See the possibilities

User Manual

SP-12401M-PGE
SP-12401C-PGE

12M CMOS Digital Progressive Scan
Monochrome and color Camera Document
Version: 1.2
SP - 12401MC -PGE_Ver.1.2 _July 2022

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.

Contents

Notice

The material contained in this manual consists of information that is proprietary to JAI Ltd., Japan and may only be used by the purchasers of the product. JAI Ltd., Japan makes no warranty for the use of its product and assumes no responsibility for any errors which may appear or for damages resulting from the use of the information contained herein. JAI Ltd., Japan reserves the right to make changes without notice.
Company and product names mentioned in this manual are trademarks or registered trademarks of their respective owners.

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 SP-12401-PGE 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.

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 GB/T 26572-2011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 GB/T 26572-2011规定的限量要求。

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。

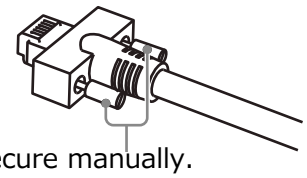
Usage Precautions

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 LAN cable connection

Secure the locking screws on the connector manually, and do not use a driver. Do not secure the screws too tightly. Doing so may wear down the screw threads on the camera. (Tightening torque: 0.147 Nm or less)



Secure manually.
Do not secure too tightly.

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 SP-12401M-PGE/SP-12401C-PGE is an industrial progressive scan camera equipped with a 1.1-inch global shutter CMOS image sensor with 12.37 effective megapixels. The SP-12401M-PGE/SP-12401C-PGE is part of JAI's Spark Series, which provides an attractive combination of high resolution, high speed, and high image quality for machine vision applications.

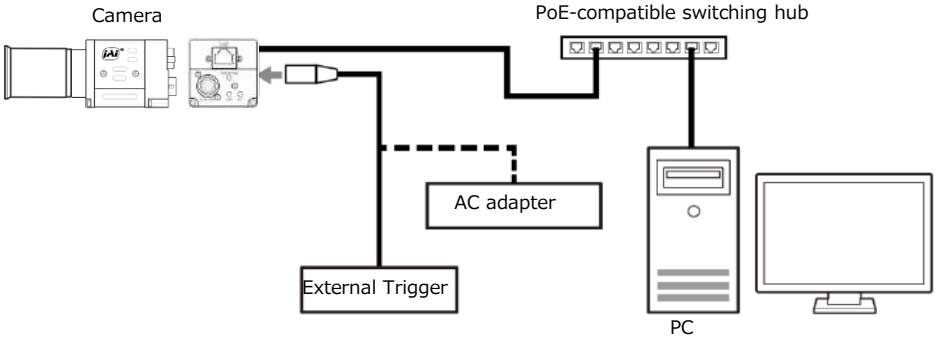
This camera is equipped with various functions required for machine vision including external trigger, exposure setting, image level control, look-up table, shading correction, blemish compensation, ROI, binning, etc.

*) The SP-12401M-PGE produces monochrome output while the SP-12401C-PGE produces Bayer output.

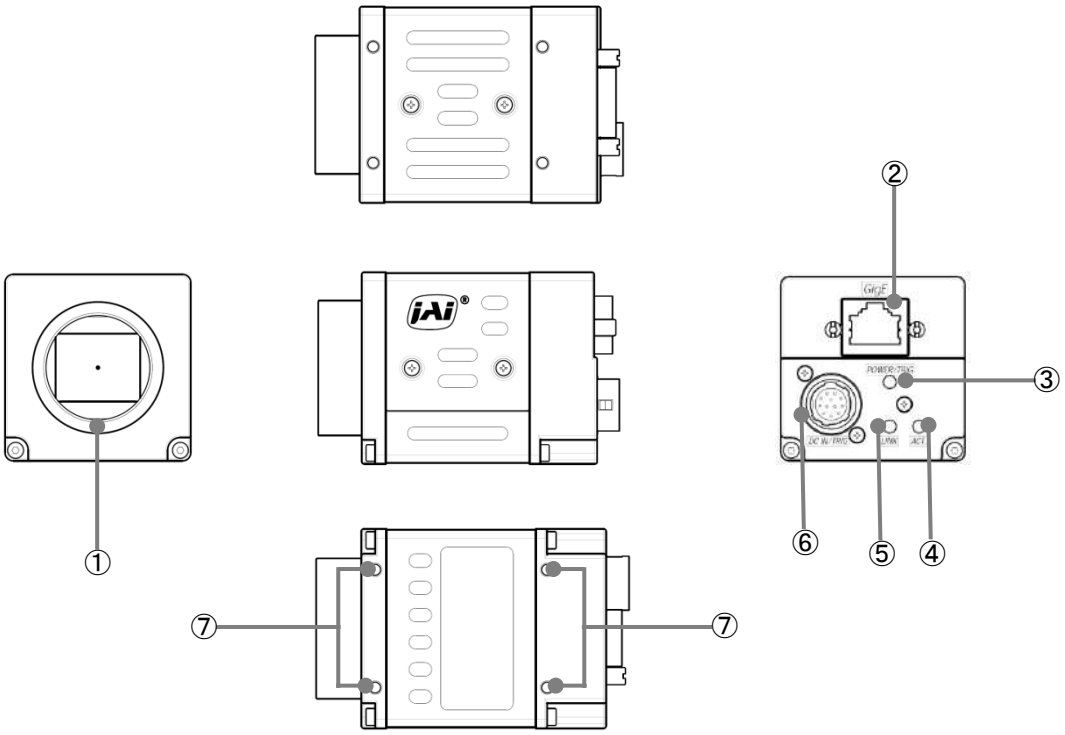
Feature overview

- Compliance with GigE Vision and GenICam standards
- 1.1-inch 12.37 megapixel Global Shutter high resolution CMOS sensor
- Lens mount: C-mount (flange back: 17.526 mm)
- Pixel size : 3.45 um × 3.45 um
- Effective pixels SP-12401M-PGE (4112(H) x 3008(V)),
  SP-12401C-PGE (4088(H) x 3000(V))
- Up to 9.3 fps at full resolution
- Various Video Output formats (RGB format supported for color model)
  SP-12401M-PGE : Mono8, Mono10, Mono10Packed, Mono12, Mono12Packed
  SP-12401C-PGE : BayerRG8, BayerRG10, BayerRG10Packed, BayerRG12, BayerRG12Packed, RGB8, RGB10V1Packed, RGB10p32
- Higher image quality by using 5x5 deBayer interpolation processing (Only for RGB format output)
- Gamma correction circuit that uses lookup tables
- Color matrix that allows faithful color reproduction
- Color space conversion function (sRGB, Adobe RGB, HSI, XYZ support)
- Internal test signal for settings configuration
- eBUS SDK for JAI that supports Windows 7, 8, 10

Connection example:



Parts Identification



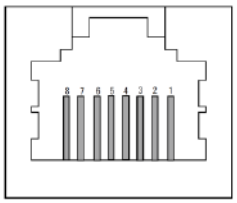
① Lens mount（C-mount）

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 RJ-45 connector

Connect a Gigabit Ethernet compatible LAN cable (Category 5e or higher, Category 6 recommended) here.



Pin No.	Input/ Output	Description
1	In/Out	MX1+ (DA+)
2	In/Out	MX1– (DA–)
3	In/Out	MX2+ (DB+)
4	In/Out	MX3+ (DC+)
5	In/Out	MX3– (DC–)
6	In/Out	MX2– (DB–)
7	In/Out	MX4+ (DD+)
8	In/Out	MX4– (DD–)

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 ACT LED

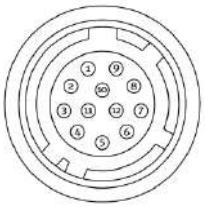
Indicates the GigE network status.

⑤ LINK LED

Indicates whether the GigE network connection is established or not.

⑥ DC IN/TRIG connector（12-pin round）

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



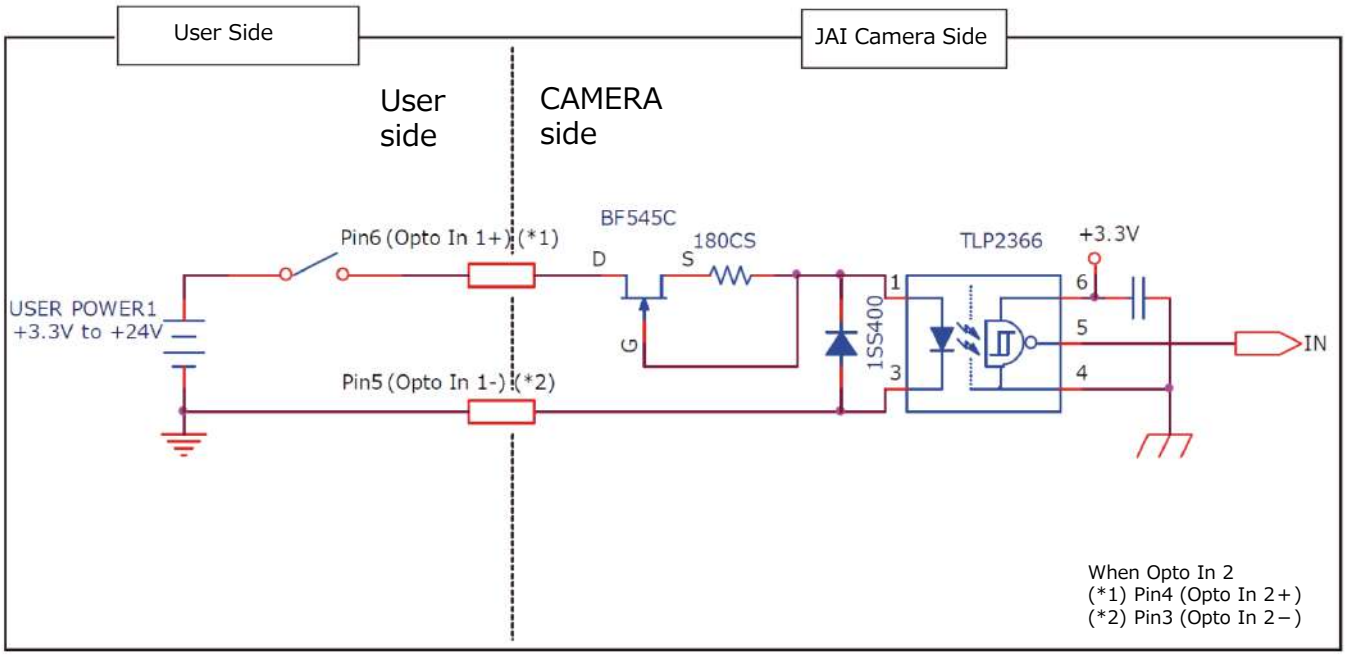
HR10A-10R-12PB（71） (Hirose Electric or equivalent)

Pin No.	Input/Output	Signal	Description
1		GND	
2	Power In	DC In	DC 12 V ～ 24 V ± 10%
3	In	Opto In 2 -	Line 6
4	In	Opto In 2 +	
5	In	Opto In 1 -	Line 5
6	In	Opto In 1 +	
7	Out	Opto Out 1 -	Line 2
8	Out	Opto Out 1 +	
9	Out	TTL Out 1	Line 1
10			
11	Power In	DC In	DC 12 V ～ 24 V ± 10%
12		GND	

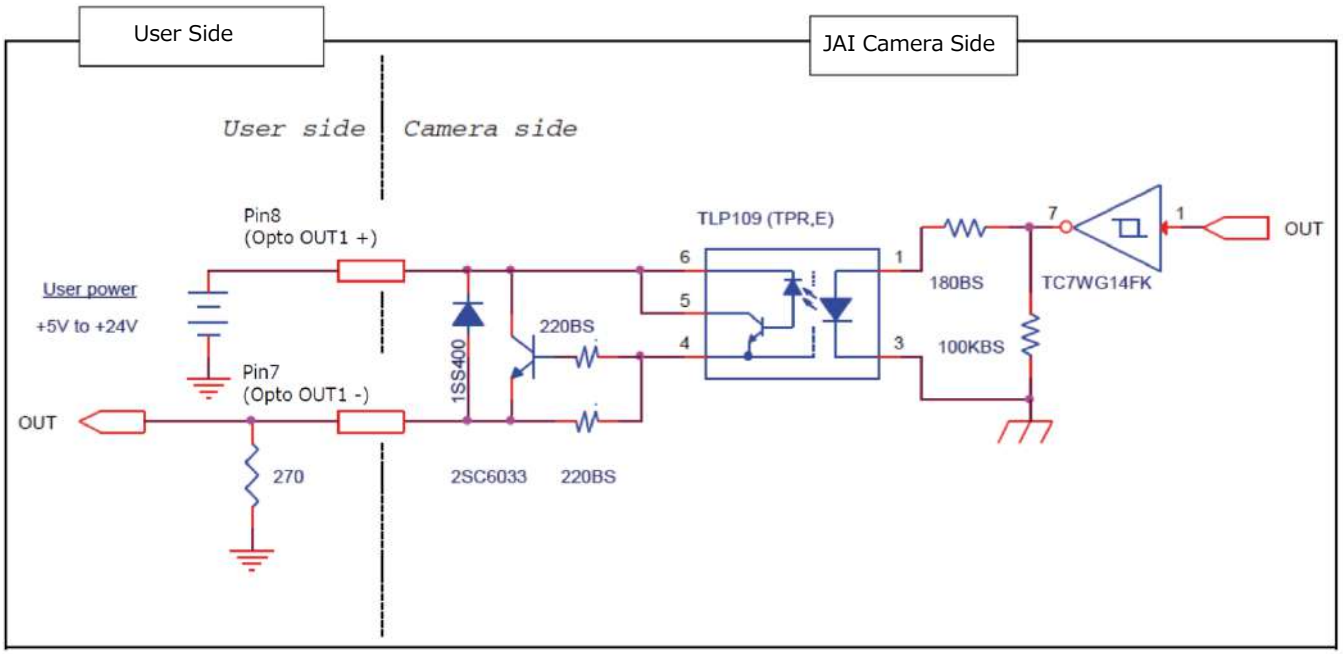
Note

When DC power is supplied to either Pin 1/Pin 2 or Pin 11/Pin 12, the camera operates.

