OMRON

USB3 Vision

Monochrome / Color CMOS Camera

STC-MBS43U3V (0.4M / Monochrome)
STC-MCS43U3V (0.4M / Color)
STC-MBS163U3V (1.6M / Monochrome)
STC-MCS163U3V (1.6M / Color)

Product Specifications and User's Guide

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OMRON SENTECH CO., LTD.

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Precautions for safe use

Please read carefully this “Precautions for safe use” before use the camera. Then the camera uses correctly with agreeing with below notes.

In this “Precautions for safe use”, notes divides into “Warning” and “Caution” to use the camera safety and prevent to harm and damage.

⚠ Warning	This shows, assumption for possibility of serious accident leading death or serious injury if ignore this note and camera uses incorrectly.
⚠ Caution	This shows, assumption for possibility of bear the damage or physical damage if ignore this note and camera uses incorrectly.

About Graphic symbols

This symbol shows general prohibition.

This symbol shows completion or instruction.

[Environment / condition]

⚠ Warning	
Do not use flammable or explosiveness atmospheres. This will cause of personal injury or fire.	Do not use for “safety for human body” related usage. This camera is designed for use “do not harm human body immediately” if by any chance the camera has malfunction.
⚠ Caution	
Use and store under specified environmental conditions (Vibration, shock, temperature, humidity) in the specifications for this camera. This will cause of fire or damage the camera.	

[Installation and cable wiring]

⚠ Warning	
Do not use with out of power voltage range that is specified in the specifications for this camera. This will cause of fire, electrification or malfunction.	Do not wrong wiring. This will cause of fire or malfunction.

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⚠ Caution	
Do not grounding DC power (+) of all devices that are connect to the camera. The camera housing is connecting to 0 V line of camera inside circuit. There is a risk of short circuit between camera inside ciurcuit and frame ground. This will cause of malfunction.	It is necessary to wiring and mounting that is specified in the specifications for this camera. This will cause of fire or malfunction.
It is necessary to wiring with turn off the camera. This will cause of electrification or malfunction.	It is necessary to mounting the camera without stress for the cable. This will case of electrification or fire.

[Usage instruction]

⚠ Warning	
Do not touch the terminal and PCB board While turn on the camera. This will cause of electrification or accident caused by malfunction.	Do not put combustibles near the camera. This will cause of fire.
Do not use without usage that is specified in the specifications for this camera. This will cause of personal injury or malfunction.	Do not push metals including screw driver into radiation holes. This will cause of electrification or malfunction.
Do not touch the camera housing while or afterusing the camera. There is a risk of get burned.	
⚠ Caution	
Do not push contamination into opening of the camera. This will cause of electrification or malfunction.	Do not block the radiation holes. This will cause of fire due to increase the camera inside temperature.

[Maintenance]

⚠ Caution	
Do not disassemble or repair the camera. This will cause of fire, electrification or malfunction.	It is turn off the camera when maintaining or inspecting the camera. This will cause of electrification.

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[Disposal]

⚠ Caution	
It is necessary to dispose as industrial waste.	

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1 Product Precautions

- Do not give shock to the camera.
- Do not haul or damage the camera cable.
- Do not wrap the camera with any material while using the camera. This will cause the internal camera temperature to increase.
- When the camera moving or using the place that temperature difference is extreme, countermeasure for dew condensation (heat removal / cold removal) is necessary.
- While the camera is not using, keep the lens cap on the camera to prevent dust or contamination from getting in the sensor or filter and scratching or damaging it.
  Do not keep the camera under the following conditions.
  - In wet, moist, high humidity or dusty place
  - Under direct sunlight
  - In extreme high or low temperature place
  - Near an object that releases a strong magnetic or electric filed
  - Place with strong vibrations
- Apply the power that satisfies the specified in specifications for the camera.
- The defective pixels may appear due to the sensor characteristics.
- Use below recommend materials (or equivalent materials) to clean the surface of glass.
  - Air dust: Non Freon air duster (NAKABAYASHI Co., LTD.)
  - Alcohol: Propan-2-ol (SAN'EI KAKO Co., LTD.)
  - Non-woven: nikowipe clean room (NKB)
- Use a soft cloth to clean the camera.

2 Warranty

■Warranty period

One year after delivery (However, the camera had malfunction with camera uses correctly)
In below case for a fee even within warranty period.

- The malfunction caused by incorrect usage, incorrect modify or repair.
- The malfunction caused by external shock including the camera dropping after delivery the camera.
- The malfunction caused by fire, earthquake, flood disaster, thunderbolt struck, other natural disaster or wrong voltage.

■Warranty coverage

Exchange or repair the malfunction camera if the malfunction is occurred by our responsibility.
"Warranty" mean is warranty for the delivered camera itself. Please accept the induction damage by the camera malfunction is not included.

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3 Overview

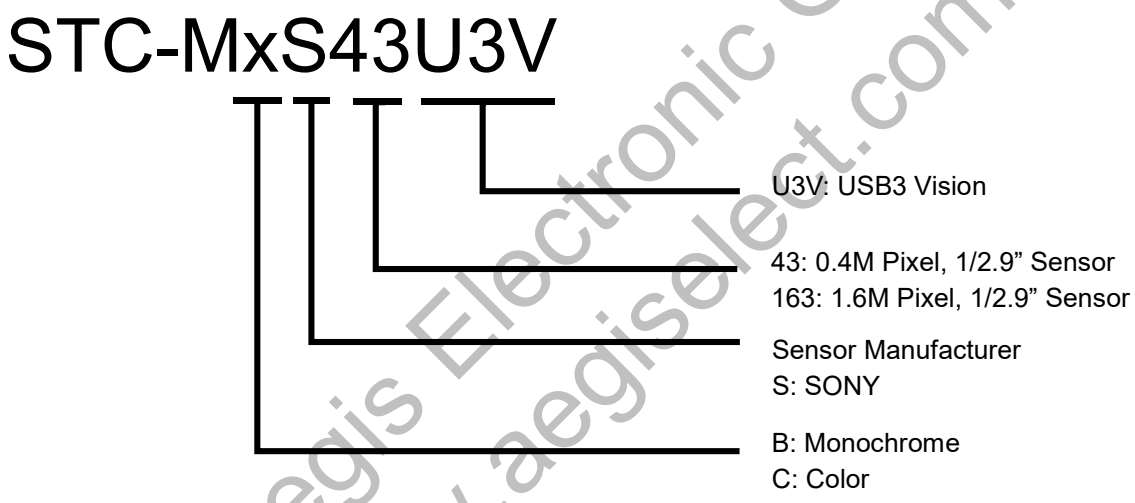
This document describes the specification of the following cameras.

STC-MBS43U3V / STC-MCS43U3V
STC-MBS163U3V / STC-MCS163U3V

3.1 Features

- USB3 Vision
- Maximum frame rate (Full resolution): 527.1 fps @ 0.4M 8bits, 238 fps @ 1.6M 8bits
- CMOS (Global Shutter)
- Up to 2,048 Pixel Defect Correction
- 8bits, 10bits, 12bits output

3.2 Product Number Naming Method



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4 Specifications

4.1 Electronic Specifications

4.1.1 STC-MBS43U3V / STC-MCS43U3V

Model Number		**STC-MBS43U3V**	**STC-MCS43U3V**
Image Sensor		1/2.9" 0.4M Progressive Monochrome CMOS (SONY: IMX287)	1/2.9" 0.4M Progressive Color CMOS (SONY: IMX287)
Shutter Type		Global	
Active Picture Elements		720 (H) x 540 (V)	
Cell Size		6.9 (H) x 6.9 (V) μm	
Sync System		External trigger (Hardware, Software) / **Free run**	
Maximum Frame Rate (at Full scanning)	8bits output (*1)	527.1 fps (Frame rate prioritized mode) / **439.9 fps (Image quality prioritized mode)**	
	10bits output	439.9 fps	
	10bits Packed output	439.9 fps	
	12bits output	322.1 fps	
	12bits Packed output	322.1 fps	
ADC bit width		10bits / 12bits	
Video Format		**8bits** / 10bits / 12bits output (Support packed on 10bits / 12bits)	
Noise Level	8bits output	Less than 6 digits (Gain 0 dB, Frame rate prioritized) / **Less than 3 digits (Gain 0 dB, Image quality prioritized)**	
	10bits / 10bits Packed output	Less than 12 digits (Gain 0 dB)	
	12bits / 12bits Packed output	Less than 48 digits (Gain 0 dB)	
Sensitivity (*2)		8bits (Frame rate prioritized): 27 Lux 8bits (Image quality prioritized) / 10bits /12bits: 108 Lux	8bits (Frame rate prioritized): 60 Lux 8bits (Image quality prioritized) / 10bits /12bits: 240 Lux
Exposure time	8bits output	1 μsecond to 16.777 seconds **(Default: 1.77373 mseconds)**	
	10bits output		
	10bits Packed output		
	12bits output		
	12bits Packed output		
Gain	Analog Gain	0 to 19.2 dB **(Default: 0 dB)**	
	Digital Gain	x1 to x2 **(Default: x1)**	
Black Level	8bits output	0 to 31 digits	
	10bits / 10bits Packed output	0 to 127 digits	
	12bits / 12bits Packed output	0 to 511 digits	
White Balance Gain		N/A	0 (Black level) to x3.99 **(Default: x1)**
ROI		Horizontal: 64 to 720 (704 on Packed) pixels / Vertical: 4 to 540 lines **(Default: 720 x 540)** Adjustable Steps for size: 16 pixels in horizontal direction (64 pixels on Packed) / 4 lines in vertical direction Adjustable Steps for offset: 4 pixels in horizontal direction / 4 lines in vertical direction	
Multi ROIs		N/A	
Gamma		Gamma Table = 0.1 to 4.0 (**Default = 1.0**)	
Binning		N/A	
Decimation		N/A	

Default: **Bold**

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Model Number		STC-MBS43U3V	STC-MCS43U3V
Image Flip		Horizontal / Vertical / Horizontal and Vertical / **Off**	
Defective Pixel Correction		Up to 2,048 points	
Auto Image Control	Auto Exposure	Support	Support
	Auto Gain	Support	Support
	Auto White Balance	N/A	Support
Operational Mode		Edge preset Trigger / Pulse width Trigger / Start Stop Trigger / **Free run**	
User Setting Storage		Support	
Communication		Through USB3.0 bus	
Interface		USB3.0 Super speed (USB3.0 Micro B)	
Protocol		USB3 Vision® 1.0.1, GenICam Standard Version (SFNC 2.2, PFNC 2.0) compliant and Sentech's original protocol (on Standard SDK, Trigger SDK)	
Input / Output		Three GPIOs, One Camera Hardware Reset	
Power	Input Voltage	+5V (typ.) (This conforms to USB standard)	
	Consumption (*4)	Max: 3.4 W, Typ: 3.1 W	

Default: **Bold**

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4.1.2 STC-MBS163U3V / STC-MCS163U3V

Model Number		STC-MBS163U3V	STC-MCS163U3V
Image Sensor		1/2.9" 1.6M Progressive Monochrome CMOS (SONY: IMX273)	1/2.9" 1.6M Progressive Color CMOS (SONY: IMX273)
Shutter Type		Global	
Active Picture Elements		1,440 (H) x 1,080 (V)	
Cell Size		3.45 (H) x 3.45 (V) µm	
Sync System		External trigger (Hardware, Software) / **Free run**	
Maximum Frame Rate (at Full scanning)	8bits output (*1)	238.0 fps (Frame rate prioritized mode) / **200.5 fps (Image quality prioritized mode)**	
	10bits output	118.1 fps	
	10bits Packed output	183.8 fps	
	12bits output	117.3 fps	
	12bits Packed output	157.5 fps	
ADC bit width		10bits / 12bits	
Video Format		**8bits** / 10bits / 12bits output (Support packed on 10bits / 12bits)	
Noise Level	8bits output	Less than 6 digits (Gain 0 dB, Frame rate prioritized) / **Less than 3 digits (Gain 0 dB, Image quality prioritized)**	
	10bits / 10bits Packed output	Less than 12 digits (Gain 0 dB)	
	12bits / 12bits Packed output	Less than 48 digits (Gain 0 dB)	
Sensitivity (*2)		8bits (Frame rate prioritized): 108 Lux 8bits (Image quality prioritized) / 10bits /12bits: 430 Lux	8bits (Frame rate prioritized): 240 Lux 8bits (Image quality prioritized) / 10bits /12bits: 960 Lux
Exposure time	8bits output	1 µsecond to 16.777 seconds **(Default: 4.05736 mseconds)**	
	10bits output		
	10bits Packed output		
	12bits output		
	12bits Packed output		
Gain	Analog Gain	0 to 19.2 dB **(Default: 0 dB)**	
	Digital Gain	x1 to x2 **(Default: x1)**	
Black Level	8bits output	0 to 31 digits	
	10bits / 10bits Packed output	0 to 127 digits	
	12bits / 12bits Packed output	0 to 511 digits	
White Balance Gain		N/A	0 (Black level) to x3.99 **(Default: x1)**
ROI (*3)		Horizontal: 64 to 1,440 (1,408 on Packed) pixels / Vertical: 4 to 1,080 lines **(Default: 1,440 x 1,080)** Adjustable Steps for image size: 16 pixels in horizontal direction (64 pixels on Packed) / 4 lines in vertical direction Adjustable Steps for offset: 4 pixels in horizontal direction / 4 lines in vertical direction	
Multi ROIs		N/A	
Gamma		Gamma Table = 0.1 to 4.0 (**Default = 1.0**)	
Binning		Individual x2 Horizontal, Vertical Binning / **Off** (Horizontal: Average, Vertical: Addition) (*8)	N/A
Decimation		Individual x2 Horizontal, Vertical Decimation / **Off**	
Image Flip		Horizontal / Vertical / Horizontal and Vertical / **Off**	
Defective Pixel Correction		Up to 2,048 points	

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Model Number		STC-MBS163U3V	STC-MCS163U3V
Auto Image Control	Auto Exposure	Support	Support
	Auto Gain	Support	Support
	Auto White Balance	N/A	Support
Operational Mode		Edge preset Trigger / Pulse width Trigger / Start Stop Trigger / **Free run**	
User Setting Storage		Support	
Communication		Through USB3.0 bus	
Interface		USB3.0 Super speed (USB3.0 Micro B)	
Protocol		USB3 Vision® 1.0.1, GenICam Standard Version (SFNC 2.2, PFNC 2.0) compliant and Sentech's original protocol (on Standard SDK, Trigger SDK)	
Input / Output		Three GPIOs, One Camera Hardware Reset	
Power	Input Voltage	+5V (typ.) (This conforms to USB standard)	
	Consumption (*4)	Max: 3.8 W, Typ: 3.4 W	

Default: **Bold**

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Precautions

(*1) When selecting 8bits output, the priority mode (Image quality / Frame rate) can be selectable.
When selecting “Image quality”, the maximum frame rate is reduced, but the low noise image is acquiring.
When selecting “Frame rate”, the camera can be operated with the fastest frame rate of this camera, but noise level is greater than “Image quality” selected image.
Please test and select suitable priority mode for the application.

(*2) The sensitivity is measuring the luminance when white level achieved 100 % in below conditions.

Camera Setting		Environment	
Parameter	Setting	Parameter	Setting
Gain Up	0 dB	Light Source	Light Box (White)
AGC	Off	Color temperature	5,100K
White Balance	Optimum	Lens	
Electrical Shutter	1/30 seconds	F on Lens	F5.6
Black Level	Optimum	Target Luminance	IM-600 (Topcon)
Gamma	Factory Setting		

(*3) The frame rate does not increase by the binning function.

(*4) The camera operates as USB3.0 standard even the camera connecting to a USB 2.0 port. Please careful about the power consumption of the camera when the camera connecting to USB2.0 port.

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The guideline to perform the full frame rate with full resolution of camera

The data transfer speed on the USB bus is depending on the performance of USB host controller.
The data transfer speed on the USB bus is very important to obtain full frame rate with full resolution. (527.1 fps @ 0.4M, 238 fps @ 1.6M)

Renesas / Fresco Logic host controller improved the data transfer speed drastically in the second generation.
However, the transferring speed of Intel chipset is 10 to 20% faster than these host controllers.

When using USB3.0 interface PCI Express board, please insert it to the PCI Express Gen2.0 (5.0[GT/s]) slot. If non-PCI Express Gen2.0 (5.0[GT/s]) is used, data transfer speed could decrease by about 50%.

If the frame rate is slow due to the performance of USB host controller, the frame rate of camera should adjust based on the performance of USB host controller. This may resolve to increase the frame rate.

PC resources may have consumed during the image processing (color interpolation, image display, etc.) with huge image data from camera.

