See the possibilities

User Manual

GO-5100MP-USB

5.1M CMOS Digital Progressive Scan
Polarized Camera
Document Version: 1.1
GO-5100MP-USB_Ver.1.1_Jun.2019

Thank you for purchasing this product.

⚠ Be sure to read this manual before use.

This manual includes important safety precautions and instructions on how to operate the unit. Be sure to read this manual to ensure proper operation.

The contents of this manual are subject to change without notice for the purpose of improvement.

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Notice

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Warranty

For information about the warranty, please contact your factory representative.

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that GO-5100MP-USB complies with the following provisions applying to its standards.
EN 61000-6-3 (Generic emission standard part 1)
EN 61000-6-2 (Generic immunity standard part 1)

FCC

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Warning

Changes or modifications to this unit not expressly approved by the party responsible for FCC compliance could void the user's authority to operate the equipment.

KC

제조년월은 제품상자의 라벨을 참조하십시요

Supplement

The following statement is related to the regulation on " Measures for the Administration of the control of Pollution by Electronic Information Products " , known as " China RoHS ". The table shows contained Hazardous Substances in this camera.

mark shows that the environment-friendly use period of contained Hazardous Substances is 15 years.

重要注意事项

有毒，有害物质或元素名称及含量表

根据中华人民共和国信息产业部『电子信息产品污染控制管理办法』，本产品《 有毒，有害物质或元素名称及含量表 》如下.

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 (PPB)	多溴二苯醚 (PBDE)
棱镜	×	○	○	○	○	○
光学滤镜	×	○	×	○	○	○
连接插头	×	○	○	○	○	○
电路板	×	○	○	○	○	○
.....	.....	.....	.....	.....	.....	.....

○: 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SJ/T11363-2006规定的限量要求以下。
×: 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SJ/T11363-2006规定的限量要求。
（企业可在此处、根据实际情况对上表中打 "×" 的技术原因进行进一步说明。）

环保使用期限

电子信息产品中含有的有毒有害物质或元素在正常使用的条件下不会发生外泄或突变、电子信息产品用户使用该电子信息产品不会对环境造成严重污染或对基人身、财产造成严重损害的期限。

数字「15」为期限15年。

Usage Precautions

Notes on cable configurations

The presence of lighting equipment and television receivers nearby may result in video noise. In such cases, change the cable configurations or placement.

Notes on attaching the lens

Avoiding dust particles
When attaching the lens to the camera, stray dust and other particles may adhere to the sensor surface and rear surface of the lens. Be careful of the following when attaching the lens.

- Work in a clean environment.
- Do not remove the caps from the camera and lens until immediately before you attach the lens.
- To prevent dust from adhering to surfaces, point the camera and lens downward and do not allow the lens surface to come into contact with your hands or other objects.
- Always use a blower brush to remove any dust that adheres.
  Never use your hands or cloth, blow with your mouth, or use other methods to remove dust.

Phenomena specific to CMOS image sensors

The following phenomena are known to occur on cameras equipped with CMOS image sensors. These do not indicate malfunctions.

- Aliasing
  When shooting straight lines, stripes, and similar patterns, vertical aliasing (zigzag distortion) may appear on the monitor.
- Blooming
  When strong light enters the camera, some pixels on the CMOS image sensor may receive much more light than they are designed to hold, causing the accumulated signal charge to overflow into surrounding pixels.This “blooming” phenomenon can be seen in the image, but does not affect the operation of the camera.
- Fixed pattern noise
  When shooting dark objects in high-temperature conditions, fixed pattern noise may occur throughout the entire video monitor screen.
- Defective pixels
  Defective pixels (white and black pixels) of the CMOS image sensor are minimized at the factory according to shipping standards. However, as this phenomenon can be affected by the ambient temperature, camera settings (e.g., high sensitivity and long exposure), and other factors, be sure to operate within the camera’s specified operating environment.

Notes on exportation

When exporting this product, please follow the export regulations of your country or region.

Features

The GO-5100MP-USB is a machine vision polarization camera incorporating a monochrome CMOS image sensor with a 2/3-inch global shutter and a four-directional polarization square pixel array that offers 5.1 effective megapixels (2464 × 2056). The unit is compact and lightweight in design and is equipped with a USB 3.0 interface.

Image sensor with four-directional polarization
Polarizers are provided for individual pixels to capture polarization.

90	45	90	45	90	45
135	0	135	0	135	0
90	45	90	45	90	45
135	0	135	0	135	0
90	45	90	45	90	45
135	0	135	0	135	0

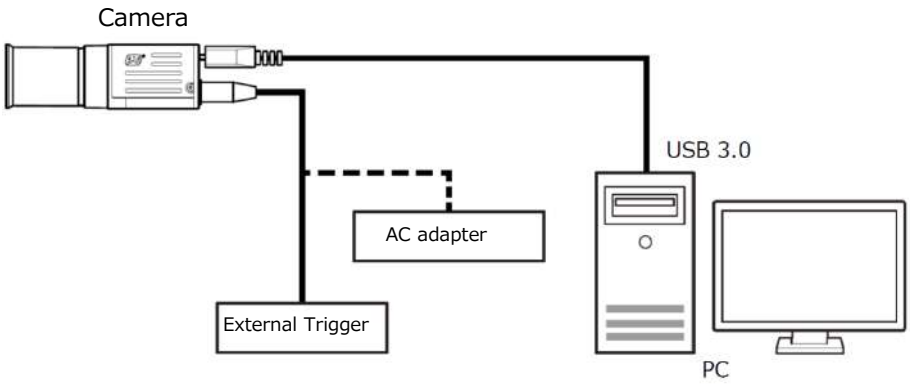
The numbers in the figure on the left indicate the polarizer angles.
Four polarizer angles are available: 0º, 45º, 90º, and 135º. Various polarization processing is performed on the four pixels enclosed in the red frame as a block.

Also, various functions considered necessary for machine vision are provided.
The unit is equipped with pre-processing circuits for shading correction and blemish correction in addition to external trigger, exposure setting, and image level control.

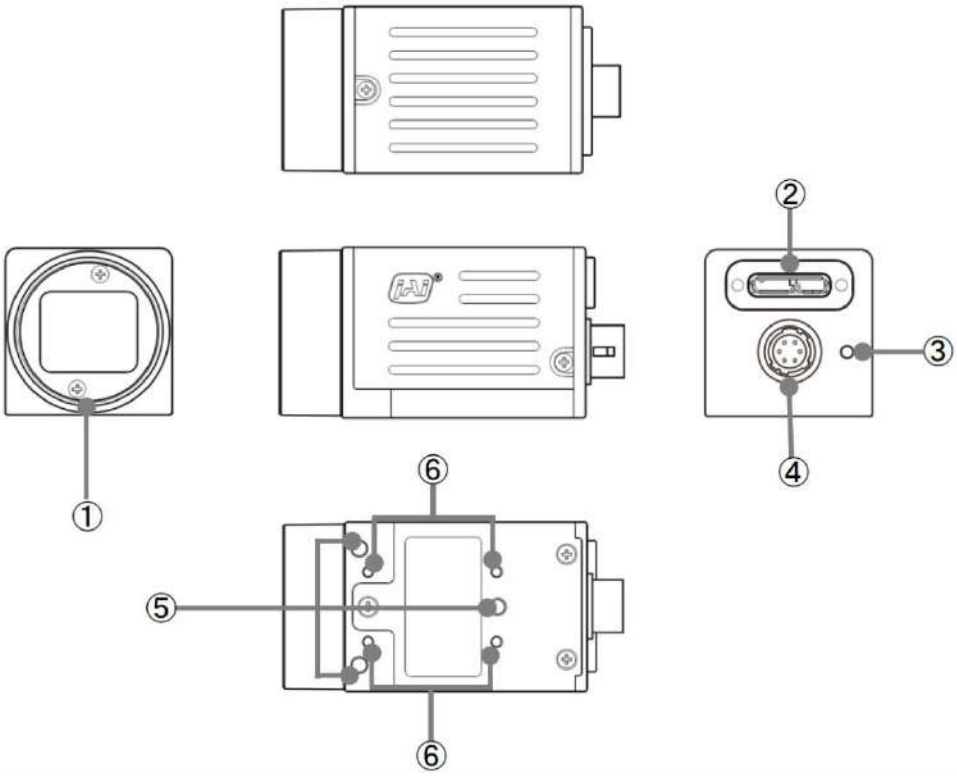
Feature overview

- Compliance with USB3 Vision and GenICam standards
- 2/3-inch global shutter and a four-directional polarization square pixel array that offers 5.1 effective megapixels CMOS sensor
- Lens mount: C-mount (flange back: 17.526 mm)
- Pixel size : 3.45 um × 3.45 um
- Effective pixels 2464(H) × 2056(V)
- Up to 74 fps at full resolution
- Various Video Output modes
  Raw Image, Four polarizer, Four functions, Color on average image and Color on gray image.
- Internal test signal for settings configuration
- eBUS SDK for JAI that supports Windows 7, 8, 10

Connection example:



Parts Identification



① Lens mount（C-mount）
Mount a C-mount lens, microscope adapter, etc. here.
❖ Before mounting a lens, be sure to refer to “Step 2:Connecting Devices” and confirm the precautions for attaching a lens and the supported lens types.

② USB 3.0 connector
Use a USB 3.0 compatible cable to connect this to a USB port on the computer.

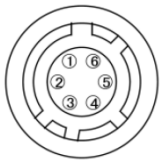
③ POWER/TRIG LED
Indicates the power and trigger input status.

LED status and camera status

LED	Light	Status
POWER/ TRIG LED	(Lit amber)	Camera initializing.
	(Lit green)	Camera in operation.
	(Blinking green)	During operation in trigger mode, trigger signals are being input. ❖ The blinking interval is not related to the actual input interval of the external trigger.

④ DC IN/TRIG connector（6-pin round）

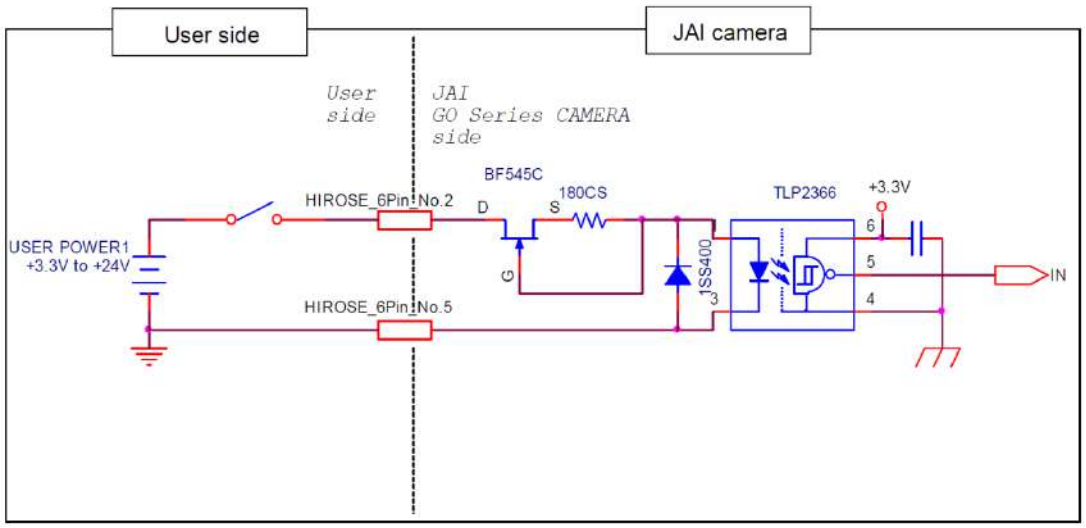
Connect the cable for a power supply (optional) or for DC IN / trigger IN here.



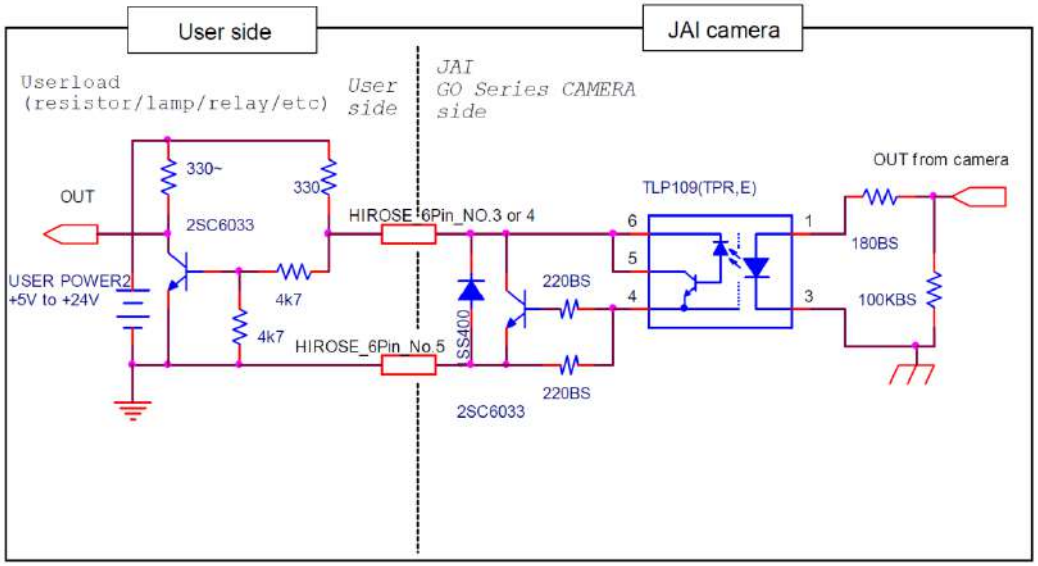
HR10A-7R-6PB（73）（Hirose Electric or equivalent）

Pin No.	Input/Output	Signal	Description
1	Power In	DC In	DC 12 V ～ 24 V ± 10%
2	In	Opto In 1	GPIO 5
3	Out	Opto In 1	GPIO 1
4	Out	Opto In 2 +	GPIO 2
5		Opto Common	
6		GND	

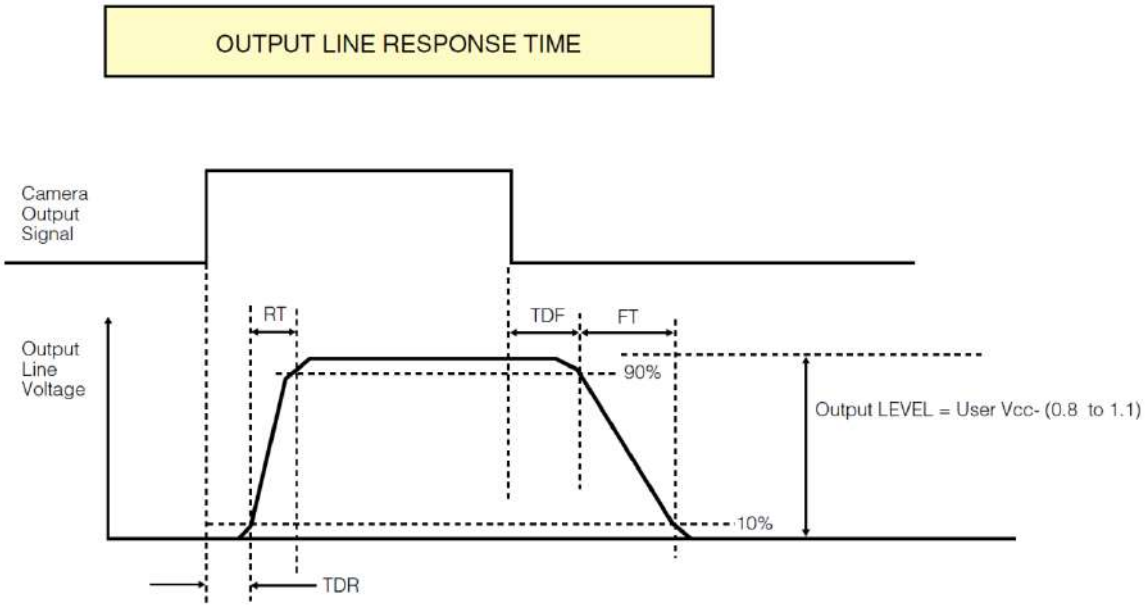
Recommended external input circuit diagram (reference example)



Recommended external output circuit diagram (reference example)
Standard circuit diagram example



Characteristics of the recommended circuits for Opto OUT



⑤ Camera locking screw holes（M3, 3mm depth）

Use these holes when attaching an MP-43 tripod adapter plate (optional) or mounting the camera directly to a wall or other structural system.

