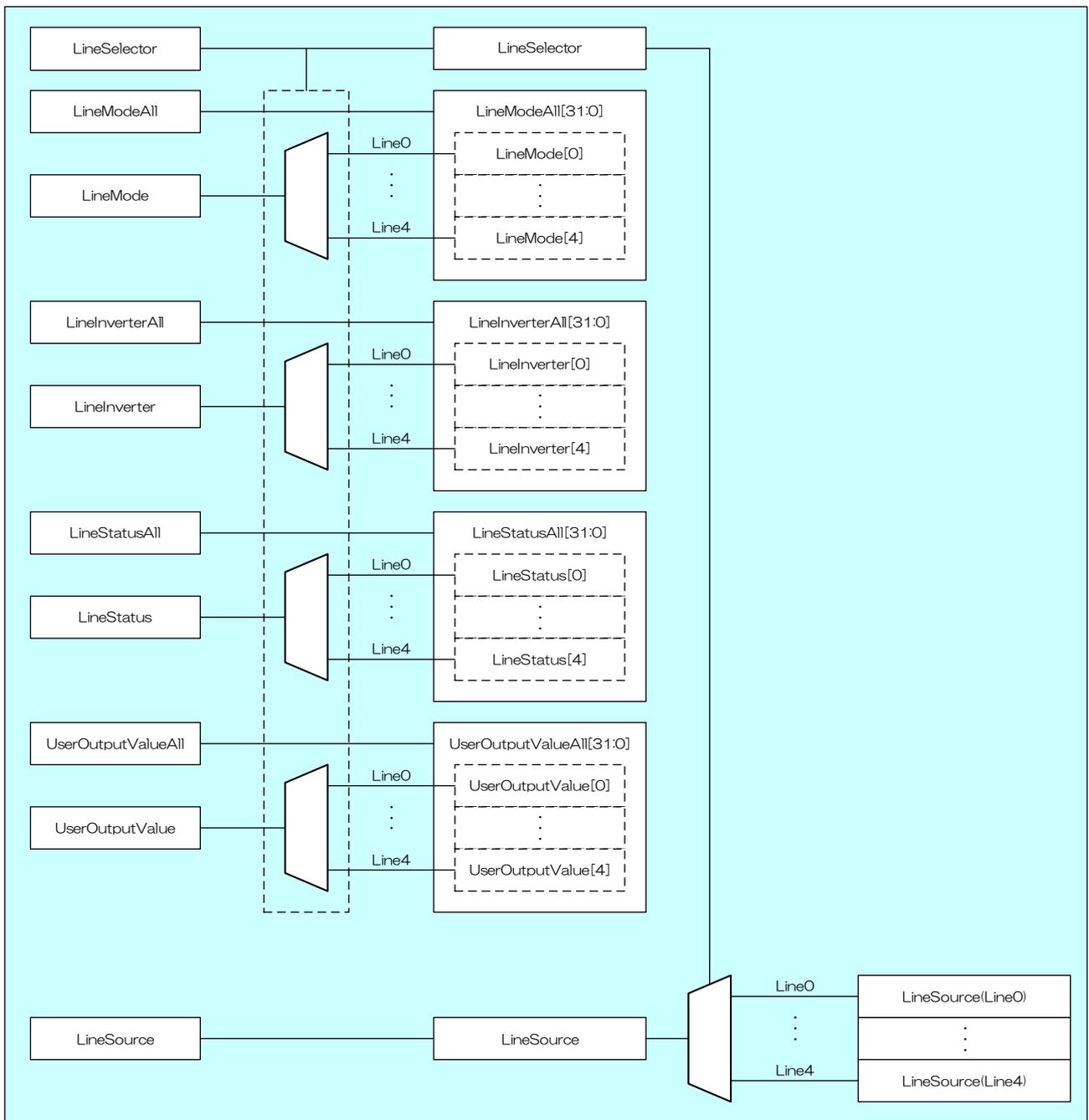
DigitalIOControl controls digital signal to be output from I/O connector. The polarity of the signal can be switched by the register setting. The following chart shows the specifications of the selectable signals.



Selectable signals



GPIO internal circuit diagram



Details of each signal

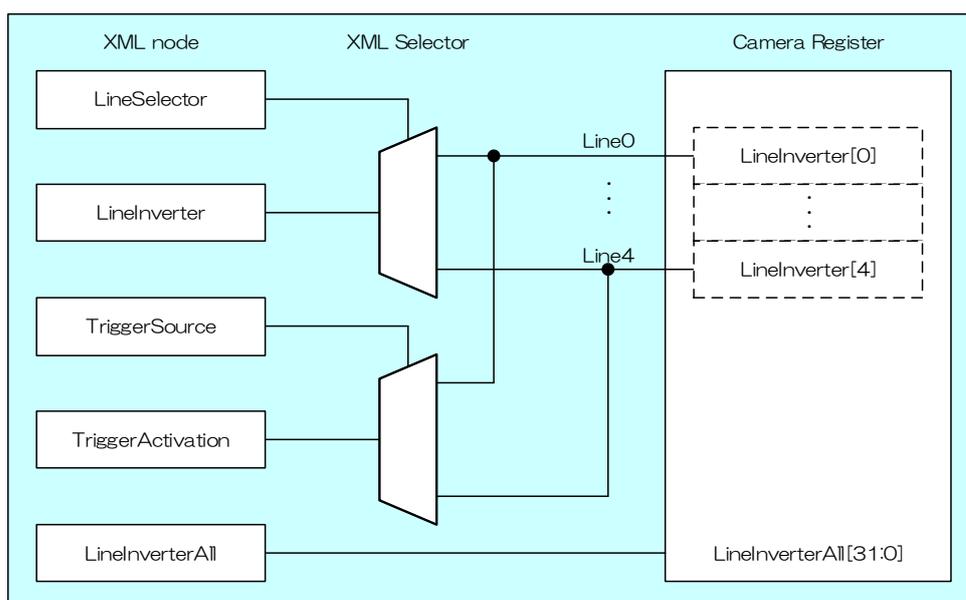
## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
LineMode	IEnumeration	4	R/W	Selects the Input / Output of each Line selected by LineSelector.
LineModeAll	IInteger	4	R/W	Selects the Input / Output of each Line.
LineInverter	IBoolean	4	R/W	Selects the polarity of each Line signal selected by LineSelector.
LineInverterAll	IInteger	4	R/W	Selects the polarity of each Line signal.
LineStatus	IBoolean	4	R	Returns the status of each Line signal selected by LineSelector.
LineStatusAll	IInteger	4	R	Returns the status of each Line signal.
UserOutputValue	IBoolean	4	R/W	Sets the user output value of each line selected by LineSelector.
UserOutputValueAll	IInteger	4	R/W	Sets the user output value of each Line.
LineSelector	IEnumeration	4	R/W	Selects the Line of I/O connector.
LineSource	IEnumeration	4	R/W	Selects the source of the output signal.

### GenICam API

Control DigitalIOControl using GenICam API.

#### ◆ LineInverterAll



Selects the polarity of each Line signal by 'LineInverterAll'.