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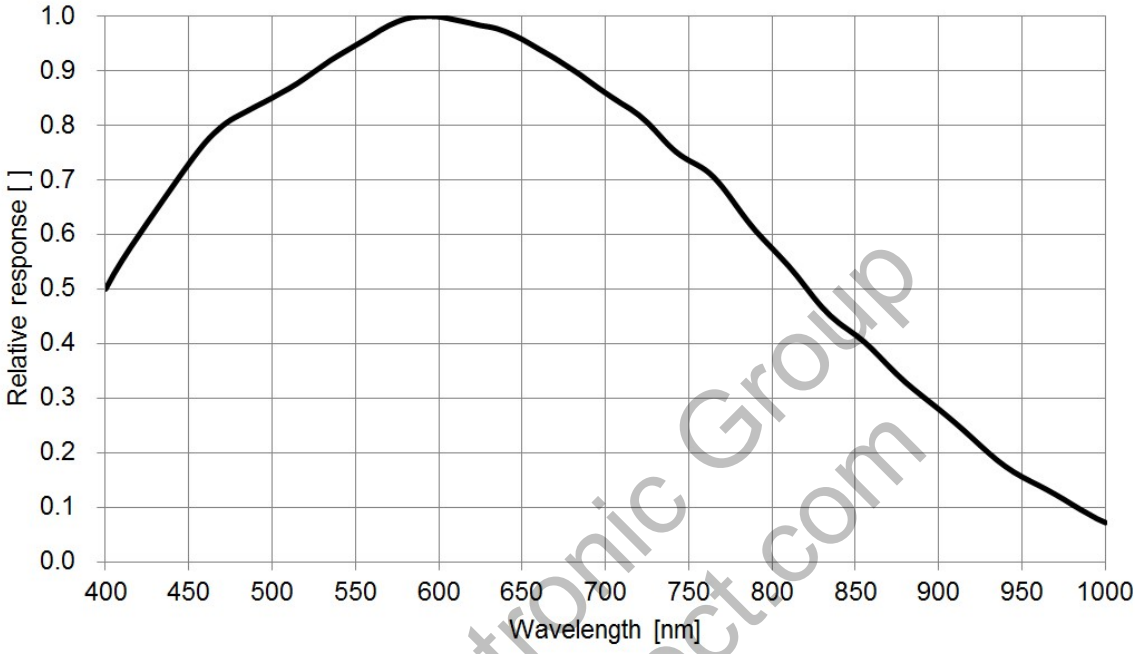
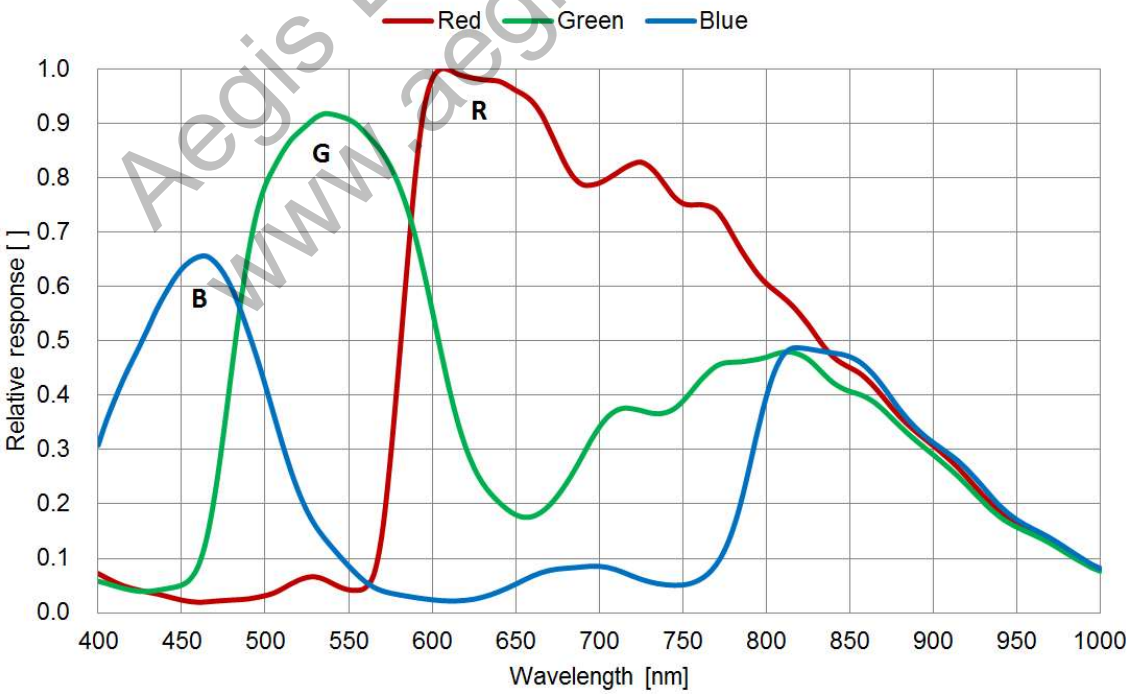
4.2 Spectral Sensitivity Characteristics

4.2.1 STC-MBS43U3V



4.2.2 STC-MCS43U3V (without IR cut filter)



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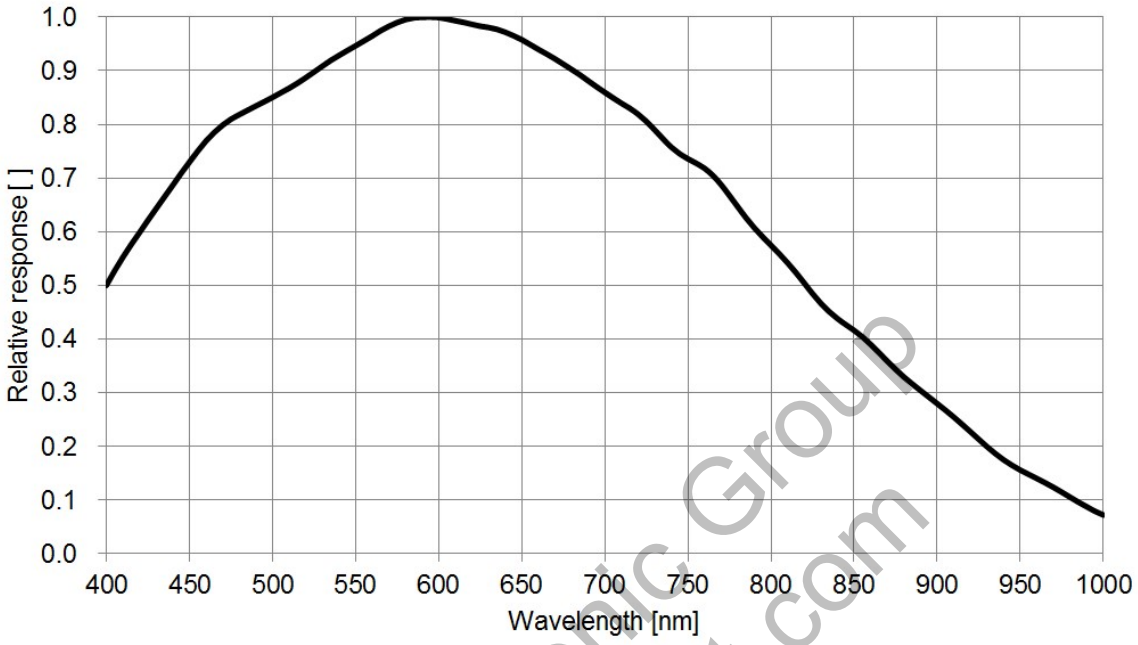
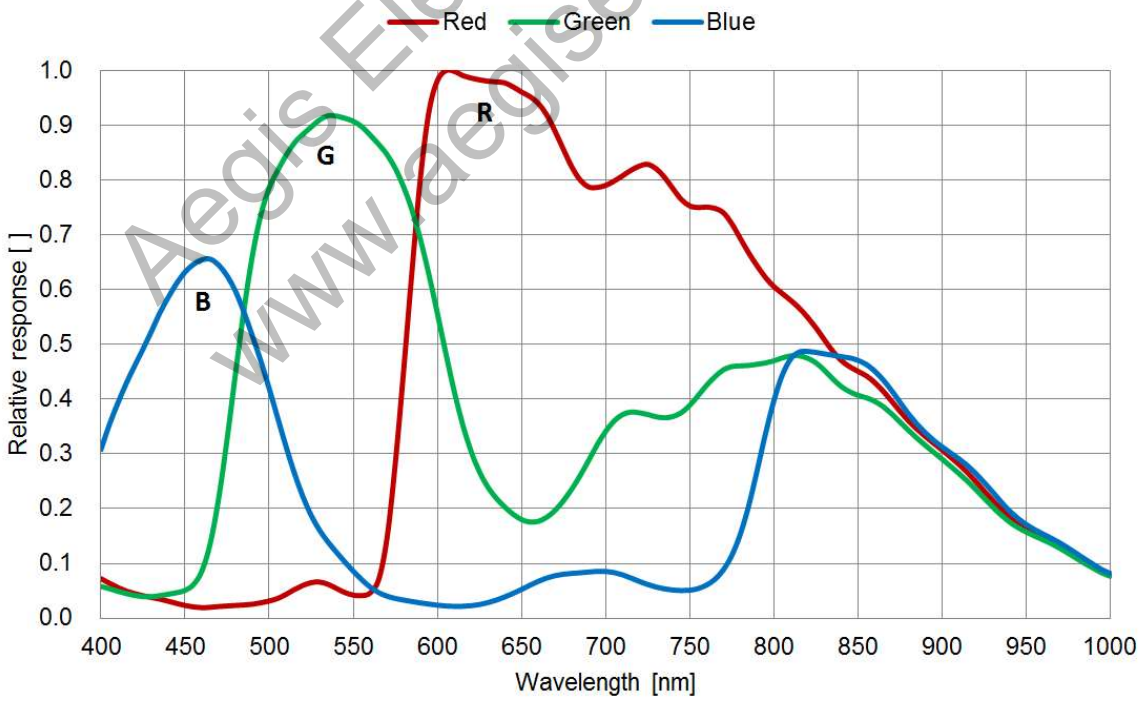
4.2.3 STC-MBS163U3V



4.2.4 STC-MCS163U3V (without IR cut filter)



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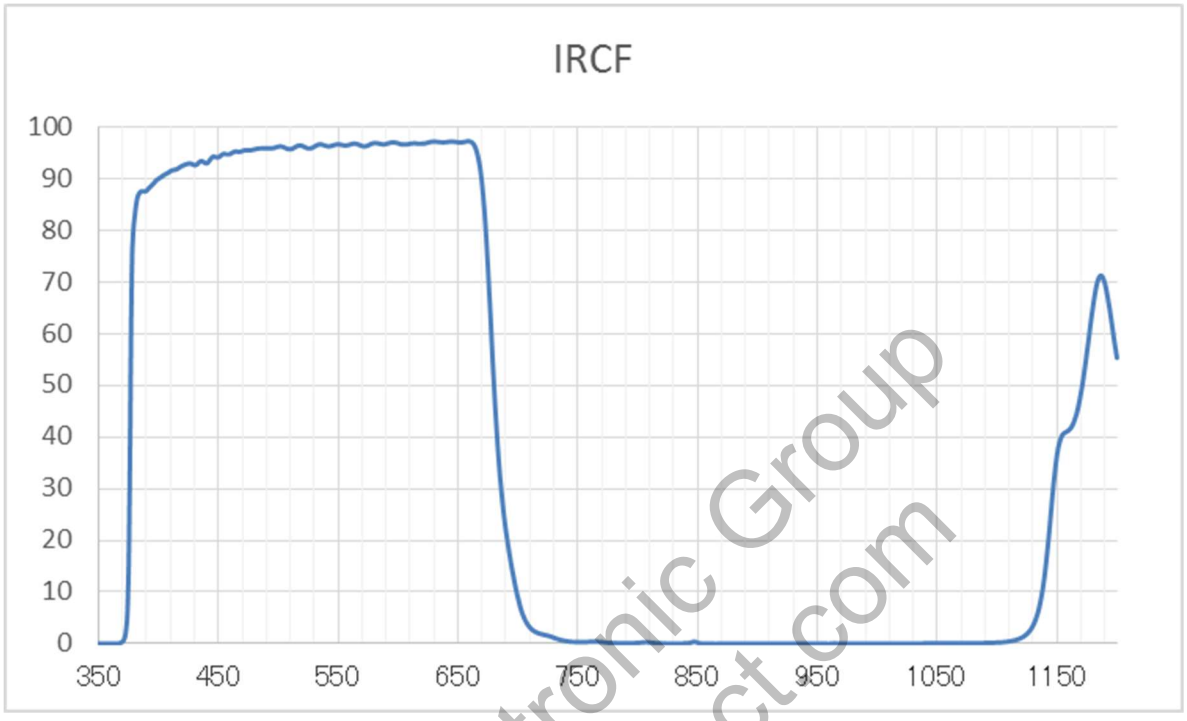
4.2.1 IR Cut Filter (STC-MCS43U3V / STC-MCS163U3V)



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4.3 Mechanical Specifications

4.3.1 STC-MBS43U3V / STC-MCS43U3V

Model Number	STC-MBS43U3V	STC-MCS43U3V
Dimensions	28 (W) x 28 (H) x 40 (D) mm (*1)	
Optical Filter	No Optical Cut Filter	IR Cut Filter
Optical Center Accuracy	Positional accuracy in Horizontal and Vertical directions: +/- 0.3 mm Rotational accuracy of Horizontal and Vertical: +/- 1.5 deg.	
Material	Aluminum alloy (AC)	
Lens Mount (*2)	C Mount	
Interface Connectors	USB Connector: USB3.0 Micro B type I/O Connector: HR10A-7R-6PB (Hirose) or equivalent	
Camera Mounting	M2 screw holes (Three on top, bottom and both side plate) M4 screws holes (Two on top, four on bottom plate)	
Weight	Approximately 46 g	

(*1) Excluding connectors

(*2) Recommend lens: More than F2.8 (Close side)

4.3.2 STC-MBS163U3V / STC-MCS163U3V

Model Number	STC-MBS163U3V	STC-MCS163U3V
Dimensions	28 (W) x 28 (H) x 40 (D) mm (*1)	
Optical Filter	No Optical Cut Filter	IR Cut Filter
Optical Center Accuracy	Positional accuracy in Horizontal and Vertical directions: +/- 0.3 mm Rotational accuracy of Horizontal and Vertical: +/- 1.5 deg.	
Material	Aluminum alloy (AC)	
Lens Mount (*2)	C Mount	
Interface Connectors	USB Connector: USB3.0 Micro B type I/O Connector: HR10A-7R-6PB (Hirose) or equivalent	
Camera Mounting	M2 screw holes (Three on top, bottom and both side plate) M4 screws holes (Two on top, four on bottom plate)	
Weight	Approximately 46 g	

(*1) Excluding connectors

(*2) Recommend lens: More than F2.8 (Close side)

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4.4 Environmental Specifications

4.4.1 STC-MBS43U3V / STC-MCS43U3V

Model Number		STC-MBS43U3V	STC-MCS43U3V
Operational Temperature / Humidity	Minimum	Environmental Temperature: 0 deg. C, Environmental Humidity: 0 to 85 %RH (No condensation)	
	Maximum	Camera housing temperature (top plate) shall not exceed 54 deg. C (*1),	
Storage Temperature / Humidity		Environmental Temperature: -25 to +70 deg. C, Environmental Humidity: 0 to 85 %RH (No condensation)	
Vibration		20 Hz to 200 Hz to 20 Hz (5 min. / cycle), acceleration 10 G, XYZ 3 directions 30 min. each	
Shock		Acceleration 38 G, half amplitude 6 ms, XYZ 3 directions 3 times each	
Standard Compliancy		EMS: EN61000-6-2, EMI: EN55011	
RoHS		RoHS Compliant	

4.4.2 STC-MBS163U3V / STC-MCS163U3V

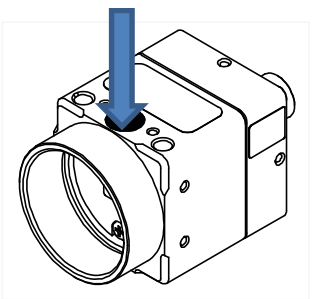
Model Number		STC-MBS163U3V	STC-MCS163U3V
Operational Temperature / Humidity	Minimum	Environmental Temperature: 0 deg. C, Environmental Humidity: 0 to 85 %RH (No condensation)	
	Maximum	Camera housing temperature (top plate) shall not exceed 54 deg. C (*1)	
Storage Temperature / Humidity		Environmental Temperature: -25 to +70 deg. C, Environmental Humidity: 0 to 85 %RH (No condensation)	
Vibration		20 Hz to 200 Hz to 20 Hz (5 min. / cycle), acceleration 10 G, XYZ 3 directions 30 min. each	
Shock		Acceleration 38 G, half amplitude 6 ms, XYZ 3 directions 3 times each	
Standard Compliancy		EMS: EN61000-6-2, EMI: EN55011	
RoHS		RoHS Compliant	

(*1) Please insure the camera is installed with the appropriate heat dissipation. If camera has a mounted lens and a tripod with an aluminum plate, this could decrease the camera housing temperature for heat dissipation. When the internal temperature sensor on the camera shows less than 64 deg. C, the camera housing temperature (top plate) will be less than 54 deg. C.