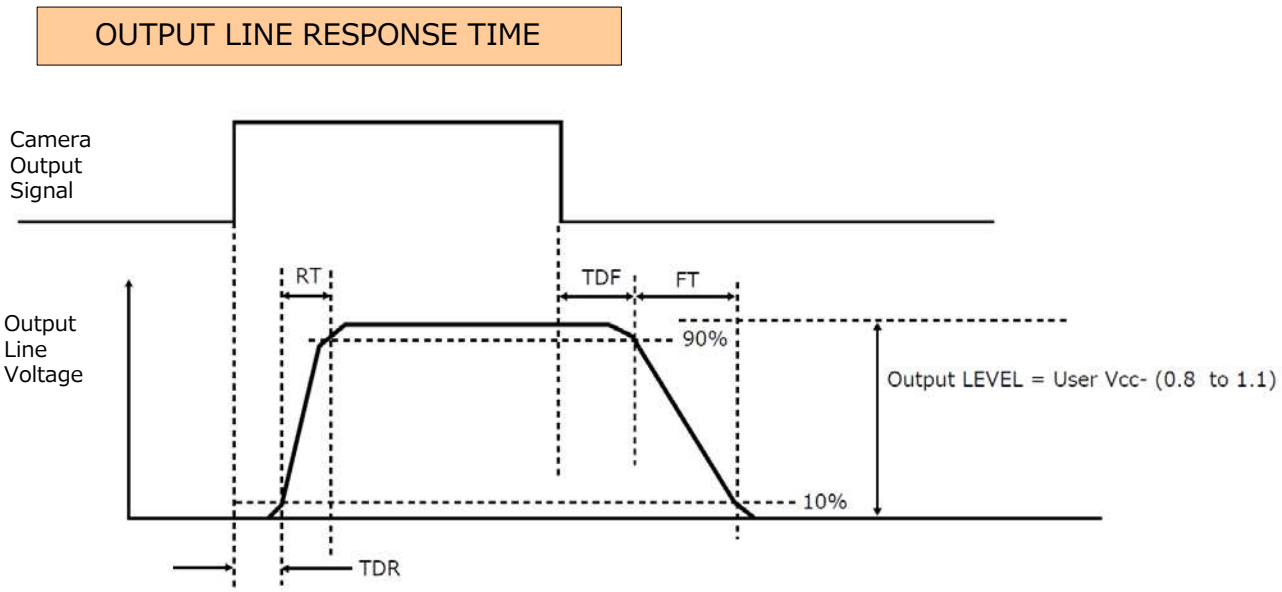
Recommended external input circuit diagram (reference example)



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



Characteristics of the recommended circuits for Opto OUT



	User Power (VCC)
	3.3 V ~ 24 V
Time Delay Rise TDR (us)	0.5 ~ 0.7
Tisc Time RT (us)	1.2 ~ 3.0
Time Delay Fall TDF (us)	1.5 ~ 3.0
Fall Time FT (us)	4 ~ 7

⑦ Camera locking screw holes（M3, 3mm depth)

Use these holes when attaching an MP-45 tripod adapter plate (optional) or 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, LAN 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 Control Tool.
↓	
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)

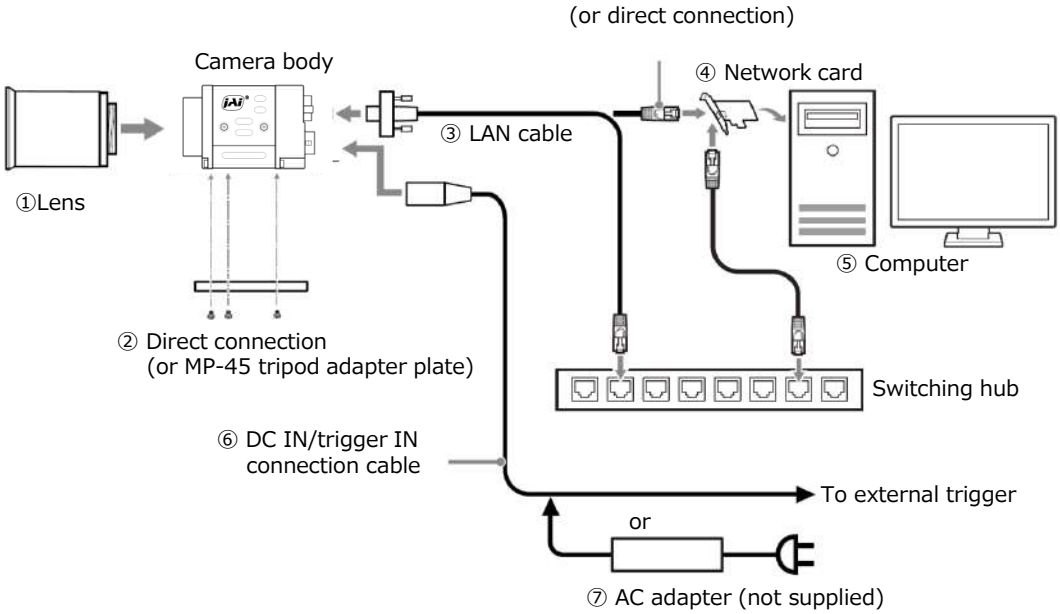
When using the camera for the first time, install the software for configuring and controlling the camera (eBUS SDK for JAI) on the computer.
❖ When you install eBUS SDK for JAI, eBUS SDK for JAI player will also be installed.

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.**

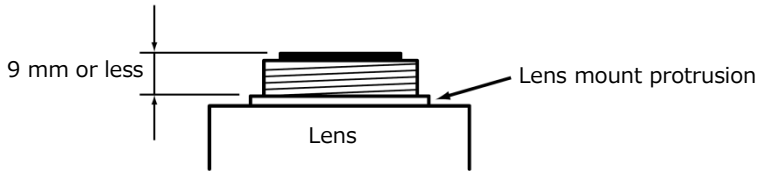
Caution
eBUS SDK for JAI is software for setting and controlling the newly released camera in April 2018.
When JAI SDK and eBUS SDK for JAI are installed on the same machine, conflicts can occur. Therefore, JAI strongly recommends that JAI SDK is uninstalled before installing eBUS SDK for JAI.

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 17.6 mm, the size of standard 1.1-inch lenses. To prevent vignetting and to obtain the optimal resolution, use a lens that will cover the 17.6 mm diagonal. Some lens manufacturers offer lenses with an 17.6 mm format. If not, a 1.1-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 (14.2 mm on this camera)

② Direct connection (or MP-45 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

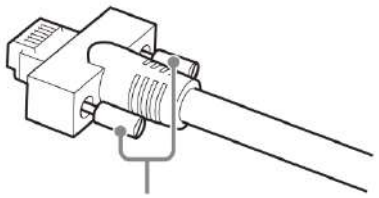
For heavy lenses, be sure to support the lens itself. Do not use configurations in which its weight is supported by the camera.

③ LAN cable

Connect a LAN cable to the RJ-45 connector.
- Use a LAN cable that is Category 5e or higher (Category 6 recommended).
- When supplying power via PoE, connect to a PoE-compatible switching hub or a PoE-compatible network card.
- Refer to the specifications of the cable for details on its bend radius.

Caution

Secure the locking screws on the connector manually, and do not use a driver. Do not secure the screws too tightly. Doing so may wear down the screw threads on the camera. (Tightening torque: 0.147 Nm or less)



Secure manually.
Do not secure too tightly.

④ Network card

Install this in the computer that will be used to configure and operate the camera. As the SP-12401M-PGE and SP-12401C-PGE supports PoE, you can also use PoE-compatible network cards. Refer to the instruction manual of the network card, and configure settings on the computer as necessary.

⑤ 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
Network card: We recommend using a network card that uses an Intel chip.

⑥ **DC IN / trigger IN connection cable**

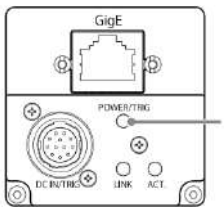
⑦ **AC adapter (power supply) (if necessary)**
Connect the AC adapter and the round connector of the connection cable to the DC IN / trigger IN connector on the camera.

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



Lit green

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

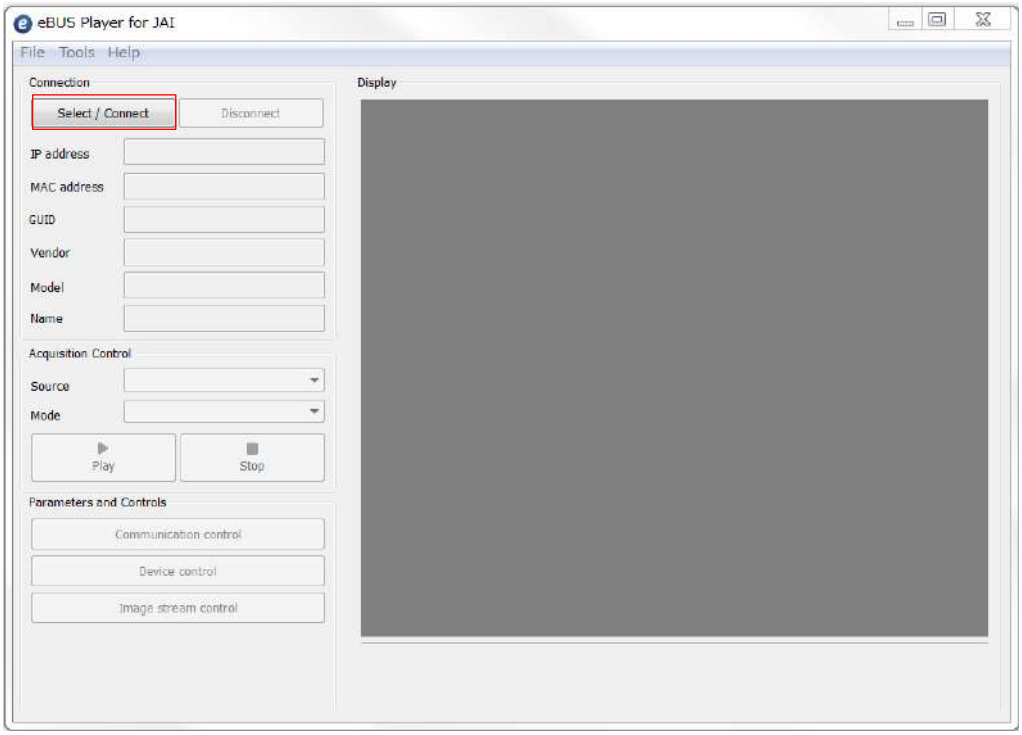
Step 4: Verifying the Connection between the Camera and PC

Verify whether the camera is properly recognized via Control Tool.

Connecting the Camera to Control Tool

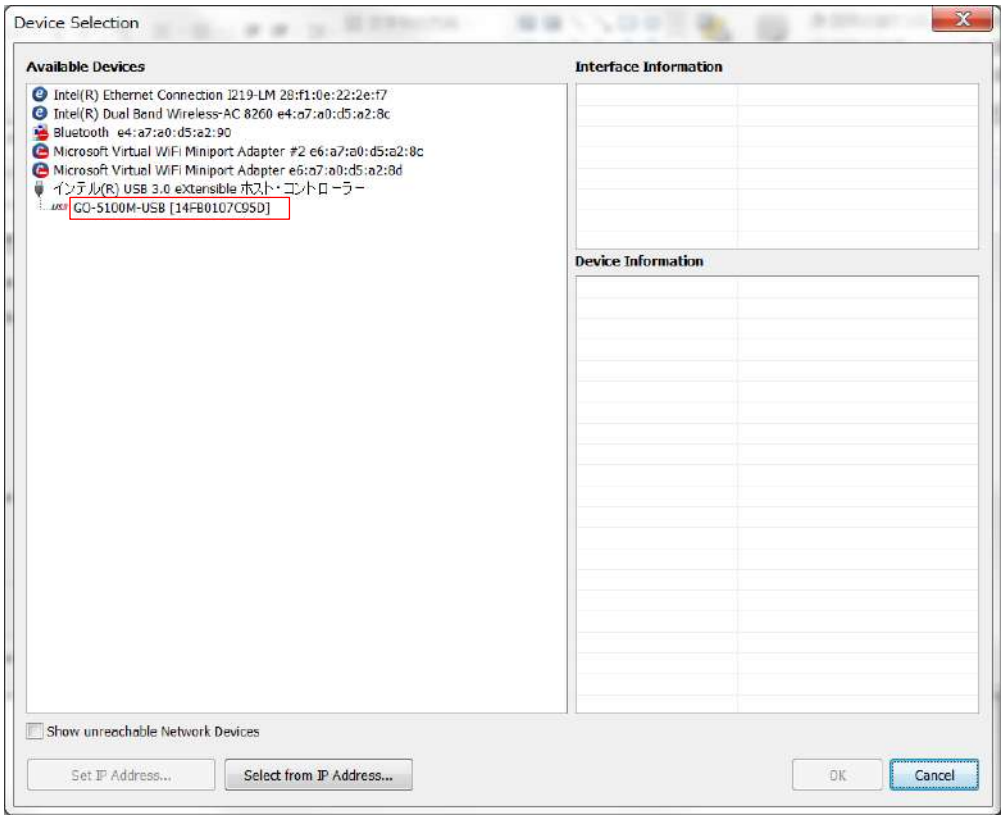
1 **Startup eBUS Player for JAI**

eBUS Player for JAI startup screen appears.



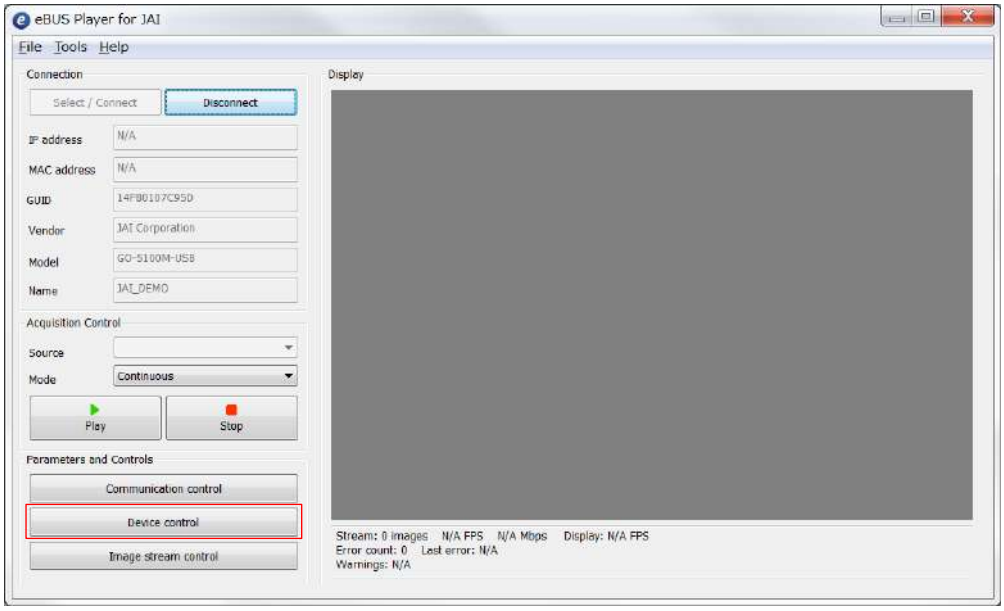
2 Select the camera you want to configure.