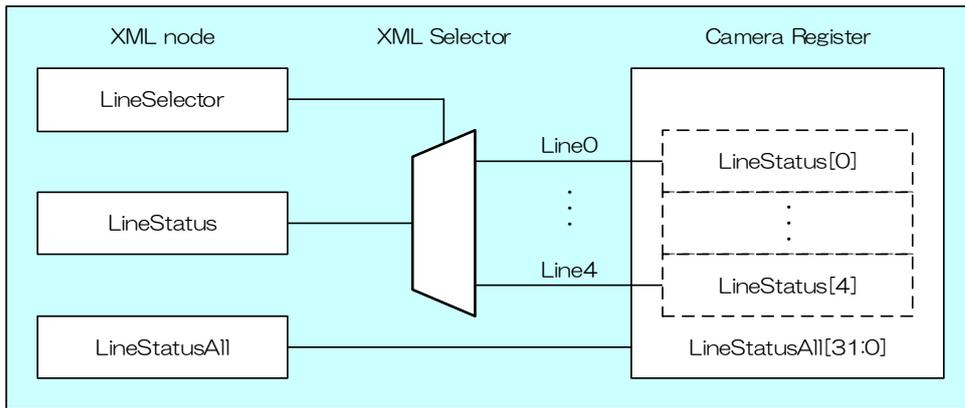
Each bit of integer value corresponds to each Line (bit0, 1, 2, 3, 4 = Line0, 1, 2, 3, 4).

bit value	Inverter
0	False (not inverted)
1	True (inverted)

LineInverterAll Value	bit value [Line4] · · · [Line0]	Inverter [Line4] · · · [Line0]
0 (*)	[0] [0] [0] [0] [0]	[off] [off] [off] [off] [off]
1	[0] [0] [0] [0] [1]	[off] [off] [off] [off] [on]
2	[0] [0] [0] [1] [0]	[off] [off] [off] [on] [off]
3	[0] [0] [0] [1] [1]	[off] [off] [off] [on] [on]
·	·	·
·	·	·
·	·	·
29	[1] [1] [1] [0] [1]	[on] [on] [on] [off] [on]
30	[1] [1] [1] [1] [0]	[on] [on] [on] [on] [off]
31	[1] [1] [1] [1] [1]	[on] [on] [on] [on] [on]

\* initial factory setting

◆LineStatusAll



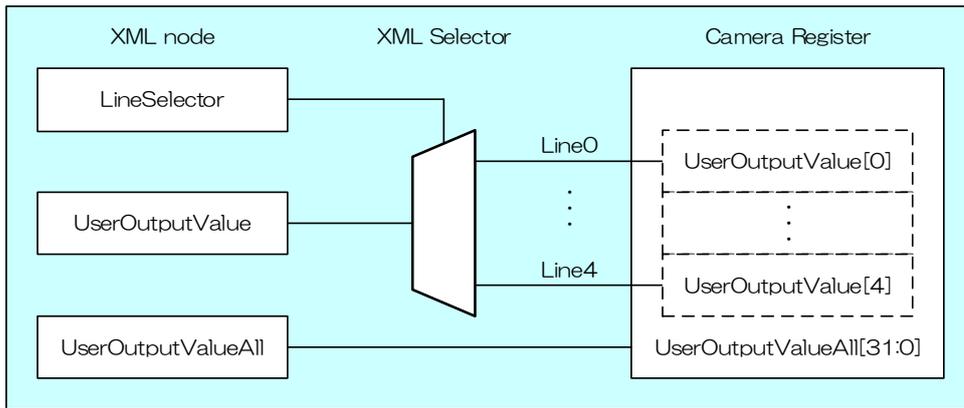
Gets the status of each Line signal by 'LineStatusAll'

Each bit of integer value corresponds to each Line (bit0, 1, 2, 3, 4 = Line0, 1, 2, 3, 4).

bit value	Line Status
0	False (Low)
1	True (High)

LineInverterAll Value	bit value [Line4] · · · [Line0]	Line Status [Line4] · · · [Line0]
0	[0] [0] [0] [0] [0]	[low] [low] [low] [low] [low]
1	[0] [0] [0] [0] [1]	[low] [low] [low] [low] [high]
2	[0] [0] [0] [1] [0]	[low] [low] [low] [high] [low]
3	[0] [0] [0] [1] [1]	[low] [low] [low] [high] [high]
·	·	·
·	·	·
·	·	·
29	[1] [1] [1] [0] [1]	[high] [high] [high] [low] [high]
30	[1] [1] [1] [1] [0]	[high] [high] [high] [high] [low]
31	[1] [1] [1] [1] [1]	[high] [high] [high] [high] [high]

### ◆ UserOutputValueAll



Sets the user output value by 'UserOutputValueAll'.

Each bit of integer value corresponds to each Line (bit0, 1, 2 = Line0, 1, 2 (not used) bit3, 4 = Line3, 4).

bit value	Output
0	False (Low)
1	True (High)

bit value [Line4] · · · [Line0]	Output [Line4] [Line3]
[0] [0] [*] [*] [*]	[low] [low]
[0] [1] [*] [*] [*]	[low] [high]
[1] [0] [*] [*] [*]	[high] [low]
[1] [1] [*] [*] [*]	[high] [high]

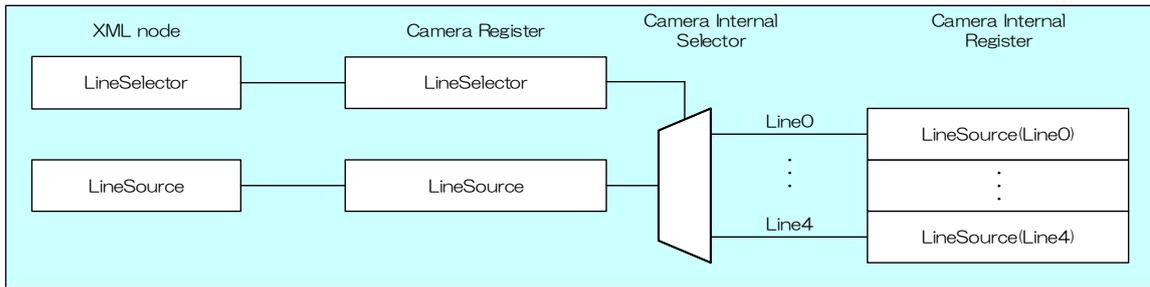
### ◆ LineSelector

Selects the I/O line to output by 'LineSelector'.

Integer value and string value of Enumeration are as follows;

Integer	String
0	Line0
1	Line1
3	Line3
4	Line4

## ◆ LineSource



Selects the source of the output signal.

Integer value and string value of Enumeration are as follows;

Integer	String	Description
0	Off	Off
32	UserOutput	Outputs the value set in 'UserOutputValueAll'.
64	Timer0Active	This signal can be used as strobe control signal. The delay time and pulse width of this signal are configurable.
99	AcquisitionActive	Indicates AcquisitionStart state of camera.
106	FrameTriggerWait	Indicates that camera is ready to accept trigger signal. (both hardware and software)
107	FrameActive	Period from exposure start to sensor read-out completion.
115	FrameTransferActive	Period of transferring image streaming data on interface bus.
123	ExposureActive	Period from exposure start to exposure end.

### ● Note

- Line0 and Line1 are dedicated inputs.
- Line3 and Line4 are dedicated outputs.
- For [Timer0Active] signal, please refer to [TimerControl] Section for more detail.

# AntiGlitch / AntiChattering

AntiGlitch and AntiChattering functions filter noise and unstable state of the digital input (trigger signal).

AntiGlitch circuit performs the digital integration of the trigger signal.

It is effective to remove impulsive noise.

AntiChattering circuit sets the edge insensible time to avoid trigger malfunction.

It is effective to remove unstable logic state and switch-chattering.