Taking these steps will maintain the heat rating of the electronic components of the camera.

Upper side of camera

Measuring point



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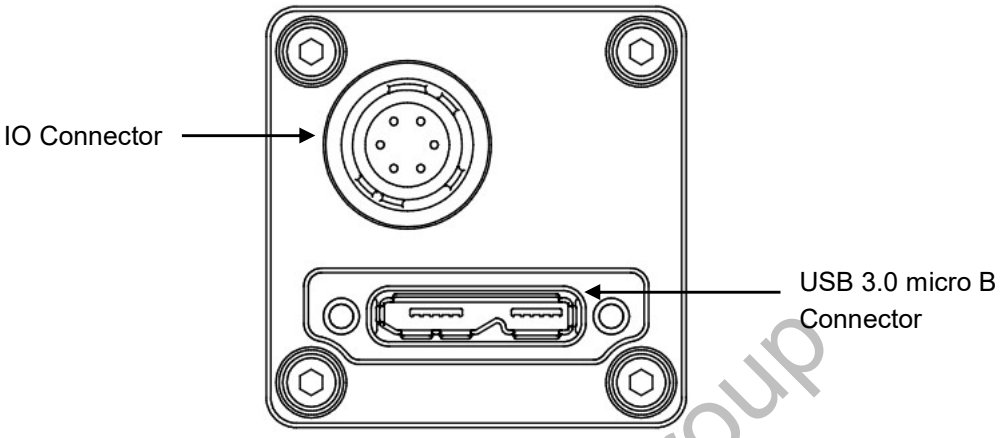
4.5 External Connector Specifications

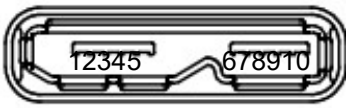


4.5.1 USB 3.0 micro B

This connector is compatible with a USB 3.0 micro B connector.
Connector size includes screw lock size and complies with USB3 Vision 1.0.1.

Pin assignment

Pin No.	Signal Name	Description
1	VBUS	Power
2	D−	USB 2.0 differential pair (D−)
3	D+	USB 2.0 differential pair (D+)
4	USB OTG	USB OTG ID
5	GND	GND
6	SSTX−	SuperSpeed transmitter differential pair (−)
7	SSTX+	SuperSpeed transmitter differential pair (+)
8	GND	GND
9	SSRX−	SuperSpeed receiver differential pair (−)
10	SSRX+	SuperSpeed receiver differential pair (+)



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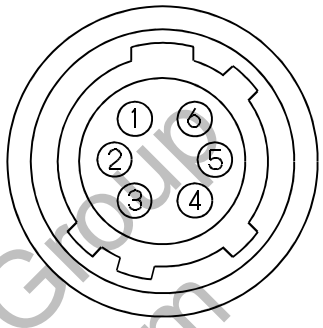
OMRON

4.5.2 IO Connector

HR10A-7R-6PB (Hirose) or equivalent.
This connector is for input and output signals.
Please use HR10A-7P-6S (Hirose) or equivalent connector for cable.

Pin assignment

Pin No.	Signal Name	IN/OUT
1	GPIO_GND	-
2	GPIO2	IN/OUT
3	GPIO1	IN/OUT
4	GPIO0	IN/OUT
5	CAM_RESET	IN
6	N.C.	-



* Possible Maximum Rated Voltage is +24 V on CAM_RESET, GPIO0, GPIO1 and GPIO2.
* Please set “OPEN” electrically on N.C. (Pin 6).

Input Output DC characteristics

Pin No.	Signal Name	Function	IN/OUT		Voltage		Current	Reference
					Low Voltage	High Voltage		
1	IO_GND	GND	-				-	-
2	GPIO2	General Purpose Input Output	IN/OUT	IN	Less than +1.00 V	+3.00 to +24 V	4 µA (typ.) (*4)	2
				OUT	0 to +2.20V (*1)	+3.00 to +24 V (*2)	15 mA (Max.) (*3)	3,4
3	GPIO1	General Purpose Input Output	IN/OUT	IN	Less than +1.00 V	+3.00 to +24 V	4 µA (typ.) (*4)	2
				OUT	0 to +2.20 V (*1)	+3.00 to +24 V (*2)	15 mA (Max.) (*3)	3,4
4	GPIO0	General Purpose Input Output	IN/OUT	IN	Less than +1.00 V	+3.00 to +24 V	4 µA (typ.) (*4)	2
				OUT	0 to +2.20 V (*1)	+3.00 to +24 V (*2)	15 mA (Max.) (*3)	3,4
5	CAM_RESET	Camera Hardware Reset	IN	IN	Less than +0.80 V	+3.00 to +24 V	4 µA (typ.)(*4)	1
6	N.C.	NC	-	-			-	-

(*1) The case that output low voltage on 15mA load. The output voltage could be higher voltage due to the generate voltage by the internal resister when the power consumption is large with low voltage output. Please evaluate carefully with the actual system.
(*2) The maximum voltage can be applied to connecting IO port as output IO port when external circuits connecting to IO port. This is equivalent to VCCext on Reference 4.
(*3) When external IO port is connected, control the currency less than 15mA on IO port. Please do not apply more than 15 mA to connecting IO port as output IO port when external circuits connecting to IO port.
(*4) The typical current value when high voltage input into Input port.

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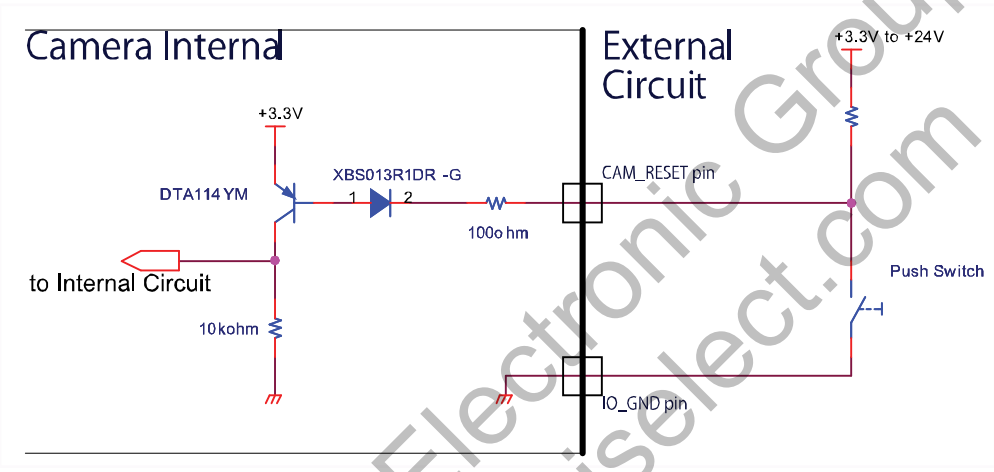
Default Setting of Input / Output

Pin No.	Signal Name	Default	
		IN/OUT	Setting
2	GPIO2	IN	Disable
3	GPIO1	IN	Disable
4	GPIO0	IN	Disable

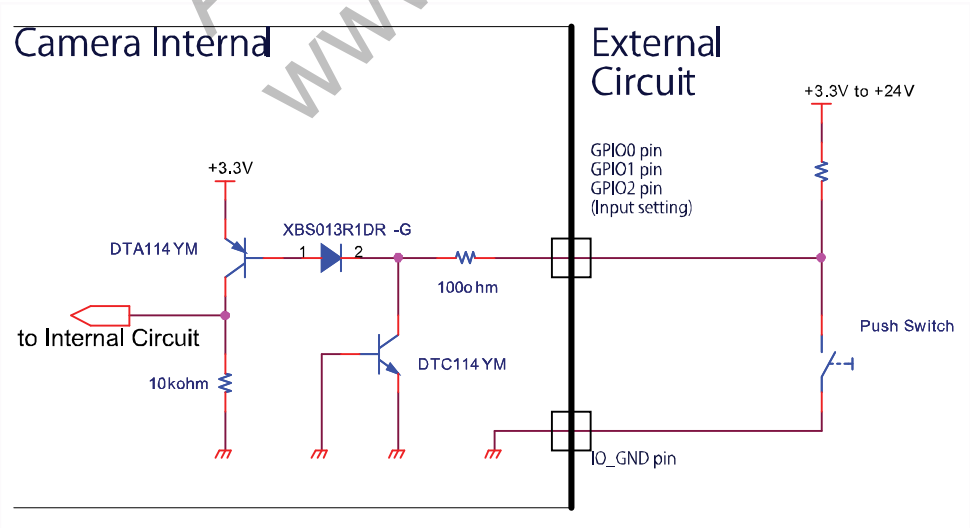
4.5.3 Reference Input Circuit

CAM_RESET (Reference 1)



The camera resets while “CAM_REST pin” connecting to GND 5 seconds in this circuit.
The default camera setting is disable for this reset function. It is necessary to turn ON.

General Purpose Input (Reference 2)



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Input Response Characteristics

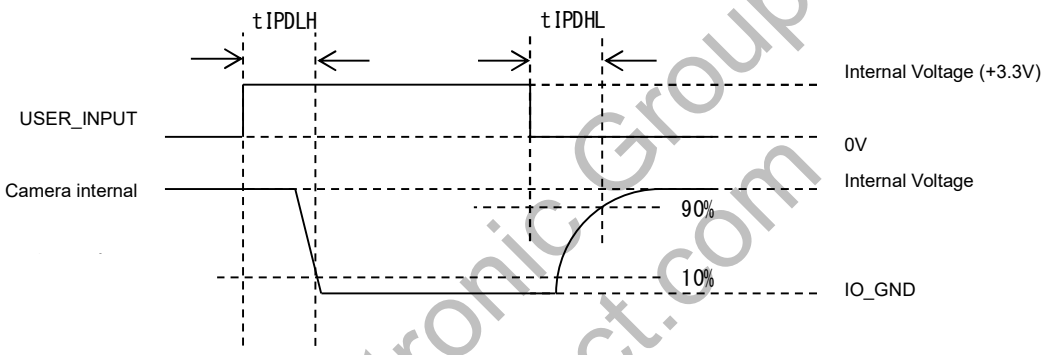
The response characteristics of CAM_RESET (Reference1), General Purpose Input (Reference 2) are shown in the following diagrams

tIPDHL	0.13 μseconds
tIPDLH	6.54 μseconds

The capable input trigger's pulse width is

Positive Trigger: More than tIPDLH

Negative Trigger: More than tIPDHL



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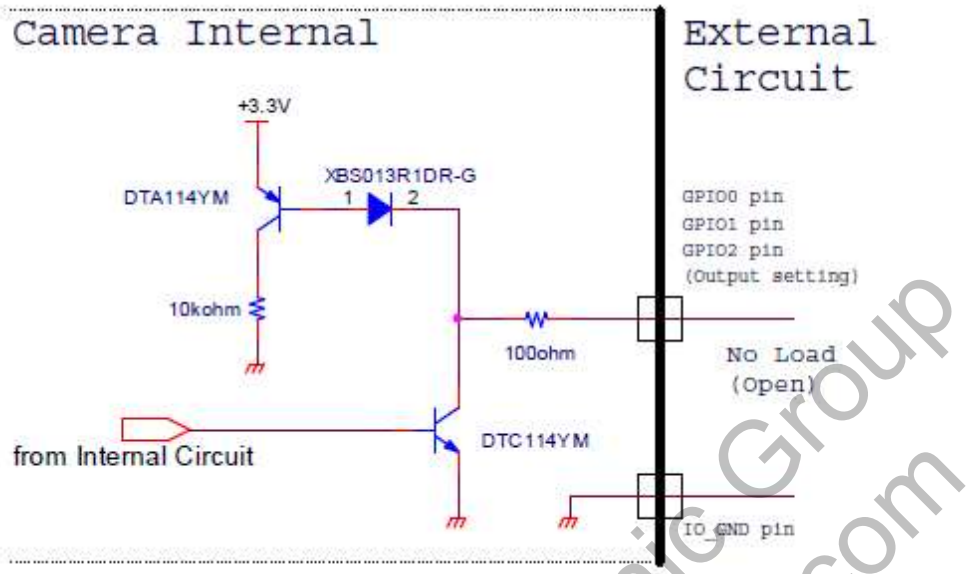
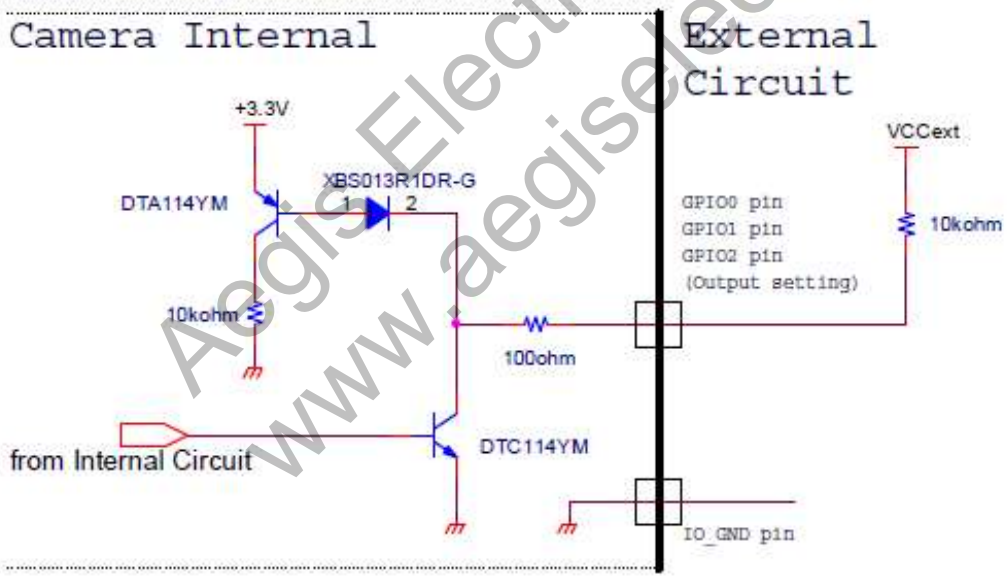
4.5.4 Reference Output Circuit

General Purpose Output (Reference 3)



O **General Purpose Output (Reference 4)**



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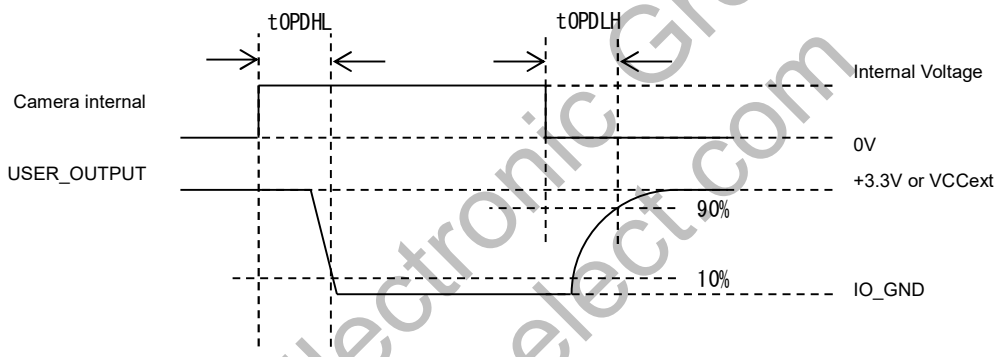
Output Response Characteristics

The response characteristics of the General Purpose output (Reference 3), and General Purpose output (Reference 4) are shown in the diagram below. Pulse width is configurable through software.
Please refer to the following response timing table.

	VCCext			
	OPEN (*1)	5 V (*2)	12 V (*2)	24 V (*2)
tOPDHL	0.21 µseconds	0.25 µseconds	0.37 µseconds	0.51 µseconds
tOPDLH	10.40 µseconds	2.69 µseconds	2.68 µseconds	2.61 µseconds

(*1) Measured on +3.3 V internal Voltage at “Reference 4”.
(*2) Measured at “Reference 3”.