⑥ Camera locking screw holes（M2, 3mm depth）

Use these holes when mounting the camera directly to a wall or other structural system.

Preparation

Preparation Process

Step 1	**Installing the Software (first time only)** Install the software for configuring and controlling the camera (eBUS SDK for JAI) on the computer.
Step 2	**Connecting Devices** Connect the lens, USB cable, AC adapter, computer, and other devices.
Step 3	**Verifying Camera Operation** Verify whether the camera is turned on and ready for use.
Step 4	**Verifying the Connection between the Camera and PC** Verify whether the camera is properly recognized via eBUS Player for JAI.
Step 5	**Changing the Camera Settings** Refer to the procedure for changing the output format setting as an example, and change various settings as necessary.
Step 6	**Adjusting the Image Quality** Refer to the procedures for adjusting the gain, white balance, and black level as examples, and adjust the image quality.
Step 7	**Saving the Settings** Save the current setting configurations in user memory.

Step 1: Installing the Software (first time only)

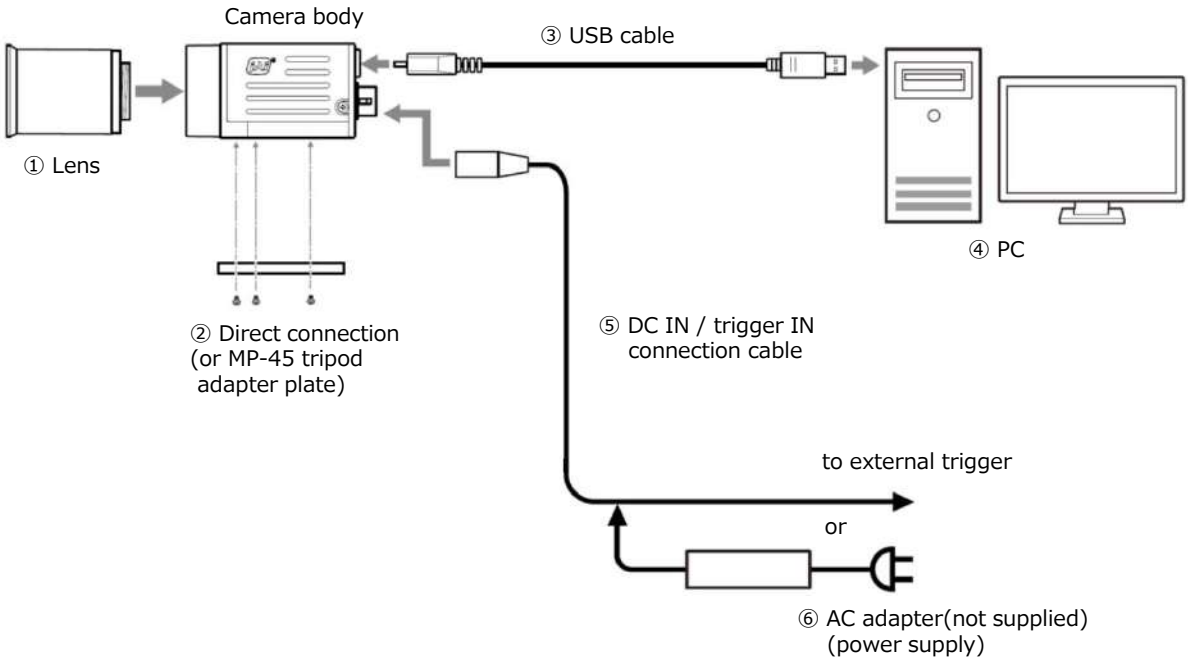
When using the camera for the first time, install the software for configuring and controlling the camera (eBUS SDK for JAI) on the computer.
❖ When you install eBUS SDK for JAI, eBUS SDK for JAI player will also be installed.

1 **Download the eBUS SDK for JAI from the JAI website.**
URL https://www.jai.com/support-software/jai-software

2 **Install eBUS SDK for JAI on the computer.**

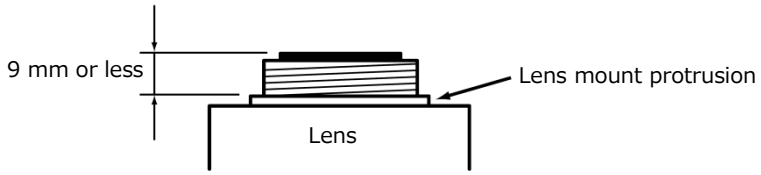
Caution
eBUS SDK for JAI was released in April 2018 and is the latest software for setting and controlling JAI cameras.
When JAI SDK and eBUS SDK for JAI are installed on the same machine, conflicts can occur. Therefore, JAI strongly recommends that JAI SDK is uninstalled before installing eBUS SDK for JAI.

Step 2: Connecting Devices



① Lens

・C-mount lenses with lens mount protrusions of 9 mm or less can be attached.



・The diagonal of the camera's CMOS image sensor is 11 mm, the size of standard 2/3-inch lenses.
To prevent vignetting and to obtain the optimal resolution, use a lens that will cover the 11 mm diagonal. Some lens manufacturers offer lenses with an 11 mm format. If not, a 2/3-inch lens is recommended.

Caution

・The maximum performance of the camera may not be realized depending on the lens.
・Attaching a lens with a mount protrusion of 9 mm or longer may damage the lens or camera.

Note

The following formula can be used to estimate the focal length.
Focal length = WD / (1 + W/w)
WD : Working distance (distance between lens and object)
W : Width of object
w : Width of sensor (8.5 mm on this camera)

② Direct connection (or MP-43 tripod adapter plate)

When mounting the camera directly to a wall or other device, use screws that match the camera locking screw holes on the camera (M3, depth: 3 mm). Use the supplied screws to attach the tripod adapter plate.

Caution

For heavy lenses, be sure to support the lens itself. Do not use configurations in which its weight is supported by the camera.

③ USB cable

Connect a USB cable to the USB 3.0 connector.

Caution

The camera is equipped with a USB 3.0 compatible Micro B connector. Although this connector includes USB 2.0 connectors, the camera does not support use of USB 2.0.

④ Computer

Use a computer that meets the following requirements.
Operating system (OS):
Microsoft Windows 7/8/10 32-bit/64-bit edition
CPU: Intel Core i3 or higher
Memory:
Windows 7/8/10 32-bit edition: DDR3, 4 GB or higher
Windows 7/8/10 64-bit edition: DDR3, 8 GB or higher
Graphics card: PCI-Express 3.0 or higher
Interface: USB 3.0 compatible connector

⑤ DC IN / trigger IN connection cable

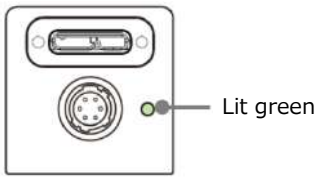
⑥ AC adapter (power supply) (if necessary)
Connect the AC adapter and the round connector of the connection cable to the DC IN / trigger IN connector on the camera.

Step 3: Verifying Camera Operation

When power is supplied to the camera while the necessary equipment is connected, the POWER/TRIG LED at the rear of the camera lights amber, and initialization of the camera starts.When initialization is complete, the POWER/TRIG LED lights green.

Verify whether power is being supplied to the camera by checking the rear LED.

When properly turned on



* For details on how to read the LEDs, see “LED status and camera status” in the “Parts Identification” section.

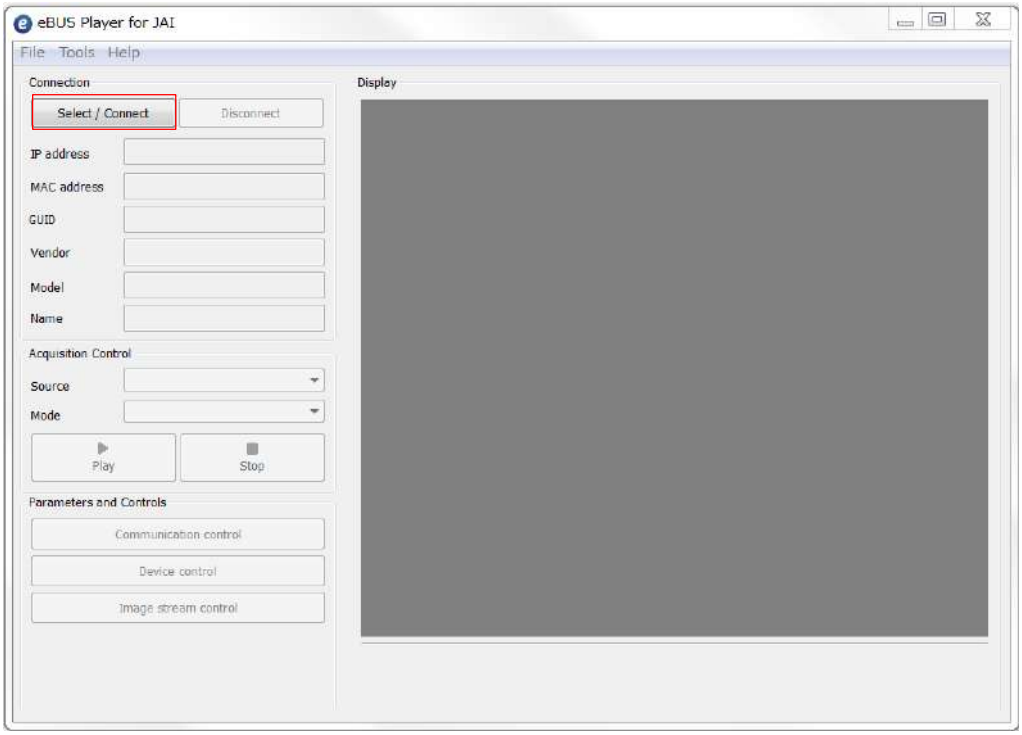
Step 4: Verifying the Connection between the Camera and PC

Verify whether the camera is properly recognized via eBUS Player for JAI.

Connecting the Camera to eBUS Player for JAI.

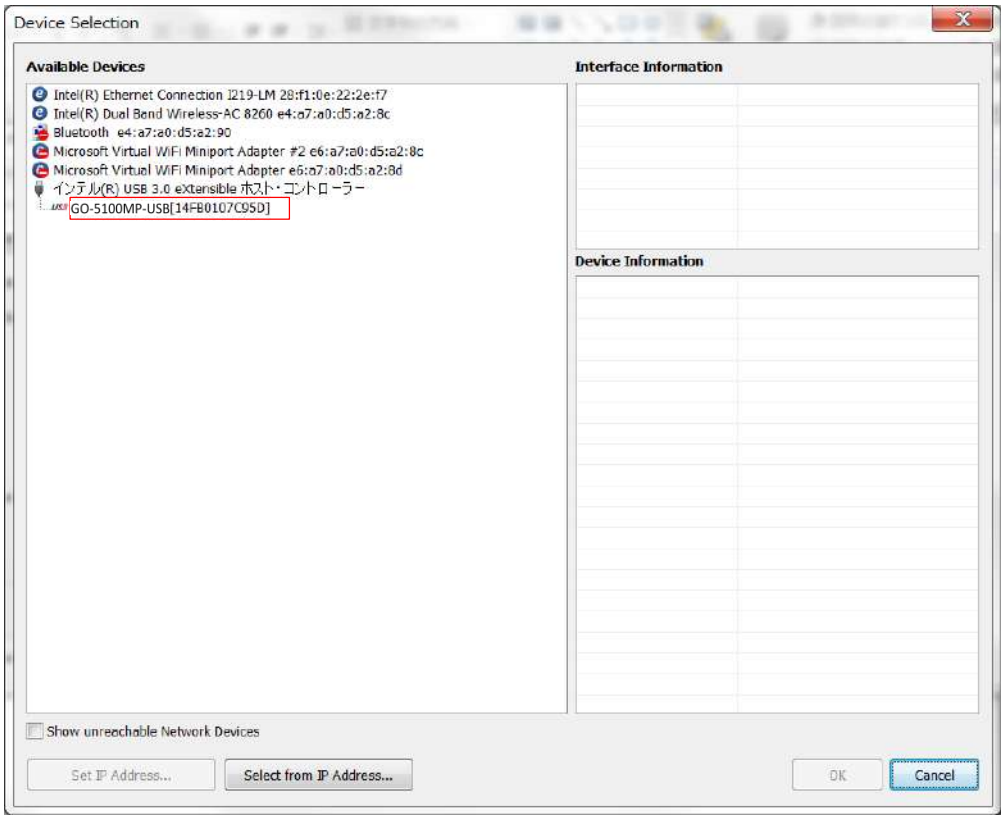
1 **Startup eBUS Player for JAI**

eBUS Player for JAI startup screen appears.



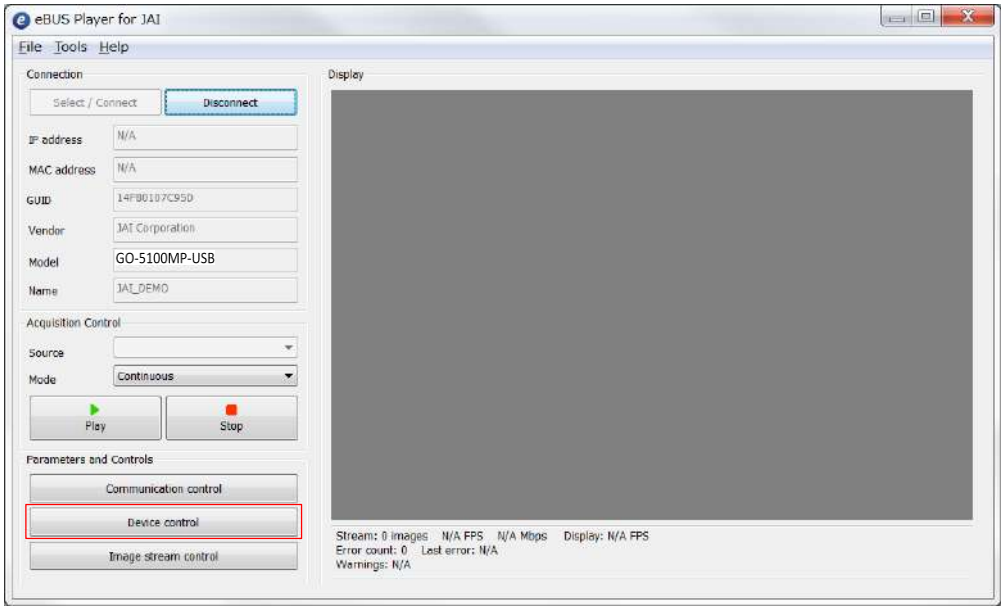
2 Select the camera you want to configure.