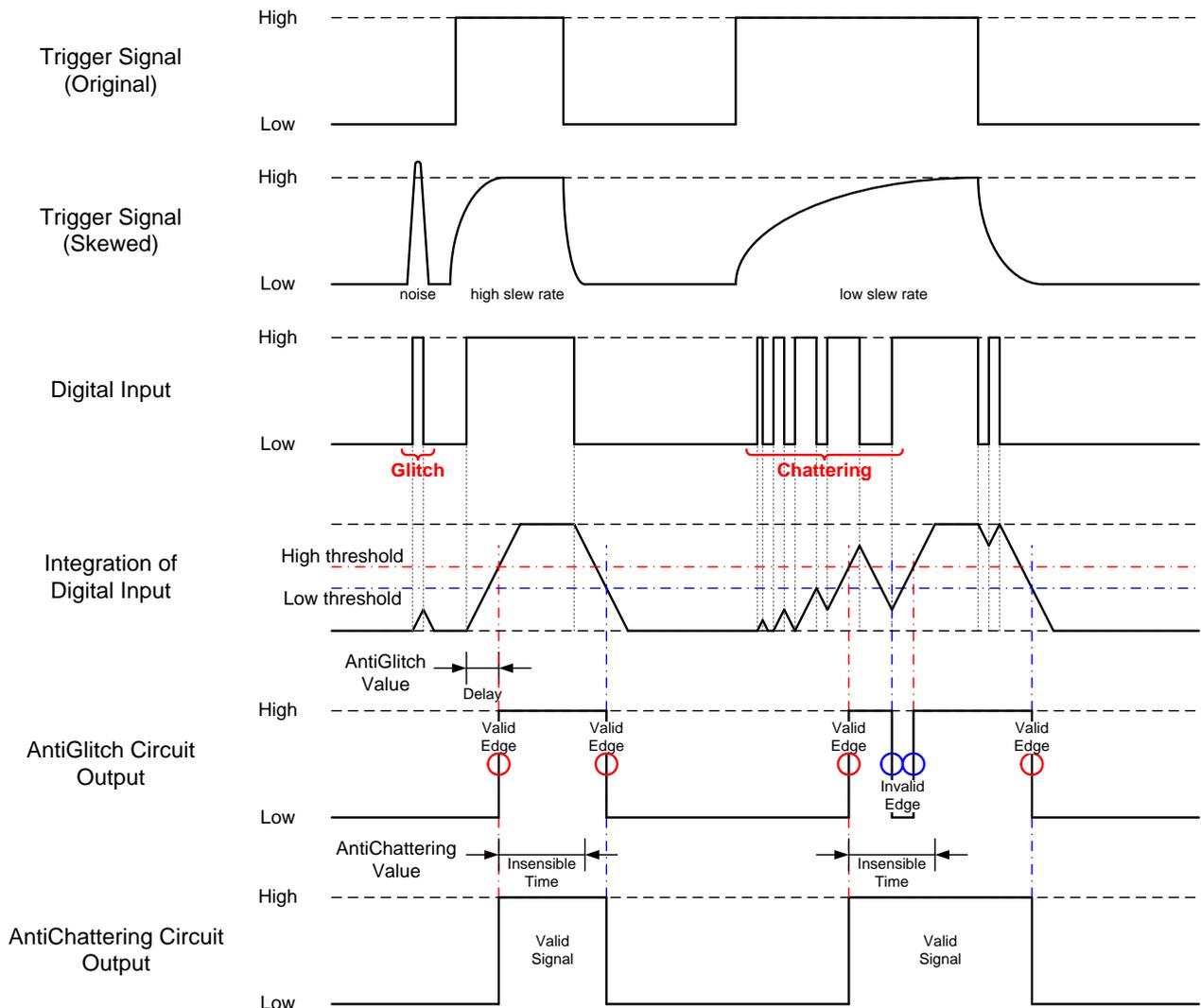


Fig. AntiGlitch and AntiChattering

## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
AntiGlitch	IFloat	4	R/W	Integration time of digital input signal. [sec]
AntiChattering	IFloat	4	R/W	Insensible time of digital input signal. [sec]

### GenICam API

Control AntiGlitch/AntiChattering using GenICam API.

#### ◆ AntiGlitch/AntiChattering

1. Set Integration time of digital input signal in [sec] to 'AntiGlitch'.
2. Set Insensible time of digital input signal in [sec] to 'AntiChattering'.

#### ◆ Minimum/Maximum Value

AntiGlitch	Raw Value	Absolute (Float) Value
Minimum	9	0.09 [us]
Maximum	200000	2000 [us]
Initial Value	9	0.09 [us]
Formula	Absolute Value [us] = Raw Value / 100	

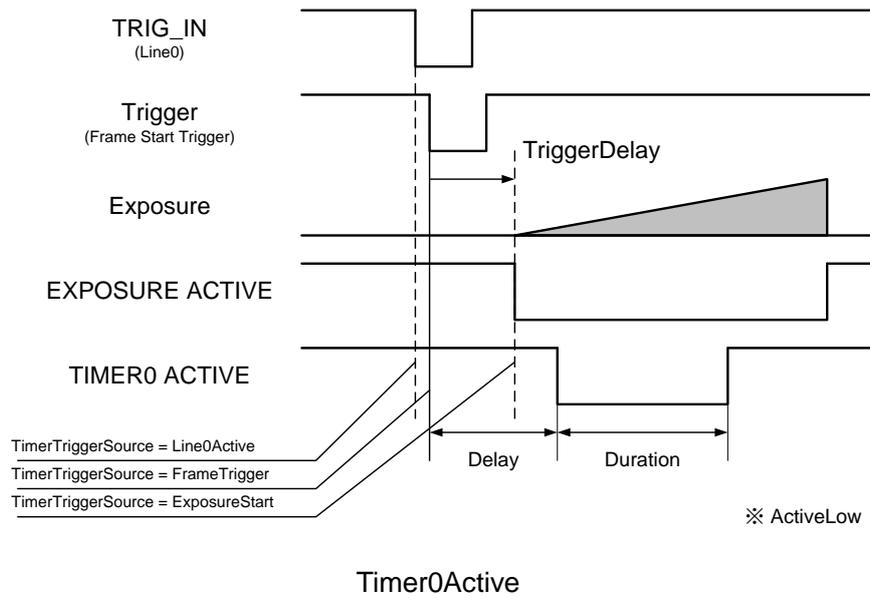
AntiChattering	Raw Value	Absolute (Float) Value
Minimum	249	1.992 [us]
Maximum	249999	1999.992 [us]
Initial Value	249	1.992 [us]
Formula	Absolute Value [us] = Raw Value / 125	

# TimerControl

This section describes TimerControl features.

This camera series is able to generate Timer0Active signal beginning from trigger or exposure start signal.

This signal can be used as strobe control signal.



## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
TimerSelector	IEnumeration	4	R	Returns the selected timer name.
TimerDelay	IFloat	4	R/W	Sets the delay of Timer0Active signal.
TimerDuration	IFloat	4	R/W	Sets the duration of Timer0Active signal.
TimerTriggerSource	IEnumeration	4	R/W	Selects the source of Timer0Active pulse to start.

### GenICam API

Control TimerControl using GenICam API.

#### ◆ TimerDelay/TimerDuration/TimerTriggerSource

1. Sets the delay of Timer0Active signal by 'TimerDelay'.
2. Sets the duration of Timer0Active signal by 'TimerDuration'.
3. Selects the source of Timer0Active pulse to start by 'TimerTriggerSource'.

Integer value and string value of Enumeration are as follows;

Integer	String	Description
0	Off	DisablesTimer0Active signal.
32	Line0	Starts when Line0 is active.
104	FrameTrigger	Starts with the reception of the Frame Start Trigger.
124	ExposureStart	Starts with the reception of the Exposure Start

#### ◆ Minimum/Maximum Value

TimerDelay TimerDuration	Raw Value	Absolute (Float) Value
Minimum	0	0 [us]
Maximum	250000000	2000000 [us]
Initial Value	0	0.00 [us]
Formula	Absolute Value [us] = Raw Value / 125	

## ● Note

'TimerTriggerSource' operation is as follows;

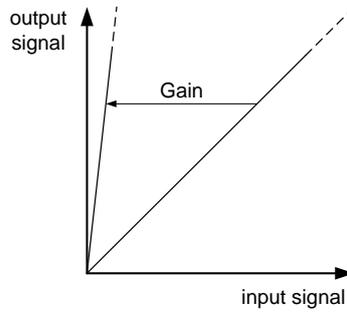
Line0Active is available in Hardware Trigger mode, and to be responded to FrameTriggerError.