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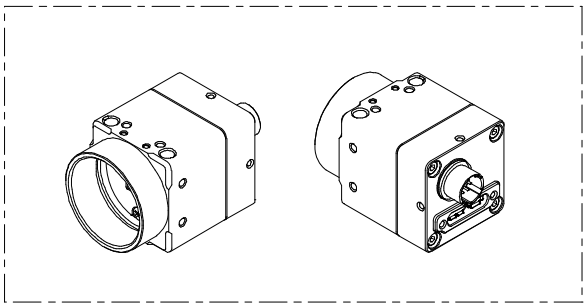
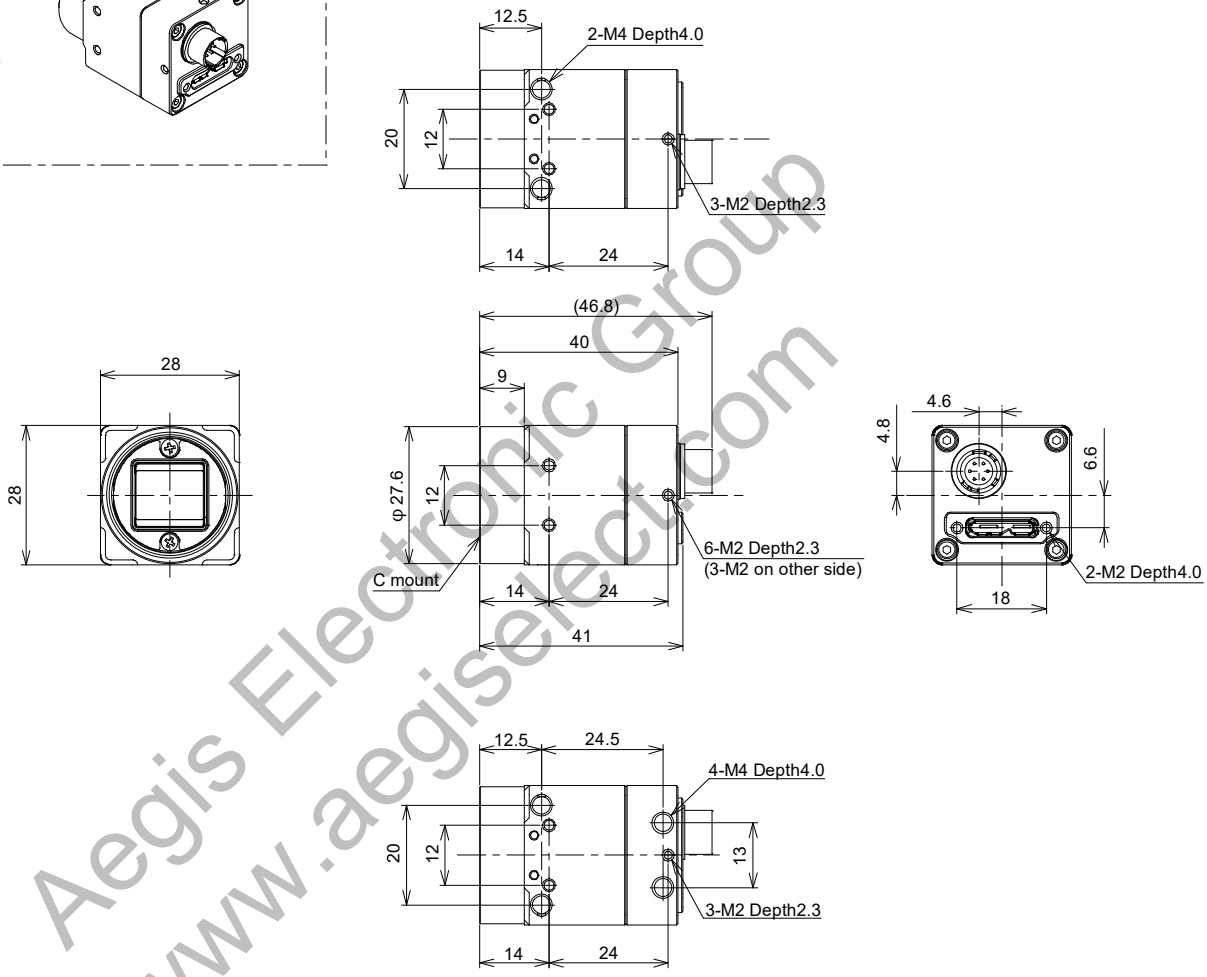
5 Dimensions





Unit: mm

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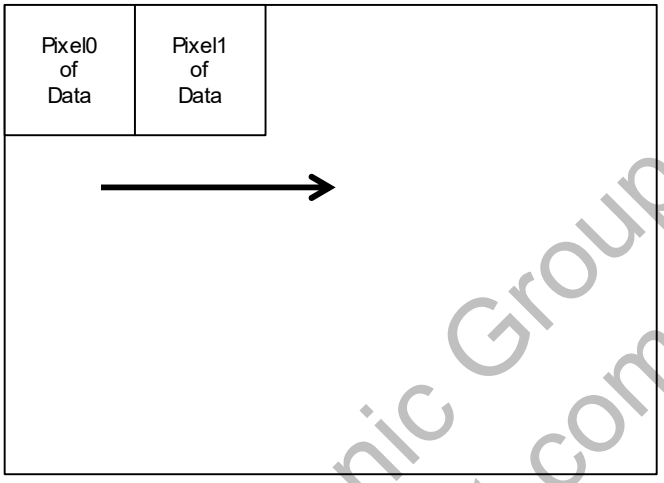
6 Sensor Information

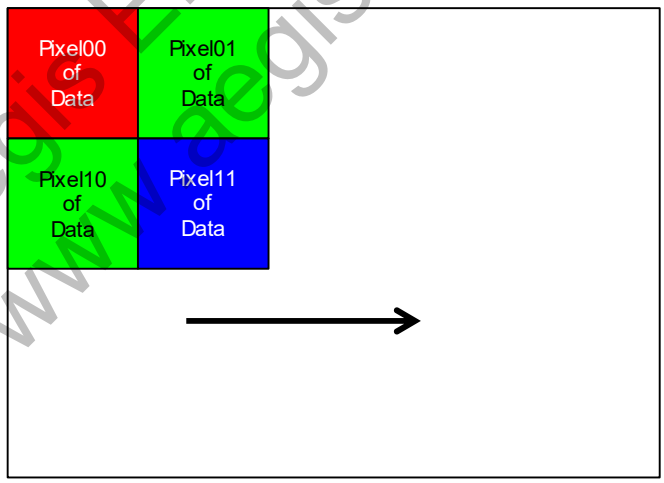
6.1 Pixel Transferring Image

STC-MBS43U3V / STC-MBS163U3V (Monochrome)



Pixel (n) of Data: nth pixel being transferred

STC-MCS43U3V / STC-MCS163U3V (Color)



Pixel (m, n) of Data: nth pixel of the mth line being transferred

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7 Image Acquisition and Camera Operational Modes (GenICam)

Please refer to another chapter for the method of switching Trigger.

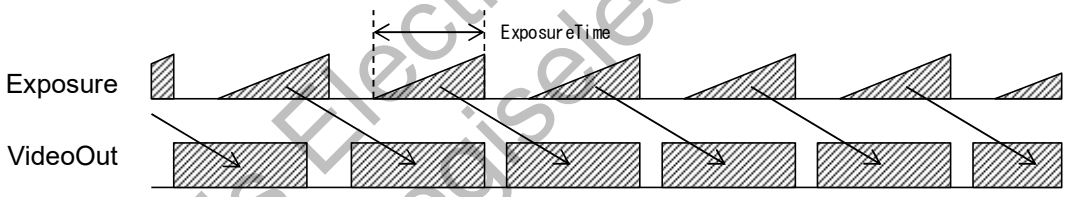
GenICam Parameters

TriggerSelector	IEnumeration Type	Select Trigger function
TriggerMode	IEnumeration Type	Select ON / OFF which was selected function on TriggerSelector On: Trigger function ON, Off: Trigger function Off
TriggerSource	IEnumeration Type	Set Trigger Source which was selected function on TriggerSelector Software: Trigger control through TriggerSoftware command LineN: Trigger control through hardware trigger (N: Line number)
ExposureMode	IEnumeration Type	Select Exposure mode

Please refer to IO function for the (*) Line.

7.1 Free run

Free run mode outputs the camera video image continuously.
In order to run Free run Mode, all trigger functions must be set to OFF via the Trigger mode.
Exposure time determines Exposure Mode. When Exposure Mode is turned off, the frame exposure will complete.
When Exposure Mode is set to Timed, the Exposure Time value will be set as the exposure time.



(*) The camera is set to Free run mode as the default mode.

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7.2 Trigger Mode

This trigger consists of Frame Start, Exposure Start and Exposure End.

1) Frame Start

This function has the capability to acquire an image from exposure through the trigger.
The Frame Start function can be enabled when “Frame Start” is selected on Trigger Selector and the Trigger mode is set to “On”.

This function supports “Edge Preset” trigger and “Pulse Width” trigger with trigger signal. This function can control exposure through Exposure Mode.

2) Exposure Start, Exposure End

This function has the capability to acquire an image from Exposure Start to Exposure End. Exposure Start trigger is pair of Exposure End.
Exposure Start and Exposure End are selectable on Trigger Selector. Exposure Start function and Exposure End function can be enable through each Trigger Mode On.
This function is only enabled when Exposure Mode sets Trigger Controlled. If Exposure Mode did not set Triger Controlled, camera exposure and image acquisition do not work.

(*) Please do not apply the Trigger through maximum frame rate on Trigger Mode. When Trigger applies within sensor Readout as exposure end, camera interrupted Readout.

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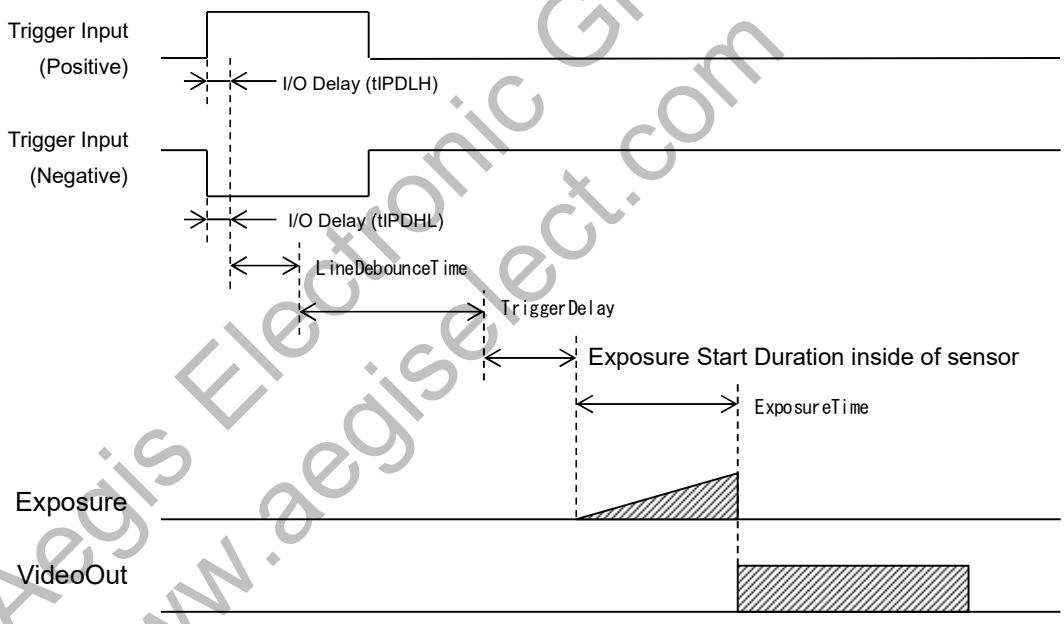
7.2.1 Frame Start Trigger (Edge Preset)

The exposure synchronizes trigger signal.
The value on Exposure Time is actual exposure time.
When the polarity on Line Inverter is positive (false), the Exposure starts on the rising edge of trigger.
When the polarity on Line Inverter is negative (true), the Exposure starts on the falling edge of trigger.

To work the camera under this mode, as following setting have to be set.
- Exposure Mode: Timed
- Trigger Selector: Frame Start
- Trigger Mode: On

(*) On Trigger Mode except Frame Start should be set Off.

Timing



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Delay time on exposure start timing in the sensor **Jitter** (unit: μseconds)

Video Output Format	**STC-MBS43U3V** **STC-MCS43U3V**	**STC-MBS163U3V** **STC-MCS163U3V**
8bits	0 to 13.4	0 to 11.4
10bits		
10bits Packed		
12bits		
12bits Packed		

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7.2.2 Frame Start Trigger (Pulse Width Trigger)

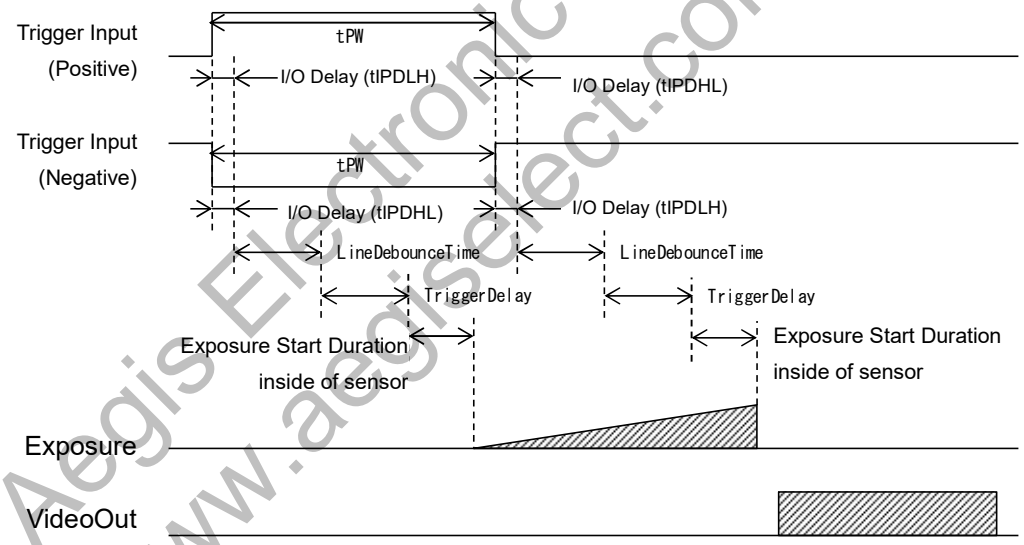
When operating in this mode, the exposure synchronizes the trigger signal.
The exposure time can be controlled by the pulse width of Frame Start trigger.
When the polarity on the Line Inverter is positive (false), the exposure can be controlled at a period of High level of input trigger signal.
When the polarity on the Line Inverter is negative (true), the exposure can be controlled at a period of Low level of input trigger signal.

To operate the camera in this mode, the following settings have to be set.

- Exposure Mode: Trigger Width
- Trigger Selector: Frame Start
- Trigger Mode: On

(*) On Trigger Mode except Frame Start should be set Off.

Timing



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Delay time on exposure start timing in the sensor **Jitter** (unit: μseconds)

Video Output Format	**STC-MBS43U3V STC-MCS43U3V**	**STC-MBS163U3V STC-MCS163U3V**
8bits	0 to 13.4	0 to 11.4
10bits		
10bits Packed		
12bits		
12bits Packed		

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7.2.3 Exposure Start Trigger, Exposure End Trigger

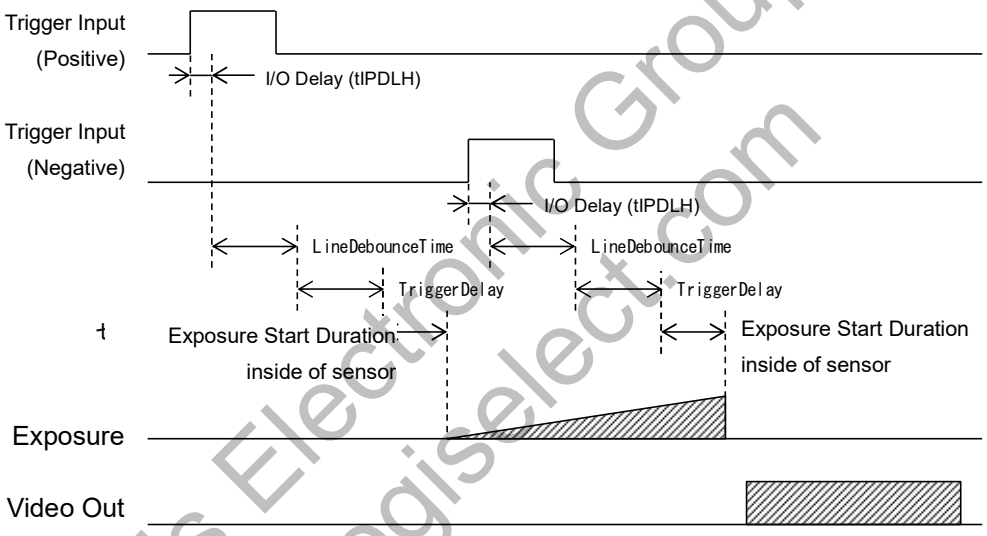
Exposure Start trigger determines exposure start timing, Exposure End trigger determines exposure end timing.

To operate the camera under this mode, the following settings have to be set.