Push Select / Connect button

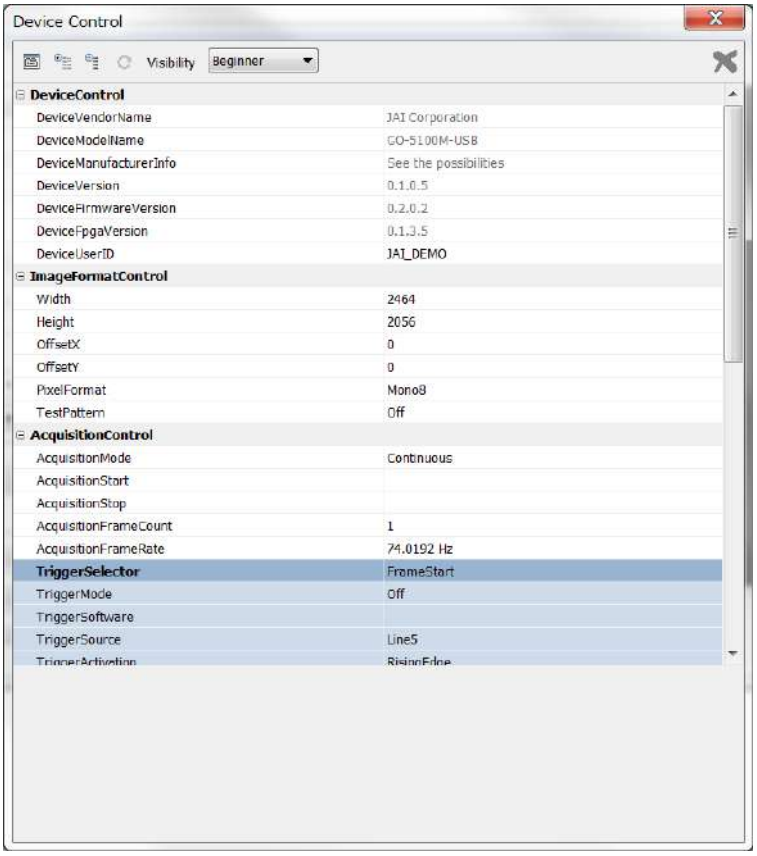


The connected camera is listed.
Please select one camera.

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.

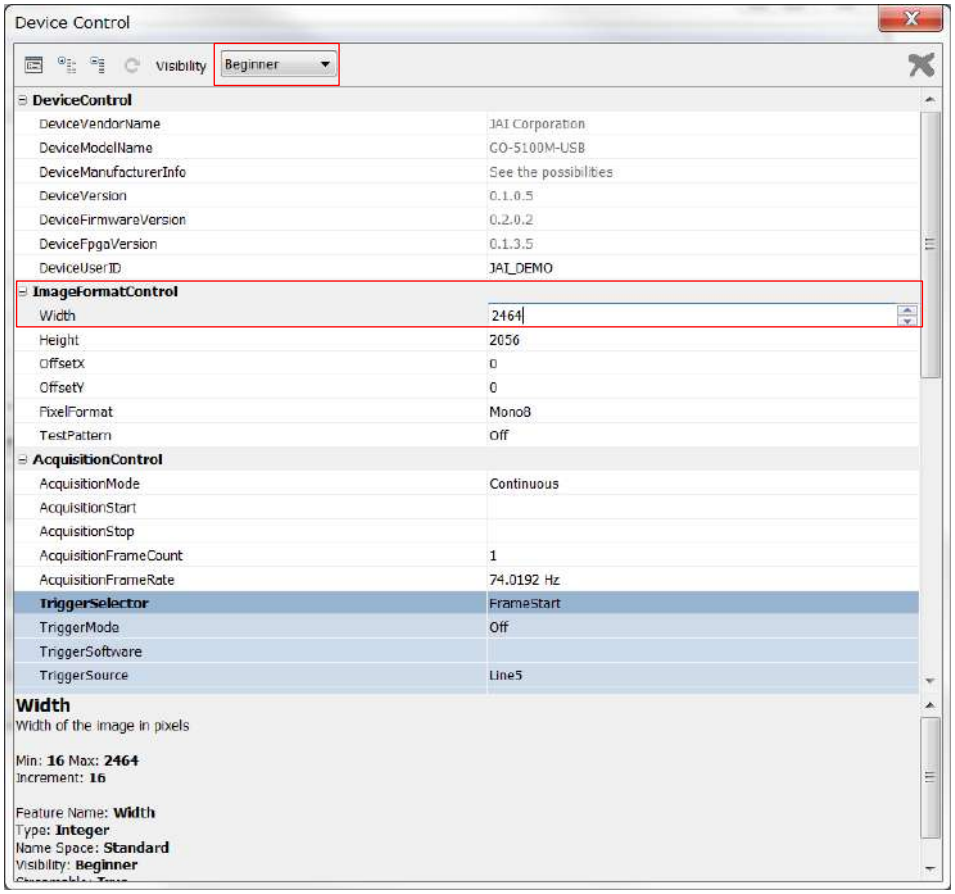
Factory default values (SP-12401C-PGE)

Item		Default value
ImageFormatControl	Width	4088
	Height	3000
	OffsetX (horizontal position)	0
	OffsetY (vertical position)	0
	PixelFormat	BayerRG8

* 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

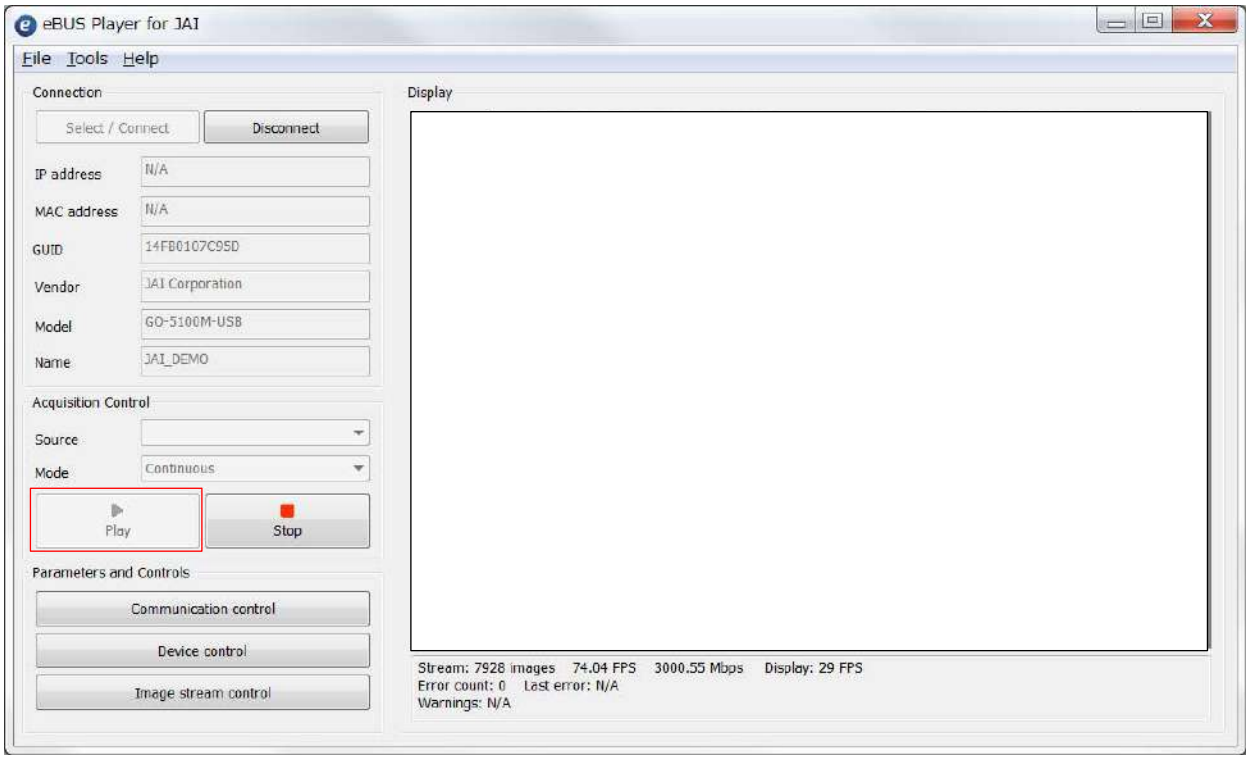
Depending on the setting item, you need to change visibility.
Please switch visibility (Beginner / Expert / Guru) as necessary.

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 and white balance* functions.
*) SP-12401C-PGE only

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), [DigitalRed]* (digital R gain), and [DigitalBlue]* (digital B 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.
- The [DigitalRed]* (digital R gain) and [DigitalBlue]* (digital B gain) can be set to a value from x0.447 to the [AnalogAll] (master gain) value.

Adjusting the White Balance*

Adjust the white balance using the automatic adjustment function.
*) SP-12401C-PGE only

■ **Automatic white balance adjustment**

1 **Place a white sheet of paper or similar object under the same lighting conditions as the intended subject, and zoom in to capture the white.**

White objects near the subject, such as a white cloth or wall, can also be used. Be sure to prevent the high-intensity spot lights from entering the screen.

2 **Select the [BalanceWhiteAuto] tab, and select [Continuous] or [Once] for the adjustment method.**

The white balance is automatically adjusted.

Adjusting the Black Level

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

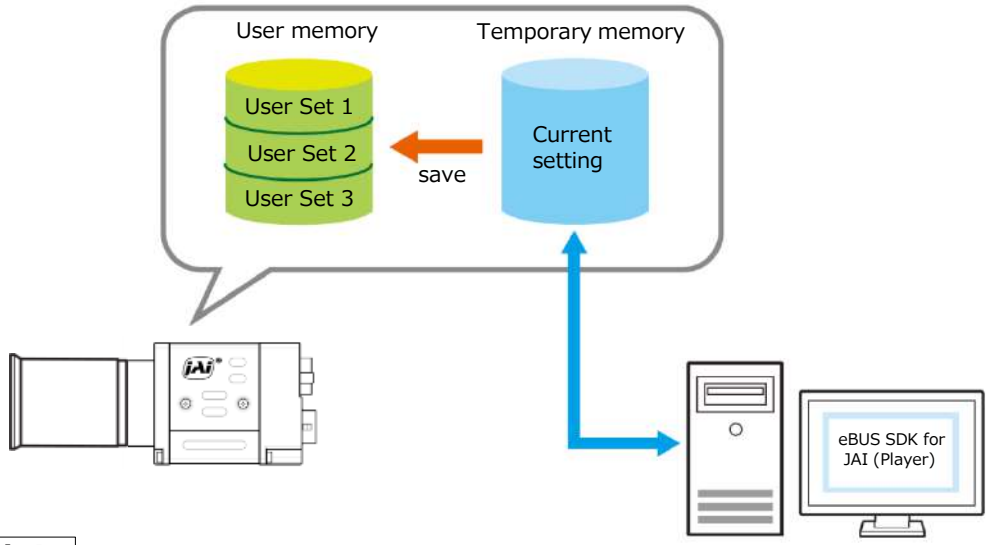
[DigitalAll] (master black), [DigitalRed]* (digital R), and [DigitalBlue]* (digital B) can be configured.

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

*) SP-12401C-PGE only

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	BinningVertical	BinningHorizontal	ExposureTime	ROI	BalanceWhiteAuto	GainAuto	ExposureAuto	Sequencer	
									TriggerSequencerMode	CommandSequencerMode
Off	Off	1	1 (Off)	×	○	○	○	×	×	×
		1	2	×	○	○	○	×	×	×
		2	1	×	○	○	○	×	×	×
		2	2	×	○	○	○	×	×	×
Timed	Off	1	1 (Off)	○	○	○	○	○	×	○
		1	2	○	○	○	○	○	×	○
		2	1	○	○	○	○	○	×	○
		2	2	○	○	○	○	○	×	○
Timed(EPS)	On	1	1 (Off)	○	○	○	○	○	○	○
		1	2	○	○	○	○	○	○	○
		2	1	○	○	○	○	○	○	○
		2	2	○	○	○	○	○	○	○
Timed(RCT)	On	1	1 (Off)	○	○	○	○	○	○	○
		1	2	○	○	○	○	○	○	○
		2	1	○	○	○	○	○	○	○
		2	2	○	○	○	○	○	○	○
TriggerWidth	On	1	1 (Off)	×	○	○	○	×	×	×
		1	2	×	○	○	○	×	×	×
		2	1	×	○	○	○	×	×	×
		2	2	×	○	○	○	×	×	×

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														
		TriggerSelector				LineSelector							PulseGeneratorSelector			
		AcquisitionStart	AcquisitionEnd	FrameStart	AcquisitionTransferStart	Line1-TTLOut1	Line2-OptOut1	TimestampReset	NANDGate0In1	NANDGate0In2	NANDGate1In1	NANDGate1In2	PulseGenerator0	PulseGenerator1	PulseGenerator2	PulseGenerator3
Signals to use as output	Low	○	○	○	○	○	○	Off	○	○	○	○	○	○	○	○
	High	○	○	○	○	○	○	×	○	○	○	○	○	○	○	○
	Line5-OptIn1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Line6-OptIn2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	UserOutput0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	UserOutput1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	UserOutput2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	UserOutput3	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Action1	○	○	○	○	○	○	○	×	×	○	○	○	○	○	○
	Action2	○	○	○	○	○	○	○	○	○	×	×	○	○	○	○
	PulseGenerator0	○	○	○	○	○	○	○	○	○	○	○	×	○	○	○
	PulseGenerator1	○	○	○	○	○	○	○	○	○	○	○	○	×	○	○
	PulseGenerator2	○	○	○	○	○	○	○	○	○	○	○	○	○	×	○
	PulseGenerator3	○	○	○	○	○	○	○	○	○	○	○	○	○	○	×
	NAND0Out	○	○	○	○	○	○	○	×	×	○	○	○	○	○	○
	NAND1Out	○	○	○	○	○	○	○	○	○	×	×	○	○	○	○
	ExposureActive	—	—	—	—	○	○	×	○	○	○	○	○	○	○	○
	AcquisitionActive	—	—	—	—	○	○	×	○	○	○	○	○	○	○	○
	AcquisitionTriggerWait	—	—	—	—	○	○	×	○	○	○	○	○	○	○	○
	FrameTriggerWait	—	—	—	—	○	○	×	○	○	○	○	○	○	○	○
	FrameActive	—	—	—	—	○	○	×	○	○	○	○	○	○	○	○
	FVAL	—	—	—	—	○	○	×	○	○	○	○	○	○	○	○
	LVAL	—	—	—	—	×	×	×	×	×	×	×	○	○	○	○
	Software	○	○	○	○	—	—	—	—	—	—	—	—	—	—	—
		TriggerSelector				LineSelector							PulseGeneratorSelector			
		Use														

: Indicates default values for each selector.

Camera Output Formats

The SP-12401M-PGE supports the following output formats.

PixelFormat	Available only VideoProcessBypassMode
Mono8, Mono10, Mono10Packed, Mono12, Mono12Packed	Mono12, Mono12Packed

The SP-12401C-PGE supports the following output formats.