Push Select / Connect button

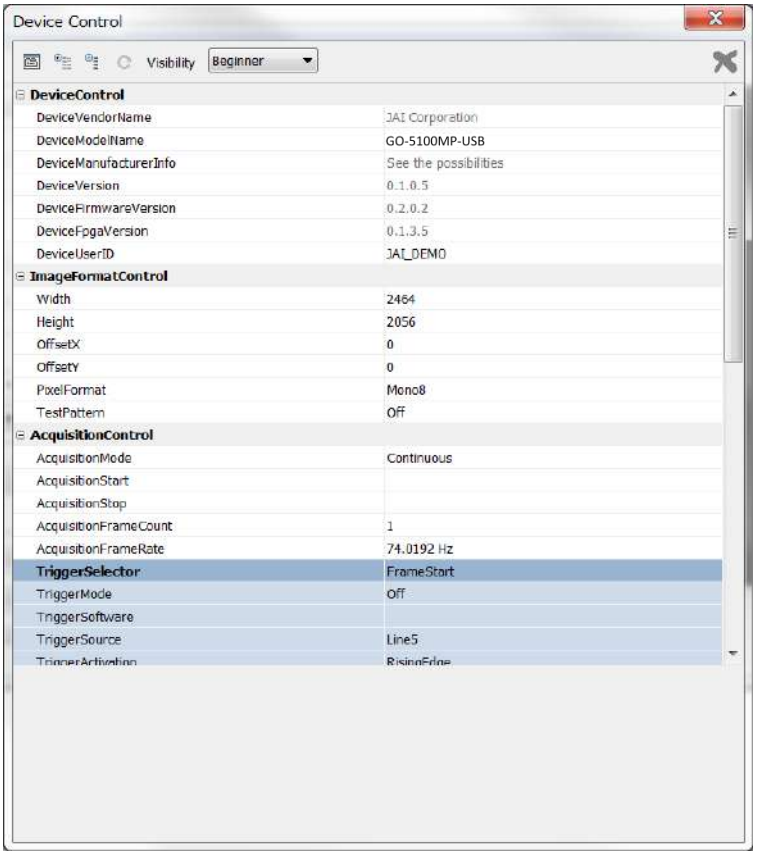


The connected camera is listed.
Please select one camera.

3 Check that the settings of the selected camera are displayed.



Push the Device control button.
The screen shown below will be displayed. In this window you can adjust various settings of the camera.



This completes the procedure for verifying whether the camera is properly recognized and whether control and settings configuration are possible.

Step 5: Changing the Camera Settings

This section explains how to change settings by describing the procedure for changing the output format as an example.

Configuring the Output Format

Configure the size, position, and pixel format of the images to be acquired.
The factory settings are as follows. Change the settings as necessary.

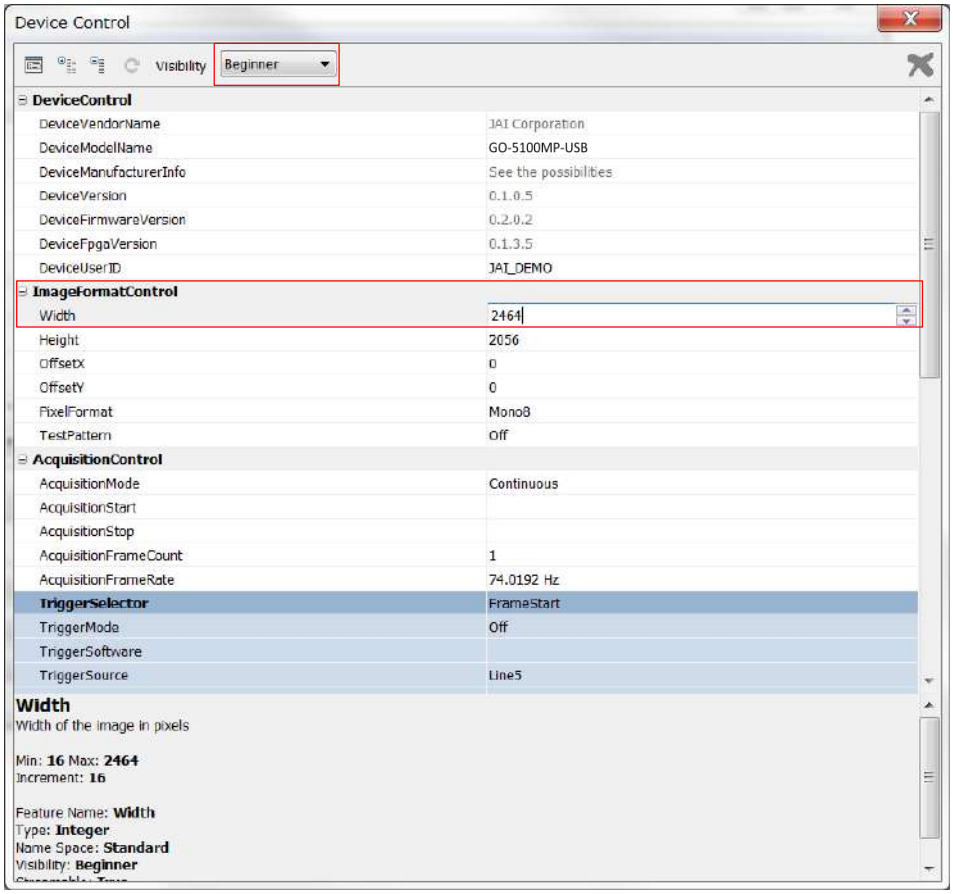
Factory default values

Item		Default value
ImageFormatControl	Width	2464
	Height	2056
	OffsetX (horizontal position)	0
	OffsetY (vertical position)	0
	PixelFormat	Mono8

* You can specify the image acquisition area. For details, see “ROI (Regional Scanning Function)”.

1 Configuring the [Width] of [ImageFormatControl]

By selecting the item of [Width], you can change the value as shown below.



Note

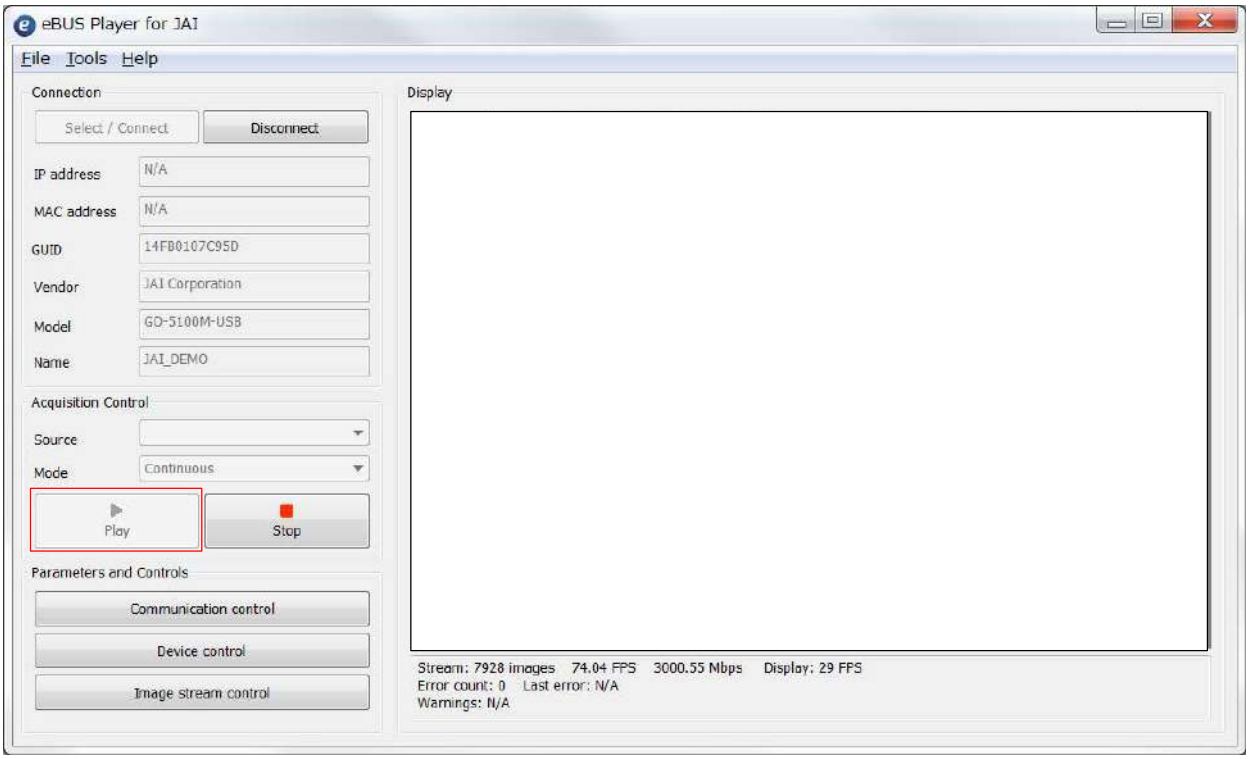
Depending on the setting item, you need to change visibility.
Please switch visibility (Beginner / Expert / Guru) as necessary.

Step 6: Adjusting the Image Quality

Display the camera image and adjust the image quality.

Displaying the Image

Display the image captured by the camera.
When you push [Play] button, the camera image appears in right area.



Adjusting the Gain

Adjust the image quality using the gain function.

To adjust the image quality

The Visibility must be changed from [Beginner] to [Guru].

Adjust the sensitivity via the analog gain (i.e., master gain).
For details on gain control, see “Gain Control” in the “Main Functions” section.

■ **Manual adjustment**

1 **Expand [AnalogControl], and set [GainAuto] to [Off].**

([Off] is default setting.)

2 **Configure the gain.**

❶ Expand [AnalogControl], and select the gain you want to configure in [GainSelector].
[AnalogAll] (master gain) can be configured.

❷ Configure the gain value in [Gain].
- [AnalogAll] (master gain) can be set to a value from x1 to x16 the analog gain value. The resolution is set in x0.1 steps. Values are configured by multipliers.

Adjusting the Black Level

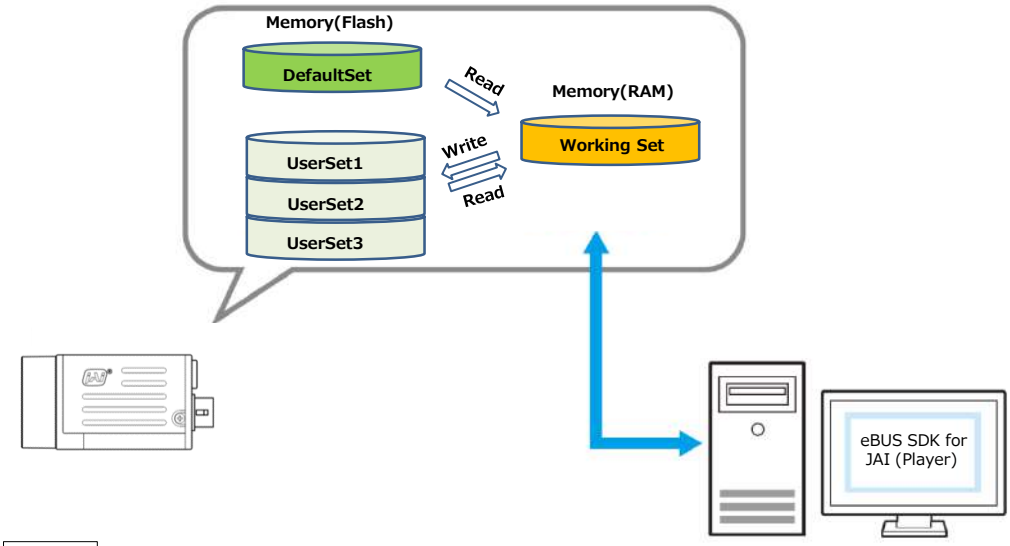
1 **Expand [AnalogControl], and select the black level you want to configure in [BlackLevelSelector].**

[DigitalAll] (master black) can be configured.

2 **Specify the adjustment value in [BlackLevel].**

Step 7: Saving the Settings

The setting values configured in the player (eBUS SDK for JAI) will be deleted when the camera is turned off. By saving current setting values to user memory, you can load and recall them whenever necessary. You can save up to three sets of user settings in the camera. (User Set1 to 3)



Note

Changes to settings are not saved to the computer (eBUS SDK for JAI).

■ **To save user settings**

1 **Stop image acquisition.**

2 **Expand [UserSetControl], and select the save destination ([UserSet1] to [UserSet3]) in [UserSetSelector].**

Note

The factory default setting values are stored in [Default] and cannot be overwritten.

Caution

Settings can only be saved when image acquisition on the camera is stopped.

3 **Select [UserSetSave], and click [Execute 'UserSetSave' Command].**

The current setting values are saved as user settings.

■ **To load user settings**

1 **Stop image acquisition.**

User settings can only be loaded when image capture on the camera is stopped.

2 **Select the settings to load (UserSet1 to UserSet3) in [UserSetSelector].**

3 **Select [UserSetLoad], and click [Execute 'UserSetLoad' Command].**

The selected user settings are loaded.

Main Functions

Basic Function Matrix

The combinations of settings for the basic functions that can be used together are as follows.

ExposureMode	FrameStartTrigger	ExposureTime	ROI	GainAuto	Sequencer	
					TriggerSequencerMode	CommandSequencerMode
Off	Off	×	○	○	×	×
Timed	Off	○	○	○	×	○
Timed(EPS)	On	○	○	○	○	○
TriggerWidth	On	×	○	○	×	×

GPIO (Digital Input/Output Settings)

The camera is equipped with GPIO (general-purpose input/output) functions for generating and using combinations of triggers and other necessary signals within the camera and of signals output from the camera to the system such as those used for lighting equipment control.

Valid Input/Output Combinations

The following signals can be used as sources for each output destination (Trigger Selector, Line Selector, Pulse Generator Selector).
You can also connect two different sources to NAND paths in the GPIO and reuse the signal generated there as a source for a different selector.

The combinations of source signals and output destinations are indicated in the following.

Selector (Cross point switch output) / Source signal (Cross point switch input)		Output destination									
		Trigger Selector				Line Selector					Pulse Generator Selector
		Acquisition Start	Acquisition Stop	Frame Start	Transfer Start	Line2 OPT Out 1	Line3 OPT Out 2	Time Stamp Reset	Nand Gate 0 In	Nand Gate 1 In	Pulse Generator 0
Signals to use as output	LOW	○	○	○	○	○	○	○	○	○	○
	HIGH	○	○	○	○	○	○	○	○	○	○
	Line5 - Optical In 1	○	○	○	○	○	○	○	○	○	○
	NAND 0 Out	○	○	○	○	○	○	○	×	○	○
	NAND 1 Out	○	○	○	○	○	○	○	○	×	○
	Pulse Generator 0	○	○	○	○	○	○	○	○	○	×
	User Output 0	○	○	○	○	○	○	○	○	○	○
	User Output 1	○	○	○	○	○	○	○	○	○	○
	Software Trigger	○	○	○	○	×	×	×	×	×	×
	FVAL	×	×	×	×	○	○	○	○	○	○
	LVAL	×	×	×	×	×	×	○	○	○	○
	Acquisition Trigger Wait	×	×	×	×	○	○	○	○	○	○
	Frame Trigger Wait	×	×	×	×	○	○	○	○	○	○
	Frame Active	×	×	×	×	○	○	○	○	○	○
	Exposure Active	×	×	×	×	○	○	○	○	○	○
		Trigger Source				Line Source					Pulse Generator Clear Source
		Use									

: Indicates default values for each selector.

Camera Output Formats

The GO-5100MP-USB supports the following output formats.

PixelFormat
Mono8, Mono10, Mono10p
*1) Mono12, Mono12p
*2) BayerRG8, BayerRG10, BayerRG10p

*1) When VideoProcessBypassMode is enabled, PixelFormat can be set to Mono12 or Mono12p. In this case, the image output mode of the camera will be fixed to the RawImage mode. For details, see "12-bit Output" section.

*2) PixelFormat is switched to BayerRG8, BayerRG10, or BayerRG10p automatically depending on the output mode setting (PolarizeImageSelector) of the camera. For details, see the "Camera Image Output Modes" section.

Camera Image Output Modes

The GO-5100MP-USB has five output modes.

First, we will explain about the monochrome CMOS image sensor with a four-directional polarization square pixel array that is incorporated in this camera.

A polarizer with one of the four angles of 0º, 45º, 90º, and 135º is provided for each pixel.