FrameTrigger is available in both Hardware Trigger and Software Trigger mode, and not to be responded to FrameTriggerError.

ExposureStart is available in both Hardware Trigger and Software Trigger mode, and not to be responded to FrameTriggerError. Timer0Active pulse delays TiggerDelay+TimerDelay[us].

# Gain

This section describes Gain feature. This control adjusts an amplification factor applied to the output signal. Gain feature adjusts manual gain. GainAuto feature adjusts gain automatically.



Gain

The formula of Gain value is as follows;

$$\text{output signal} = \text{input signal} \times 10^{(\text{Gain} / 20)}$$

Gain is in [dB] unit.

## • GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
Gain	IFloat	4	R/W	Sets a manual Gain.
GainAuto	IEnumeration	4	R/W	Adjusts Gain automatically.

### GenICam API

Control Gain using GenICam API.

#### ◆ Gain

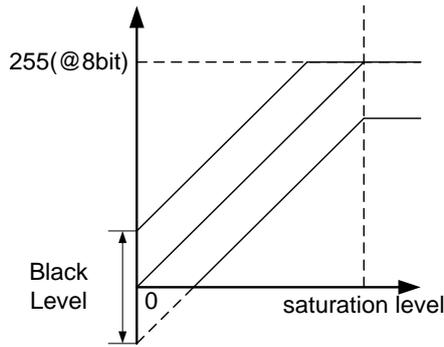
Use 'IFloat' interface to control Gain.

#### ◆ Minimum/Maximum Value

Gain	Raw Value	Absolute (Float) Value
Minimum	0	0.00 [dB]
Maximum	360	36.00 [dB]
Initial Value	0	0.00 [dB]
Formula	Absolute Value [dB] = Raw Value / 10	

# BlackLevel

This section describes BlackLevel feature. This control adjusts the black level applied to the output signal. It is adjustable from -25% to +25% as white saturation level is 100%. If BlackLevel is set lower than 0[%], the image level may not be saturated.



Black Level

## • GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
BlackLevel	IFloat	4	R/W	Black Level value.

## GenICam API

Control BlackLevel using GenICam API.

### ◆ BlackLevel

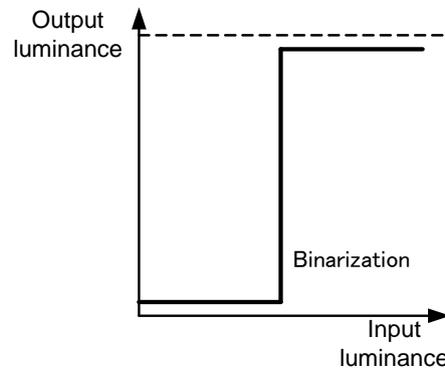
Use 'IFloat' interface to control BlackLevel.

### ◆ Minimum/Maximum Value

Gain	Raw Value	Absolute (Float) Value
Minimum	-256	-25.00[%]
Maximum	256	+25.00[%]
Initial Value	0	0.00[%]
Formula	Absolute Value [%] = Raw Value * 100 / 1024	

# LUTControl

This function allows you to apply the arbitrary LUT(input: 12it, output: 12bit) to the output images.



example of LUT setting

## • GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
LUTEnable	IBoolean	4	R/W	Sets the activation of LUT function.
LUTIndex	IInteger	4	R/W	Sets the input level of LUT.
LUTValue	IInteger	4	R/W	Sets the output level of LUT.

### GenICam API

Control LUT using GenICam API.

#### ◆LUT

1. Set the input level of LUT to 'LUTIndex'.
2. Set the output level of LUT to 'LUTValue'
3. Set the activation of LUT function by 'LUTEnable'

#### ◆Minimum/Maximum Value

LUTIndex/LUTValue	Value
Minimum	0
Maximum	4095

# UserSetControl

You are able to save a user setting to the non-volatile or volatile memory of the camera. There are 15 user memory channels for user setting.

By using user memory, you are able to restore frequent used settings at the time of next start-up.

The following table is the list of registers applied to “UserSetLoad”/“UserSetSave”, “UserSetQuickSave”.

Table: List of registers to be applied to UserSet

Category	Register	Category	Register
ImageFormatControl	ImageFormatSelector	DigitalIOControl	AntiGlitch
	Width		AntiChattering
	Height	TimerControl	TimerTriggerSource
	OffsetX		TimerDuration
	OffsetY		TimerDelay
	Binning	AnalogControl	Gain
	Reverse		BlackLevel
	PixelFormat	LUTControl	LUTEnable
	TestPattern	EventControl	EventNotification
AcquisitionControl	AcquisitionFrameRateEnable	DPCControl	DPCEnable(*)
	AcquisitionFrameRate	SequentialShutterControl	SequentialShutterEnable(*)
	AcquisitionFrameIntervalControl		SequentialShutterTerminateAt(*)
	AcquisitionFrameInterval		SequentialShutterEntry(*)
TriggerControl	TriggerMode		
	TriggerSequence		
	TriggerSource		
	TriggerAdditionalParameter		
	TriggerDelay		
ExposureControl	ExposureTime		
	ExposureControl		
DigitalIOControl	LineModeAll		
	LineInverterAll		
	UserOutputValueAll		
	LineSelector		
	LineSource		

(\*) DPC and SequentialShutter entries are stored to a single channel. Entries are shared with all channels.

## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
UserSetSelector	IEnumeration	4	R/W	Selects a channel of user setting.
UserSetLoad	ICommand	4	W	Loads a user setting.
UserSetSave	ICommand	4	W	Saves a user setting to non-volatile memory.
UserSetQuickSave	ICommand	4	W	Saves a user setting to volatile memory.
UserSetDefault	IEnumeration	4	R/W	Selects a channel of user setting when camera powers up.

### GenICam API

Control UserSetControl using GenICam API.

#### ◆ UserSetLoad/UserSetSave/UserSetQuickSave

1. Select a channel of user setting by 'UserSetSelector'.

Integer value and string value of Enumeration are as follows;

Integer	String	Description	Save	Load
0	Default	Initial factory setting.	-	✓
1	UserSet1	Memory channel 1 for user setting. - DPC feature is enabled.	✓	✓
2~15	UserSet2~15	Memory channel 2 to 15 for user setting.	✓	✓

2. Execute UserSetLoad, UserSetSave or UserSetQuickSave

When execute 'UserSetLoad', the camera loads user setting from the channel selected in 'UserSetSelector' register and applies them.

When execute 'UserSetSave' or 'UserSetQuickSave', the camera saves user setting to the channel selected in 'UserSetSelector' register.

#### ◆ UserSetDefault

Select a channel of user setting when camera powers up by 'UserSetDefault'.

Integer value and string value of Enumeration are as follows;

Integer	String	Description
0	Default	Initial factory setting.
1~15	UserSet1~15	Memory channel 1 to 15 for user setting.