PixelFormat	Available only VideoProcessBypassMode
BayerRG8, BayerRG10, BayerRG10Packed, BayerRG12, BayerRG12Packed RGB8,RGB10V1Packed, RGB10p32	BayerRG12, BayerRG12Packed

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

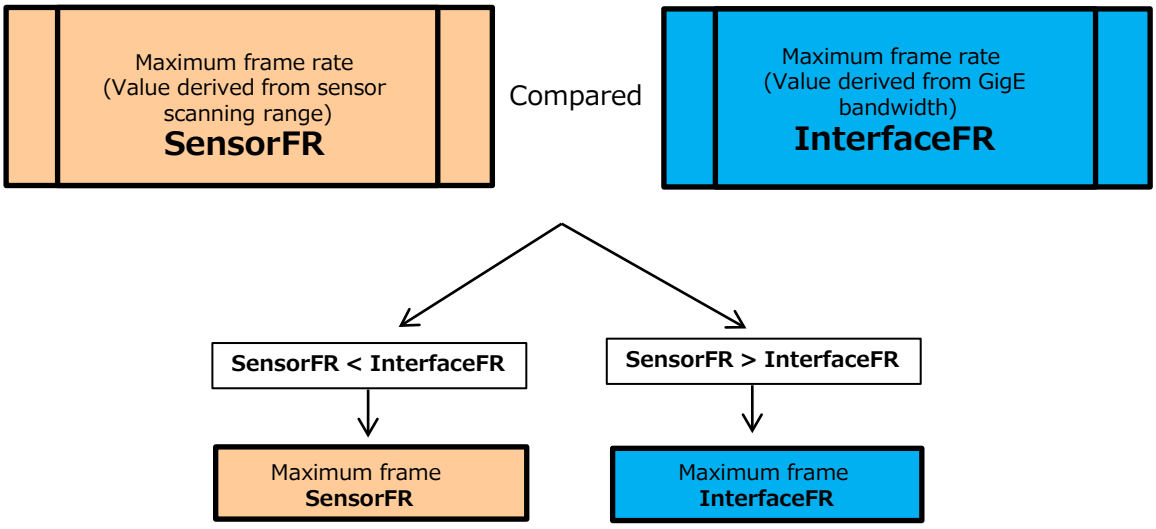
When [TriggerMode] is disabled, you can change the frame rate in [AcquisitionFrameRate].

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 GigE bandwidth.



■ Maximum frame rate period formula

About the H_Period

For a full image, the H_period values are as follows for each PixelFormat.

PixelFormat	H_period (us)
Mono8, Mono10, Mono12 Mono10Packed, Mono12Packed	28.121
BayerRG8, BayerRG10, BayerRG12 BayerRG10Packed, BayerRG12Packed	28.013
RGB8, RGB10V1Packed, RGB10p32	28.04

Calculate the H_Period using the following formulas when cutting out a portion of the image using ROI.

■ When [PixelFormat] is Mono8, Mono10Packed, Mono12Packed, Mono10 or Mono12.
GIGE_H_Count_Max = (Width / 2 + 32)
Sensor_H_Count: 1041

■When [PixelFormat] is BayerRG8, BayerRG10Packed, BayerRG12Packed, BayerRG10 or BayerRG12.
GIGE_H_Count_Max = ((Width + 8) / 2 + 32)
Sensor_H_Count: 1041

■ When [PixelFormat] is RGB8, RGB10V1Packed or RGB10p32.
GIGE_H_Count_Max = ((Width + 8) / 2 + 32)
Sensor_H_Count: 2082

H_Count = Max(Sensor_H_Count, GIGE_H_Count_Max)
H_Period = H_Count / PixelClock
PixelClock: 74.25 (MHz)

■ During continuous operation ([Frame Start] trigger is [Off] or [ExposureMode] is [Off])

- Maximum frame rate of sensor output
  SensorFR = 1 / ((Height_s + 36)×Hperiod)
- Maximum frame rate by interface
  InterfaceFR = 920 × 1000000 / (Height_s × Width × Pack value)

Height_s : [SP-12401M-PGE]
When [VerticalBinning] is [1]. Height_s = Heigh
When [VerticalBinning] is [2]. Height_s = Height x 2
[SP-12401C-PGE]
Height_s = Height + 8

For a full image, the PackValue are as follows for each PixelFormat.

PixelFormat	PackValue
Mono8/BayerRG8	8
Mono10Packed/Mono12Packed/ BayerRG10Packed/BayerRG12Packed	12
Mono10/Mono12/ BayerRG10/BayerRG12	16
RGB8	24
RGB10V1Packed/RGB10p32	32

- Maximum frame rate
  FR_Cont = Min (< SensorFR > , < InterfaceFR >)
- Exposure time possible within frames
  MaxOverlapTime_longExp = (1 / FR_Cont) − (14 × H_Period)
- Exposure time outside of frame interval
  NonOverlapExposureTime = ExposureTime − MaxOverlapTime_long
  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_longExp = 1 / { (1 / FR_Cont) + NonOverlapExposureTime}

■ **When [Frame Start] trigger is [On] and [TriggerOverLap] is [Off]**

- Maximum frame rate of sensor output
  Sensor FR = 1 / {H Period × (Height_s + 36)}
- Maximum frame rate by interface
  Interface FR = 920 × 1000000 / (Height×Width×Pack value)
- Maximum frame rate
  FR_Cont = Min（< SensorFR > , < InterfaceFR >）

- 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 [TriggerOverLap] is [Readout]**

- Maximum frame rate of sensor
  Sensor FR = 1 / {H Period × (Height_s + 36)}
- Maximum frame rate by interface
  Interface FR = 920 × 1000000 / (Height × Width × Pack value)
- Maximum frame rate
  FR_TrOloff = 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}

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.

ExposureMode	Shortest exposure time
Timed	15.26us (8bit)
TriggerWidth	15.26us (8bit)

・The actual exposure time will consist of the image sensor's offset duration (14.26 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 + 14.26 µs (offset duration of image sensor) = 15.26 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 15.26 µs and the exposure time offset is 14.26 µs, use 15.26 µs - 14.26 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 7 frames (RGB8: 4 frames) 10 bit: Up to 7 frames (RGB10V1Packed, RGB10p32: 4 frames) 12 bit: Up to 7 frames

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

(1) You can delay when exposure actually starts after a trigger is received by a specific amount of time by configuring [TriggerDelay].

BurstTriggerMode

In burst mode, continuous imaging is performed at a maximum speed of 23.4 fps, images are temporarily stored in the memory, and data can be read later. Data reading is limited to the speed of GigE Vision. Up to seven full images can be stored in the memory in the camera. This function can be used by setting [ExposureModeOption] to [BurstTrigger].

*) SP-12401C-PGE
This function can not be used when PixelFormat is RGB8, RGB10V1Packed and RGB10p32.

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.

■ **SP-12401C-PGE**

Scanning range	Shortest period of trigger				
	BayerRG8	BayerRG10, BayerRG12	BayerRG10Packed, BayerRG12Packed	RGB8	RGB10V1Packed, RGB10p32
Full	106.6ms	213.2ms	160ms	319.5ms	427.4ms
ROI (Height = 1500)	53.3ms	106.6ms	80ms	160ms	213.2ms
ROI (Height = 750)	26.7ms	53.3ms	40ms	80ms	106.6ms

■ **SP-12401M-PGE**

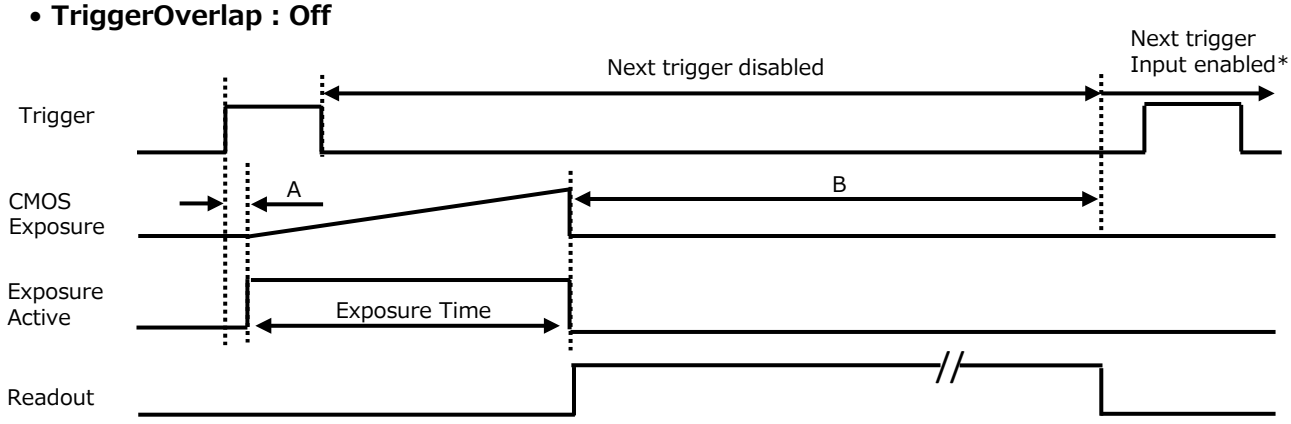
Scanning range	Shortest period of trigger		
	Mono8	Mono10, Mono12	Mono10Packed, Mono12Packed
Full	107.5ms	215.1ms	161.3ms
ROI (Height = 1500)	53.8ms	107.5ms	80.6ms
ROI (Height = 750)	26.9ms	53.8ms	40.3ms
BinningVertical2	53.8ms	107.5ms	80.6ms

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]

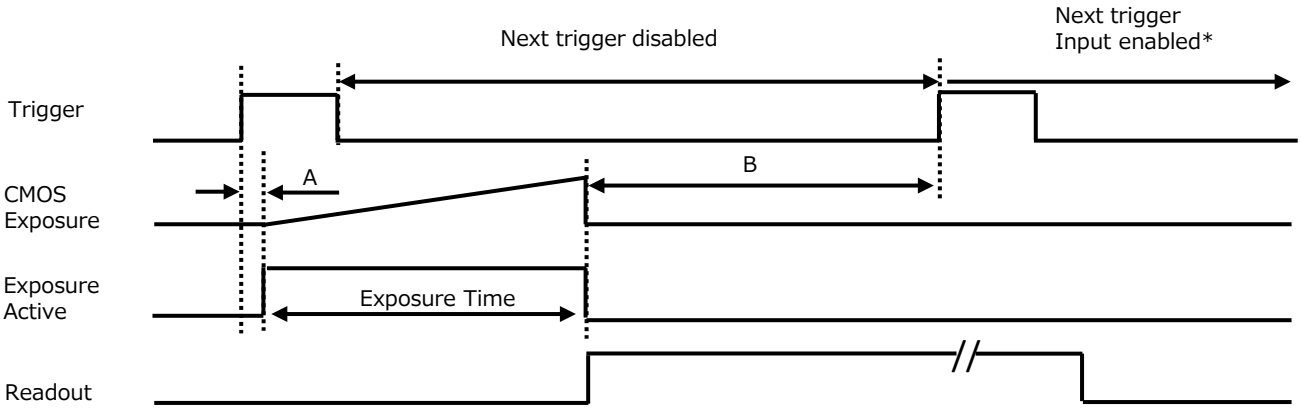
• **TriggerOverlap : Off**



PixelFormat	Line Period (usec)	Period from Trigger start edge to Exposure start [A] (usec)	Minimum Period Exposure end to next trigger start [B] (usec)
Mono8	28.121	85.1	85906
Mono10Packed Mono12Packed	28.121	85.1	85906
Mono10 Mono12	28.121	85.1	85906
BayerRG8	28.013	85.1	85900
BayerRG10Packed BayerRG12Packed	28.013	85.1	85900
BayerRG10 BayerRG12	28.013	85.1	85900
RGB8	28.04	85.1	85896
RGB10V1Packed RGB10p32	28.04	85.1	85896

*) If the exposure time is longer than the frame period excluding [B], the next trigger input will not be accepted.

- **TriggerOverlap : readout**



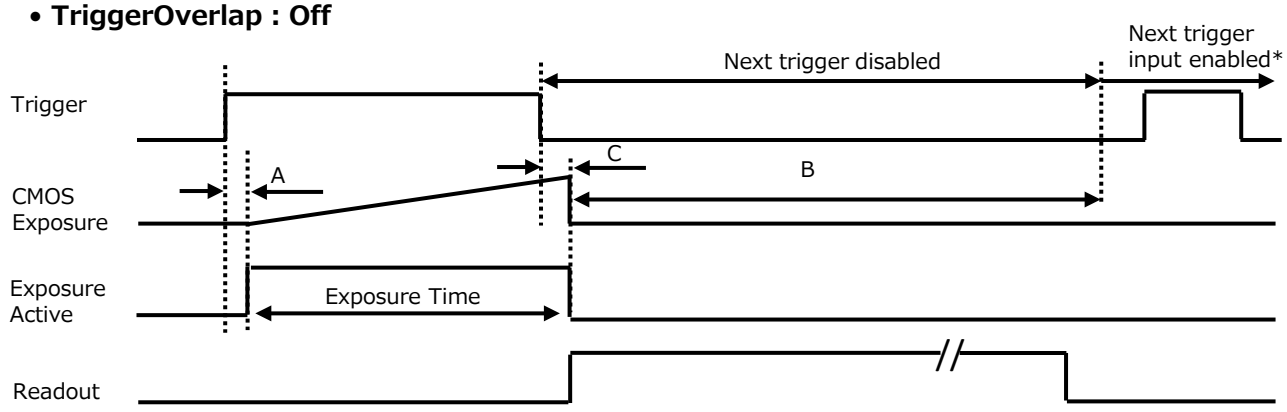
PixelFormat	Line Period (usec)	Period from Trigger start edge to Exposure start [A] (usec)	Minimum Period from Exposure end to next trigger start[B](usec)
Mono8	28.121	85.1	282
Mono10Packed Mono12Packed	28.121	85.1	282
Mono10 Mono12	28.121	85.1	282
BayerRG8	28.013	85.1	280
BayerRG10Packed BayerRG12Packed	28.013	85.1	280
BayerRG10 BayerRG12	28.013	85.1	280
RGB8	28.04	85.1	280
RGB10V1Packed RGB10p32	28.04	85.1	280

*) If the exposure time is longer than the frame period excluding [B], the next trigger input will not be accepted.