- Exposure Mode: Trigger Controlled
- Selects Trigger Selector: Exposure Start, and Trigger Mode: On
- Selects Trigger Selector: Exposure End, and Trigger Mode: On

(*) On Trigger Mode except Frame Start should be set Off.

Timing



(*)When all of Trigger Mode (Frame Start trigger, Exposure Start trigger, Exposure End) are On, camera's behavior depends on Exposure Mode setting.
When the Exposure Mode sets the Trigger Control, this function works through Trigger Start/End Trigger
This function works through Frame Start trigger for the remainder of the Exposure Mode.

Delay time on exposure start timing in the sensor **Jitter** (unit: μseconds)

Video Output Format	**STC-MBS43U3V** **STC-MCS43U3V**	**STC-MBS163U3V** **STC-MCS163U3V**
8bits	0 to 13.4	0 to 11.4
10bits		
10bits Packed		
12bits		
12bits Packed		

7.2.4 Trigger Software

This function can apply either external signal or a software command as the trigger.
The software trigger can be applied through the "execute Trigger Software" command when the trigger is selected on the Trigger Selector.

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8 IO Function

This chapter describes the IO functions.
In this chapter, the IO Port places as “Line”. The follow chart details the relationship of the Line and IO Port.

IO Port Pin No.	Signal Name	Line number
2	GPIO2	Line2
3	GPIO1	Line1
4	GPIO0	Line0

GenICam Parameters

LineSelector	IEnumeration Type	Select Line
LineMode	IEnumeration Type	Switch input / output direction for the Line that was selected at LineSelector. Input: set as input, Output: set as output
LineInverter	IBoolean Type	Switch polarity inversion ON / OFF for the Line that was selected at LineSelector. False: polarity inversion Off (Active-High), True: polarity inversion On (Active-Low)
LineStatus	IBoolean Type	Line status (High / Low)
LineSource	IEnumeration Type	Set function for the Line that was selected at LineSelector
UserOutputSelector	IEnumeration Type	Select UserOutput
UserOutputValue	IBoolean Type	Switch voltage level of UserOutput that was selected at UserOutputSelector False: Low voltage level, True: High voltage level

8.1 Input Port Function

This function sets the input on Line Mode, then assigns Line as the input.
The following functions can be assigned as input.

8.1.1 Trigger Input

When select “input” assign port at the Trigger Source, the input signal can be assigned as Trigger.

The input signal can be switched to Active-Low (Line Inverter: true) or Active-High (Line Inverter: false).

(*) When the Line polarity changing by Line Inverter, the active polarity of input trigger signal is changed.

8.1.2 Line Status

This function monitors the signal status on the input Line.
The High level (Line Status: true) or Low level (Line Status false) status can be seen through the software.

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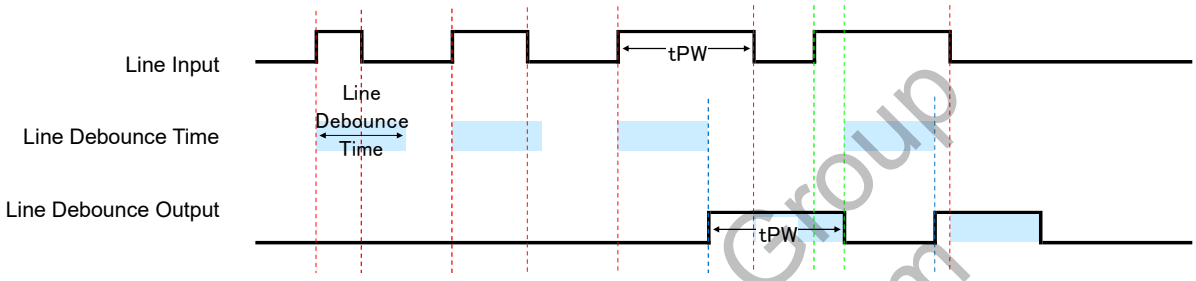
8.1.3 Line Debouncer

Line Debouncer can reduce the wrong input signal detection that is noise on the signal or chartering, by the filtering input signal.

GenICamParameters

LineDebounceTime	Integer Type	Line Debounce Time Range: 0 to 10,000 µseconds, Default: 1 µseconds

Timing



8.1.4 Trigger Delay

As mentioned in the previous chapter, “Image acquisition and Camera Mode”, each trigger can add to the duration of the input signal

This Trigger Delay can add to the duration per µsecond.

GenICam Parameters

TriggerDelay	Integer Type	Trigger Delay Range: 0 to 262,143 µseconds, Default: 0 µsecond

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8.2 Output Port Function

This function sets the Output to Line Mode, and then the Line is assigned as the output.
The following functions can be assigned when the IO port is used as the output signal port.

8.2.1 Line Source

The following list shows the configurable functions available through the Line Source.
The function that describes as “Enable” on “Changeable Polarity” is the configurable polarity on the Line Inverter (true, false).

No.	Function Name	Changeable Polarity
1)	Off (Default)	-
2)	User Output	-
3)	Trigger Out	Enable
4)	Exposure End Out	Enable
5)	Frame End Out	Enable
6)	Transfer End Out	Enable
7)	Strobe Out	Enable
8)	Exposure Active	Enable

1) Off (Disable)
Disable the output signal.

2) User Output (General Output)
High or Low level signal that sets on the software is output.

3) Trigger Out (Trigger Output)
The trigger signal that added “Trigger Out Delay (Output pulse delay time)” and “Trigger Out On Time (Output pulse width)” is output.

4) Exposure End Out (Exposure End)
“Trigger Out on Time (Output pulse width)” activation time signal with set “Trigger Out Delay (Output pulse delay time)” is output when the expose was finished.

5) Frame End Out (Sensor Readout End)
“Trigger Out on Time (Output pulse width)” activation time signal with set “Trigger Out Delay (Output pulse delay time)” is output when the sensor read out was finished.

6) Transfer End Out (Transfer End Output)
“Trigger Out on Time (Output pulse width)” activation time signal with set “Trigger Out Delay (Output pulse delay time)” is output when one frame image transferring from camera was finished.

7) Strobe Out (Strobe Output)
“Strobe Out on Time (Output pulse width)” activation time signal with set “Strobe Out Delay (Strobe output delay time)” is output when the trigger signal is received.

8) Exposure Active (In Exposure Period)
The signal that activation time is exposure time is output.
(*) Actual exposure period = Output signal pulse width + Minimum exposure time 13.73 μseconds

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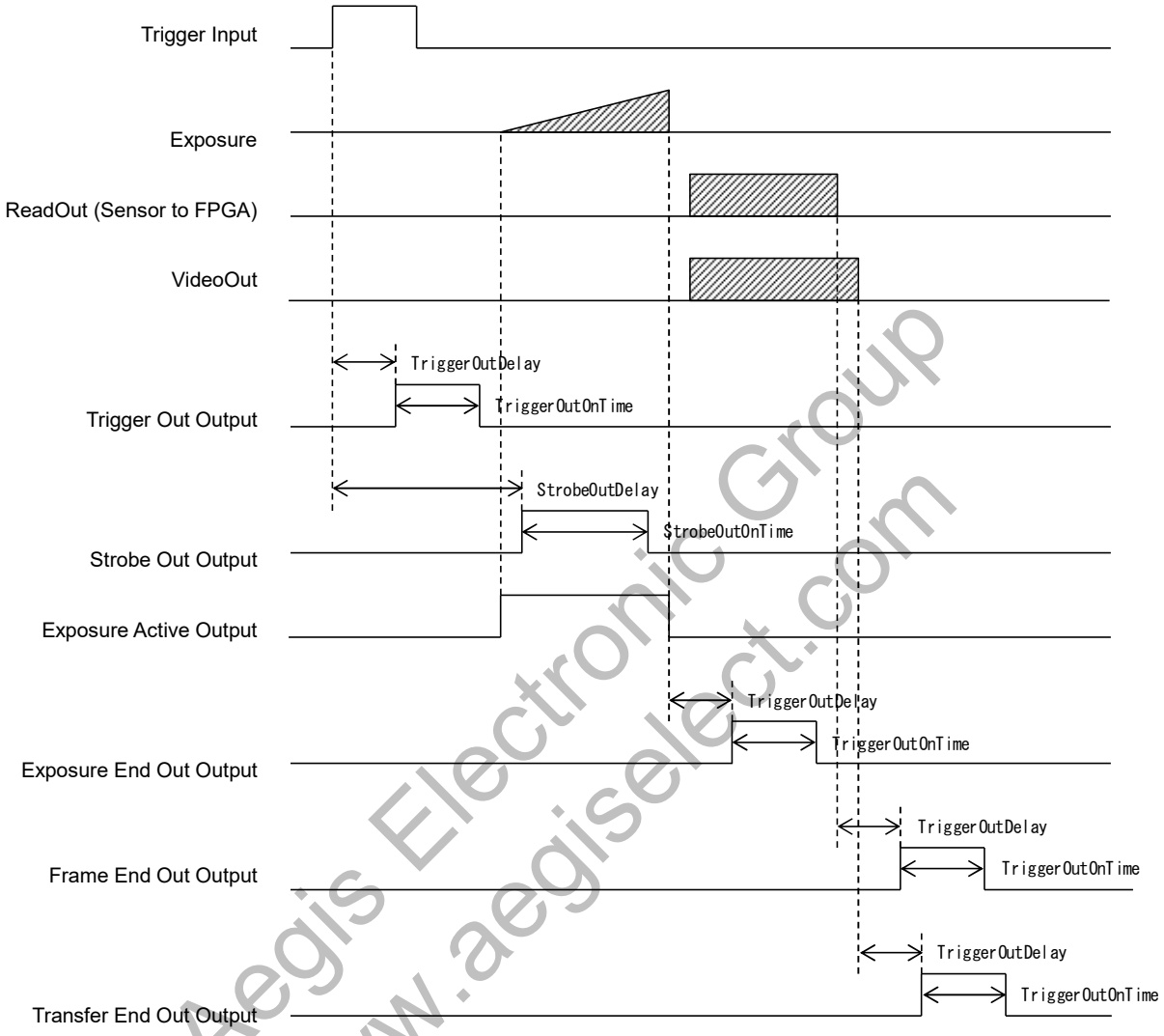
OMRON

Line Source Timing



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(*) This timing chart does not include the delay of the IO circuit
(*) The trigger port in this chart describes Frame Start trigger as an example
(*) Trigger Out and Strobe Out do not output from the camera for Exposure Start trigger and Exposure End trigger

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8.2.2 User Output

High or low level signal that was configured on the software is output.

Setting Procedure

Selects Line N (N: any number from 0, 1 or 2)

1) Sets the User Output N (N is Line number) as Line Source
2) Selects User Output N (N is same as selected Line number on User Output) on User Output Selector
3) Sets the value (True: High level, False: Low level) on User Output Value

8.2.3 Line Status

Monitor the status on output port.

Monitor the output voltage level High (Line Status: true) or Low (Line Status: false) through the software.

8.2.4 Output signal duration setting and Pulse width setting

Some selectable functions can be modified in order to add to the duration or pulse width on Line Source.

The configurable parameters are shown in the chart below.

Please refer to Line Source for the applicable functions of Parameters.

GenICamParameters

TriggerOutDelay	Integer Type	Trigger Out Delay Time Range: 0 to 262,143 µseconds, Default: 0 µsecond
TriggerOutOnTime	Integer Type	Trigger Out On Time Range: 4 to 262,143 µseconds, Default: 32 µseconds
StrobeOutDelay	Integer Type	Strobe Out Delay Time Range: 0 to 262,143 µseconds, Default: 30 µseconds
StrobeOutOnTime	Integer Type	Strobe Out On Time Range: 4 to 262,143 µseconds, Default: 32 µseconds

8.3 Hardware Reset

The hardware reset can be done by CAM_RESET port.

Sets On (Default: Off) at Line Device Reset Mode, and apply the Low voltage in 5 seconds on CAM_RESET port then camera rest.

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9 Camera Functions

This chapter describes the camera functions.

9.1 ROI (Region of Interest)

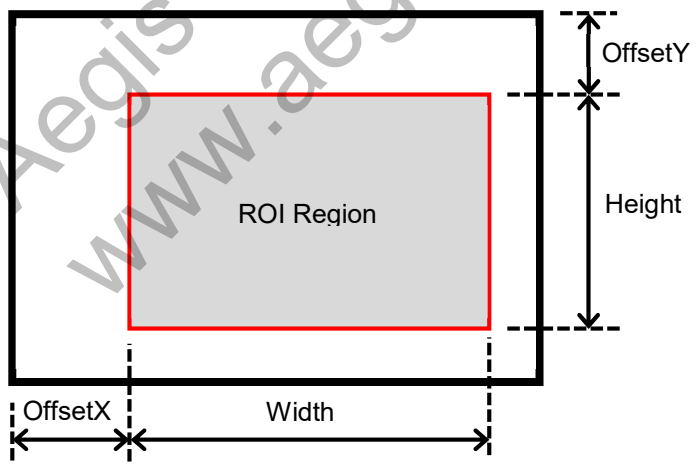
This sets the ROI in order to output the selected area of image.
The frame rate increases when reducing the height of image. The frame rate does not change when reducing the width of image.

9.1.1 ROI (One Region)

GenICam Parameters

Width	Integer Type	Horizontal (Pixel) size Sets the width of image. “Width + OffsetX” should not exceed the maximum width.
Height	Integer Type	Vertical (Line) size Sets the height of image. “Height + OffsetY” should not exceed the maximum height.
OffsetX	Integer Type	Horizontal (Pixel) offset Default: 0 Setting steps: 4 pixels
OffsetY	Integer Type	Vertical (Line) offset Default: 0 Setting steps: 4 lines

The parameters define as following chart.



(*) Width, Height, OffsetX, OffestY setting steps is the same in Binning and Decimation.

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Width / Height setting range

		STC-MBS43U3V STC-MCS43U3V	STC-MBS163U3V STC-MCS163U3V
Width	Setting range:	64 to 720 pixels (*) 704 pixels is maximum width on Packed output	64 to 1,440 pixels (*) 1,408 pixels is maximum width on Packed output
	Default:	720 pixels	1,440 pixels
	Setting steps	16 pixels unit (*) 64 pixels unit on Packed output	16 pixels unit (*) 64 pixels unit on Packed output
Height	Setting range:	4 to 540 pixels	4 to 1,080 lines
	Default:	540 pixels	1,080 lines
	Setting steps	4 lines	4 lines

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9.1.2 Multi ROI (Only available for STC-MBS163U3V / STC-MCS163U3V)

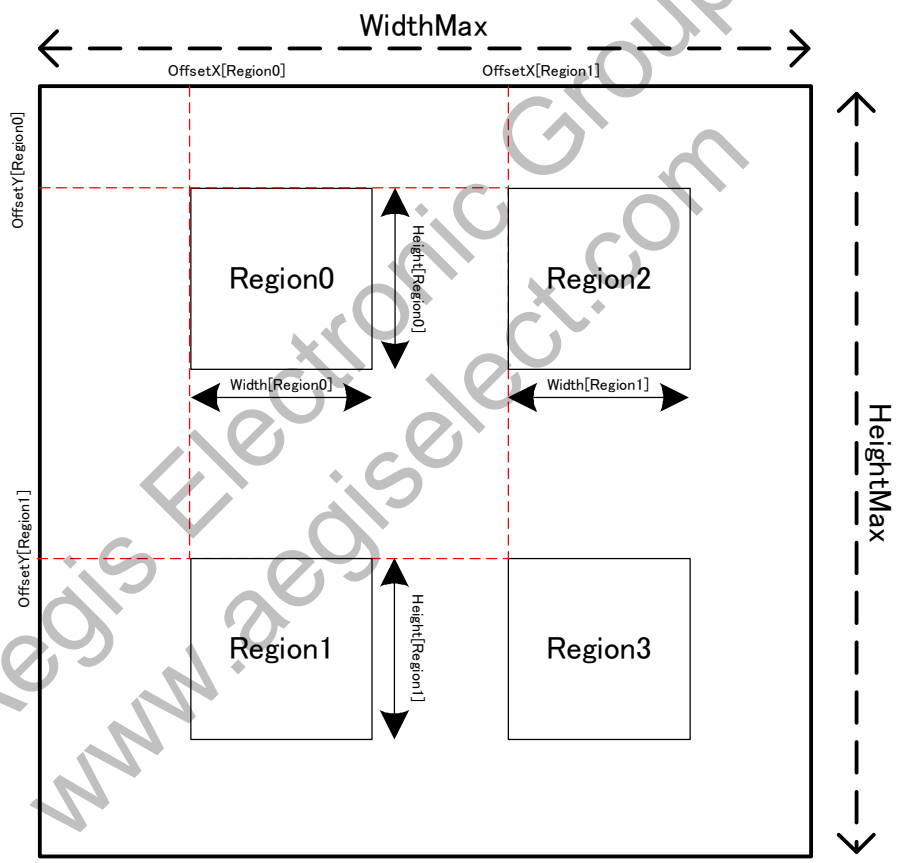
When utilizing the Multi-ROI function, please make note of the following:

This image format is Sentech original format, which does not comply with USB3Vision. Therefore, this Multi ROI will not work on 3rd party applications that conform to USB3Vision.