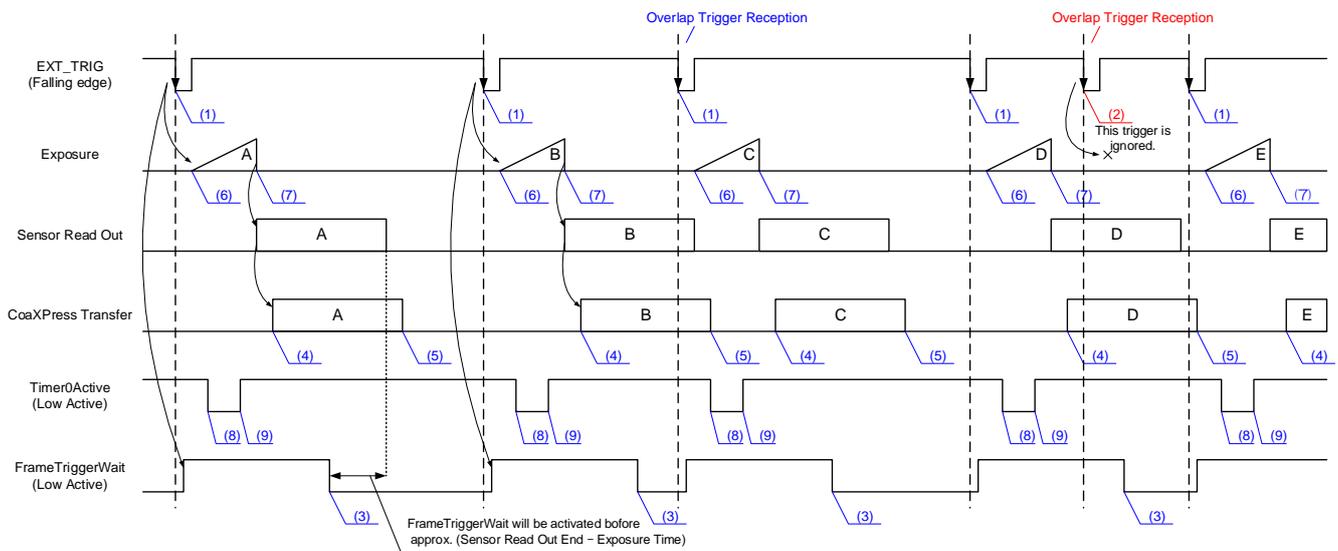
# EventControl

Event will be implemented at a newer firmware version

Camera notifies FrameTrigger status and other information by CoaXPress 2.0 Event Packet.

- FrameTrigger : Reception of Frame Start Trigger
- FrameTriggerError : Rejection of Frame Start Trigger
- FrameTriggerWait : Start of waiting for Frame Start Trigger
- FrameTransferStart : Start of transferring streaming data
- FrameTransferEnd : End of transferring streaming data
- ExposureStart : Start of Exposure
- ExposureEnd : End of Exposure
- Timer0Start : Start of Timer0
- Timer0End : End of Timer0

Events timing are as following chart.



**Event Name**

- (1) FrameTrigger : Reception of Frame Start Trigger.
- (2) FrameTriggerError : Rejection of Frame Start Trigger.
- (3) FrameTriggerWait : Start of waiting for Frame Start Trigger.
- (4) FrameTransferStart : Start of transferring streaming data.
- (5) FrameTransferEnd : End of transferring streaming data.
- (6) ExposureStart : Start of Exposure.
- (7) ExposureEnd : End of Exposure.
- (8) Timer0Start : Start of Timer0.
- (9) Timer0End : End of Timer0.

## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
EventSelector	IEnumeration	4	R/W	Selects which Event to signal to the host application.
EventNotification	IEnumeration	4	R/W	Sets the activation of event notification

# DPCControl

DPC (Defective Pixel Correction) function of the image sensor can be enabled and corrects defective pixels in the image sensor. The DPC is based on a median filter,

## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
DPCEnable	IEnumeration	4	R/W	Sets the activation of DPC function.

### GenICam API

Control DPC using GenICam API.

#### ◆ DPCEnable

Set the activation of DPC function by 'DPCEnable'.

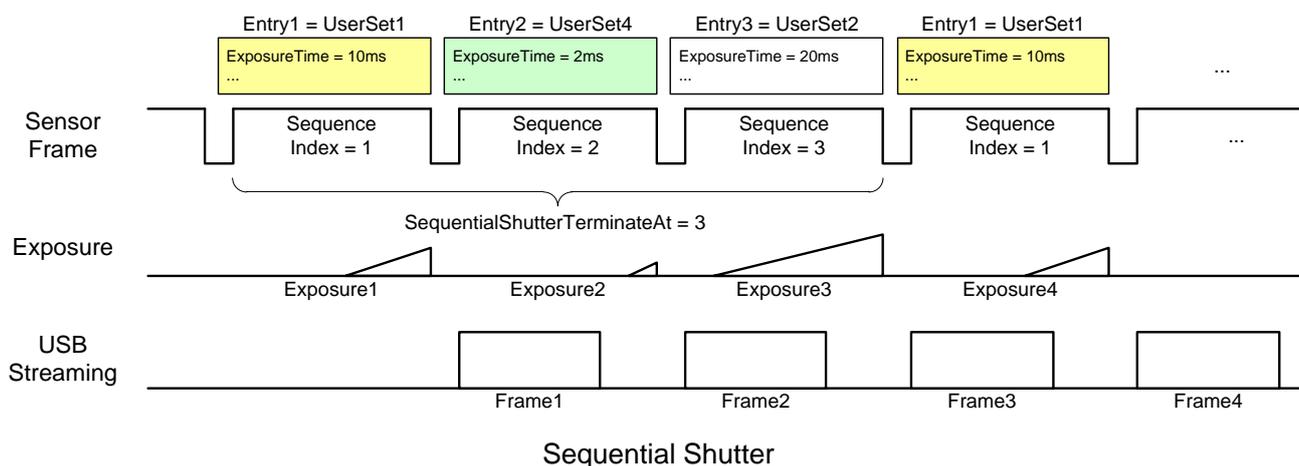
Integer value and string value of Enumeration are as follows;

Integer	String	Description
0	Off	Defective Pixel Correction OFF
1 (*)	On	Defective Pixel Correction ON

\* initial factory setting

# SequentialShutterControl

Sequential Shutter function performs sequential capturing with applying the settings of UserSet that have been made entry in advance.



## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
SequentialShutterEnable	IEnumeration	4	R/W	Sets the activation of Sequential Shutter function.
SequentialShutterTerminateAt	Integer	4	R/W	Sets the number of Index to repeat the sequence.
SequentialShutterIndex	Integer	4	R/W	Sets the sequence number to register.
SequentialShutterEntry	Integer	4	R/W	Sets the UserSet number to register to the sequence.

## GenICam API

Control SequentialShutter using GenICam API.

### ◆ SequentialShutter

1. Set the camera parameters and save them to UserSet. Repeat this as you required.
2. Set the sequence number to register to 'SequentialShutterIndex' and Sets the UserSet number to register to the sequence to 'SequentialShutterEntry'. Repeat this as you required.
3. Set the number of Index to repeat the sequence to 'SequentialShutterTerminateAt'.
4. Set the activation of SequentialShutter function by 'SequentialShutterEnable'.

Integer value and string value of Enumeration are as follows;

Integer	String
0	Off
1	On

5. Capture image stream.

To start and stop capturing image is the same way as AcquisitionControl.

◆ **Minimum/Maximum Value**

SequentialShutterIndex	setting value
Minimum (*)	1
Maximum	16

\* initial factory setting

SequentialShutterEntry	setting value
Minimum (*)	1
Maximum	15

\* initial factory setting

● **Note**

The following table is the list of registers applied to “SequentialShutter”.

Table: List of registers to be applied to SequentialShutter

Category	Register
ImageFormatControl	OffsetX
	OffsetY
ExposureControl	ExposureTime
DigitalIOControl	UserOutputValueAll
	LineSource
CounterAndTimerControl	TimerDuration
	TimerDelay

Category	Register
AnalogControl	Gain
	BlackLevel
LUTControl	LUTEnable

# TransportLayerControl

This function changes the settings on transport layer.