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

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

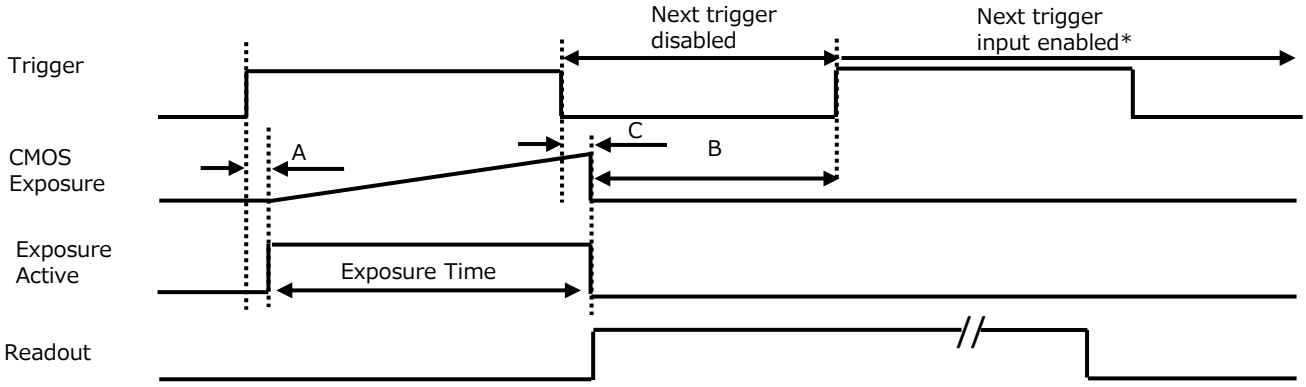
• **TriggerOverlap : Off**



PixelFormat	Line Period (usec)	Period from Trigger start edge to Exposure start [A] (usec)	Minimum Period Exposure end to next trigger start[B](usec)	Period from Trigger end edge to Exposure end[C] (usec)
Mono8	28.121	85.1	85906	85.1
Mono10Packed Mono12Packed	28.121	85.1	85906	85.1
Mono10 Mono12	28.121	85.1	85906	85.1
BayerRG8	28.013	85.1	85900	85.1
BayerRG10Packed BayerRG12Packed	28.013	85.1	85900	85.1
BayerRG10 BayerRG12	28.013	85.1	85900	85.1
RGB8	28.04	85.1	85896	85.1
RGB10V1Packed RGB10p32	28.04	85.1	85896	85.1

*) If the exposure time is longer than the frame period excluding [B], the next trigger input will not be accepted.

- **TriggerOverlap : readout**



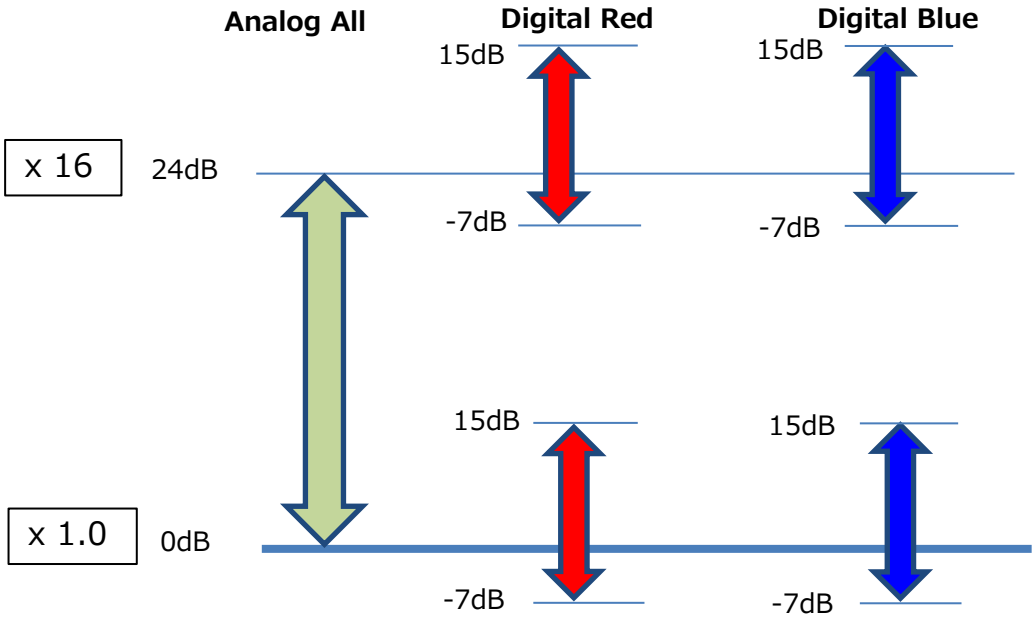
PixelFormat	Line Period (usec)	Period from Trigger start edge to Exposure start [A] (usec)	Minimum Period Exposure end to Next trigger start[B] (usec)	Period from Trigger end edge to Exposure end[C] (usec)
Mono8	28.121	85.1	288	85.1
Mono10Packed Mono12Packed	28.121	85.1	288	85.1
Mono10 Mono12	28.121	85.1	288	85.1
BayerRG8	28.013	85.1	288	85.1
BayerRG10Packed BayerRG12Packed	28.013	85.1	288	85.1
BayerRG10 BayerRG12	28.013	85.1	288	85.1
RGB8	28.04	85.1	288	85.1
RGB10V1Packed RGB10p32	28.04	85.1	288	85.1

*) If the exposure time is longer than the frame period excluding [B], the next trigger input will not be accepted.

Gain Control

Adjust the [AnalogAll] (master gain) setting first, and then adjust the [AnalogRed], [DigitalRed], [AnalogBlue], and [DigitalBlue] setting values to perform fine adjustment.

*) Adjustment of DigitalRed and DigitalBlue is possible only for SP-12401C-PGE



Automatic Gain Level Control

Set [GainAuto] to [Continuous] to control the gain level automatically.

When [GainAuto] is set to [Continuous], you can configure the conditions for automatic adjustment in detail.

Item	Description
ALCReference	Specify the target level for automatic gain control. (This setting is also used for automatic exposure control.)
ALCAreaEnableAll	Select whether to specify all areas as auto gain metering areas or whether to specify the areas individually. [False]: Specify areas as auto gain metering areas (16 areas) individually.[True]: Specify all areas as auto gain metering areas.
ALCAreaSelector	Individually select any of 16 areas for automatic gain metering. (This setting is also used for automatic exposure control.)
ALCAreaEnable	Select [True] to enable the metering area selected in [ALCAreaSelector], or select [False] to disable it.
AGCMax.	Specify the maximum value for the automatic gain control range.
AGCMin.	Specify the minimum value for the automatic gain control range.
ALCControlSpeed	Specify the reaction speed for automatic gain control. (This setting is also used for automatic exposure control.)

When [GainAuto] is set to [Continuous], automatic adjustment will be performed continuously.
When [GainAuto] is set to [Once], automatic adjustment will be performed only once.

Auto gain metering areas (16 areas)

High Left	High Mid-left	High Mid-right	High Right
Mid-High Left	Mid-High Mid-left	Mid-High Mid-right	Mid-High Right
Mid-Low Left	Mid-Low Mid-left	Mid-Low Mid-right	Mid-Low Right
Low Left	Low Mid-left	Low Mid-right	Low Right

Lookup Table (LUT)

The LUT function is used to generate a non-linear mapping between signal values captured on the sensor and those that are output from the camera. You can specify the output curve using 257 setting points (indexes).

■ To use the LUT function

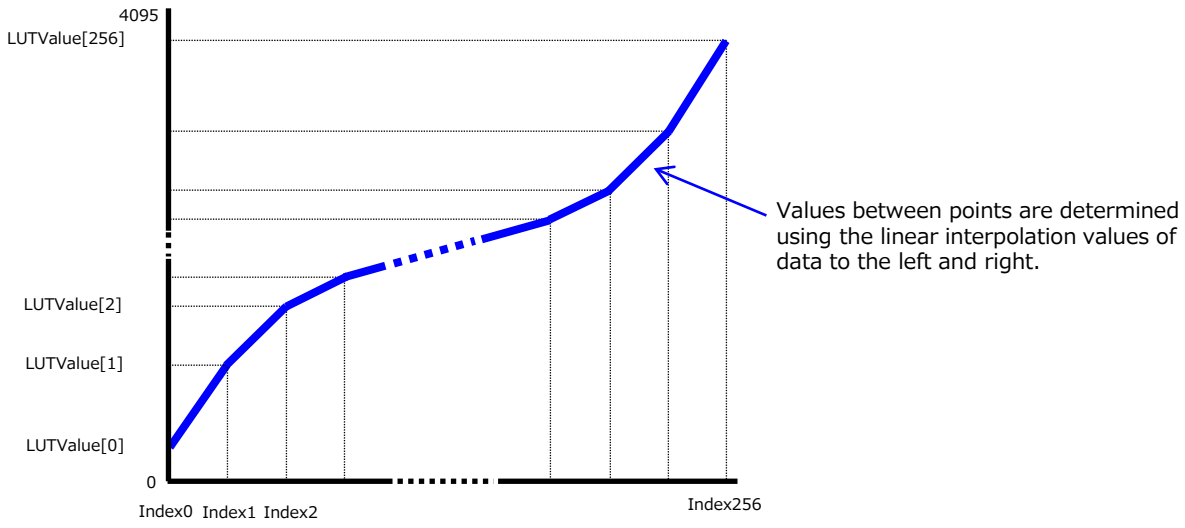
Configure the settings as follows.

Item	Setting value / selectable range	Description
LUTMode	LUT	Use LUT.
LUTSelector*	Red, Green, Blue	Select the LUT channel to control.
LUTIndex	0 ～ 256	Select the LUT index to configure. Indexes represent the possible pixel values captured on the sensor, from the lowest value (Index 0) to the highest (Index 256). For example, Index 0 represents a full black pixel and Index 256 represents a full white pixel.
LUTValue	0 ～ 4095	Set the LUT output value for the selected index.

*) SP-12401C-PGE only

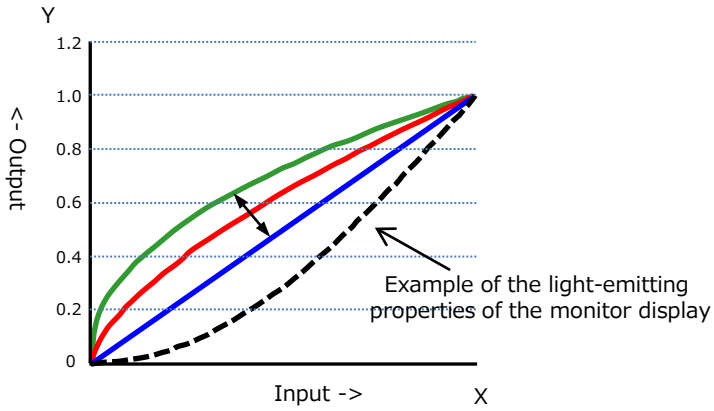
■ LUT values

LUT values range from 0 at the lowest to 4095 at the highest. Linear interpolation is used to calculate LUT values between the index points.



Gamma Function

The gamma function corrects the output signals from the camera beforehand (reverse correction), taking into consideration the light-emitting properties of the monitor 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. The gamma function can be used to correct the camera signals with an opposite-direction curve and produce a display that is close to linear.



■ **To use the gamma function**

Configure the settings as follows.

Item	Setting value / selectable range	Description
Gamma	0.45, 0.5, 0.55, 0.6, 0.65, 0.75, 0.8, 0.9, 1.0	Select the gamma correction value.
LUTMode	Gamma	Use gamma.

Note

You can use the LUT function to configure a curve with more detailed points. For details, see “Lookup Table (LUT)”.

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 800 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 800 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 1 to 800. 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 ShadingCorrection function 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).

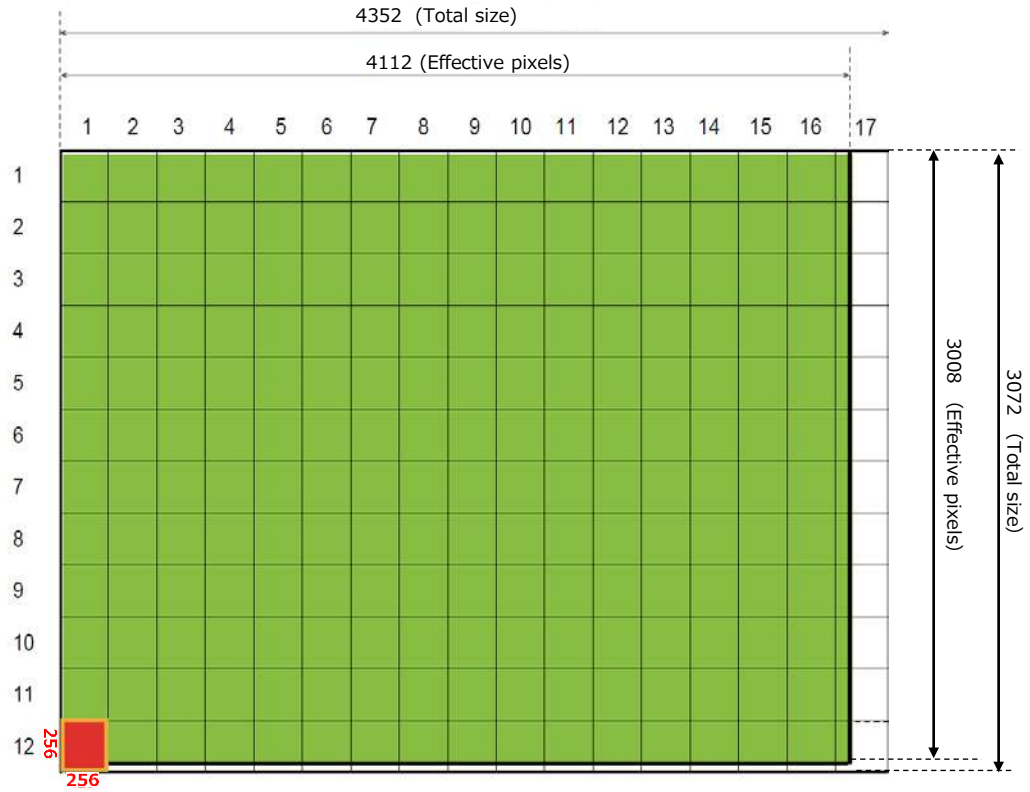
This function can be used even when the effective image area is limited (an area with both Width and Height set to more than 128 must be configured) by the ROI function. In such cases, the correction area is included in the image area configured by the ROI.

SP-12401M-PGE
For a full image, the number of correction blocks is 17 (H) × 12 (V) blocks and calculation errors in the correction data are minimized due to the small interpolation areas. Each block is 256 × 256 pixels. The total size of the blocks is 4352 (H)× 3072 (V), but the actual number of effective pixels for the camera is 4112 (H) ×3008 (V) .The ineffective peripheral areas will be deleted internally on the camera automatically.

SP-12401C-PGE
For a full image, the number of correction blocks is 16 (H) × 12 (V) blocks.
The total size of the blocks is 4096 (H) × 3072 (V).
The actual number of effective pixels for the camera is 4088 (H) x 3000 (V).

When using ROI, the number of blocks and the number of pixels that comprise each block differ from a full image.

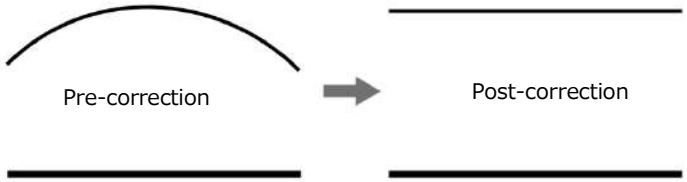
SP-12401M-PGE



The following shading correction modes are available on the camera.