To use Multi ROI, one of following application is required.

- The application that built on Sentech's SDK (Standard SDK / Trigger SDK)
- The application that built on Sentech's DirectShowFilter
- The application that built on Sentech's GenTL module (*1)

(*1) Sentech's original format data process has to be implemented into application



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Multi ROI can be configuring 4 regions as Region 0 to 3.

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Restriction of ROI operation

Region 0 is always ON

Region(X+Y) can be enable (On) after sets ON Region (X) and Region (Y).

The following restriction exist to set region's Width, Height, OffsetX and OffsetY

Width[Region0] = Width[Region1]

Height[Region0] = Height[Region2]

OffsetX[Region0] = OffsetX[Region1]

OffsetY[Region0] = OffsetY[Region2]

Overlapped region setting is invalid

When setting the Horizontal flip, Vertical flip, Horizontal Vertical flip, position of region 0 to 15 are changed. Please refer to the drawing that follows.

All of selected data outputs as single image data.

If Binning / Decimation is enable, obtained Width and Height values are as "Binning / Decimation" functioned value. When changing Binning / Decimation settings, the image size and region position are changed. Please set correct image size and region position after change Binning / Decimation settings.

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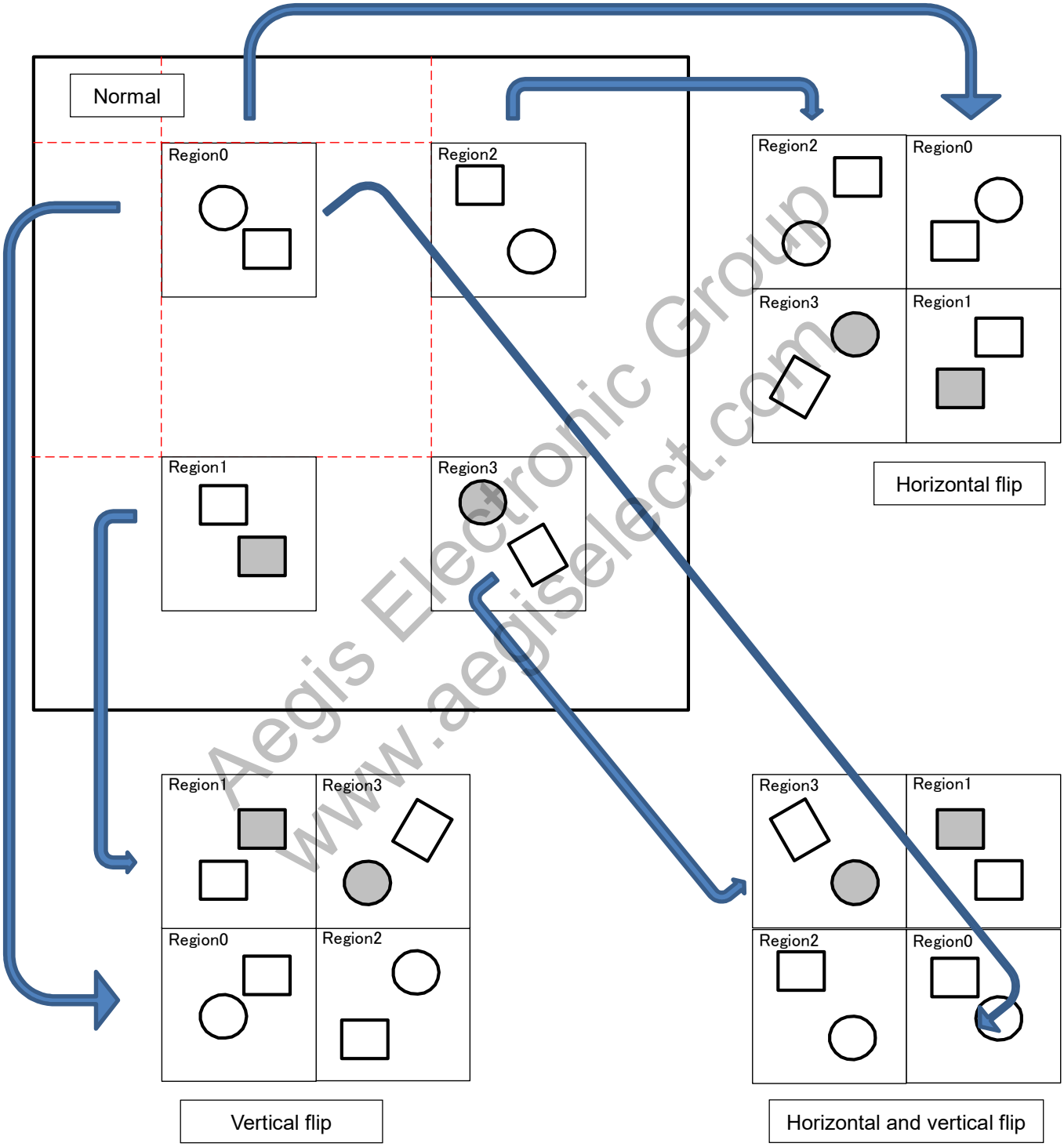
The region position when using image flip function

Region, Width, Height, OffsetX and OffsetY at normal image is applying.



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9.2 Pixel Format

The image format from camera can be set on the Pixel Format.

GenICam Parameters

PixelFormat	IEnumeration Type	Pixel Format

The following chart shows the available Pixel Formats on the camera:

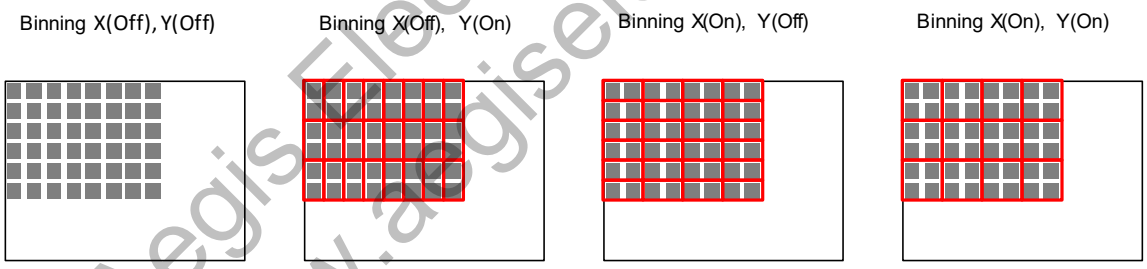
Output Bit	Pixel Format	
	Monochrome Camera	Color Camera
8bits	Mono8	BayerRG8
10bits	Mono10	BayerRG10
10bits Packed	Mono10p	BayerRG10p
12bits	Mono12	BayerRG12
12bits Packed	Mono12p	BayerRG12p

Each format specified on GenICam PFNC (Pixel Format Naming Convention).

9.3 Binning (Only available for STC-MBS163U3V / STC-MCS163U3V)

Binning is add and average beside pixels into one pixel.

The pixel data inside of red square add or average as one pixel.



GenICamParameters

BinningHorizontal	Integer Type	Sets Binning on Horizontal direction 1: Disable Binning 2: Binning 2 Pixel
BinningVertical	Integer Type	Sets Binning on Vertical direction 1: Disable Binning 2: Binning 2 Pixel

(*) Binning and Decimation function cannot be use simultaneously.

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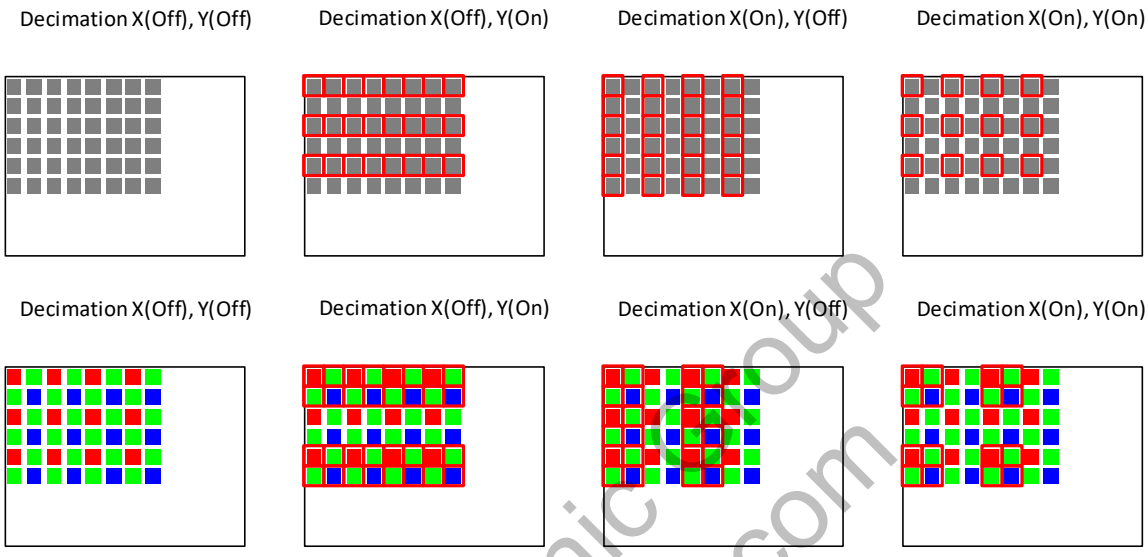
9.4 Decimation (Only available for STC-MBS163U3V / STC-MCS163U3V)

When using Decimation mode, the decimated image can be output.
The images below show decimated pixels (red squares) where they are output.



GenICam Parameters

DecimationHorizontal	Integer Type	Sets decimation on horizontal direction 1: Disable Decimation, 2: Decimate one of two pixels
DecimationVertical	Integer Type	Sets decimation on vertical direction 1: Disable Decimation, 2: Decimate one of two pixels

(*) Binning and Decimation function cannot be use simultaneously.

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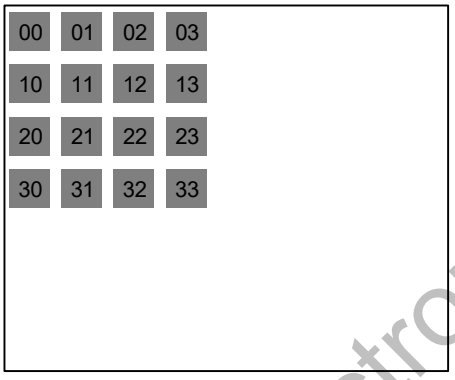
9.5 Image Flip

Flip the image through ReverseX and ReverseY.

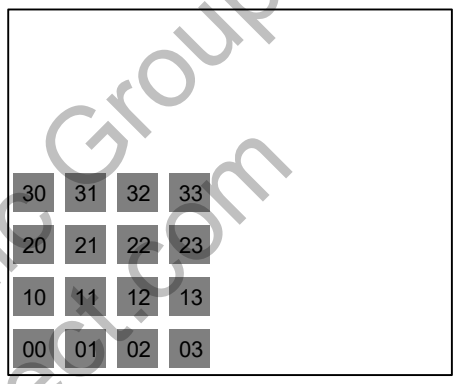
GenICam Parameters

ReverseX	IBoolean Type	Switch ON / OFF at Horizontal False: Horizontal Flip Off, True: Horizontal Flip On. Default: False
ReverseY	IBoolean Type	Switch ON / OFF at Vertical False: Vertical Flip Off, True: Vertical Flip On. Default: False

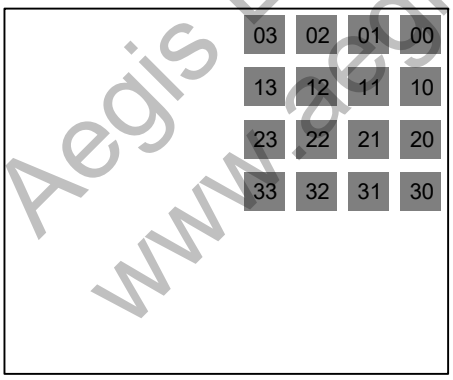
Reverse X(Off), Y(Off)



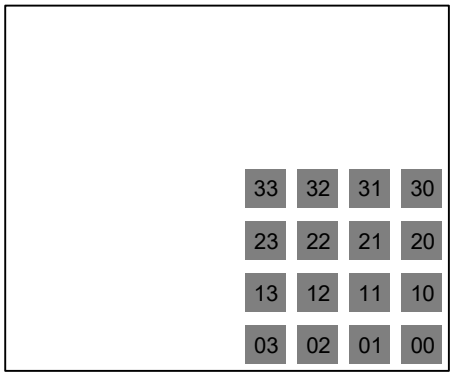
Reverse X(Off), Y(On)



Reverse X(On), Y(Off)



Reverse X(On), Y(On)



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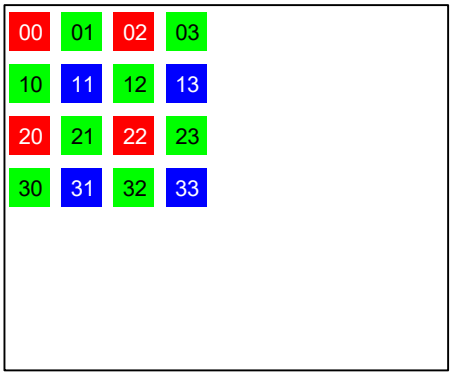
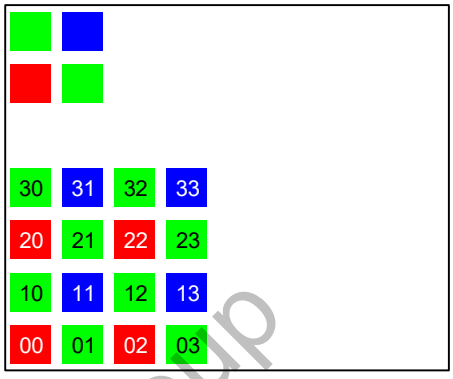
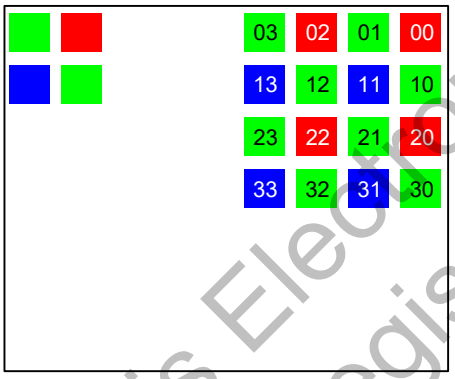
Reverse X(Off), Y(Off)



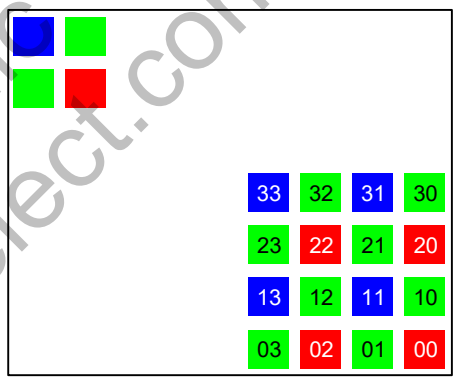
Reverse X(Off), Y(On)



Reverse X(On), Y(Off)



Reverse X(On), Y(On)



(*) When the image is flipping for color camera, the pixel array is also flipped.

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9.6 Priority Mode

The frame rate prioritized mode or the Image quality prioritized mode is selectable for 8bits image output.

GenICam Parameters

PrioiryMode	IEnumeration 型	Switch Priority mode for 8bits output 0: Image quality prioritized, 1: Frame rate prioritized, Default: Image quality prioritized

STC-MBS43U3V / STC-MCS43U3V

Priority Mode	Maximum frame rate (fps)	Noise level
Image quality	439.9	Less than 3 digits (Gain 0 dB)
Frame rate	527.1	Less than 6 digits (Gain 0 dB)

STC-MBS163U3V / STC-MCS163U3V

Priority Mode	Maximum frame rate (fps)	Noise level
Image quality	200.5	Less than 3 digits (Gain 0 dB)
Frame rate	238.0	Less than 6 digits (Gain 0 dB)

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9.7 Gain

The gain has Analog Gain, Digital Gain and White Balance Gain.

(*) When increasing the gain level may increase the noise level.
Please check the image on the actual environment when adjusting brightness of image.

9.7.1 Analog Gain

This parameter sets the analog gain.
Selects “Analog ALL” at “Gain Selector”, sets gain at “Gain[Gain Selector]”.