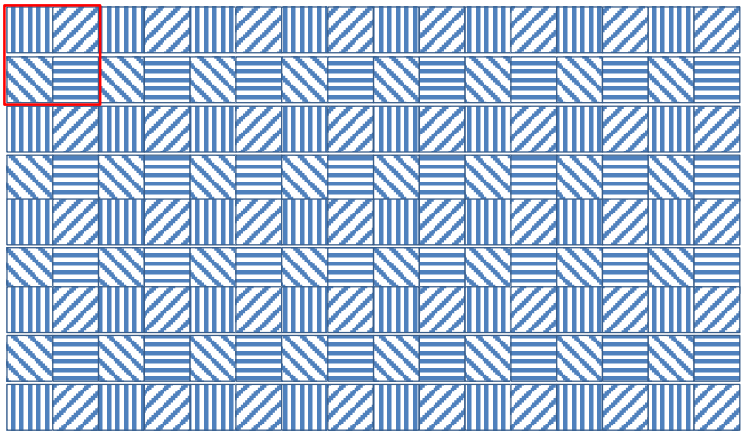
90	45	90	45	90	45
135	0	135	0	135	0
90	45	90	45	90	45
135	0	135	0	135	0
90	45	90	45	90	45
135	0	135	0	135	0

The numbers in the figure on the left indicate the polarizer angles.
Four polarizer angles are available: 0º, 45º, 90º, and 135º. Various polarization processing is performed on the four pixels enclosed in the red frame as a block.

The number of effective pixels is 2464 x 2056, and polarizers angled at 90º and 45º are provided alternately for each pixel on the first line. Polarizers angled at 135º and 0º are provided alternately for each pixel on the second line.

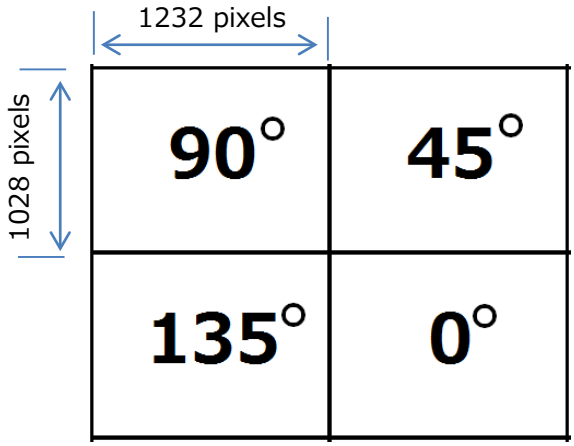
2464 pixels

2056 pixels



1. RawImage mode
   The data output from the image sensor is output as is from the camera.
   As shown in the figure above, the data of the pixels where there are polarizers angled at 90º and 45º is output as the first line, and the data of the pixels where there are polarizers angled at 135º and 0º is output as the second line.

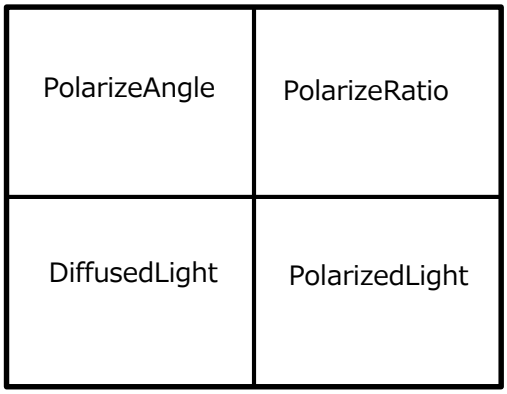
2. FourPolarizeElement mode
The data is output arranged as a screen divided into four (pixels of the polarizers angled at 45º at the top right, pixels of the polarizers angled at 90º at the top left, pixels of the polarizers angled at 0º at the bottom right, and pixels of the polarizers angled at 135º at the bottom left).



3. FourFunctions mode
The six available functions are described below. Each function utilizes the four-pixel calculation blocks to create images that are 1232 x 1028 in resolution.

PolarizeAngle (AoLP) (polarization angle (AoLP : The Angle of Linear Polarization)),
PolarizeAmplitude(The Amplitude of polarization component),
PolarizeDegree (DoLP) (polarization ratio (DoLP : The Degree of Linear Polarization)),
DiffusedLight (diffused light), PolarizedLight (polarized light),
and AverageLight (average brightness)

The follow example shows the settings that would be used to configure the output into four functions arranged as shown in the screen diagram below.



Setting item	**Setting value**
PolarizeImageSelector:	FourFunctions
Panel1selector:	PolarizeAngle
Panel2selector:	PolarizeDegree
Panel3selector:	DiffusedLight
Panel4selector:	AverageLight

*) The same function can be output in multiple quadrants.

Polarize Angle (AoLP):
The polarization angle producing the greatest luminance for a given pixel block. (Also referred to as AoLP: The Angle of Linear Polarization)
Intensity values assigned to pixels represent angles from 0 to 180°.

8-bit output:	00000000 to 10110100
10-bit output:	0000000000 to 1110000100

Polarize Amplitude:
The Amplitude of polarization component.
It takes a value in the range of 0 to 125.

Polarize Degree (DoLP):
The proportion of polarized light contained within the total light falling on a pixel block. (Also referred to as DoLP: The Degree of Linear Polarization)
Intensity values represent proportions of polarized light from 0 to 100%.

8-bit output:	00000000 to 11111111
10-bit output:	0000000000 to 1111111111

Diffused Light:
The intensity of light falling on a pixel block when some or all of the polarized light is excluded. The ReflectionAdjust control determines how much of the polarized component is removed. The higher the ReflectionAdjust setting, the more polarized light is removed. Set to maximum to display only the diffused component.

Polarized Light:
The intensity of the polarized light that is falling on a pixel block after the diffused light has been excluded.

Average Light:
The average brightness of all four pixels in a block.

Two additional output modes are available to users. These are not selectable in the FourFunctions mode. Instead, they produce a single image that combines information from the functions above with the main image being captured.

4. ColorOnPicture mode
This mode provides a pseudo-color overlay representing polarization angle and polarization degree information displayed over an image built using average light information. The PixelFormat is automatically changed in this mode as follows:
When PixelFormat is Mono8, the image is output as BayerRG8
When PixelFormat is Mono10, the image is output as BayerRG10
When PixelFormat is Mono10p, the image is output as BayerRG10p

5. ColorOnGray mode
This mode provides a pseudo-color overlay representing polarization angle and polarization degree information displayed over a gray image. The PixelFormat is automatically changed in this mode as follows:
When PixelFormat is Mono8, the image is output as BayerRG8
When PixelFormat is Mono10, the image is output as BayerRG10
When PixelFormat is Mono10p, the image is output as BayerRG10p

For both ColorOnPicture and ColorOnGray modes, angle of polarization is represented by color hue while degree of polarization is represented by color saturation.

Binning Function

The binning function allows you to combine the signal values of clusters of adjacent pixels to create improved virtual pixels. Using the function results in images with lower pixel resolution and higher sensitivity.

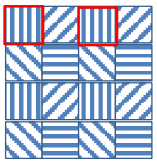
This camera performs both horizontal binning and vertical binning via digital addition or averaging processing.

The following four conditions must be met to use the binning function.

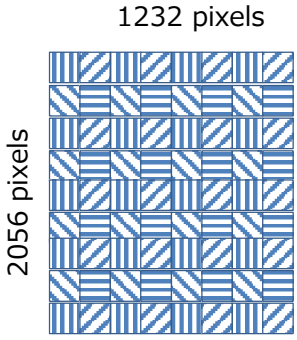
1. [PolarizeImageSelector] is [RawImage].
2. The ROI function, sequencer function, and binning function cannot be used at the same time.
3. PixelFormat is one of Mono8, Mono10, and Mono10p.
4. [VideoProcessBypassMode] is [Off].

■ When horizontal binning only (2x1)

The signal values of the pixels having polarizers at the same angle are combined. The signal values of the two pixels indicated by the red frames in the following figure are combined.

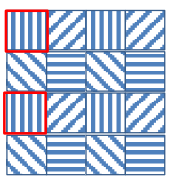


The image data output from this camera becomes RawImage with 1232 pixels (horizontally) x 2056 pixels (vertically).

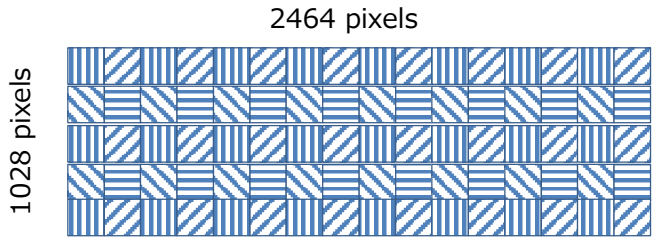


■ When vertical binning only (1x2)

The signal values of the pixels having polarizers at the same angle are combined.
The signal values of the two pixels indicated by the red frames in the following figure are combined.

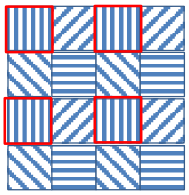


The image data output from this camera becomes RawImage with 2464 pixels (horizontally) x 1028 pixels (vertically).

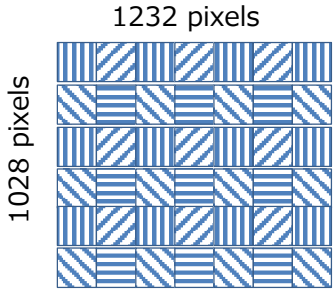


■ When horizontal and vertical binning (2x2)

The signal values of the pixels having polarizers at the same angle are combined.
The signal values of the four pixels indicated by the red frames in the following figure are combined.



The image data output from this camera becomes RawImage with 1232 pixels (horizontally) x 1028 pixels (vertically).



12-bit Output

With this camera, when VideoProcessBypassMode is enabled, output with PixelFormat as Mono12 or Mono12p is possible.

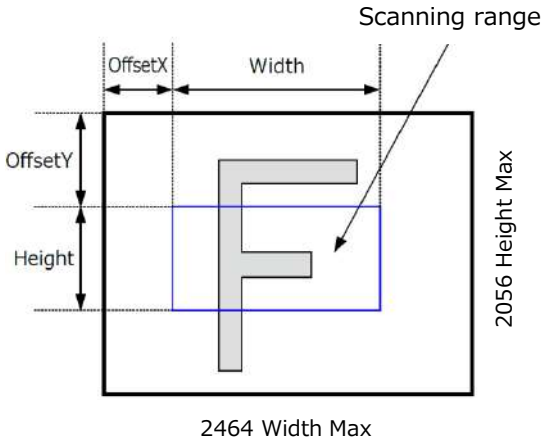
When VideoProcessBypassMode is enabled, video output is fixed to the RawImage mode and the binning function and ROI function cannot be used.

ROI (Regional Scanning Function)

The ROI (region of interest) function allows you to output images by specifying the areas to scan.

ROI Settings

Specify the area to scan by specifying width, height, and horizontal/vertical offset values under [ImageFormatControl].



You can increase the frame rate by specifying a lower height, as the number of lines scanned decreases.The setting ranges for the ROI function's readable area based on the Binning setting (BinningHorizontal, BinningVertical) are as follows.

Width	Height
16 ~ 2464 16 pixels / step	2 ~ 2056 2 Lines / step

Offset X	Offset Y
0 ~ 2448 16 pixels / step	0 ~ 2054 2 Lines / step

Image Acquisition Controls

Perform operations and configure settings related to image acquisition in [AcquisitionControl].

The following acquisition modes are available on the camera.

AcquisitionMode	Description
SingleFrame	Acquire a single frame when the [AcquisitionStart] command is executed.
MultiFrame	Acquire the number of frames specified in [AcquisitionFrameCount] when the [AcquisitionStart] command is executed.
Continuous	Acquire images continuously until the [AcquisitionStop] command is executed.

Changing the Frame Rate

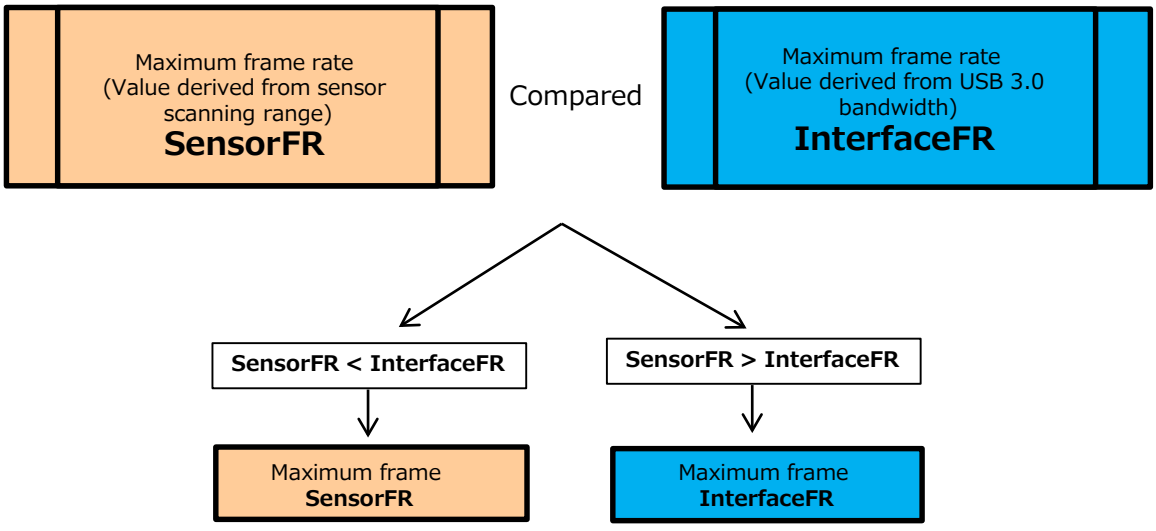
When [TriggerMode] is disabled, you can change the frame rate in [AcquisitionFrameRate].

Note

- The shortest frame period varies depending on the ROI, pixel format, and binning mode selected. The longest frame period is 0.125 Hz (8 sec.).
- When TriggerMode[FrameStart] is enabled, the [AcquisitionFrameRate] setting is disabled.

Maximum Frame Rate

The maximum frame rate is the smaller value between the SensorFR that is calculated from the readable range of the sensor and the InterfaceFR that is limited by the USB 3.0 bandwidth.



■ Maximum frame rate period formula

During continuous operation ([Frame Start] trigger is [Off] or [Exposure Mode] is [Off])

- Maximum frame rate of sensor output
  SensorFR = 1 / {Hperiod × (Height + 40)}
- Maximum frame rate by interface
  InterfaceFR = 3000 × 1000000 / (Height × Width × Pack value)
- Maximum frame rate
  FR_Cont = Min (Sensor FR, Interface FR)

When the exposure time is longer than the frame interval

- Maximum exposure time at maximum frame rate
  MaxExposureTime_TrOlrd = (1 / FR_Cont) - (14 × H Period)
- Exposure time outside of frame interval
  NonOverlapExposureTime = ExposureTime - MaxExposureTime_TrOlrd
  However, NonOverlapExposureTime calculation results that are 0 or below will be considered as 0.
- Maximum frame rate
  FR_ContLongExposure = 1/{(1/FR_Cont) + NonOverlapExposureTime}

When [Frame Start] trigger is [On] and [Trigger OverLap] is [Off]

- Maximum frame rate of sensor output
  Sensor FR = 1 / {H Period × (Height + 40)}
- Maximum frame rate by interface
  Interface FR = 3000 × 1000000 / (Height × Width × Pack value)
- Maximum frame rate
  FR_Cont = Min (Sensor FR, Interface FR)

- Exposure time possible within frames
  MaxOverlapTime_TrOloff = (1 / FR_Cont) - (1 / Sensor FR)
- Exposure time outside of frame interval
  NonOverlapExposureTime_TrOloff = ExposureTime - MaxOverlapTime_TrOloff
  However, NonOverlapExposureTime_TrOloff calculation results that are 0 or below will be considered as 0.
  For TriggerWidth, the trigger pulse is equivalent to ExposureTime.
- Maximum frame rate
  FR_TrOloff = 1 / {(1 / FR_Cont) + NonOverlapExposureTime_TrOloff}

When [Frame Start] trigger is [On] and [Trigger OverLap] is [Readout]

- Maximum frame rate of sensor
  Sensor FR = 1 / {H Period × (Height + 40)}
- Maximum frame rate by interface
  Interface FR = 3000 × 1000000 / (Height × Width × Pack value)
- Maximum frame rate
  FR_Cont = Min (Sensor FR, Interface FR)

- Exposure time possible within frames
  MaxOverlapTime_TrOlrd = (1 / FR_Cont) - (14 × H Period)
- Exposure time outside of frame interval
  NonOverlapExposureTime_TrOlrd = ExposureTime - MaxOverlapTime_TrOlrd
  However, NonOverlapExposureTime_TrOlrd calculation results that are 0 or below will be considered as 0.
  For TriggerWidth, the trigger pulse is equivalent to ExposureTime.
- Maximum frame rate
  FR_TrOlrd = 1 / {(1 / FR_Cont) + NonOverlapExposureTime_TrOlrd}

Tap Geometry	H Period (µs)	Pack Value
8 bit	5.93	8
10 bit packed	6.99	10
12 bit packed	6.99	12
10 bit/12 bit	6.99	16

ExposureMode

The following exposure modes are available on the camera.