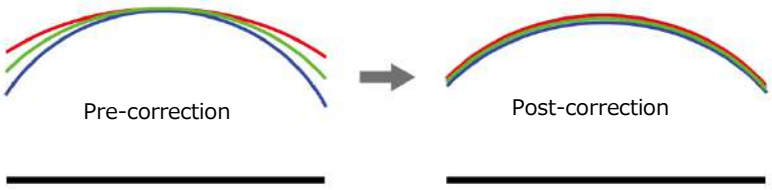
■ FlatShading

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.



■ ColorShading (SP-12401C-PGE only)

R-channel and B-channel properties are adjusted to using the G-channel shading properties as a reference.



Caution

- For FlatShading and ColorShading, the maximum amount of correction gain for all pixels is limited to 8 times the amount of gain before correction. (The amount of gain cannot be increased to more than 8 times the amount of gain from before correction.)
- If the area in the screen with the highest brightness level is 175 LSB or less (during 10-bit video output), proper correction is not possible.

■ To use the shading correction function

Configure the settings as follows.

Item	Setting value	Description
ShadingCorrectionMode	FlatShading, ColorShading	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].

Binning Function

(SP-12401M-PGE only)
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.

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].
For details on how to configure the settings, see “Configuring the Output Format”.
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.

SP-12401M-PGE

Width (pixels)	Height (pixels)
BinningHorizontal Off: 16 to 4112, 8 pixels / step	BinningVerticall Off: 8 to 3008, 4 lines / step
BinningHorizontal On: 8 to 2056, 4 pixels / step	BinningVertical On: 8 to 1504, 2 lines / step

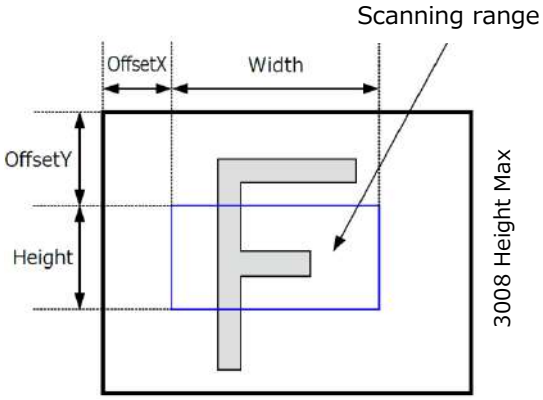
Offset X (pixels)	Offset Y (pixels)
BinningHorizontal Off: 0 to 4096, 8 pixels / step	BinningHorizontal Off: 0 to 3004, 4 lines / step
BinningHorizontal On: 0 to 2048, 4 pixels / step	BinningVertical On: 0 to 1500, 2 lines / step

SP-12401C-PGE

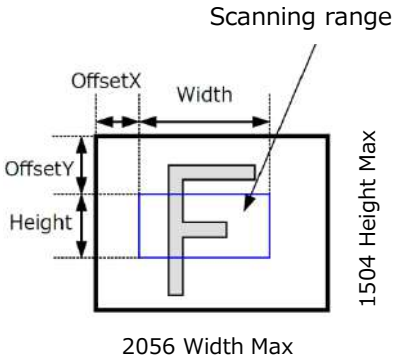
Width (pixels)	Height (pixels)
16 to 4088, 8 pixels / step	8 to 3000, 4 lines / step

Offset X (pixels)	Offset Y (pixels)
0 to 4072, 8 pixels / step	0 to 2992, 4 lines / step

Example 1) Without Binning
[BinningHorizontal] :1
[BinningVertical] :1



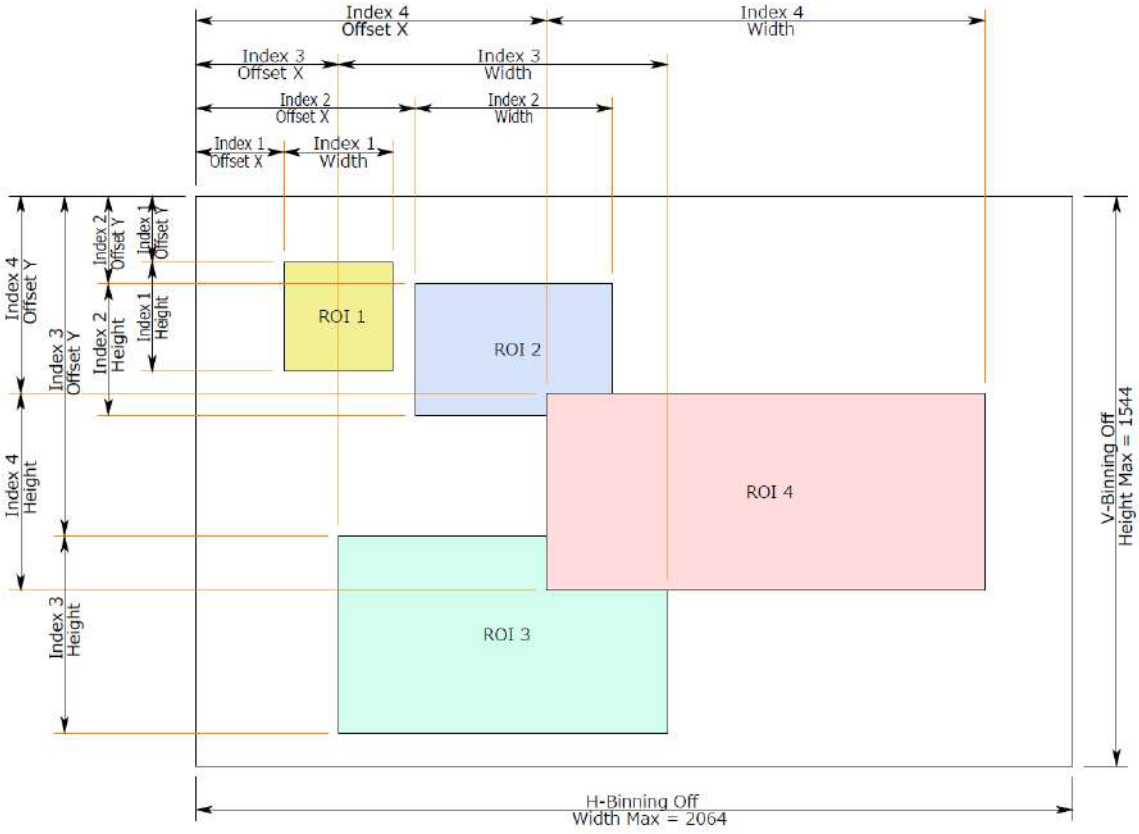
Example 2) With Binning
[BinningHorizontal] :2
[BinningVertical] :2



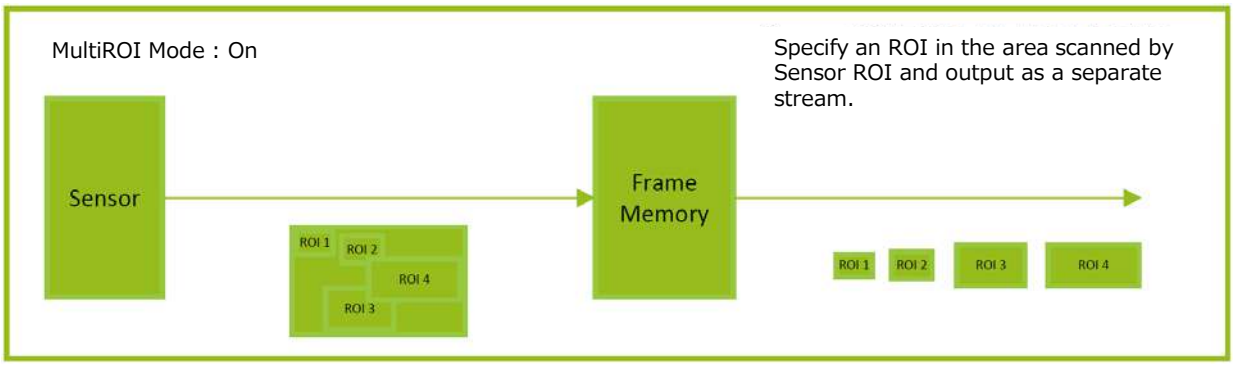
* For details on the frame rates for common ROI sizes, see “Frame Rate Reference” .

Overlap Multi ROI Mode

In Overlap Multi ROI mode, you can specify up to five scanning areas (Index 1 to 5) for a single-frame image. The areas can overlap, and a separate frame will be output for each area.



Specify the areas by specifying width, height, and horizontal/vertical offset values for each index under [JAICustomControlMultiROI].



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

Sequencer function can not be used with Overlap Multi ROI Function.

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.

[SequencerLUTMode]

This defines whether to apply gamma or LUT to the sequence.When gamma is selected, the gamma setting defined in [AnalogControl] is applied to all exposures in the sequence. When LUT is selected, the LUT characteristics defined in [AnalogControl] are applied to indexes for which [SequencerLUT enable] is set to ON.

[SequencerReset]

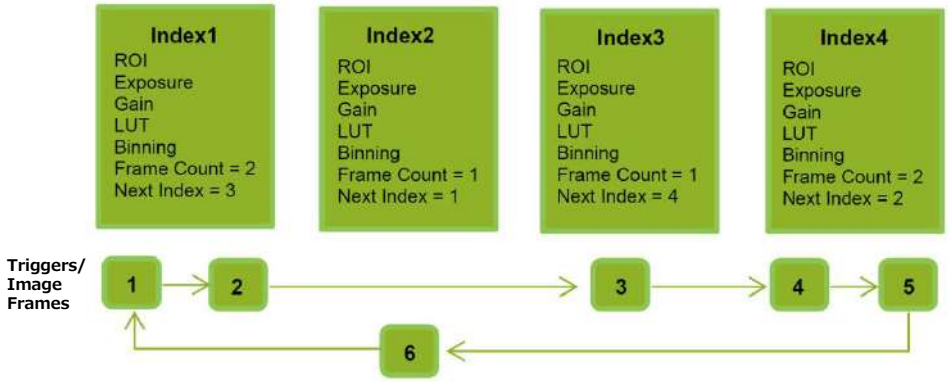
During TriggerSequencer mode operation, this switches the index number to be executed to that specified in [SequencerSetStart].

[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

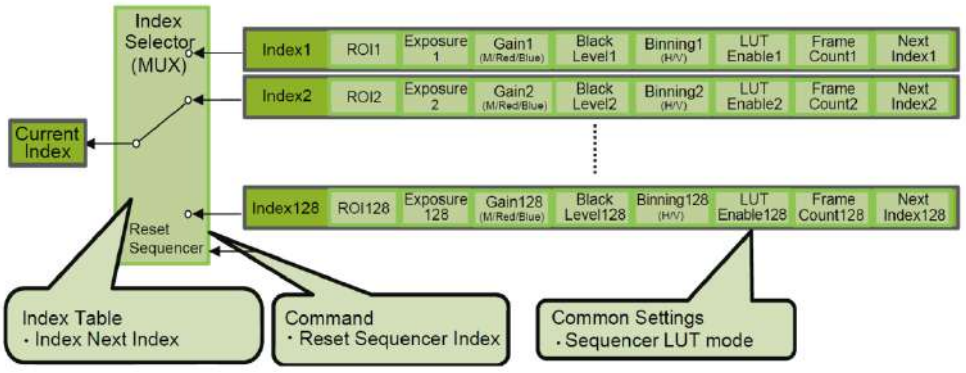
In addition to repeating multiple conditions as in the above example, you can specify "0" (which indicates the end of TriggerSequencer mode) in [SequencerSetNext] of index 2, and specify the number of repetitions in [SequencerRepetition].

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

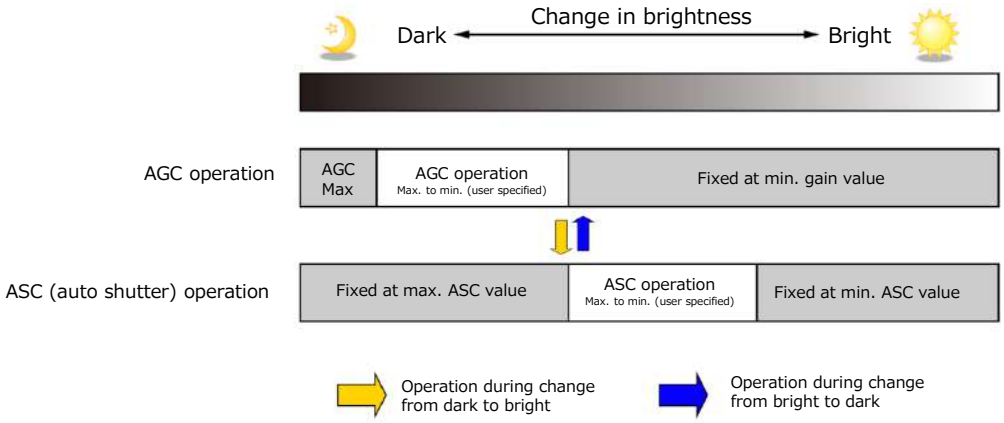
This function imposes a heavy processing load on the network bandwidth, as images from multiple cameras are read out simultaneously. The number of frames that can be stored for delayed readout depends on PixelFormat.

For details, see “Trigger Control” .

ALC (Automatic Level Control) Function

The ALC (automatic level control) function combines the automatic gain control (AGC/Auto Gain Control) and automatic exposure control (ASC/Auto Shutter Control) functions, and is capable of handling various changes in brightness.The function operates as follows in response to changes in brightness.

Change from bright to dark: ASC → AGC
Change from dark to bright: AGC □ ASC



■ **To use the ALC function**

Set [GainAuto] or [ExposureAuto] or both to [Continuous] mode. Configure the minimum value, maximum value, etc. for AGC and ASC under [JAICustomControlALC].The target video levels for AGC and ASC are configured in [ALCReference]. For example, when [ALCReference] is set to 95%, video levels will be maintained at 95% for AGC and ASC.

Color Space Conversion (ColorTransformationControl)

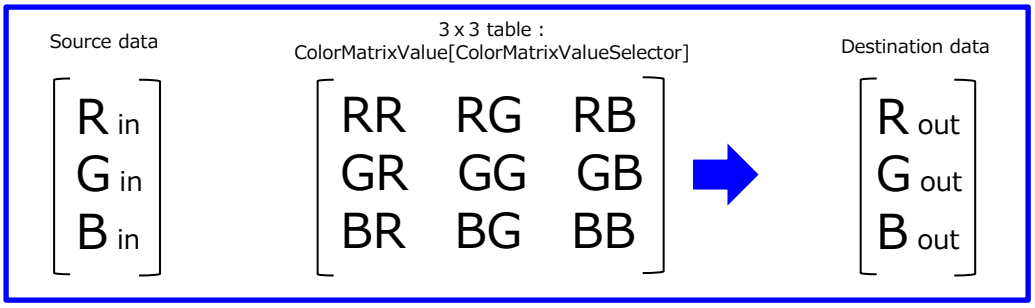
The SP-12401C-PGE model allows you to convert the standard color space (RGB) that is used to produce colors into other color spaces, including XYZ and HSI.
Five color spaces are available: RGB(sRGB), RGB(AdobeRGB), RGB(UserCustom), XYZ, and HSI. Specify the desied color space by configuring ColorTransofrmationMode and ColorTransformationRGBMode as follows.