GenICam Parameters

Gain[Analog All]	IFloat Type	Analog Gain Range: 0 to 192, Default: 0

Analog Gain Formula
Gain (dB) = Gain[Analog All] / 10

9.7.2 Digital Gain

This parameter sets the digital gain.
Selects “Digital ALL” at “Gain Selector”, sets gain at “Gain[Gain Selector]”.

GenICam Parameters

Gain[Digital All]	IFloat Type	Digital Gain Range: 0 to 64, Default: 0

Digital Gain Formula
Gain (x times) = 1 + (Gain[Digital All] / 64)

9.7.3 White Balance Gain (Only available for the color model)

This parameter sets the Bayer patter color gain.
Sets gain at “Balance Ratio” for selected color at “Balance Ratio Selector”.

GenICam Parameters

BalanceRatio[BalanceRatioSelector]	IFloat Type	White Balance Gain Range: 0 to 511, Default: Red: 158, Green: 128, Blue: 304

White Balance Gain Formula
Gain (x times) = BalanceRatio[BalanceRatioSelector] / 128

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9.8 Black Level

This parameter sets the black level (the clamp level for the black signal).
Sets the black level at “BlackLevel[Black Level Selector]”.
The lower limit of the signal is clamped at this setting level. The signal does not lower than this.

(*) “Analog All” is only selectable at “Black Level Selector”.

GenICam Parameters

BlackLevel[Black Level Selector]	IFloat Type	Black Level, Default: 7 (on 8bits output) Range: 8bits output: 0 to 31 10bits output: 0 to 127 (10bits Packed outputs same as this mode) 12bits output: 0 to 511 (12bits Packed outputs same as this mode)

9.9 ALC (Auto Light Control)

ALC has AGC (Auto Gain Control) and auto exposure function. It can be set individually.
The camera parameters adjust automatically based on current brightness of image, to achieve the target brightness with ALC function.

GenICam Parameters (for AGC and Auto Exposure)

AutoLightTarget	Integer Type	Target Brightness Range: 0 to 255, Default: 127

Target Brightness Formula (Auto Light Target)

8bits output: Target Brightness (Gradient) ＝ Auto Light Target
10bits output: Target Brightness (Gradient) ＝ Auto Light Target × 4
12bits output: Target Brightness (Gradient) ＝ Auto Light Target × 16

9.9.1 ALC Control Method

The brightness of image adjusts to achieve “Auto Light Target” brightness with AGC and auto exposure function. When AGC and auto exposure are enabled, at first, the brightness adjusts with auto exposure function. If the brightness does not achieve “Auto Light Target” brightness with auto exposure function, the brightness adjusts with the AGC function.

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9.9.2 AGC (Auto Gain Control)

The gain adjusts automatically to achieve the target brightness.
When the current brightness of image was darker than target brightness, increases the gain up to “Gain Auto Limit Max”.
When the current brightness of image was brighter than target brightness, decrease the gain down to “Gain Auto Limit Min”.

GenICam Parameters

GainAuto	IEnumeration Type	Switch ON / OFF for AGC Continuous: AGC On, Off: AGC Off. Default: Off
GainAutoLimitMax	IFloat Type	Sets the maximum gain for AGC Range: 0 to 192, Default: 127 This value sets as maximum gain for AGC.
GainAutoLimitMin	IFloat Type	Sets the minimum gain for AGC Range: 0 to 192, Default: 0 This value sets as minimum gain for AGC.

9.9.3 Auto Exposure

The exposure time adjusts automatically to achieve the target brightness.
When the current brightness of image was darker than target brightness, extend exposure time up to “Exposure Auto Limit Max”.
When the current brightness of image was darker than target brightness, reduce exposure time down to “Exposure Auto Limit Min”.

GenICamParameters

ExposureAuto	IEnumeration Type	Switch ON / OFF for Auto Exposure Continuous: Auto Exposure On, Off: Auto Exposure Off. Default: Off
ExposureAutoLimitMax	IFloat Type	Sets the maximum exposure time in μsecond unit Range: Same as Exposure Time Range for each PixelFormat
ExposureAutoLimitMin	IFloat Type	Sets the minimum exposure time in μsecond unit Range: Same as Exposure Time Range for each PixelFormat

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9.9.4 The setting procedure of ALC

Please follow setting procedure shown below.

Setting Procedure

1. Sets “Timed” at “Exposure Mode” (When using Auto Exposure)
2. Sets “Continuous” at “Exposure Auto” (When using Auto Exposure)
3. Sets “Exposure Auto Limit Max” (When using Auto Exposure)
4. Sets “Exposure Auto Limit Min” (When using Auto Exposure)
5. Sets “Continuous” at “Gain Auto” (When using AGC)
6. Sets “Gain Auto Limit Max” (When using AGC)
7. Sets “Gain Auto Limit Min” (When using AGC)

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9.10 White Balance (Only available for the color model)

The color compensates by the gain adjustment for each individual color.
The gain for each color has to adjust to same brightness with the flat white target.
The white balance control methods are the listed in the below:

- Disable
- Manual (Off)
- Auto White Balance (Continuous)
- Push to set white balance (Once)

9.10.1 White balance control methods

GenICam Parameters

BalanceWhiteAuto	IEnumeration Type	White balance control method selection. Default: Off (Manual)
BalanceRatioSelector	IEnumeration Type	White balance control target color selection.
BalanceRatio	IFloat Type	Color gain setting for selected color selects at “BalanceRatioSelector”.

9.10.2 Disable

Disabled white balance gain and each color gain set as x1.

Setting Procedure

1. Sets “Disable” at “Balance White Auto”

9.10.3 Manual (Off)

The optimized Balance Ratio (Red, Green or Blue) for the white balance.

Setting Procedure

1. Sets “Red” (when Red gain set) at “Balance White Selector”
2. Sets value at “Balance Ratio”
3. Sets “Green” at “Balance White Selector”
4. Sets value at “Balance Ratio”
5. Sets “Blue” (when Blue gain set) at “Balance White Selector”
6. Sets value at “Balance Ratio”
7. Sets “Off” at “Balance White Auto”

9.10.4 Auto White Balance (Continuous)

Optimizes white balance gain each frame automatically.

Setting Procedure

1. Sets “Continuous” at “Balance White Auto”

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9.10.5 Push to Set White Balance (Once)

The white balance gain adjusts once after selecting this white balance method. Then each gain set to “Balance White (Red, Green and Blue)”.
Sets “Off” at “Balance White Auto” automatically after set “White Balance Gain”.

Setting Procedure

1. Sets the flat white target (To process white balance correctly)
2. Sets Once on Balance White Auto

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9.11 Gamma Table

The linearity of gradient of image can be correct by the gamma table on the camera.

GenICam Parameters

Gamma	IFloat Type	Gamma Range: 0.1 to 4.0, Default: 1.0

Gamma Formula

For 12bits image

$$\text{Output data} = 4{,}095 \times \left(\frac{\text{Input data}}{4{,}095}\right)^{\gamma}$$

For 10bits image

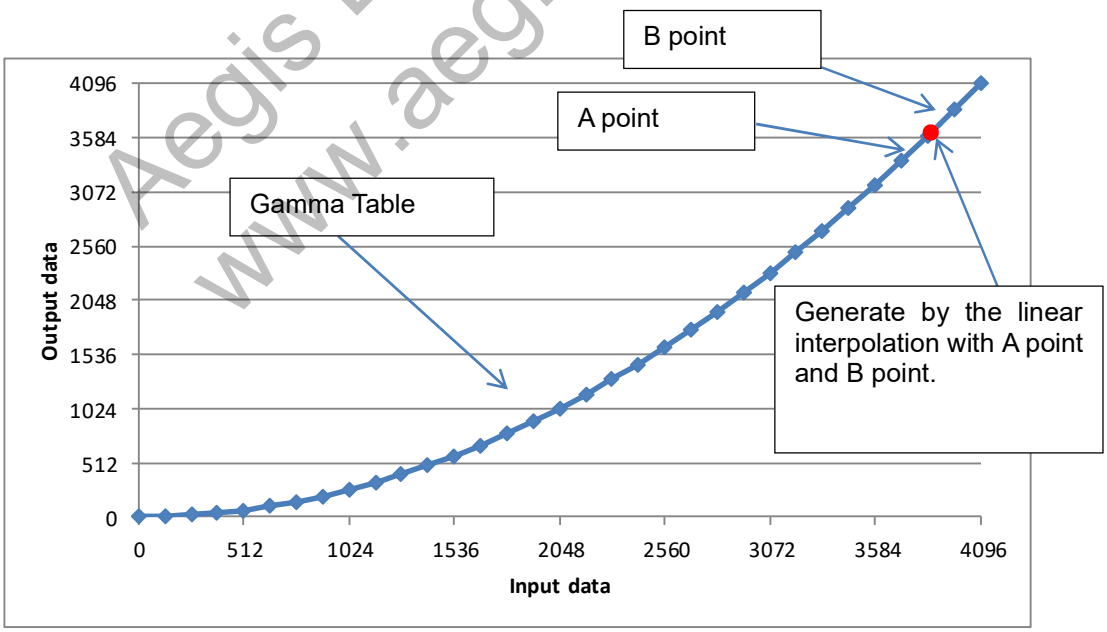
$$\text{Output data} = 1{,}023 \times \left(\frac{\text{Input data}}{1{,}023}\right)^{\gamma}$$

For 8bits image

$$\text{Output data} = 255 \times \left(\frac{\text{Input data}}{255}\right)^{\gamma}$$

The input signal divides into 32 equal part and have 33 points of gamma table.
The between the points is generates by the linear interpolation.

For 12bits image (Gamma = 2.0)



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9.12 Save and load the camera settings

The camera has the camera setting save function, the camera setting including factory default loads function.
The camera has below two camera settings.

Default: The factory default settings (This setting cannot change)
User Set X: Over writeable camera settings (X: 0 to 7)

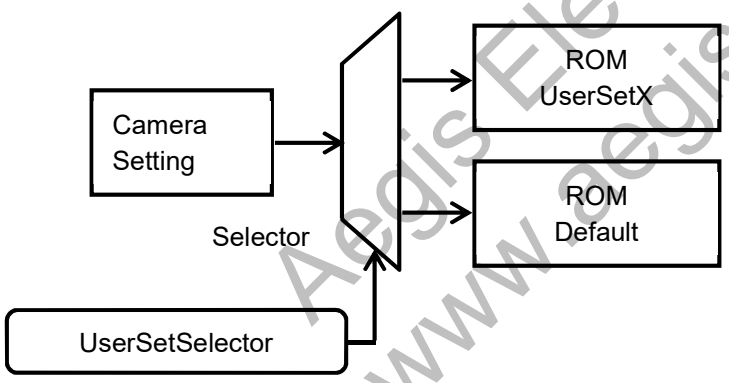
These camera settings load from ROM to the register in the RAM on the camera and camera settings save to ROM.
The camera settings saving and loading is controllable with Parameters (User Set Selector, User Set Default), and commands (UserSetLoad, UserSetSave) in UserSetControl category of GenICam.

The details of the parameters and the functions are in the table below:

GenICam Parameters

UserSetSelector	IEnumeration Type	Select “Default” or ”UserSet1” UserSetLoad or UserSetSave process for the selected settings.
UserSetLoad	ICommand Type	The camera settings load from ROM to the register in RAM.
UserSetSave	ICommand Type	The camera settings at the register in RAM save to ROM.
UserSetDefault	IEnumeration Type	Select which settings (“Default or UserSet X) load automatically when the camera power is on. This selection saves automatically.

9.12.1 Saving the Camera Settings



When UserSetSave is executing,
the camera settings at the register in RAM are saved to the ROM that is selected at UserSetSelector.
Caution:
UserSetSave cannot execute when “Default” was selected at “UserSet Selector”

Setting Procedure

1. Selects “UserSetX” at “UserSetSelector”
2. Execute “UserSetSave”

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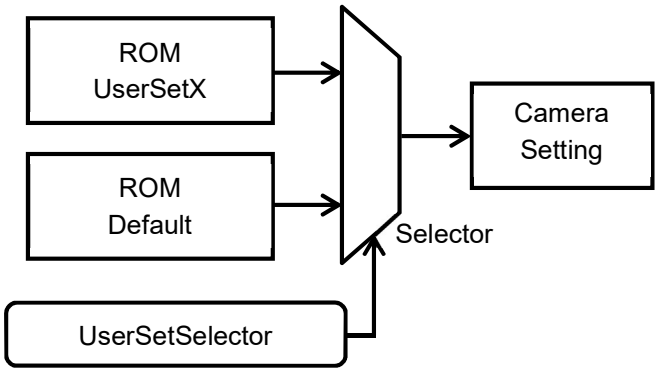
9.12.2 Loading Camera Settings

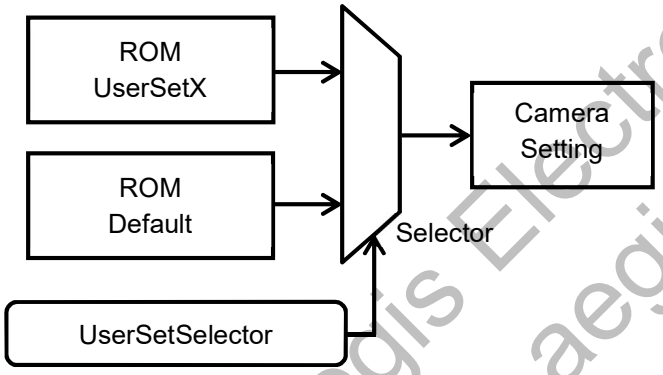


When UserSetLoad is executing,
the camera settings load from the selected ROM that was selected at “UserSetSelector” to the register at RAM.

Setting Procedure

1. Select “UserSetX” (or Default) at “UserSetSelector”
2. Execute “UserSetLoad”

9.12.3 Loading Camera Settings when the Camera Power is on



When the camera power is on,
the camera settings load from the selected ROM that was selected at “UserSetDefault” to the register at RAM.

Setting Procedure

1. Set “UserSetX” or “Default” at “UserSetDefault”

9.12.4 Camera Settings Initialization

Please follow the below procedure for the camera settings put back to the factory default settings.

Setting Procedure

1. Selects “Default” at “UserSetSelector”.
2. Executes “UserSetLoad”.

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9.13 Pixel Defect Correction

The defected pixel corrects with horizontally beside pixel information.
In the color camera, using same color of horizontally beside same pixel.
When consecutive defect pixels are selected, corrects up to 2 pixels.

GenICamParameters

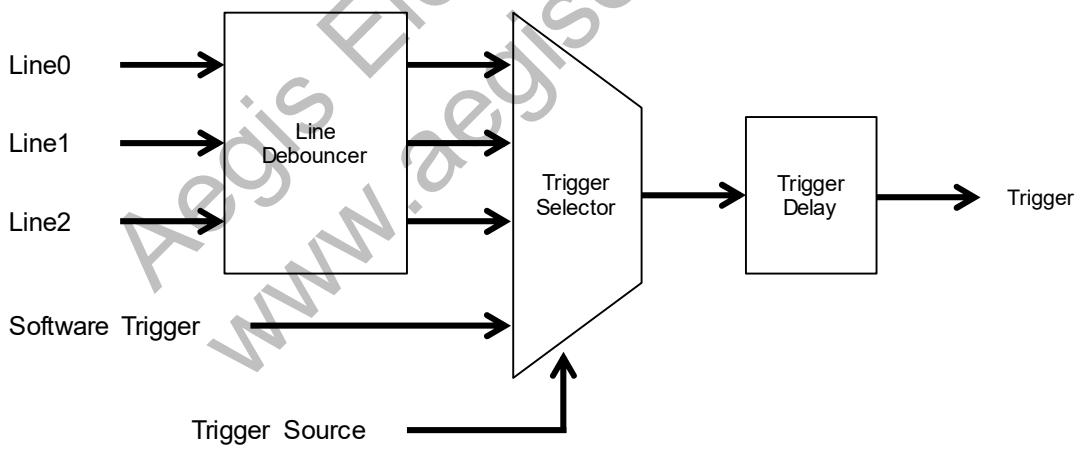
PixelCorrectionAllEnabled	IBoolean Type	Switch ON / OFF for Pixel Defect Correction True: On, False: Off
PixelCorrectionIndex	Integer Type	Pixel Correction Index
PixelCorrectionX	Integer Type	Defect position on X coordinate for Index was selected at "PixelCorrectionIndex"
PixelCorrectionY	Integer Type	Defect position on Y coordinate for Index was selected at "PixelCorrectionIndex"
PixellCorrectionEnabled	IBoolean Type	Switch ON / OFF for pixel defect correction for Index was selected at "PixelCorrectionIndex" True: On, False: Off

9.14 Trigger

The description of trigger type and characteristic, please refer to the chapter "Image acquisition and Camera Mode".

9.14.1 Trigger Signal Process

When the external hardware or software signal is input to the camera, the following process are proceeding.