ExposureMode	Description
Off	Exposure control is not performed (free-running operation).
Timed	Mode in which control is performed using exposure time. Acquire images using an exposure time configured beforehand on an external trigger.
TriggerWidth	Mode in which control of the exposure time is performed using the pulse width of the trigger input signal. The exposure time will be the same as the pulse width of the trigger input signal. This allows long exposure.

※The settings for exposure control and triggers are related to each other. Be sure to configure the settings described in “Trigger Control”.

Actual Exposure Times

The shortest exposure times that can be configured are as follows.

Exposure Mode	Shortest exposure time
Timed	14.7µs
TriggerWidth	14.7µs

・The actual exposure time will consist of the image sensor’s offset duration (13.7 µs) added to the setting configured on the camera.

・When [ExposureMode] is set to [Timed] and the exposure time is set to 1 µs, the actual exposure time will be as follows.
1 µs + 13.7 µs (offset duration of image sensor) = 14.7 µs

・When [ExposureMode] is set to [TriggerWidth], the exposure is slightly longer than the width of the trigger signal. To achieve an exposure time of 14.7 µs and the exposure time offset is 13.7 µs, use 14.7 µs - 13.7 µs = 1 µs as the high or low time for the trigger signal.

Trigger Control

The camera allows the following controls to be performed via external trigger signals.

TriggerSelector	Description
FrameStart	Start exposure in response to the external trigger signal input. Select this to perform exposure control using external triggers.
AcquisitionStart	Start image acquisition in response to the external trigger signal input.
AcquisitionEnd	Stop image acquisition in response to the external trigger signal input.
AcquisitionTransferStart	Output acquired images at a specified timing in response to an external trigger signal input. * There is a limit to the number of image frames that can be stored internally. The limits for each image format are as follows. Acquired images must be output to avoid exceeding these limits. 8 bit: Up to 8 frames 10 bit: Up to 4 frames 12 bit: Up to 4 frames

- The settings for exposure control and triggers are related to each other. Be sure to configure the settings described in “ExposureMode” .

Shortest Repetition Period for Triggers

The reciprocal of the maximum frame rate is the time required to output one frame. The shortest repetition periods for triggers cannot be lower than that value.

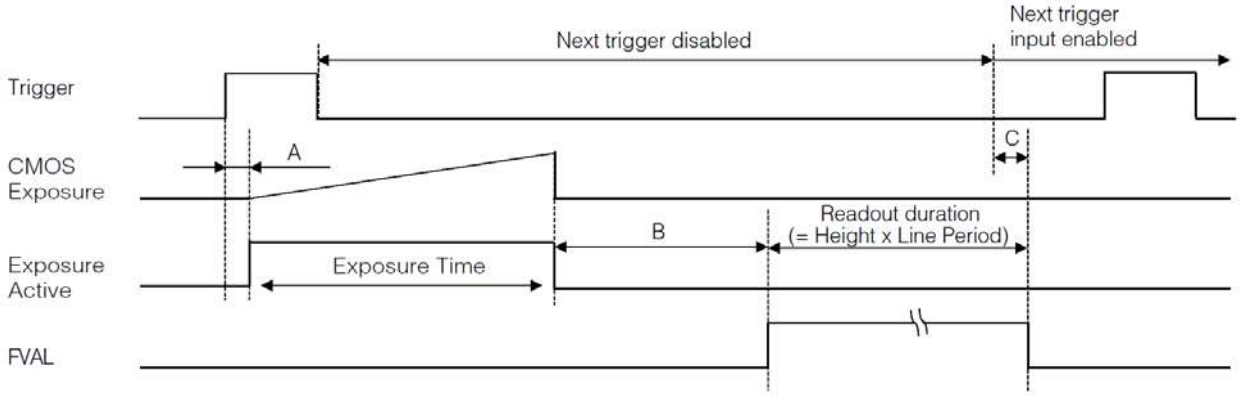
Scanning range	Shortest period of trigger		
	8 bit	10 bit Packed	10 bit
Full	13.426 ms	16.788 ms	26.920 ms
ROI 2/3 (Height=1370)	8.918 ms	11.154 ms	17.905 ms
ROI 1/2 (Height=1028)	6.671 ms	8.354 ms	13.411 ms
ROI 1/4 (Height=514)	3.294 ms	4.123 ms	6.656 ms
ROI 1/8 (Height=256)	1.671 ms	2.004 ms	3.266 ms
Binning Vertical 2*	6.671 ms	8.345 ms	13.411 ms

The above table indicates the shortest trigger periods for when [TriggerOverLap] is set to [Readout]. When [TriggerOverLap] is set to [Off], even when the exposure time is shorter than the frame period, the cycle may be extended.

■ **When [ExposureMode] is [Timed]**

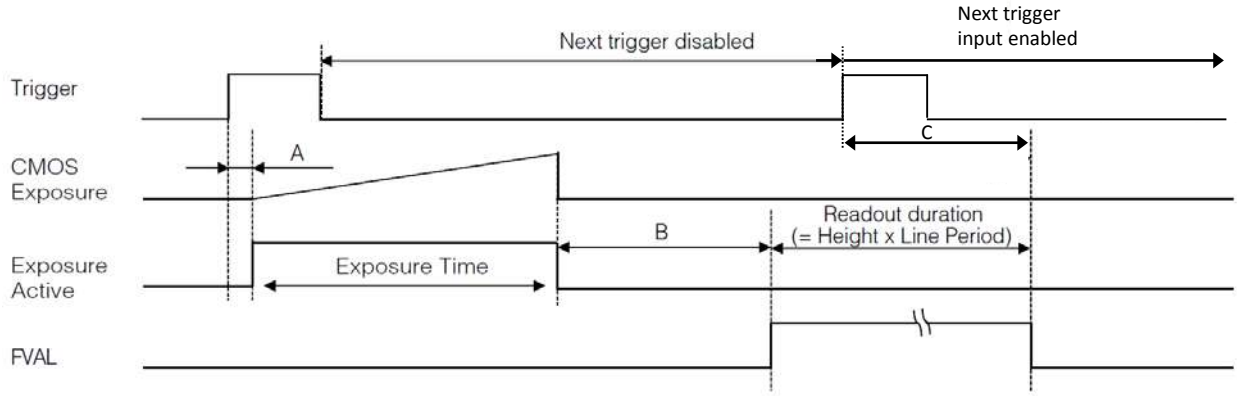
Example: When [TriggerSource] is set to [Line 5 - OptIn1] and [OptInFilterSelector] is set to [10 µs]

• TriggerOverlap : Off



PixelFormat	Sensor Dig Bit	Period from Trigger start edge to Exposure start [A] (usec)	Period from Exposure end to FVAL start [B] (usec)	Period FVAL end to next trigger start [C] (usec)
Mono8	12	25.1	201.8	1.9
Mono10p	12	28.3	238	6.7
Mono10	12	28.3	237	6.1

- **TriggerOverlap : readout**

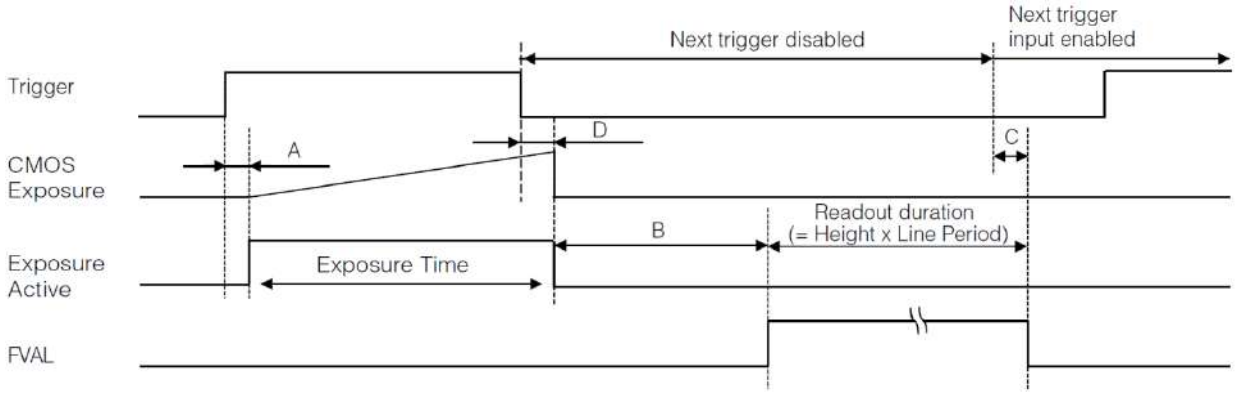


PixelFormat	Sensor Dig Bit	Period from Trigger start edge to Exposure start [A] (usec)	Period from Exposure end to FVAL start [B] (usec)	Period FVAL end to next trigger start [C] (usec)
Mono8	12	25.1	201.8	13,500 - Exposure Time
Mono10p	12	28.3	238	16,900 - Exposure Time
Mono10	12	28.2	238	27,000 - Exposure Time

■ **When [ExposureMode] is [TriggerWidth]**

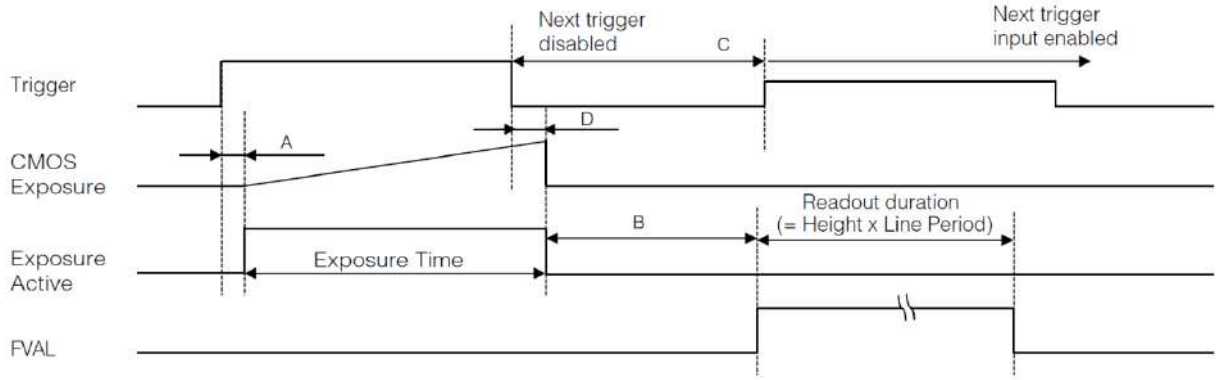
Example: When [TriggerSource] is set to [Line 5 - Optical In 1] and [OptInFilterSelector] is set to [10 µs]

• **TriggerOverlap : Off**



PixelFormat	Sensor Dig Bit	Period from Trigger start edge to Exposure start [A] (usec)	Period from Exposure end to FVAL start [B] (usec)	Period FVAL end to next trigger start [C] (usec)	Period from Trigger end edge to Exposure end [D] (usec)
Mono8	12	25.1	201.8	2.2	25.1
Mono10p	12	28.3	238	6.9	28.3
Mono10	12	28.3	238	6.5	28.3

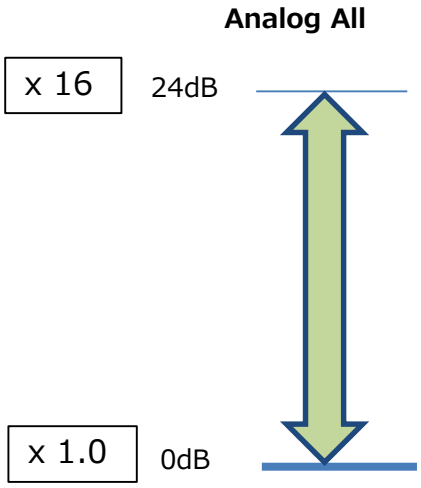
• **TriggerOverlap : readout**



PixelFormat	Sensor Dig Bit	Period from Trigger start edge to Exposure start [A] (usec)	Period from Exposure end to FVAL start [B] (usec)	Next trigger start prohibited period [C] (usec)	Period from Trigger end edge to Exposure end [D] (usec)
Mono8	12	25.1	201.8	23.2	25.1
Mono10p	12	28.3	238	29	28.3
Mono10	12	28.3	238	29.1	28.3

Gain Control

Adjust the [AnalogAll] (master gain) setting.



LineStatus

The line status function allows you to verify the status of external input/output signals. You can verify the status of the following signals.

- Line5-OptIn1, Line6-OptIn2
- NANDGate0In1, NANDGate0In2
- NANDGate1In1, NANDGate1In2
- Line1-TTLOut1, Line2-OptOut1
- TimestampReset

BlemishCompensation

Multiple defective pixels that are not adjacent to each other can occur on conventional CMOS sensor cameras.
This camera features a function that interpolates defective pixels using the surrounding pixels. Up to 256 pixels can be corrected for each of the three sensors. Pixel interpolation can be performed via automatic detection or point-by-point manual settings.

■ Automatic detection

Automatic detection can only detect lit defective pixels (i.e., white blemishes).

1 **Shield the camera sensor.**

If a lens is attached, use the lens cap as a shield, for example.

2 **Configure the threshold level for defective pixel detection.**

Up to 256 pixels can be corrected.
The threshold value is specified as a percentage.
The default setting is "10" with 10% of the full scale (100%) specified as the threshold value.

3 **Execute [BlemishDetect] to start automatic detection.**

After detection, the interpolation data is saved to the camera's internal memory.

To check the number of interpolated pixels after automatic detection
You can check the number of pixels interpolated via automatic detection by loading the BlemishNum data.

■ Manual configuration

1 **Select the index in [BlemishCompensationIndex].**

You can select from 0 to 255. However, configure the indexes in order starting with the smallest index. If you skip indexes while configuring settings, interpolation may not be performed.

2 **Specify the pixel points for interpolation using the [BlemishCompensationPositionX] and [BlemishCompensationPositionY] settings.**

You can configure values that are within the total effective pixel area. Specify pixels for which interpolation is not necessary as -1. If 0 is specified, the first line or first pixel will be interpolated.

Note

BlemishCompensationDataClear[BlemishCompensationIndex], you can return a specific pixel correction setting to the default value (storage not required).

3 **Execute [BlemishStore].**

Blemish compensation data will be stored.