*) This function is valid only when PixelFormat is RGB8, RGB10V1Packed, RGB10p32.

ColorTransformation	ColorTransformationMode	ColorTransformationRGBMode
RGB(sRGB)	RGB	sRGB
RGB(AdobeRGB)	RGB	AdobeRGB
RGB(UserCustom)	RGB	UserCustom
XYZ	XYZ	Off
H S I	H S I	Off
Default	RGB	Off

■ Note on RGB (UserCustom)

This allows you to use user configured 3x3 conversion tables to perform color space conversion.



Caution

If you set the color space to XYZ or HSI, JAI Control Tool will not display the images captured by the camera properly. To display them properly, XYZ- or HSI-compatible image processing must be performed on the computer side.

Configuration 3x3 table. Select the item you want to configure in [ColorMatrixValueSelector]. And configure the value in [ColorMatrixValue]. [ColorMatrixValue] can be set to a value from -2 to +2.

Item		Setting value	Description
ColorMatrixValueSelector		ColorMatrixR-R, ColorMatrixR-G, ColorMatrixR-B, ColorMatrixG-R, ColorMatrixG-G, ColorMatrixG-B, ColorMatrixB-R, ColorMatrixB-G, ColorMatrixB-B	Select the ColorMatrix setting component.
	ColorMatrixValue	−2 to 2	Set the Color Matrix value.

Note

Color space (H S I)
Value of Hue : For 0°-360°, specify as follows.
8bit output: 2°/step 0°(00000000) ～ 360°(10110100)
10bit output: 0.5°/step 0°(0000000000) ～ 360°(1011010000)
12bit output: 0.125°/step 0°(000000000000) ～ 360°(101101000000)

Value of Saturation, Intensity: For 0% - 100%, specify as follows.
8bit output: 0%(00000000) ～ 100%(11111111)
10bit output : 0%(00000000) ～ 100%(1111111111)
12bit output : 0%(00000000) ～ 100%(111111111111)

Edge Enhancer, Color Enhancer

This camera is equipped with an edge enhancer function for enhancing the contrast of lines or edges within images and a color enhancer function for enhancing specified colors.

Edge enhancer function
The edge enhancer function is enabled when EnhancerEnable[Edge] is set to True. Four enhancement levels are available: Low, Middle, High, and Strong.
*) For SP-12401C-PGE, This function is valid only when PixelFormat is RGB8, RGB10V1Packed, RGB10p32.

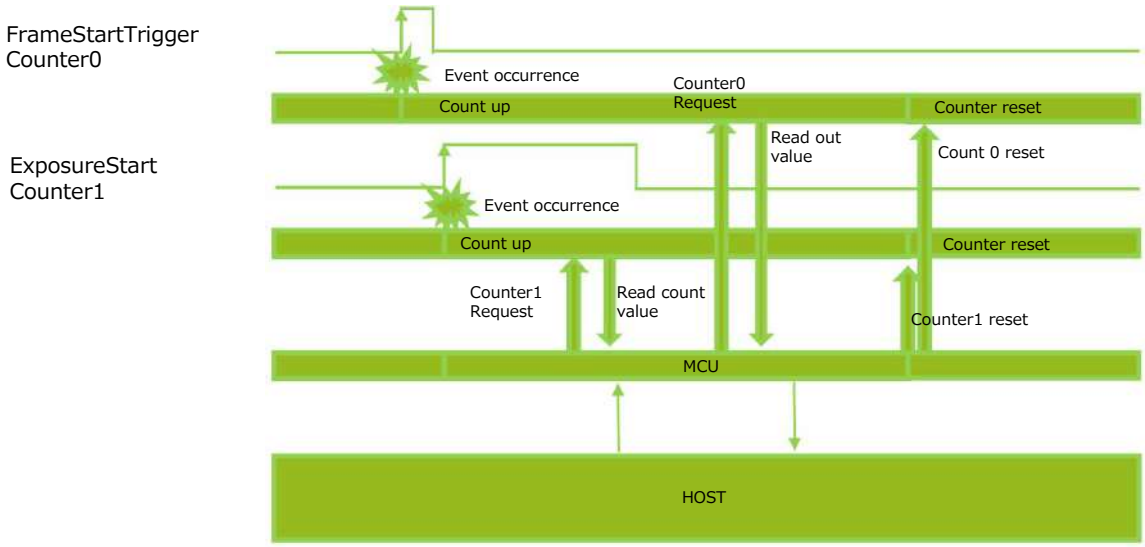
Color enhancer function (SP-12401C-PGE only)
The color enhancer function is enabled when EnhancerEnable[Color] is set to True. Set a value from 0 to 1 (0.1 steps) for ColorEnhancerValue[ColorEnhancerSelector] to set the enhancement to one of ten levels (0: no enhancement; 1: approx. x2 the color level of the original data) Six colors can be specified in ColorEnhancerSelector: Red, Cyan, Green, Magenta, Blue, and Yellow.
*) This function is valid only when PixelFormat is RGB8, RGB10V1Packed, RGB10p32.

CounterAndTimerControl Function

This camera supports only the counter 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.
Four counters are available on the camera; Counter0, Counter1, Counter2, and Counter3.
The functions that can be counted are fixed for each counter.
Counter0: Counts the number of FrameStartTrigger instances.
Counter1: Counts the number of ExposureStart instances.
Counter2: Counts the number of SensorReadOut instances.
Counter3: Counts the number of FrameTransferEnd instances.

When a problem occurs in a system that includes this camera, comparing the values from multiple counters allows you to verify the extent of normal operability and can be useful when investigating the cause of the problem.

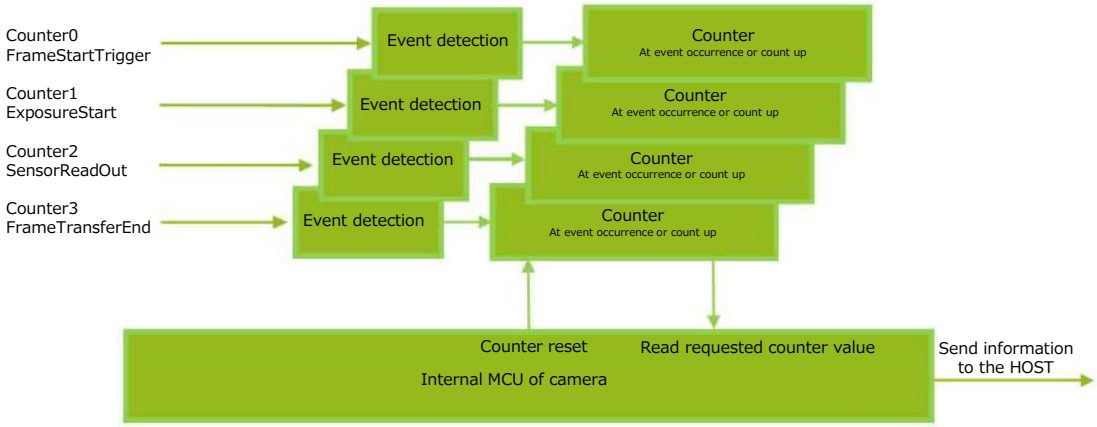
■ **Counter occurrence diagram**



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.
Four counters are available. Specify a counter (Counter0 to Counter3), and configure the settings.

Item	Setting value / selectable range	Description
Counter 0 ～ 3	Counter 0 ～ 3	Select the counter.
CounterEventSource	Counter0 Off, Frame Trigger Counter1 Off, ExposureStart Counter2 Off, SensorReadOut Counter3 Off, FrameTransferEnd	Select the counter event signal for which to read the count value. When set to Off, the counter operation will stop (but will not be reset).
CounterEventActivation	When the counter function is enabled, Counter0, Counter1, and Counter2 are fixed at RisingEdge. Counter3 is fixed at FallingEdge.	Specify the timing at which to count.

VideoProcessBypassMode

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.
12-bit outputs can only be performed in bypass mode.

VideoProcessBypassMode	On	Off
Camera operation	The following functions will be disabled, regardless of their configurations. Gain[DigitalRed], Gain[DigitalBlue] , BlackLevel, LUT, Shading, Binning(H,V), Enhancement, ColorMatrix	All video processes are enabled.
Camera output (PixelFormat)	The following format will be availabled. Mono8,Mono10, Mono10Packed, BayerRG8, BayerRG10, BayerRG10Packed, RGB8,RGB10V1Packed, RGB10p32, Mono12,Mono12Packed, BayerRG12, BayerRG12Packed,	The following format will be availabled. Mono8,Mono10, Mono10Packed, BayerRG8, BayerRG10, BayerRG10Packed, RGB8,RGB10V1Packed, RGB10p32,

■ Functions available in VideoProcessBypassMode

The following functions can be used in video process bypass mode.
Gain[AnalogAll], Gain[AnalogRed], Gain[AnalogGreen], Gain[AnalogBlue], AutoGainControl, AutoShutterControl, AutoWhiteBalance, SequencerMode, BlemishCompensation

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

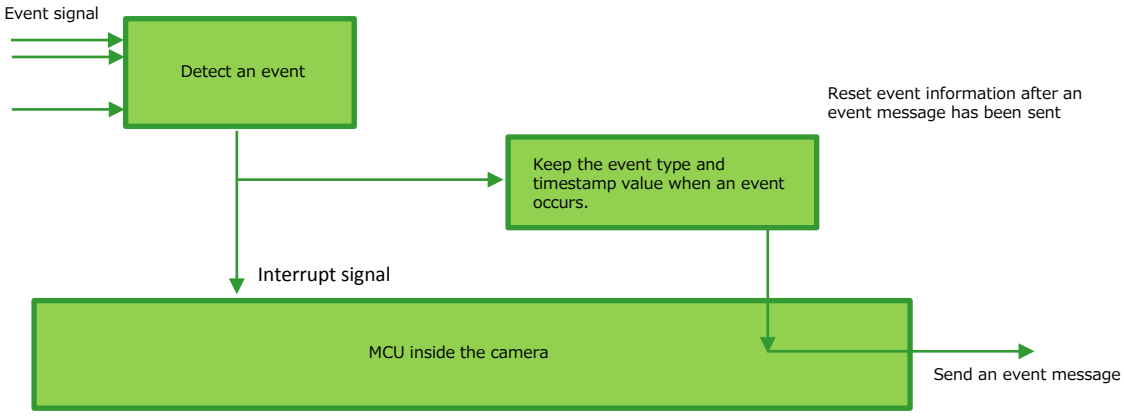
The Chunk Data function settings cannot be changed during image output. To change the settings, stop Acquisition.

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

Event Control Function

The Event Control Function is a function that outputs a signal change point inside the camera as information indicative of an event occurrence (event message) by using GVCP (GigE Vision Control Protocol).

■ Flow from detecting an event to sending an event message



■ Events that can use the Event Control Function

Events that can use the Event Control Function are as follows. You can specify whether or not to send an event message when an event occurs at each event.

AcquisitionTrigger,
FrameStart,
FrameEnd,
FVALStart,
FVALEnd,
ExposureStartRed,
ExposureEndRed,
Line1-TTLOut1-RisingEdge,
Line1-TTLOut1-FallingEdge,
Line2-OptOut1-RisingEdge,
Line2-OptOut1-FallingEdge,
Line5-OptIn1-RisingEdge,
Line5-OptIn1-FallingEdge,
Line6-OptIn2-RisingEdge,
Line6-OptIn2-FallingEdge,

Action Control Function

The Action Control Function is a function that executes the pre-configured action when the camera receives action commands. Action commands can send both unicast and broadcast messages and give instructions for actions to multiple cameras simultaneously by broadcasting them. A camera that has this function can even give instructions for actions to different types of multiple cameras. Although this function includes jitter and delays, it is useful for controlling multiple cameras simultaneously.

Actions are performed when the following three conditions are met.
1. ActionDeviceKey set to the camera and ActionDeviceKey in the action command match
2. ActionGroupKey set to the camera and ActionGroupKey in the action command match
3. ActionGroupMask set to the camera and GroupMask in the action command perform AND operation, and the result is not 0.

■ About the settings of the camera

1. Specify ActionDeviceKey.
2. Then, specify two actions that can be configured on the camera.
   Action1
   Select 1 in ActionSelector.
   Specify ActionGroupMask [ActionSelector].
   Specify ActionGroupKey [ActionSelector].
   Action2
   Select 2 in ActionSelector.
   Specify ActionGroupMask [ActionSelector].
   Specify ActionGroupKey [ActionSelector].
3. Set triggers (AcquisitionStart, AcquisitionEnd, FrameStart, AcquisitionTransferStart) to Action1 and Action2.

■ Setting example

Assume that the following settings have been pre-configured on the camera.
ActionDeviceKey : 0x00001001
ActionGroupMask[1] : 0x00000011
ActionGroupKey[1] : 0x00000001
ActionGroupMask[2] : 0x00000111
ActionGroupKey[2] : 0x00000002

When the camera receives action commands (ActionDeviceKey:0x00001001, ActionGroupMask:0x00000011, ActionGroupKey: 0x00000002), Action2 is executed.

When the camera receives action commands (ActionDeviceKey:0x00001001, ActionGroupMask:0x00000011, ActionGroupKey: 0x00000001), ActionDevice and ActionGroupKey[1] match. However, the result of AND operation performed by ActionGroupMask is 0. Therefore, in this case, neither Action1 nor Action2 is executed.

Non-Volatile Flash Memory

The camera has non-volatile memory for users to store data.
Refer to the technical note "Storing Data in On-Camera Flash Memory" for more information.

Note

JAI strongly recommends saving images to the PC or other storage location because the non-volatile flash memory may not have enough memory size to store large data.