## ● GenICam Node

Name	Interface	Length Byte / [bit]	Access	Description
PayloadSize	Integer	4	R	Provides the number of bytes transferred for each image on the stream channel.
DeviceTapGeometry	IEnumeration	4	R	Returns the geometrical properties characterizing the taps of the camera.
StreamType	IEnumeration	4	R/W	Selects stream type.
CxpLinkConfigurationPreferred	IEnumeration	4	R	Provides the Link configuration that allows the camera to operate in its default mode.
CxpLinkConfiguration	IEnumeration	4	R/W	Specifys the Link configuration for the communication between the host and the camera.

### GenICam API

Control TrasportLayerControl using GenICam API.

#### ◆ DeviceTapGeometry

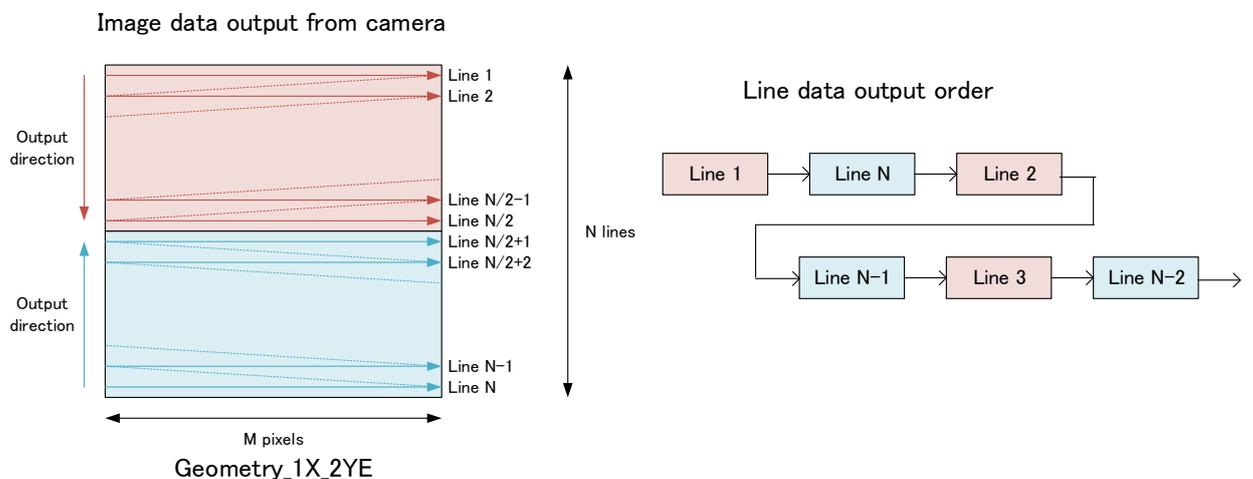
Get taps and geometry information on the stream with DeviceTapGeometry.

Integer value and string value of Enumeration are as follows;

Integer	String	Discription
2*	Geometry_1X2YE	1X 2YE tap geometry

\* initial factory setting

Image data output from the camera and line data output order are as follows;



### ◆StreamType

Set stream type on the stream.

This setting is required for CoaXPress frame grabber (Host) to decode stream data, and needs to be set corresponding to CoaXPress frame grabber.

Integer	String	Discription
0*	SingleStream	Single Stream
2	MultiStream	Multi Stream

\* initial factory setting

### ◆CxpLinkConfiguration

Specifays the Link configuration for the communication between the host (CoaXPress frame grabber) and the camera. In default, it is set by CxpLinkConfigurationPreferred.

Integer value and string value of Enumeration are as follows;

Integer	String	Discription
0x00010048	CXP6_X1	CXP-6 (6.25Gbps) x 1 lane
0x00040048	CXP6_X4	CXP-6 (6.25Gbps) x 4 lanes
0x00010058	CXP12_X1	CXP-12 (12.5Gbps) x 1 lane
0x00040058	CXP12_X4	CXP-12 (12.5Gbps) x 4 lanes

### ● Note

Changing 'DeviceTapGeometry' and 'CxpLinkConfiguration' value are invalid during image stream data output.

CXP-6 x 1 lane with Mono10p or Mono12p can be set, but these operations are not guaranteed.

# Appendix

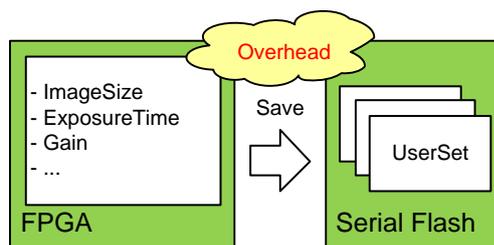
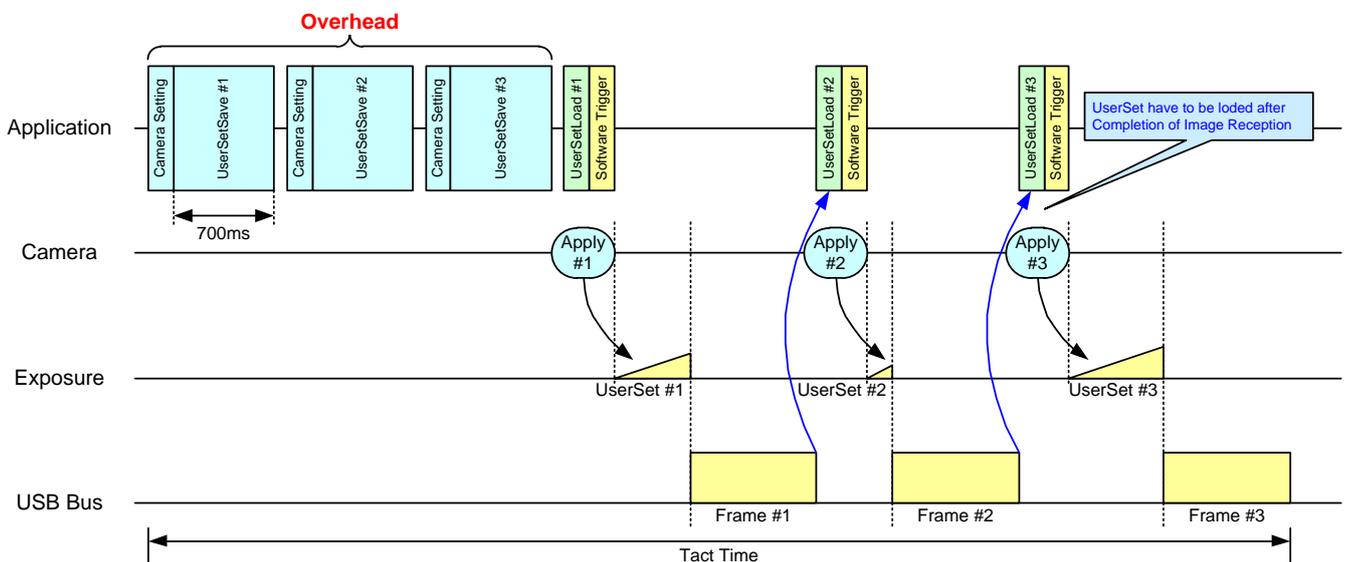
## UserSetSave and UserSetQuickSave difference

If you want to change multiple Camera Settings (e.g. ROI setting) at once, UserSet feature is useful.