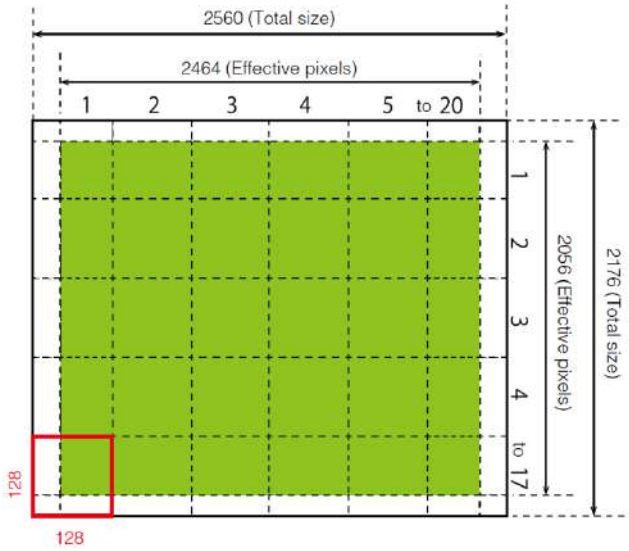
4 **Set [BlemishEnable] to [True], and execute interpolation.**

If it is set to [False] , Blemish compensation is not effective.

ShadingCorrection

The shading correction is a function that corrects non-uniformity (i.e., shading) in the amount of light generated by the lens and lighting equipment. Using this function allows correction even if top, bottom, left, and right shading is not symmetrical in relation to the center of the screen (H, V).

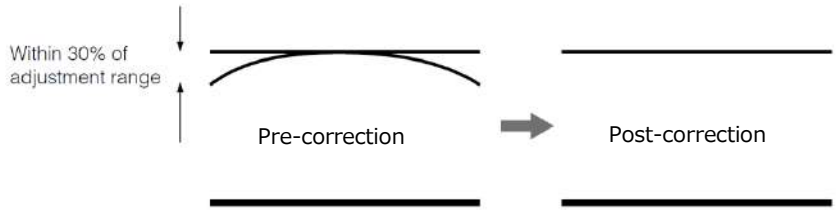
The size of the correction block is 20 (H) × 17 (V) blocks and calculation errors in the correction data are minimized due to the small interpolation block. Each block is 128 × 128 pixels.The total size of the blocks is 2560 (H) × 2176 (V), but the actual number of effective pixels for the camera is 2464 (H) × 2056 (V). The ineffective peripheral areas will be deleted internally on the camera automatically.



The following shading correction modes are available on the camera.

■ FlatShading

Correction is performed using the area of the screen with the highest brightness level as the reference, and adjusting the brightness levels of the other areas to match this level.



Caution

Proper correction is not possible under the following conditions.

- If an area with a brightness level that is more than 30% less than the reference level exists within the screen
- If the brightness level is saturated in parts or all of the screen
- If the area in the screen with the highest brightness level is 300 LSB or less (during 10-bit video output)

■ **To use the shading correction function**

Configure the settings as follows.

Item	Setting value	Description
ShadingCorrectionMode	FlatShading	Select the shading correction mode.
ShadingMode	User1, User2, User3, Off	Select the user area to which to save the shading correction value.

Display a white chart under a uniform light, and execute [PerformShadingCalibration].

Note

After shading correction is executed, the shading correction value is automatically saved to the user area selected in [ShadingMode].

Sequencer Function

The Sequencer function lets you define up to 128 index combinations of exposure time, gain, ROI, and other settings which can be stepped through each time a trigger is received.This is particularly useful for quickly capturing multiple exposures of objects under inspection to adjust for areas or components with significantly different levels of reflectance. You can specify the next index in the stepping sequence and the order in which indexes are executed. Multiple indexes can also be executed repeatedly.

Two operation modes (TriggerSequencer mode and CommandSequencer mode) are available for the Sequencer function.

Note

The following four conditions must be met to use the Sequencer function.

1. [PolarizeImageSelector] is [RawImage].
2. Sequencer Width, Sequencer Offset X function, and Sequencer H Binning function cannot be used at the same time.
3. Sequencer Height, Sequencer Offset Y function, and Sequencer V Binning function cannot be used at the same time.

About indexes (imaging conditions)

Up to 128 indexes can be configured.The following settings can be configured for each index. However, SequencerFrameNumber and SequencerSetNext can only be configured in TriggerSequencer mode.

Trigger Sequencer mode

With this mode, the Sequencer Trigger “pattern” is predetermined by the user. The user defines up to 128 different “indexes.” The items indicated in the above index can be configured for each index. The operation of this mode is controlled using the following five commands.

[SequencerSetActive]

This allows you to confirm the currently configured index number.

[SequencerSetStart]

This configures the index number to execute at the start of TriggerSequencer mode.

[SequencerReset]

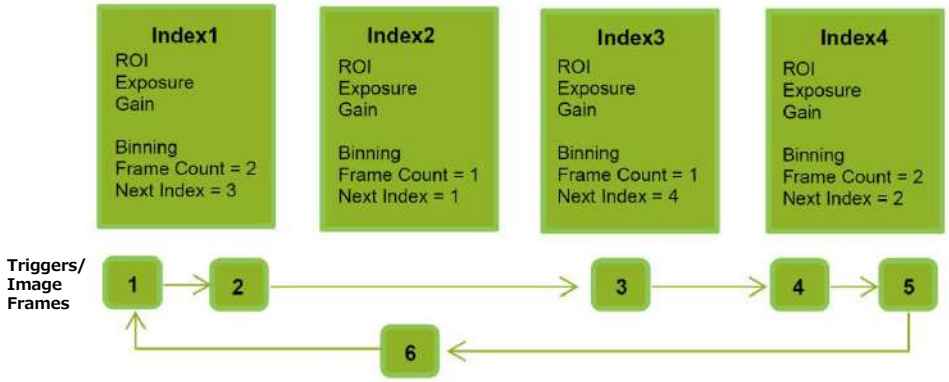
During TriggerSequencer mode operation, this switches the index number to be executed to that specified in [SequencerSetStart].

[SequencerRepetition]

This parameter applies to TriggerSequencer patterns which include an index whose [SequencerROINextIndex] is set to 0 (OFF).When the index whose [SequencerROINextIndex] is set to 0 (OFF) is finished executing, the value of Sequencer Repetition (range = 1-255) is decremented internally. If the result of the decrement is not zero, the TriggerSequencer pattern starts over from the index specified in SequencerSetStart. If the result of the decrement is zero, the status changes to Acquisition Stop and external triggers are not accepted.

Sample TriggerSequencer mode operation

User-defined Indexes (up to 128)



1 **Specify "1" in [SequencerSetStart], and start TriggerSequencer mode with index 1.**

2 **Capture a 2-frame image with the first and second triggers.**

3 **For the next index, configure index 3 specified in [SequencerSetNext], and capture an image with the number of frames (number of triggers) specified in [SequencerFrameNumber].**

Proceed to sequence from index 4 to index 2 to index 1.

Note

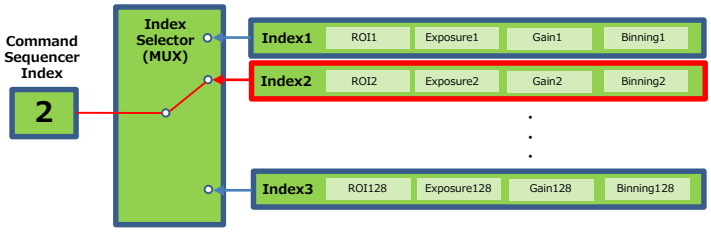
In addition to repeating multiple conditions as in the above example, you can specify "0" (which indicates the end of TriggerSequencer mode) in [SequencerSetNext] of index 2, and specify the number of repetitions in [SequencerRepetition].

Command Sequencer mode

As with TriggerSequencer mode, you can define up to 128 indexes beforehand in this mode. Set [SequencerCommandIndex] to point to one of your pre-configured indexes. This index will be executed on each trigger, until it is changed to point to a different index, typically by your vision application. In this way, Command Sequencer mode allows you to programmatically adjust your sequence in response to image analysis or input from other sensors.

Note

- The same index table will be executed for subsequent triggers unless the [CommandSequencerIndex] value is changed.
- [SequencerFrameNumber] and [SequencerSetNext] cannot be used in CommandSequencer mode.



Delayed Readout

Delayed readout allows images captured by a [FrameStart] trigger command to be stored temporarily inside the camera (delayed readout buffer) and read out using a [AcquisitionTransferStart] trigger after capture.This function is useful when executing triggers simultaneously on multiple cameras.

Note

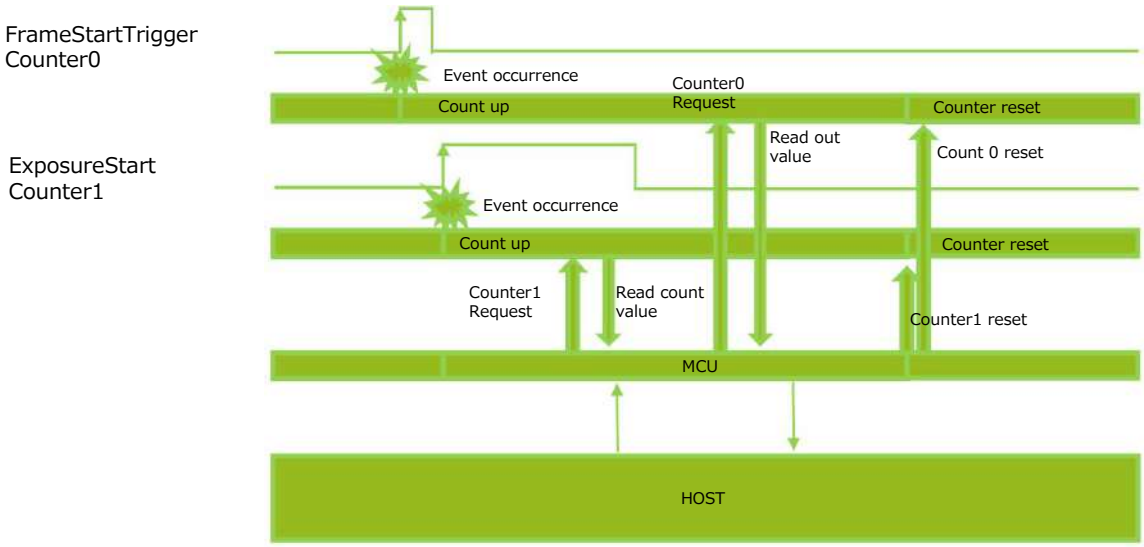
This function imposes a heavy processing load on the network bandwidth, as images from multiple cameras are read out simultaneously. The number of frames that can be stored for delayed readout depends on PixelFormat.

For details, see “Trigger Control” .

CounterAndTimerControl Function

The counter function counts up change points in the camera’s internal signals using the camera’s internal counter, and reads that information from the host side. This function is useful for verifying error conditions via the count value using internal camera operations.Counting is performed at frame trigger, frame start, exposure start, and exposure transfer end, and by comparing these values, you can determine the internal camera state at which missed triggers will occur.

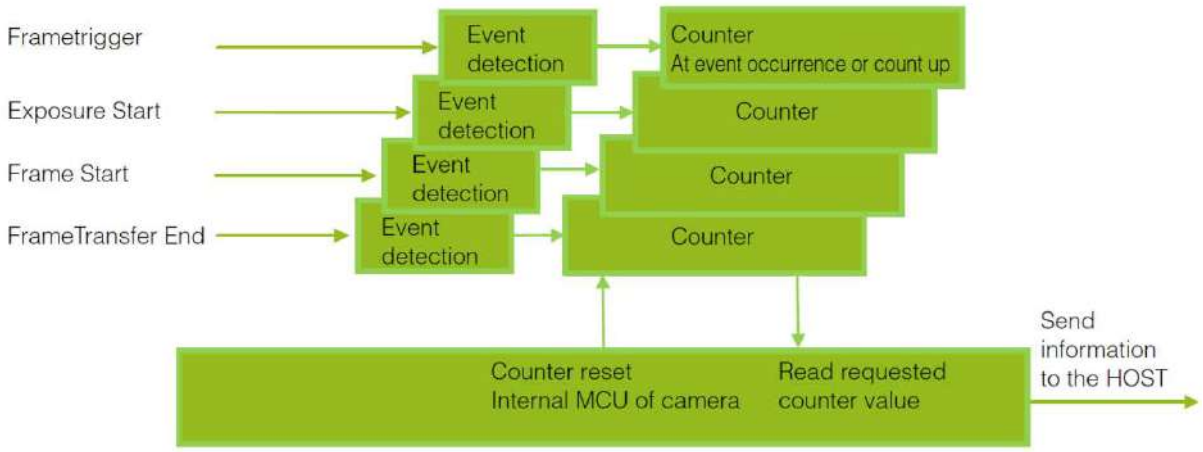
■ **Counter occurrence diagram**



Note

You can reset a specific counter's count value by executing CounterReset[Counter0, Counter1, Counter2, Counter3].

■ **Internal camera blocks**



■ **To use the counter function**

Configure the settings as follows.
Three counters can be configured (Counter 0 to 2).

Item		Setting value / selectable range	Description
Counter 0 to 2		Counter 0 to 2	Select the counter.
	Counter 0 to 2 Event Source	Off, Frame Trigger, Frame Start, Exposure Start, Exposure Transfer End	Select the counter event signal for which to read the count value.
	Counter 0 to 2 Event Activation	Rising Edge or Falling Edge	Specify the timing at which to count.

* The three counter event signals are always counted up internally on the camera.

Chunk Data Function

The Chunk Data function adds camera configuration information to the image data that is output from the camera. Embedding camera configuration information in the image data allows you to use the serial number of the camera as a search key and find specific image data from among large volumes of image data. In addition, when images are shot with a single camera in sequence under multiple setting conditions, you can search for images by their setting conditions.
The following information can be added to image data as chunk data.

■ **Configuring Chunk Data**

1 **Set [ChunkModeActive] to [True].**

2 **Select the items of information you want added to image data with [ChunkSelector], and set [ChunkEnable] from [False] to [True].**

Note

When [ChunkModeActive] is set to [True], [ChunkImage] is automatically set to [True].

Caution

The Chunk Data function settings cannot be changed during image output. To change the settings, stop Acquisition.

*) For items that can be added to image data as Chunk Data, refer to [m) ChunkDataControl] in the setting item list.

Video Process Bypass Mode

The video process bypass mode is a function that bypasses internal video processing on the camera. When bypass is enabled, the sensor output and camera output data can be set to the same bit width. Operation using 12-bit outputs must be performed in bypass mode.

Functions disabled in Video Process Bypass mode
BlackLevel, Shading, Binning(H, V)
Polarize Image Selector (Fixed to Raw Image)

PixelFormat available only in Video Process Bypass mode
Mono12, Mono12p

Setting List

Feature Properties

Item	Setting range	Default value	Description
a) Device Control			Display/configure information related to the device.
Device Vendor Name	—	"JAI Corporation"	Display the manufacturer name.
Device Model Name	—	GO-5100MP-USB	Display the model name.
Device Manufacturer Info	—	See the possibilities	Display the manufacturer information.
Device Version	—	—	Display the hardware version.
Device Firmware Version	—	—	Display the firmware version.
Device Fpga Version	—	—	Display the FPGA version.
Device Serial Number	—	—	Display the device ID.
Device User ID	Any	—	Set the user ID (64bytes) for the camera.
Device Temperature Selector	Mainboard	Mainboard	Select the area of the camera's interior for which to display the temperature sensor's reading. (fixed Mainboard)
Device Temperature(C)	—	—	Display the internal temperature (°C) of the camera.
Device Reset	—	—	Reset the device. (After the camera receives this command, it returns an ACK response. Then, execute reset.)