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9.15 Device User ID

Device User ID provides the user access to the writable memory area.
Up to 64 bytes data can be stored (The data still remains, even the camera power is off)
When the data is less than 64 bytes, please add 0x00 at the end of data.

9.16 Event Control (Only available with USB3 Vision protocol)

The camera can be send notification of event inside of the camera to host controller.

GenICamParameters

EventSelector	IEnumeration Type	Select Event Function
EventNotification	IEnumeration Type	Switch ON / OFF for Event function that was selected at “EventSelector”. On: Event function On, Off: Event function Off

9.16.1 The way to use Event

Please select the available event at “EventSelector” then select “On” at “EventNotification” then the event function is enabled.

9.16.2 Event Function

The event functions on the camera are as follows.

1) Event Exposure Start
   Send notification as event when expose starts in the camera.
   Event ID is 0x9002.

2) Event Exposure End
   Send notification as event when expose finishes in the camera.
   Event ID is 0x9001.

(*) The event occurrence frequently, the stream data transferring rate could be reduced because Event and Stream (image data) share USB bus.

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9.17 Chunk Control (Only available with USB3 Vision protocol)

This function has is attached the additional image information to image data.

For example, the exposure time and gain information do not include in image data itself. However, Chunk data transfers parameters when image was acquiring.

GenICam Parameters

ChunkModeActive	IBoolean Type	Enable transfer Chunk data on Payload True: Enable Chunk data transfer, False: Disable Chunk data transfer,
ChunkSelector	IEnumeration Type	Select the transfer Chunk data
ChunkEnable	IBoolean Type	Enable Chunk data that was selected at “ChunkSelector” True: Enable Chunk data, False: Disable Chunk data

9.17.1 The way to use Chunk

Please enabled “Chunk data Active” then enabled “ChunkEnable” to enable Chunk Control.

Setting Procedure

1. To enable Chunk, set “Ture” at “ChunkModeActive”
2. Select “Chunk data type” at “ChunkSelector”
3. To enable Chunk, set “True” at “ChunkEnable”

9.17.2 Chunk Data

1) Chunk Counter Value
   Transfer the value of Counter0 in the camera as Chunk data.
   Chunk ID is 0x00000001.

   “Frame Start”, “Frame End” or “Frame Trigger” can be set as Counter Event Source. Execute “Counter Reset” to reset counter.

2) Chunk Gain
   Transfer the Gain when image was acquiring, as Chunk data.

   Chunk Gain contains Analog All, Digital All, Red, Blue and Green
   Chunk ID is 0x00000002.

3) Chunk Black Level
   Transfer the Black Level when image was acquiring, as Chunk data.

   Chunk Black Level contains Analog All and Digital All.
   Chunk ID is 0x00000003.

4) Chunk Exposure Time
   Transfer the exposure time when image was acquiring, as Chunk data.
   Chunk ID is 0x00000004.

5) Chunk Gamma
   Transfer the Gamma when image was acquiring, as Chunk data.
   Chunk ID is 0x00000005.

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9.18 GenICam command list

9.18.1 DeviceControl

Name	Description
DeviceType	Returns the device type.
DeviceScanType	Scan type of the sensor of the device.
DeviceVendorName	Name of the manufacturer of the device.
DeviceModelName	Model of the device.
DeviceFamilyName	Identifier of the product family of the device.
DeviceManufacturerInfo	Manufacturer information about the device.
DeviceVersion	Version of the device.
DeviceFirmwareVersion	Version of the firmware in the device.
DeviceSerialNumber	Device's serial number. This string is a unique identifier of the device.
DeviceUserID	User-programmable device identifier.
DeviceSFNCVersionMajor	Major version of the Standard Features Naming Convention that was used to create the device`s GenICam XML.
DeviceSFNCVersionMinor	Minor version of the Standard Features Naming Convention that was used to create the device`s GenICam XML.
DeviceSFNCVersionSubMinor	Sub minor version of Standard Features Naming Convention that was used to create the device`s GenICam XML.
DeviceManifestEntrySelector	Selects the manifest entry to reference.
DeviceManifestXMLMajorVersion	Indicates the major version number of the GenICam XML file of the selected manifest entry.
DeviceManifestXMLMinorVersion	Indicates the minor version number of the GenICam XML file of the selected manifest entry.
DeviceManifestXMLSubMinorVersion	Indicates the sub minor version number of the GenICam XML file of the selected manifest entry.
DeviceManifestSchemaMajorVersion	Indicates the major version number of the schema file of the selected manifest entry.
DeviceManifestSchemaMinorVersion	Indicates the minor version number of the schema file of the selected manifest entry.
DeviceTLType	Transport Layer type of the device.
DeviceTLVersionMajor	Major version of the Transport Layer of the device.
DeviceTLVersionMinor	Minor version of the Transport Layer of the device.
DeviceTLVersionSubMinor	Sub minor version of the Transport Layer of the device.
DeviceGenCPVersionMajor	Major version of the GenCP protocol supported by the device.
DeviceGenCPVersionMinor	Minor version of the GenCP protocol supported by the device.
DeviceMaxThroughput	Maximum bandwidth of the data that can be streamed out of the device. This can be used to estimate if the connection can sustain transfer of free-running images from the camera at its maximum speed.
DeviceLinkSelector	Selects which Link of the device to control.
DeviceLinkThroughputLimitMode	Controls if the DeviceLinkThroughputLimit is active. When disabled, lower level TL specific features are expected to control the throughput. When enabled, DeviceLinkThroughputLimit controls the overall throughput.
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.
DeviceLinkCommandTimeout	Indicates the command timeout of the specified Link. This corresponds to the maximum response time of the device for a command sent on that link.

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Name	Description
DeviceCharacterSet	Character set used by the strings of the device`s bootstrap registers.
DeviceReset	Resets the device to its power up state.
DeviceRegistersStreamingStart	Prepare the device for registers streaming without checking for consistency.
DeviceRegistersStreamingEnd	Announce the end of registers streaming. This will do a register set validation for consistency and activate it.
DeviceTemperatureSelector	Selects the location within the device, where the temperature will be measured.
DeviceTemperature	Device temperature in degrees Celsius (C). It is measured at the location selected by DeviceTemperatureSelector.
TimestampLatch	Latches the current timestamp counter into TimestampLatchValue.
TimestampLatchValue	Returns the latched value of the timestamp counter.

9.18.1 ImageFormatControl

Name	Description
SensorWidth	Effective width of the sensor in pixels.
SensorHeight	Effective height of the sensor in pixels.
SensorShutterMode	Sets the shutter mode of the device.
WidthMax	Maximum width of the image (in pixels). The dimension is calculated after horizontal binning, decimation or any other function changing the horizontal dimension of the image.
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
BinningSelector	Selects which binning engine is controlled by the BinningHorizontal and BinningVertical features.
BinningHorizontalMode	Sets the mode to use to combine horizontal photo-sensitive cells together when BinningHorizontal is used.
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.
BinningVerticalMode	Sets the mode used to combine vertical photo-sensitive cells together when BinningVertical is used.
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.
DecimationHorizontal	Horizontal sub-sampling of the image. This reduces the horizontal resolution (width) of the image by the specified horizontal decimation factor.
DecimationVertical	Vertical sub-sampling of the image. This reduces the vertical resolution (height) of the image by the specified vertical decimation factor.
RegionSelector	Selects the Region of interest to control. The RegionSelector feature allows devices that are able to extract multiple regions out of an image, to configure the features of those individual regions independently.
ImageComponentSelector	Selects a component to activate data streaming from.
ImageComponentEnable	Controls if the selected component streaming is active.
Width	Width of the image provided by the device (in pixels).
Height	Height of the image provided by the device (in pixels).
OffsetX	Horizontal offset from the origin to the region of interest (in pixels).
OffsetY	Vertical offset from the origin to the region of interest (in pixels).

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Name	Description
PixelFormat	Format of the pixels provided by the device. It represents all the information provided by PixelCoding, PixelSize, PixelColorFilter combined in a single feature.
PixelFormatInfoSelector	Select the pixel format for which the information will be returned.
PixelFormatInfoID	Returns the value used by the streaming channels to identify the selected pixel format.
PixelSize	Total size in bits of a pixel of the image.
PixelColorFilter	Type of color filter that is applied to the image.
ReverseX	This feature is used to flip horizontally the image sent by the device. The AOI is applied after the flipping.
ReverseY	This feature is used to flip vertically the image sent by the device. The AOI is applied after the flipping.
MultiROIsInMultiPayloads	MultiROIs In MultiPayloads.
PirorityMode	Select image output priority, image quality or frame rate.

9.18.2 AcquisitionControl

Name	Description
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.
AcquisitionStart	Starts the Acquisition of the device. The number of frames captured is specified by AcquisitionMode.
AcquisitionStop	Stops the Acquisition of the device at the end of the current Frame. It is mainly used when AcquisitionMode is Continuous but can be used in any acquisition mode.
AcquisitionArm	Arms the device before an AcquisitionStart command. This optional command validates all the current features for consistency and prepares the device for a fast start of the Acquisition.
AcquisitionFrameRate	Controls the acquisition rate (in Hertz) at which the frames are captured.
TriggerSelector	Selects the type of trigger to configure.
TriggerMode	Controls if the selected trigger is active.
TriggerSoftware	Generates an internal trigger. TriggerSource must be set to Software.
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.
TriggerDelay	Specifies the delay in microseconds (us) to apply after the trigger reception before activating it.
ExposureMode	Sets the operation mode of the Exposure (or shutter).
ExposureTimeSelector	Selects which exposure time is controlled by the ExposureTime feature. This allows for independent control over the exposure components.
ExposureTime	Sets the Exposure time when ExposureMode is Timed and ExposureAuto is Off. This controls the duration where the photosensitive cells are exposed to light.
ExposureTimeAbs	Sets the Exposure time when ExposureMode is Timed and ExposureAuto is Off. This controls the duration where the photosensitive cells are exposed to light.
ExposureTimeRaw	Sets the Exposure time when ExposureMode is Timed and ExposureAuto is Off. This controls the duration where the photosensitive cells are exposed to light.
ExposureAuto	Sets the automatic exposure mode when ExposureMode is Timed. The exact algorithm used to implement this control is device-specific.
ExposureAutoLimitMax	Determine the upper limit of exposure time when ExposureAuto is set to Continuous.
ExposureAutoLimitMin	Determine the lower limit of exposure time when ExposureAuto is set to Continuous.

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9.18.3 TransportLayerControl

Name	Description
PayloadSize	Provides the number of bytes transferred for each image or chunk on the stream channel. This includes any end-of-line, end-of-frame statistics or other stamp data. This is the total size of data payload for a data block.

9.18.4 DigitalIOControl

Name	Description
LineSelector	Selects the physical line (or pin) of the external device connector to configure.
LineMode	Controls if the physical Line is used to Input or Output a signal.
LineInverter	Controls the inversion of the signal of the selected input or output Line.
LineStatus	Returns the current status of the selected input or output Line.
LineSource	Selects which internal acquisition or I/O source signal to output on the selected Line. LineMode must be Output.
UserOutputSelector	Selects which bit of the User Output register will be set by UserOutputValue.
UserOutputValue	Sets the value of the bit selected by UserOutputSelector.
StrobeOutDelay	Delay of StrobeOut signal when LineSource is set to StrobeOut(us).
StrobeOutOnTime	Duration of StrobeOut signal when LineSource is set to StrobeOut(us).
TriggerOutDelay	Delay of TriggerOut signal when LineSource is set to TriggerOut(us).
TriggerOutOnTime	Duration of TriggerOut signal when LineSource is set to TriggerOut(us).
LineDeviceResetMode	Sets the Line device reset mode.
LineDebounceTime	Sets the value of the input line debouncer time.

9.18.5 CounterAndTimerControl

Name	Description
CounterSelector	Selects which Counter to configure.
CounterEventSource	Select the events that will be the source to increment the Counter.
CounterEventActivation	Selects the Activation mode Event Source signal.
CounterResetSource	Selects the signals that will be the source to reset the Counter.
CounterResetActivation	Selects the Activation mode of the Counter Reset Source signal.
CounterReset	Does a software reset of the selected Counter and starts it. The counter starts counting events immediately after the reset unless a Counter trigger is active. CounterReset can be used to reset the Counter independently from the CounterResetSource. To disable the counter temporarily, set CounterEventSource to Off.
CounterValue	Reads or writes the current value of the selected Counter.
CounterValueAtReset	Reads the value of the selected Counter when it was reset by a trigger or by an explicit CounterReset command.
CounterDuration	Sets the duration (or number of events) before the CounterEnd event is generated.
CounterStatus	Returns the current status of the Counter.
CounterTriggerSource	Selects the source to start the Counter.
CounterTriggerActivation	Selects the activation mode of the trigger to start the Counter.

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9.18.6 EventControl

Name	Description
EventSelector	Selects which Event to signal to the host application.
EventNotification	Activate or deactivate the notification to the host application of the occurrence of the selected Event.

9.18.7 EventExposureEndData

Name	Description
EventExposureEnd	Returns the unique identifier of the ExposureEnd type of Event. This feature can be used to register a callback function to be notified of the event occurrence. Its value uniquely identifies the type of event that will be received.
EventExposureEndTimestamp	Returns the Timestamp of the ExposureEnd Event. It can be used to determine precisely when the event occured.

9.18.8 EventExposureStartData

Name	Description
EventExposureStart	Returns the unique Identifier of the Exposure Start type of Event.
EventExposureStartTimestamp	Returns the Timestamp of the Exposure Start Event.

9.18.9 EventTestData

Name	Description
EventTest	Returns the unique identifier of the Test type of Event. This feature can be used to register a callback function to be notified of the event occurrence. Its value uniquely identifies the type of event that will be received.
EventTestTimestamp	Returns the timestamp of the Test event.

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9.18.10 AnalogControl

Name	Description
GainSelector	Selects which Gain is controlled by the various Gain features.
Gain	Controls the selected gain as an absolute physical value. This is an amplification factor applied to the video signal.
GainAuto	Sets the automatic gain control (AGC) mode. The exact algorithm used to implement AGC is device-specific.
GainAutoLimitMax	Determine the upper limit of gain when GainAuto is set to Continuous.
GainAutoLimitMin	Determine the lower limit of gain when GainAuto is set to Continuous.
AutoLightTarget	Determine the brightness target for GainAuto.
BlackLevelSelector	Selects which Black Level is controlled by the various Black Level features.
BlackLevel	Controls the black level as an absolute physical value. This represents a DC offset applied to the video signal.
BalanceRatioSelector	Selects which Balance ratio to control.
BalanceRatio	Controls ratio of the selected color component to a reference color component. It is used for white balancing.
BalanceWhiteAuto	Controls the mode for automatic white balancing between the color channels. The white balancing ratios are automatically adjusted.

9.18.11 LUTControl

Name	Description
PixelCorrectionAllEnabled	Enable pixel correction for all pixels.
PixelCorrectionIndex	Determine index of targeted pixel for pixel correction.
PixelCorrectionEnabled	Determine if targeted pixel is enabled for pixel correction.
PixelCorrectionX	Determine x-coordinate of targeted pixel for pixel correction.
PixelCorrectionY	Determine y-coordinate of targeted pixel for pixel correction.

9.18.12 UserSetControl

Name	Description
UserSetSelector	Selects the feature User Set to load, save or configure.
UserSetLoad	Loads the User Set specified by UserSetSelector to the device and makes it active.
UserSetSave	Save the User Set specified by UserSetSelector to the non-volatile memory of the device.
UserSetDefault	Selects the feature User Set to load and make active by default when the device is reset.

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9.18.13 ChunkDataControl

Name	Description
ChunkModeActive	Activates the inclusion of Chunk data in the payload of the image.
ChunkSelector	Selects which Chunk to enable or control.
ChunkEnable	Enables the inclusion of the selected Chunk data in the payload of the image.
ChunkCounterSelector	Selects which counter to retrieve data from.
ChunkCounterValue	Returns the value of the selected Chunk counter at the time of the FrameStart event.
ChunkGainSelector	Selects which Gain to return.
ChunkGain	Returns the gain used to capture the image.
ChunkBlackLevelSelector	Selects which Black Level to return.
ChunkBlackLevel	Returns the black level used to capture the image included in the payload.
ChunkExposureTimeSelector	Selects which exposure time is read by the ChunkExposureTime feature.
ChunkExposureTime	Returns the exposure time used to capture the image.
ChunkGamma	Returns the gamma used to capture the image.

9.18.14 TestControl

Name	Description
TestPendingAck	Tests the device's pending acknowledge feature. When this feature is written, the device waits a time period corresponding to the value of TestPendingAck before acknowledging the write.
TestEventGenerate	Generates a Test Event.
TriggerEventTest	This register is used to control the generation of test events.

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10 Revision History

Rev	Date	Changes	Note
00	2017/11/27	● New Document	
01	2019/02/27	● Revised Revised maximum gain Added trademark information	

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