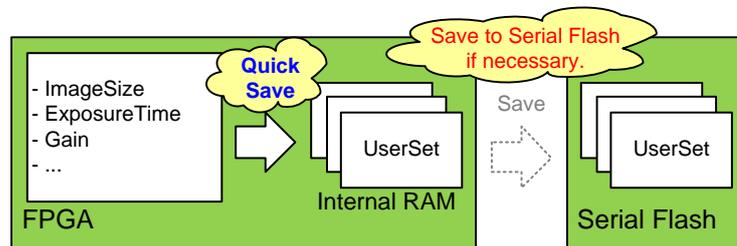
Application needs to save the camera settings in UserSet memory in advance or in initialization stage.

By **UserSetSave**, UserSet is stored to non-volatile flash memory.

It takes about **700ms** to execute UserSetSave because Non-volatile flash memory needs to be erased before writing. If you want to switch over multiple different settings in run time, overhead time of **UserSetSave** is inevitable.



By **UserSetQuickSave**, UserSet is stored to internal RAM. It takes less than **100us** in execution. It can reduce the overhead time of **UserSetSave** greatly. You can also save UserSets to Serial Flash if necessary by **UserSetSave**.



# MultiFrame and Bulk function difference

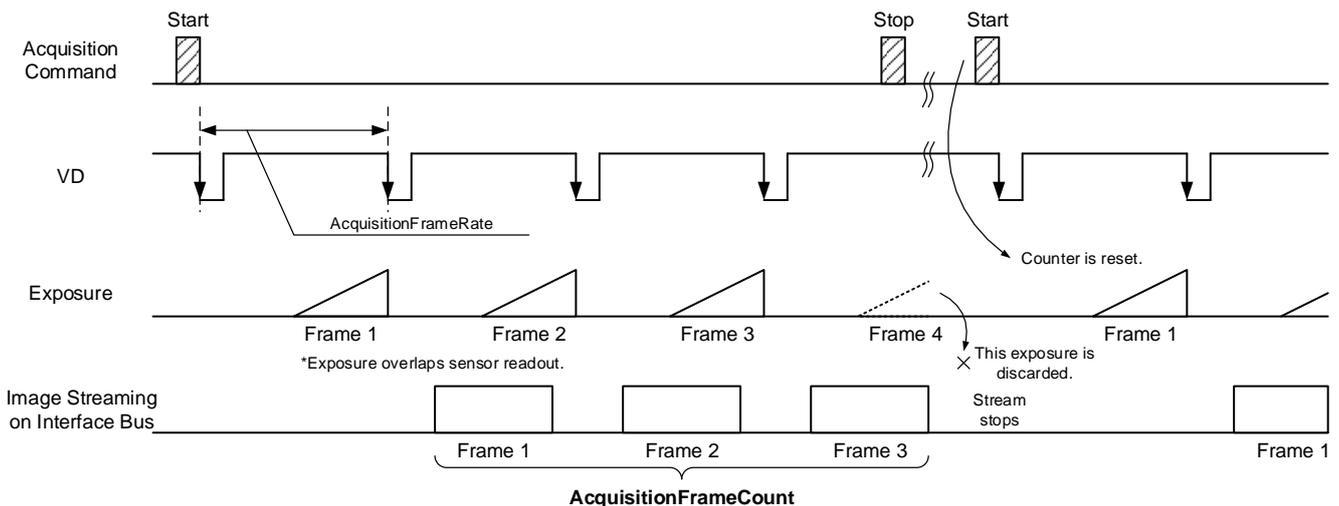
This section describes the difference between MultiFrame function of AcquisitionMode and Bulk function of TriggerSequence.

- MultiFrame function sets limits to the number of frames to transfer with AcquisitionFrameCount register.
- Bulk function sets limits to the number of frames to exposure with TriggerAdditionalParameter register.

## - MultiFrame function in Normal Shutter mode (TriggerMode = Off)

Camera transfers "AcquisitionFrameCount" frame(s).

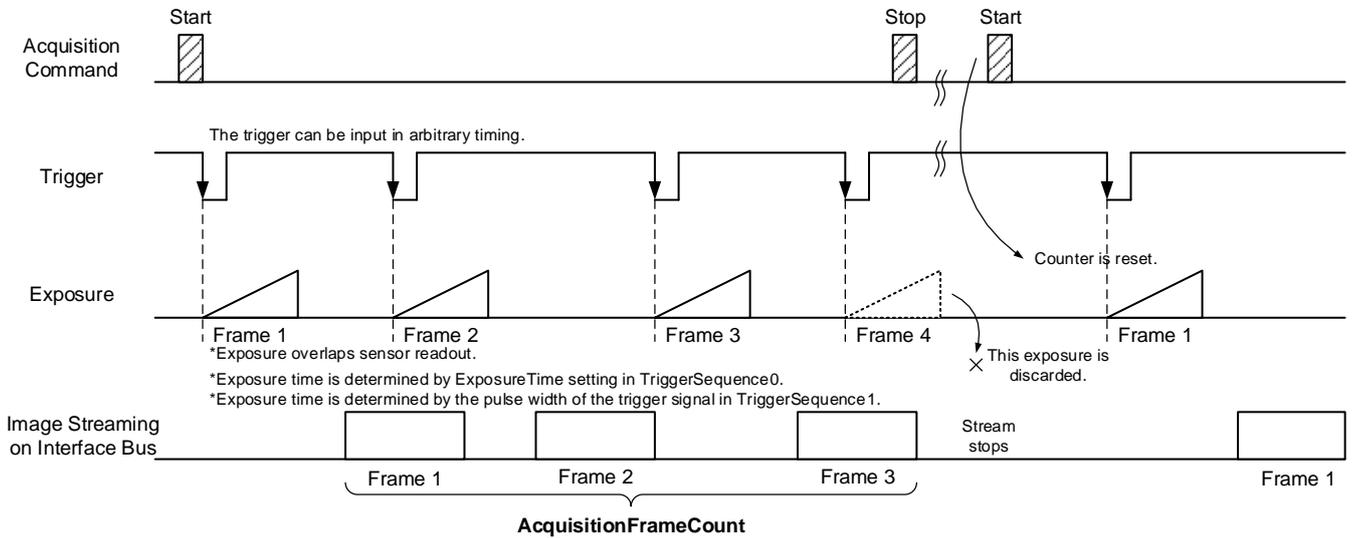
**AcquisitionMode = MultiFrame  
AcquisitionFrameCount = 3  
TriggerMode = Off**



**- MultiFrame function in Random Shutter mode (TriggerMode = On, TriggerSequence = 0 or 1)**

Camera transfers "AcquisitionFrameCount" frame(s). It requires "AcquisitionFrameCount" time(s) of trigger.