Item	Setting range	Default value	Description
b) Image Format Control			Configure image format settings.
Sensor Width	2464	2464	Display the maximum image width.
Sensor Height	2056	2056	Display the maximum image height.
Width Max	2464	2464	Display the maximum image width.
Height Max	2056	2056	Display the maximum image height.
Width	BinningHorizontal 1: 16～2464 BinningHorizontal 2: 16～1232	2464	Set the image width.
Height	BinningVertical 1: 1 ～ 2056 step 2 BinningVertical 1: 1 ～ 1028 step 2	2056	Set the image height.
Offset X	BinningHorizontal 1: 0～2448 BinningHorizontal 2: 1～1216	0	Set the horizontal offset.
Offset Y	BinningVertical 1: 0 ～ 2055 BinningVertical 1: 0 ～ 1027	0	Set the vertical offset.
Binning Horizontal Mode	Average, Sum	Sum	Set the addition process to be used during horizontal binning.
Binning Horizontal	1,2	1	Set the number of pixels in the horizontal direction for which to perform binning.
Binning Vertical Mode	Average, Sum	Sum	Display the addition process to be used during vertical binning.
Binning Vertical	1,2	1	Set the number of pixels in the vertical direction for which to perform binning.
Pixel Format	Mono8, Mono10, Mono10p Mono12, Mono12p	Mono8	Set the pixel format. The following mode are enabled when [VideoProcessBypassMode] is set to [On]. Mono12, Mono12p
Test Pattern	Off, GreyHorizontalRamp, GreyVerticalRamp, GreyHorizontalRampMoving	Off	Select the test image.

Item	Setting range	Default value	Description
c) Acquisition Control			Configure image capture settings.
Acquisition Mode	Single Frame, Multi Frame, Continuous	Countinuous	Select the image capture mode.
Acquisition Start	—	—	Start image capture.
Acquisition Stop	—	—	Stop image capture.
AcquisitionFrameCount	1～255	1	In [MultiFrame] mode, set the number of frames to capture.
AcquisitionFrameRate(Hz)	0.125～74.0192	74.0192	Set the frame rate as a frequency. (unit: Hz) The maximum value varies depending on the PixelFormat and ROI settings.
Trigger Selector	Acquisition Start, Acquisition End, Frame Start, Acquisition Transfer Start	Frame Start	Select the trigger operation.
Trigger Mode	Off, On	Off	Select the trigger mode.
Trigger Software	—	—	Execute a software trigger.
Trigger Source	Low High Software Pulse Generator0 User Output 0 User Output 1 Line5 NAND0 NAND1	Line 5	Select the trigger signal source.
Trigger Activation	Rising Edge Falling Edge	Rising Edge	Select the polarity of the trigger signal (i.e., location of signal at which trigger is applied).
Trigger Overlap	Off, ReadOut	Off	Select the trigger overlap operation.
ExposureMode	Off, Timed, Trigger Width	Timed	Select the exposure mode.
ExposureTime	1 ～	—	Set the exposure time. The specifiable range varies depending on the [StartTriggerMode] and [PixelFormat] setting.
ExposureAuto	Off, Continuous	Off	Set whether to enable auto exposure.

Item	Setting range	Default value	Description
d) Analog Control			Configure analog control settings.
Gain Selector	Analog All	Analog All	Select the gain to configure.
Gain	x1.0 ～ x16.0	x1.0	Set the gain value for the gain setting selected in [GainSelector].
Black Level Selector	Digital All	Digital All	Select the black level to configure.
Black Level	-133～255	0	Set the black level value.
GainAuto	Off, Continuous	Off	Enable/disable gain auto adjustment. [Once] automatically changes to [Off] when the signal level converges once.

Item	Setting range	Default value	Description
e) Digital I/O control			Configure settings for digital input/output.
Line Selector	Line2, Line3, Line5, Time Stamp Reset, NAND0_In_1, NAND0_In_2, NAND1_In_1, NAND1_In_2	Line2	Select the input/output to configure.
Line Source	Low, High, Acquisitiion Trigger Wait, Acquisition Active, Frame Trigger Wait, Frame Active, Exposure Active, JAIFVAL, User Output 0, User Output 1, Opt In 1, JAIPulseGenerator0, NAND0, NAND1,	Low	Select the line source signal for the item selected in [LineSelector].
Line Inverter	True, False	False	Enable/disable polarity inversion for the selected input signal or output signal.
Line Status	True, False	—	Display the status of the input signal or output signal (True: High, False: Low).
Line Mode	Input, Output	—	Display the input/output status (whether it is input or output).
Line Format	—	Opto Coupled	Display the signal format.
Line Status All	—	0x00	Display the input/output signal status. The state is shown with 16 bits. Bit assignments are as follows. [0] (unused) [1] Line2 - OptOut1 [2] Line3 - OptOut2 [3] (unused) [4] Line5 - Opt In 1 [5], [6], [7], [8], [9], [10] (unused) [11] Time Stamp Reset [12] NAND Gate 0 In 1 [13] NAND Gate 0 In 2 [14] NAND Gate 1 In 1 [15] NAND Gate 1 In 2
User Output Selector	User Output 0 User Output 1	User Output 0	Set the UserOutput signal.
User Output Value	True, False	False	Set the value for the UserOutput selected in [UserOutputSelector].

Item	Setting range	Default value	Description
f) Counter And Timer Control			Configure counter settings. (This camera only supports counter functions.)
Counter0 Event Source	Off, Frame Trigger, Frame Start, Exposure Start, Frame Transfer End	Off	Assign the counter event signal for which you want to read the count value to a dedicated counter, and read the value.
Counter0 Event Activation	Rising Edge Falling Edge	—	Set the count timing.
Counter0 Reset	—	—	Reset the counter.
Counter0 Refresh	—	—	Update the count value.
Counter0 Value	—	0	Display the count value.
Counter0 Status	Counter Active	Counter Active	Display the counter status. CounterIdle: Idle CounterActive: Counting CounterOverflow: Count value exceeded the mazimum value
Counter1 Event Source	Off, Frame Trigger, Frame Start, Exposure Start, Frame Transfer End	Off	Assign the counter event signal for which you want to read the count value to a dedicated counter, and read the value.
Counter1 Event Activation	Rising Edge Falling Edge	—	Set the count timing.
Counter1 Reset	—	—	Reset the counter.
Counter1 Refresh	—	—	Update the count value.
Counter1 Value	—	0	Display the count value.
Counter1 Status	Counter Active	Counter Active	Display the counter status. CounterIdle: Idle CounterActive: Counting CounterOverflow: Count value exceeded the mazimum value
Counter2 Event Source	Off, Frame Trigger, Frame Start, Exposure Start, Frame Transfer End	Off	Assign the counter event signal for which you want to read the count value to a dedicated counter, and read the value.
Counter2 Event Activation	Rising Edge Falling Edge	—	Set the count timing.
Counter2 Reset	—	—	Reset the counter.
Counter2 Refresh	—	—	Update the count value.
Counter2 Value	—	0	Display the count value.
Counter2 Status	Counter Active	Counter Active	Display the counter status. CounterIdle: Idle CounterActive: Counting CounterOverflow: Count value exceeded the mazimum value
Item	**Setting range**	**Default value**	**Description**
g) User Set Control			Configure user settings.
User Set Selector	Default, UserSet1, UserSet2, UserSet3	Default	Select the user settings.
User Set Load	0(default), 1, 2, 3	—	Load user settings. (If 0 is specified, the factory default setting is read.)
User Set Save	1,2,3	—	Save the current setting values as user settings.

Item	Setting range	Default value	Description
h) Sequencer Control			Configure sequencer settings.
Sequencer Mode	Off, On	Off	Enable(On)/disable(Off) [SequencerMode].
Sequencer Mode Select	Trigger Sequencer Mode, Command Sequencer Mode	Trigger Sequencer Mode	Select the sequencer mode.
Sequencer Configuration Mode	Off, On	On	Select [On] to change the settings within the index.
Sequencer Set Selector	1～128	1	Select the index number to configure.
Sequencer Frame Number	1～255	1	Set the number of frames to display for the selected SequencerIndex. (Enabled only for TriggerSequencer.)
Sequencer Set Next	0～128	—	Set the next index to be displayed for the selected SequencerIndex. (Enabled only for TriggerSequencer.) If 0 is specified, the operation of Sequencer is stopped.
Sequencer Width	16～2464	2464	Set the width of the selected SequencerIndex.
Sequencer Height	1～2056	2056	Set the height of the selected SequencerIndex.
Sequencer OffsetX	0 ～ 2448	0	Set the horizontal offset value for the selected SequencerIndex.
Sequencer OffsetY	0 ～ 2055	0	Set the vertical offset value for the selected SequencerIndex.
Sequencer Gain	100～1600	100	Set the GainAnalogAll value.
Sequencer Exposure Time	1 ～ 8000000	—	Set the exposure time for the selected SequencerIndex.
Sequencer Black Level	-133～255	0	Set the BlackLevelDigitalAll for the selected SequencerIndex.
Sequencer H Binning	1,2	1	Set the H Binning for the selected SequencerIndex. Binning Horizontal Mode setting is applied in binning mode.
Sequencer V Binning	1,2	1	Set the V Binning for the selected SequencerIndex. Binning Vertical Mode setting is applied in binning mode.
Sequencer Repetition	1～255	1	Set the repeat count for the sequencer.
Sequencer Set Active	1～128	1	Displays the sequencer set number.
Sequencer Command Index	1～128	1	Set this to change the SequencerIndex. (Enabled only for CommandSequencer.)
Sequencer Set Start	1～128	1	Specify the first index number to switch to when starting [TriggerSequencerMode].
Sequencer Reset	—	—	In [TriggerSequencerMode], reset the current index number to the number configured in [SequencerSetStart].

Item	Setting range	Default value	Description
i) ChunkDataControl			Configure chunk control settings.
Chunk Mode Active	True, False	False	Set whether to enable ChunkData.
Chunk Selector	Image Offset X, Offset Y, Width, Height, Pixel Format, TimeStamp, Line Status All, ExposureTime, Gain All, Black Level All, Sequencer Set Active, Frame Trigger Counter, Exposure Start Counter, Fame Start Counter, Frame Transfer End Counter, Line Status All On FVAL Start, Device Temperature, Device Serial Number, Device User ID	OffsetX	Select the ChunkData to be added.
ChunkEnable	True, False	False	Select whether to output ChunkData. Default: Only [ChunkImage] is [True].

Item	Setting range	Default value	Description
j) Test Control			
Test Pending Ack (ms)	—	—	PendingAck function test command. The camera waits for TestPendingAck (ms) time and returns an Ack response.

Item	Setting range	Default value	Description
k) TransportLayerControl			Display information on transport layer control.
PlayloadSize (B)			Display the payload size.
DeviceTapGeometry	—	Geometry_1X_1Y	Set the transfer method (tap configuration) of images transferred from the camera at one time.

Item	Setting range	Default value	Description
l) PulseGenerator			Configure pulse generator settings.
Clock Pre Scaler	1～4096	165	Set the division value for the prescaler (12 bit) using PixelClock as the base clock.
Pulse Generator Clock (MHz)	0.018127～74.25	0.45	Set the clock used for the pulse generator. This value is calculated using the [ClockPreScaler] value as a base.
Pulse Generator Selector	Pulse Generator 0	Pulse Generator 0	Select the pulse generator.
Pulse Generator Length	1～1048575	30000	Set the maximum count-up value as a clock count.
Pulse Generator Length (ms)	0.00222222～2330.17	66.6667	Set the maximum count-up value in milliseconds. This value is calculated using the [PulseGeneratorLength] value as a base. The setting range varies depending on the [ClockPreScaler] value.
Pulse GeneratorFrequency (Hz)	0.429154～450000	15	Set the maximum count-up value as a frequency. This value is calculated using the [PulseGeneratorLength] value as a base.
Pulse Generator Start Point	0 ～ 1048575	0	Set the start point of the High interval as a clock count. When the counter reaches this value, the output will be 1.
Pulse Generator Start Point (ms)	0.002222～2330.166666	0	Set the start point of the High interval in milliseconds. When the counter reaches this value, the output will be 1. The setting range varies depending on the [ClockPreScaler] value.
Pulse Generator End Point	1 ～ 1048575	15000	Set the start point of the Low interval as a clock count. When the counter reaches this value, the output will be 0.
Pulse Generator End Point (ms)	0.002222～2330.166666	33.3333	Set the start point of the Low interval in milliseconds. When the counter reaches this value, the output will be 0. The setting range varies depending on the [ClockPreScaler] value.
Pulse Generator Pulse Width (ms)	0.002222～2330.166666	33.3333	Display the High interval width of the pulse in milliseconds. The duration between the Start Point and End Point is calculated. The setting range varies depending on the [ClockPreScaler] value.
Pulse Generator Repeat Count	0 ～ 255	0	Set the repeat count for the counter. When this is set to [0], a free counter is enabled with no repeat limit.

Pulse Generator Clear Activation	Off, LevelHigh, LevelLow, RisingEdge, FallingEdge	Off	Set the clear signal condition for the count clear input of the pulse generator.
Pulse Generator Clear Source	Low, High, Acquisitiion Trigger Wait, Frame Trigger Wait, Frame Active, Exposure Active, FVAL, LVAL, User Output 0 User Output 1 Line5 - Opt In 1 NAND0 Out NAND1 Out	Low	Select the count clear input signal source.
Pulse Generator Clear Inverter	True, False	False	Select whether to invert the polarity of the count clear input signal.
Pulse Generator Clear Sync Mode	Async Mode, Sync Mode	Async Mode	Select the sync mode for the count clear input signal.

Item	Setting range	Default value	Description
m) JAI Custom Control ALC			Configure JAI ALC settings. These settings are also used for AGC (auto gain control).
ALC Reference	10 ～ 95	50	Set the target level for ALC. (unit: %)
ALC Area Selector	Low Right, Low Mid-Right, Low Mid-Left, Low Left, Mid-Low Right, Mid-Low Mid-Right, Mid-Low Mid-Left, Mid-Low Left, Mid-High Right, Mid-High Mid-Right, Mid-High Mid-Left, Mid-High Left, High Right, High Mid-Right, High Mid-Left, High Left	Low Right	Select the area for which to configure [ALCAreaEnable].
ALC Area Enable	True, False	True	Enable/disable the photometry area selected in [ALCAreaSelector].
ALC Area Enable All	True, False	True	True: Operate ALC with all areas designated as photometry areas, regardless of the individual enabled/disabled photometry area states configured in [ALCAreaSelector]. False: Operate ALC according to the individual enabled/disabled photometry area states configured in [ALCAreaSelector].
AutoShutterControlExposureMin	100 ～ 13426	100	Set the minimum value for the ExposureAuto(ASC) control range.
AutoShutterControlExposureMax	101 ～ 13427	13427	Set the maximum value for the ExposureAuto(ASC) control range.
AutoGainControlGainRawMin	100 ～ 1599	100	Set the minimum value for the GainAuto(ASC) control range.
AutoGainControlGainRawMax	101 ～ 1600	1600	Set the maximum value for the GainAuto(ASC) control range.
ALC Control Speed	1 ～ 8	4	Set the response speed for AGC/ASC. (8 is the fastest.)
ALC Status	Off, ASC, AGC	—	Allows confirmation of the current operation area during ALC operation.

Item	Setting range	Default value	Description
n) JAI Custom Control Blemish			Configure settings for JAI white blemish correction.
Blemish Enable	True, False	True	Enable/disable blemish correction.
Blemish Detect	—	—	Execute blemish detection.
Blemish Detect Threshold	1 ～ 100	10	Set the blemish detection threshold.
Blemish Compensation Index	0 ～ 255	0	Select the index for the target blemish coordinates (BlemishDataPosition X/Y).
Blemish Compensation PositionX	-1 ～ 2463	-1	Display the X coordinate (horizontal pixel position) of the target blemish selected in [BlemishCompensationIndex]. You can also manually enter the X coordinate of the blemish you want to correct.
Blemish Compensation PositionY	-1 ～ 2055	-1	Display the Y coordinate (vertical pixel position) of the target blemish selected in [BlemishCompensationIndex]. You can also manually enter the Y coordinate of the blemish you want to correct.
Blemish Compensation Number	0 ～	—	Display the number of target blemishes.