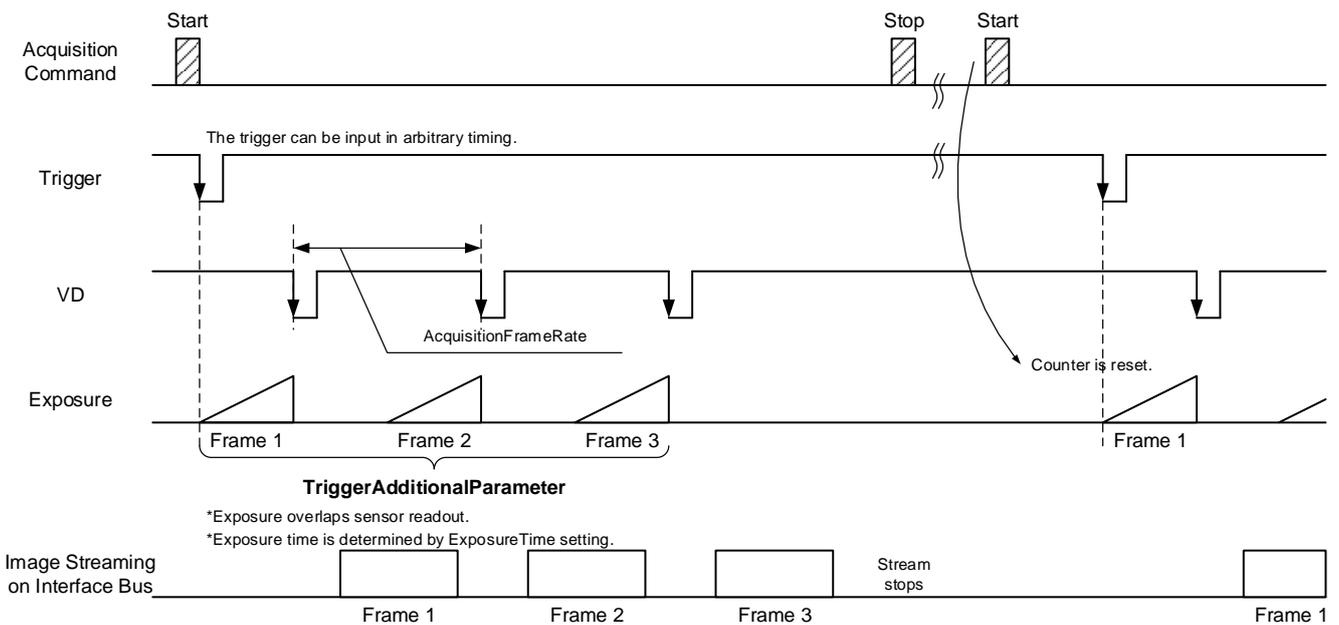
AcquisitionMode = MultiFrame  
 AcquisitionFrameCount = 3  
 TriggerMode = On  
 TriggerSequence = 0 or 1



**- Bulk function (TriggerMode = On, TriggerSequence = 6)**

Camera transfers "TriggerAdditionalParameter" frame(s) by a single trigger.

AcquisitionMode = Continuous  
 TriggerMode = On  
 TriggerSequence = 6  
 TriggerAdditionalParameter = 3

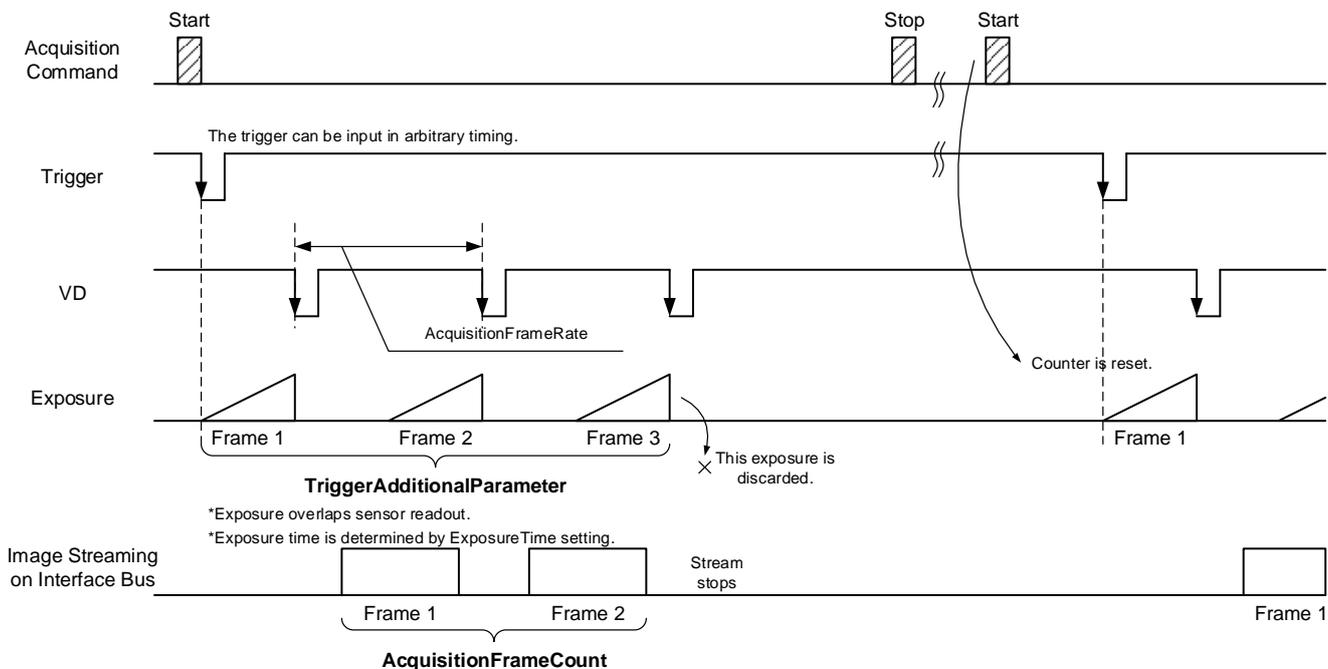


● **Note**

In Bulk function, you may want to set “Continuous” to “AcquisitionMode” register.

You can set “MultiFrame”, but acquisition frame number is limited by “AcquisitionFrameCount”.

**AcquisitionMode = MultiFrame**  
**AcquisitionFrameCount = 2**  
**TriggerMode = On**  
**TriggerSequence = 6**  
**TriggerAdditionalParameter = 3**



# Warranty rules

- **Warranty term**

Warranty term is 36 months after your purchase. We may assume the date of the purchase from our shipping date when the date is unidentified.

- **Limited Warranty**

Free warranty is not applicable for the troubles, damages or losses caused by the cases of the followings, even if it is during the warranty term.

1. Natural exhaust, wear or degradation of a component parts
2. Handling against the instructions and conditions described in the instruction manual
3. Remodeling, adjustment and the part exchange. (including the opening of the enclosure box and the alteration)
4. Using the accessories not included with the product or our non-designated optional articles
5. Damages caused during the transportation or deficiency of the handling such as drop or fall of the products after the products having been transferred to customers, leaving the products to corrosive environment such as sunlight, fire, sand, soil, heat, moisture, or an inappropriate storing method
6. A fire, an earthquake, a flood, a lightning, or other natural disasters, pollution and a short circuit, abnormal voltage, excessive physical pressure, theft, other accident
7. When connected to a product which is not recommended
8. When connected to the power supply which is not suitable
9. Forgery product, products which does not have proper serial number, products of which serial number is forged, damaged or deleted
10. All defects that happened after the expiration for a warranty term

# Repair

## ● Repair methods

Basically, has to return it to our company when the user requests us to repair product.  
In the case, exchange to a replacement or an equal function product.

## ● Repair request methods

On the occasion of a repair request, please download the "Failure situation report sheet" from our website, fill in the necessary items and return it together with the defective product.

Repair Request Methods

[http://www.toshiba-teli.co.jp/en/support/contact/failure\\_situation.htm](http://www.toshiba-teli.co.jp/en/support/contact/failure_situation.htm)

Please read the following instructions carefully.

1. Please return our product alone, taking out of your equipment in case that our product is installed to an equipment
2. We are unable to return the information such as your own serial numbers, control number, the identification seal, if it is attached to the returned products. Please keep record before you return the product.
3. As the data saved in the camera will not be kept after the repair, please take out data before return.
4. We are unable to accept the cancellation after the repair request by the customer's reason.
5. About the repair product shipping expenses, please bear the charges when you return the product to us. We bear the charges to you from us only for a warranty period.
6. We are unable to accept your request of a delivery date and time of the product return, or the delivery method.
7. We are unable to accept a trouble factor investigation, the request of the repair report.
8. We accept a repair of out of warranty product, if it is repairable.
9. The proprietary rights of the repair request products after the exchange repair belong to us.
10. The immunity from responsibility of the product is applied in the repair completion products.

\* Please refer for the inquiry about the software to our website or sales personnel.