Item	Setting range	Default value	Description
o) JAI Custom Control Shading			Configure shading correction settings.
Shading Correction Mode	Flat Shading	Flat Shading	Select the shading correction method.
Shading Mode	Off, User1, User2, User3	Off	Set the area to which to save shading correction data. When this is set to [Off], shading correction data is not saved.
Perform Shading Calibration	—	—	Execute shading correction.
Shading Detect Result	—	—	Display the shading correction results.

Item	Setting range	Default value	Description
p) JAICustomControlPolarized			Configure controling polarization settings.
Polarize Image Selector	Raw Image, Four Polarize Element, Four Functions, Color on Picture, Color on Gray	Raw Image	Set the video output mode.
Panel1 Selector	PolarizeAngle, PolarizeAmplitude, PolarizeDegree, DiffusedLight, PolarizedLight, AverageLight,	—	This mode allows you to set the image to output by assigning any of the following six information items to each area of the screen divided into four. The six information items are as follows. PolarizeAngle, PolarizeAmplitude, PolarizeDegree, DiffusedLight, PolarizedLight, AverageLight Panel 1 to 4 show the 4 division positions as shown below. Panel1 Selector : top left Panel2 Selector : top right Panel3 Selector : bottom left Panel4 Selector : bottom right
Panel2 Selector	PolarizeAngle, PolarizeAmplitude, PolarizeDegree, DiffusedLight, PolarizedLight, AverageLight,	—	
Panel3 Selector	PolarizeAngle, PolarizeAmplitude, PolarizeDegree, DiffusedLight, PolarizedLight, AverageLight,	—	
Panel4 Selector	PolarizeAngle, PolarizeAmplitude, PolarizeDegree, DiffusedLight, PolarizedLight, AverageLight,	—	
Reflection Adjust [%]	50 ～ 200 % step 10	100	The ratio for removing the polarized light component can be changed by adjusting Reflection Adjust. If ReflectionAdjust is set higher, DiffusedLight with more of the polarized light component removed can be obtained.

Item	Setting range	Default value	Description
q) JAICustomControlMisc			Configure settings for other JAI functions.
VideoProcessBypassMode	Off, On	Off	Enable/disable VideoProcessBypass mode.
Trigger Option	Off	Off	
OptIn Filter Selector	10µs, 100µs, 500µs, 1ms, 5ms, 10ms		Select the surge protection filter
Video Send Mode	Normal Mode, Trigger Sequencer Mode, Command Sequencer Mode	Normal Mode	Display the [VideoSendMode].
Sensor LVDS Ch Num	8	8	Display the number of sensor output LVDS channels.
Sensor Digitization Bits	10Bits, 12Bits	10Bits	Display the resolution per pixel of sensor output.

Miscellaneous

Troubleshooting

Check the following before requesting help. If the problem persists, contact your local JAI distributor.

■ Power supply and connections

Problem	Cause and solution
The POWER/TRIG LED remains lit amber and does not turn green, even after power is supplied to the camera.	Camera initialization may not be complete due to lack of a network connection. Check the 12-pin power cable connection.

■ Image display

Problem	Cause and solution
Gradation in dark areas is not noticeable.	Use the gamma function to correct the display. As the light-emitting properties of the monitor are not linear, the entire image may be darker or the gradation in the dark areas may be less noticeable when camera outputs are displayed without processing. Using the gamma function performs correction to produce a display that is close to linear. For details, see “Gamma Function”.

■ Settings and operations

Problem	Cause and solution
Settings cannot be saved to user memory.	You cannot save to user memory while images are being acquired by the camera. Stop image acquisition before performing the save operation.
I want to restore the factory default settings.	Load [Default] under [User Set Selector] in the [Feature Properties] tab to restore the factory default settings.

Specifications

Item			GO-5100MP-USB
Scanning system			Progressive scan, 1 tap
Synchronization			internal
Interface			USB 3 Vision compatible
Image sensor			monochrome CMOS image sensor with a four-directional polarization grid
Image size (effective image)			2/3-inch 8.5mm(H) x 7.09mm(V) : 11.1mm(diagonal)
Pixel size			3.45 µm (H) x 3.45µm(V)
Effective image pixel (Image sensor)			2464(H) x 2056(V)
Acquisition Frame Rate (max)	8bit	Mono8	74.0 fps
	10 Packed	Mono10Packed	59.2 fps
	12bit Packed	Mono12Packed	49.0 fps
	10/12bit UnPacked	Mono10, Mono12	37.0 fps
EMVA1288 parameters Absolute sensitivity Maximum SN ratio			T.B.D.
Digital image output format	Full		2464(H) x 2056(V)
	ROI	Width	16 ～2464 pixels, 16 pixels/step
		Offset X	0 ～2448 pixels, 16 pixels/step
		Height	1 ～2056 lines, 2 lines/step
		Offset Y	0 ～2054 lines, 2 lines/step
	Pixel Format		Mono8,Mono10, Mono10P, Mono12, Mono12p *When the video output mode is ColorOnPicture mode or ColorOnGray mode. BayerRG8, BayerRG10, BayerRG10p
Acquisition Mode			Continuous / Single Frame / Multi Frame（1 ～ 255）
Trigger Selector	Acquisition		Acquisition Start / Acquisition Stop
	Exposure		Frame Start
	Transfer		AcquisitionTransfer Start（delayed readout）
OptIn filter (for trigger noise)			5 steps (10 µs(Typ), 100 µs, 500 µs, 1ms, 5ms, 10ms)
Trigger overlap			Off / Read out
Trigger input signals			Line 5 (Opt In)、Software、PG0、NAND Out 0/1、Action 1/2
Exposure Mode	Timed		14.7 µs（min） ～ 8 s（max） variable unit : 1 µs ❖ Performance verified for up to 1 second.
	Trigger Witdh		14.7 µs（min） ～ ∞ s（max） variable unit : 1 µs ❖ Performance verified for up to 1 second.
Video send mode			Normal Mode, Trigger Sequencer Mode, Command Sequencer Mode, Multi Mode
Digital I/O			Line Selector（6P） : GPIO IN / GPIO OUT
Black Level adjustment	Default level		33LSB@10bit
	Video level adjustment range		0 ～ 100 @10bit －33LSB ～+64LSB against reference level（during 10bit output）
	Adjustment range		1 STEP ＝0.25LSB
Gain adjustment	Manual adjustment range		0dB ～ 24dB 1 step = x 0.01 (0.005dB～0.08dB:varies by setting value)
Blemish correction	Detection		Detect white blemishes using threshold values (black blemish correction performed only at factory)
	Correction		Interpolation using nearby pixels (continuous blemishes not corrected)
	Correctable pixels		256 pixels
Vibration resistance			10G（20 Hz ～ 200 Hz X-Y-Z direction）
Impact resistance			80G
Power supply	6-pin connector	Input range	DC + 12 V ～+ 24 V ± 10%（Via input terminal）
		Power consumption	4.2 W (typ.) (at 12 V input, full pixel)
	USB BUS Power	Input range	DC 5V
		Power consumption	4.35 W (typ.) (at 5 V input, full pixel)
Lens mount			C mount Lens mount protrusion length of 9 mm or less is supported
Flange back			17.526, tolerance: 0 mm ～− 0.05 m
Optical filter			none
Verified performance temperature / humidity			− 5℃～+ 45℃ / 20%～ 80%（non-condensing）
Storage temperature / humidity			− 25℃～+ 60℃ / 20%～ 80%（non-condensing）
Regulations			CE（EN61000-6-2 and EN61000-6-3）、FCC part 15 class B、 RoHS、WEEE
Dimensions (housing)			29 × 29 × 41.5 mm（W×H×D） (excluding mount protrutions)
Weight			46 g

Package contentsCamera
body (1)
Sensor protection cap (1)
Dear Customer (sheet) (1)

Optional accessories (not supplied)
MP-43 tripod mount

Design and specifications are subject to change without notice.

Approximately 5 minutes of warm-up are required to achieve these specifications.

Caution

About the verified performance temperature make sure the following temperature conditions are met when operating the unit.
1) The camera's internal temperature sensor detects temperatures of 65 °C or less during operation.
2) The top surface of the camera's casing is 61°C or less.

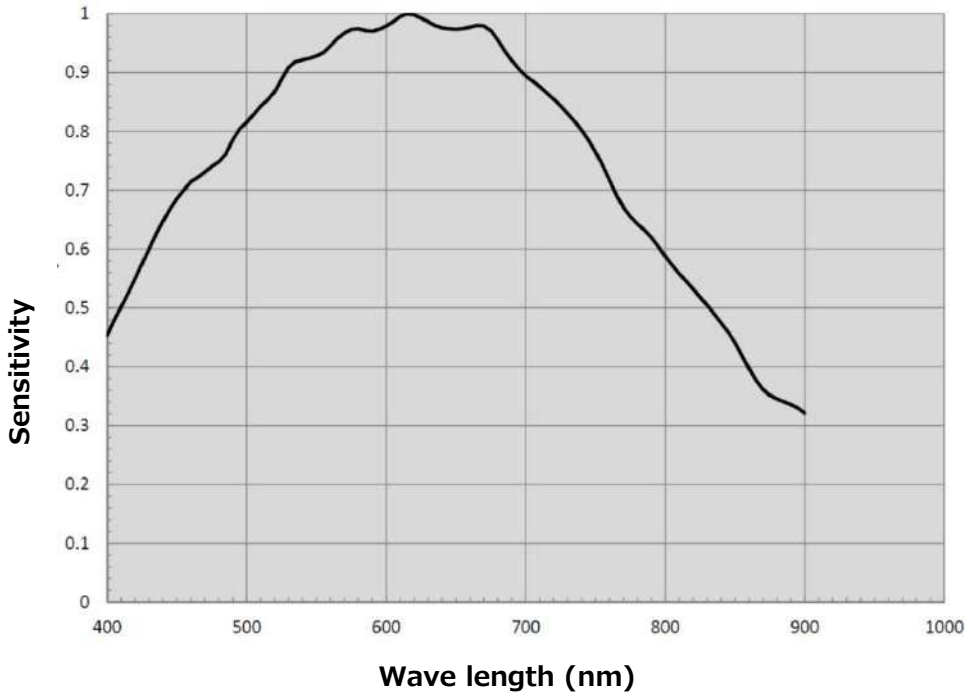
If the above temperature conditions are exceeded, take measures to dissipate heat according to your installation environment and conditions.

Frame Rate Reference

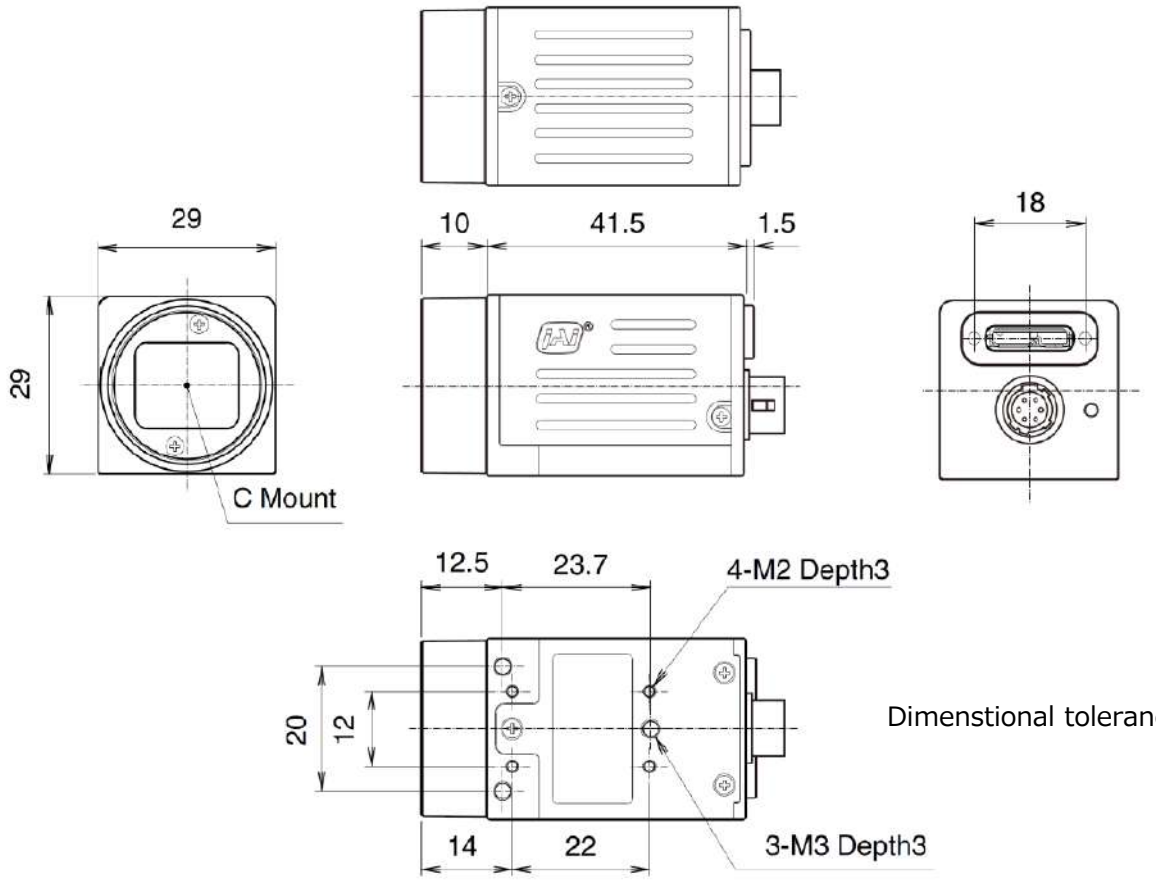
[Theoretical value]

Pixel count (MP)	Resolution (screen size)	Pixel size (um)	Imge size (mm)	Frame rate (fps @8bit)
5.1MP	2464 x 2056	3.45 x 3.45	2/3" (11.1 mm)	74.0
2MP	1920 x 1080	3.45 x 3.45	1/2" (7.6 mm)	150.6
1.4MP	1408 x 1050	3.45 x 3.45	1/2.6" (6.04 mm)	154.8
1.3MP	1280 x 1024	3.45 x 3.45	1/2.8" (5.66 mm)	158.6
0.5MP	800 x 600	3.45 x 3.45	1/4.6" (3.45 mm)	263.6
0.3MP	640 x 480	3.45 x 3.45	1/5.75" (2.76 mm)	324.5

Spectral Response



Dimensions



Dimenstional tolerance: ± 0.3mm
Unit: mm

Comparison of the Decibel Display and Multiplier Display

Decibels[db]	Multipliers[x]	Remarks
-6	0.501	
-5	0.562	
-4	0.631	
-3	0.708	
-2	0.794	
-1	0.891	
0	1	
1	1.122	
2	1.259	
3	1.413	
4	1.585	
5	1.778	
6	1.995	
7	2.239	
8	2.512	
9	2.818	
10	3.162	
11	3.548	
12	3.981	
13	4.467	
14	5.012	
15	5.623	
16	6.31	
17	7.079	
18	7.943	
19	8.913	
20	10	
21	11.22	
22	12.589	
23	14.125	
24	15.849	
25	17.783	
26	19.953	
27	22.387	
28	25.119	
29	28.184	
30	31.623	
31	35.481	
32	39.811	
33	44.668	
34	50.119	
35	56.234	
36	63.096	

User's Record

Camera type: GO-5100MP-USB

Revision: ·····

Serial No: ·····

Firmware version: ·····

For camera revision history, please contact your local JAI distributor.

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Revision history

Revision	Date	Changes
1.1	Jun. 2019	Camera Image Output Modes