Setting List

Feature Properties

F	Setting range	Default value	Description
a) DeviceContr			Display/configure information related to the device.
DeviceVendorName	—	"JAI Corporation"	Display the manufacturer name.
DeviceModelName	—	SP-12401M-PGE/ SP-12401C-PGE	Display the model name.
DeviceManufacturerInfo	—	See the possibilities	Display the manufacturer information.
DeviceVersion	—	—	Display the hardware version.
DeviceFirmwareVersion	—	—	Display the firmware version.
DeviceSerialNumber	—	—	Display the device ID.
DeviceUserID	Any	—	Set the user ID (16bytes) for the camera.
DeviceTemperatureSelector	Mainboard	Mainboard	Select the area of the camera's interior for which to display the temperature sensor's reading. (fixed Mainboard)
DeviceTemperature(C)	—	—	Display the internal temperature (°C) of the camera.
Timestamp (ns)	—	0～ 9223372036854775807 (maximum value of signed 64-bit)	Display the timestamp value. Resets to 0 when the signed maximum 64-bit value is exceeded.
TimestampReset	—	—	Forcibly sets the timestamp's count value to 0.
TimestampLatch	—	—	Sets the timestamp's count value to TimestampLatchValue.
TimestampLatchValue (ns)	0～9223372036854775807 (maximum value of signed 64-bit)	0	
DeviceReset	—	—	Reset the device. (After the camera receives this command, it returns an ACK response. Then, execute reset.)
b) ImageFormatContr			Configure image format settings.
SensorWidth	4112	4112	Display the maximum image width.
SensorHeight	3008	3008	Display the maximum image height.
SensorDigitizationBits	12 Bits	12 Bits	Display the number of bits at which the sensor is operating.
WidthMax	SP-12401M-PGE BinningHorizontal 1: 4112 BinningHorizontal 2: 2056 SP-12401C-PGE 4088	SP-12401M-PGE BinningHorizontal 1: 4112 BinningHorizontal 2: 2056 SP-12401C-PGE 4088	Display the maximum image width. (The values are different between SP-12401M-PGE and SP-12401C-PGE.) (SP-12401M-PGE : This value will vary depending on the HorizontalBinning setting.)
HeightMax	SP-12401M-PGE BinningVertical 1: 3008 BinningVertical 1: 1504 SP-12401C-PGE 3000	SP-12401M-PGE BinningVertical 1: 3008 BinningVertical 1: 1504 SP-12401C-PGE 3000	Display the maximum image height. (The values are different between SP-12401M-PGE and SP-12401C-PGE.) (SP-12401M-PGE : This value will vary depending on the VerticalBinning setting.)

Width	SP-12401M-PGE BinningHorizontal 1: 16～4112 step 8 BinningHorizontal 2: 8～2056 step 4 SP-12401C-PGE 16～4088 step 8	SP-12401M-PGE BinningHorizontal 1: 4112 BinningHorizontal 2: 2056 SP-12401C-PGE 4088	Set the image width.
Height	SP-12401M-PGE BinningVertical 1: 8 ～ 3008 step 2 BinningVertical 1: 8 ～ 1504 step 2 SP-12401C-PGE 8 ～ 3000 step 2	SP-12401M-PGE BinningVertical 1: 3008 BinningVertical 1: 1504 SP-12401C-PGE 3000	Set the image height.
OffsetX	SP-12401M-PGE BinningVertical 1: 0 ～ 4096 step 8 BinningVertical 2: 0 ～ 2048 step 4 SP-12401C-PGE 0 ～ 4072 step 8	0	Set the horizontal offset.
OffsetY	SP-12401M-PGE BinningVertical 1: 0 ～ 3000 step 4 BinningVertical 2: 0 ～ 1496 step 2 SP-12401C-PGE 0 ～ 2992 step 4	0	Set the vertical offset.
BinningHorizontalMode	Average, Sum	Sum	Set the addition process to be used during horizontal binning. (SP-12401M-PGE only)
BinningHorizontal	1,2	1	Set the number of pixels in the horizontal direction for which to perform binning. (SP-12401M-PGE only)
BinningVerticalMode	Average, Sum	Sum	Display the addition process to be used during vertical binning. (SP-12401M-PGE only)
BinningVertical	1,2	1	Set the number of pixels in the vertical direction for which to perform binning. (SP-12401M-PGE only)
PixelFormat	SP-12401M-PGE Mono8, Mono10, Mono10Packed, Mono12, Mono12Packed SP-12401C-PGE BayerRG8, BayerRG10, BayerRG10Packed, BayerRG12, BayerRG12Packed RGB8, RGB10V1Packed, RGB10p32	SP-12401M-PGE Mono8 SP-12401C-PGE BayerRG8	Set the pixel format. The following mode are enabled when [VideoProcessBypassMode] is set to [On]. SP-12401M-PGE Mono12, Mono12Packed SP-12401M-PGE BayerRG12, BayerRG12Packed

TestPattern	Off, GreyHorizontalRamp, GreyVerticalRamp, GreyHorizontalRampMoving, 以下 SP-12041C-PGEのみ HorizontalColorBar, VerticalColorBar, HorizontalColorBarMoving	Off	Select the test image.
c) AcquisitionControl			Configure image capture settings.
AcquisitionMode	SingleFrame, MultiFrame, Continuous	Countinuous	Select the image capture mode.
AcquisitionStart	—	—	Start image capture.
AcquisitionStop	—	—	Stop image capture.
AcquisitionFrameCount	1～65535	1	In [MultiFrame] mode, set the number of frames to capture.
AcquisitionFrameRate(Hz)	0.125～		Set the frame rate as a frequency. (unit: Hz) The maximum value varies depending on the PixelFormat and ROI settings.
TriggerSelector	AcquisitionStart, AcquisitionEnd, FrameStart, AcquisitionTransferStart	AcquisitionStart	Select the trigger operation.
TriggerMode	Off, On	Off	Select the trigger mode.
TriggerSoftware			Execute a software trigger.
TriggerSource	Low High Software PulseGenerator0 PulseGenerator1 PulseGenerator2 PulseGenerator3 UserOutput0 UserOutput1 UserOutput2 UserOutput3 Line5 - OptIn1 Line6 - OptIn2 NAND0Out NAND1Out	TriggerSource [AcquisitionStart]=Low TriggerSource [AcquisitionEnd]=Low TriggerSource [FrameStart]=FrameStart TriggerSource [AcquisitionTransferStart] =Low	Select the trigger signal source.
TriggerActivation	RisingEdge FallingEdge LevelHigh LevelLow	RisingEdge	Select the polarity of the trigger signal (i.e., location of signal at which trigger is applied).
TriggerOverlap	Off, ReadOut	TriggerOverlap [AcquisitionStart] = Off TriggerOverlap [AcquisitionEnd] = Off TriggerOverlap [FrameStart]=ReadOut TriggerOverlap [AcquisitionTransferStart] =Off	Select the trigger overlap operation.
TriggerDelay (us)	0～500000	0	Set the time of exposure start from trigger input. (unit: μs)

ExposureModeOption	Off, RCT, BurstTrigger	Off	Set whether to enable RCT mode. (BurstTrigger mode is available only when the video output mode is 8 bit.)
ExposureMode	Off, Timed, TriggerWidth	Timed	Select the exposure mode.
ExposureTime (us)	1μs ～	—	Set the exposure time. The specifiable range varies depending on the [StartTriggerMode] and [PixelFormat] setting.
ExposureAuto	Off, Continuous, Once	Off	Set whether to enable auto exposure.
d) AnalogControl			Configure analog control settings.
GainSelector	SP-12401M-PGE AnalogAll SP-12401C-PGE AnalogAll, DigitalRed, DigitalBlue	AnalogAll	Select the gain to configure.
Gain	SP-12401M-PGE AnalogAll x1.0 ～ x16.0 SP-12401C-PGE AnalogAll, x1.0 ～ x16.0 DigitalRed, x0.447～x5.624 DigitalBlue, x0.447～x5.624	SP-12401M-PGE AnalogAll x1.0 SP-12401C-PGE AnalogAll, x1.0 DigitalRed, x1.0 DigitalBlue, x1.0	Set the gain value for the gain setting selected in [GainSelector].
GainAuto	Off, Continuous, Once	Off	Enable/disable gain auto adjustment. [Once] automatically changes to [Off] when the signal level converges once.
BalanceWhiteAuto	Off, Continuous, Once, Preset3200K, Preset5000K, Preset6500K, Preset7500K	Off	Enable/disable auto white balance.
BlackLevelSelector	DigitalAll, DigitalRed, DigitalBlue	DigitalAll	Select the black level to configure.
BlackLevel	DigitalAll, -133～255 DigitalRed, -64～ 64 DigitalBlue -64～ 64	DigitalAll, 0 DigitalRed, 0 DigitalBlue 0	Set the black level value.
Gamma	0.45, 0.5, 0.55, 0.6, 0.65, 0.75, 0.8, 0.9, 1.0	0.45	Set the gamma value.
LUTMode	Off, Gamma, LUT	Off	Select the LUT mode.
e) LUTControl			Configure LUT settings.
LUTSelector	Red, Green, Blue	Red	Select the LUT channel to control.
LUTIndex	0～256	0	Set the LUT index table number.
LUTValue	0～4095	Gamma=1.0	Set the LUT value.
f) ColorTransformationControl			
ColorTransformationMode	RGB, XYZ, H S I	RGB	Set the output image format.
ColorTransofrmationRGBMode	Off, sRGB, AdobeRGB, UserCustom	Off	Set the detailed mode when RGB is selected for the color space.

ColorMatrixValueSelector	ColorMatrixR-R ColorMatrixR-G ColorMatrixR-B ColorMatrixG-R ColorMatrixG-G ColorMatrixG-B ColorMatrixB-R ColorMatrixB-G ColorMatrixB-B	ColorMatrixR-R	Select the ColorMatrix setting component.
ColorMatrixValue	-2.0 ～ 2.0	ColorMatrixValue [ColorMatrixR-R] = 1.0 ColorMatrixValue [ColorMatrixR-G] = 0 ColorMatrixValue [ColorMatrixR-B] = 0 ColorMatrixValue [ColorMatrixG-R] = 0 ColorMatrixValue [ColorMatrixG-G] = 1.0 ColorMatrixValue [ColorMatrixG-B] = 0 ColorMatrixValue [ColorMatrixB-R] = 0 ColorMatrixValue [ColorMatrixB-G] = 0 ColorMatrixValue [ColorMatrixB-B] = 1.0	Set the Color Matrix value.
g) DigitalI/Ocontrol			Configure settings for digital input/output.
LineSelector	Line1-TTLOut1 Line2-OptOut1 Line5-OptIn1 Line6-OptIn2 TimeStampReset NANDGate0In1 NANDGate0In2 NANDGate1In1 NANDGate1In2	Line2-OptOut1	Select the input/output to configure.
LineMode	Input, Output	—	Display the input/output status (whether it is input or output).
LineInverter	True, False	False	Enable/disable polarity inversion for the selected input signal or output signal.
LineStatus	True, False	—	Display the status of the input signal or output signal (True: High, False: Low).

LineSource	Low High AcquisitiionTriggerWait AcquisitionActive FrameTriggerWait FrameActive ExposureActive FVAL LVAL PulseGenerator0 PulseGenerator1 PulseGenerator2 PulseGenerator3 UserOutput0 UserOutput1 UserOutput2 UserOutput3 Line5 - OptIn1 Line6 - OptIn2 NAND0Out NAND1Out Action1 Action2 Off	LineSource [Line1-TTLOut1] = ExposureActive LineSource [TImestampReset] = Off Other default value is Off.	Select the line source signal for the item selected in [LineSelector].
LineFormat	NoConnect, TTL, OptoCoupled InternalSignal	—	Display the signal format.
LineStatusAll	—	—	Display the input/output signal status. The state is shown with 16 bits. Bit assignments are as follows. [0] Line1 - TTL Out 1 [1] Line2 - OptOut1 [2], [3] (unused) [4] Line5 - Opt In 1 [5] Line6 - Opt In 2 [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
OptInFilterSelector	Off, 10us, 100us, 500us, 1ms, 5ms, 10ms	Off	Remove noise from the OptIn input signal of Digital I/O.
UserOutputSelector	UserOutput0 UserOutput1 UserOutput2 UserOutput3	UserOutput0	Set the UserOutput signal.
UserOutputValue	True, False	False	Set the value for the UserOutput selected in [UserOutputSelector].
h) CounterAndTimerControl			Configure counter settings. (This camera only supports counter functions.)
CounterSelector	Counter0 Counter1 Counter2 Counter3	—	Select the counter.

	CounterEventSource	Counter0 Off, FrameTrigger Counter1 Off, ExposureStart Counter2 Off, SensorReadOut Counter3 Off, FrameTransferEnd	Off	Assign the counter event signal for which you want to read the count value to a dedicated counter, and read the value.
	CounterEventActivation	—	—	Set the count timing. The setting value is fixed with the following data. Counter0 RisingEdge Counter1 RisingEdge Counter2 RisingEdge Counter3 FallingEdge
	CounterReset	—	—	Reset the counter.
	CounterRefresh	0～65535	0	Update the count value.
	CounterValue	0～65535	0	Display the count value.
	CounterStatus	—	—	Display the counter status. CounterIdle: Idle CounterActive: Counting CounterOverflow: Count value exceeded the mazimum value
i) ActionControl				Configure settings for action control.
ActionDeviceKey		0x00000000～ 0xFFFFFFFF	—	An action command is executed if this ActionDeviceKey matches the DeviceKey contained in the action command message.
ActionSelector		1,2	1	select the ActionSelector.
	ActionGroupMask	0x00000000～ 0xFFFFFFFF	—	An action command is executed if the result of an AND operation of GroupMask contained in this ActionGroupMask and an action command message is not 0.
	ActionGroupKey	0x00000000～ 0xFFFFFFFF	—	An action command is executed if this ActionGroupKey matches the GroupKey contained in the action command message.
j) EventControl				Configure settings for event control.
EventSelector		AcquisitionTrigger, FrameStart, FrameEnd, FVALStart, FVALEnd, ExposureStartRed, ExposureEndRed, Line1-TTLOut1-RisingEdge, Line1-TTLOut1-FallingEdge, Line2-OptOut1-RisingEdge, Line2-OptOut1-FallingEdge, Line5-OptIn1-RisingEdge, Line5-OptIn1-FallingEdge, Line6-OptIn2-RisingEdge, Line6-OptIn2-FallingEdge	AcquisitionTrigger	Select the event to send the event message.
	EventNotification	On, Off	Off	Sets whether or not to send an event message when an event selected by [EventSelector] occurs.

AcquisitionTriggerEventData		—	—	When the event [AcquisitionTrigger] occurs, the following three data can be checked.
	EventAcquisitionTrigger	—	—	Display the EventID(9002).
	EventAcquisitionTriggerTimeStamp	—	—	Displays the Timestamp value when an event occurs.
	EventAcquisitionTriggerFrameID	—	—	The FrameID value at the time of the event is displayed.
FrameStartEventData		—	—	When the event [FrameStart] occurs, the following three data can be checked.
	EventFrameStart	—	—	Display the EventID(9300).
	EventFrameStartTimestamp	—	—	Displays the Timestamp value when an event occurs.
	EventFrameStartFrameID	—	—	The FrameID value at the time of the event is displayed.
FrameEndEventData		—	—	When the event [FrameEnd] occurs, the following three data can be confirmed.
	EventFrameEnd	—	—	Display the EventID(9301).
	EventFrameEndTimestamp	—	—	Displays the Timestamp value when an event occurs.
	EventFrameEndFrameID	—	—	The FrameID value at the time of the event is displayed.
FVALStartEventData		—	—	When the event [FVALStarrt] occurs, the following three data can be confirmed.
	EventFVALStart	—	—	Display the EventID(9320).
	EventFVALStartTimestamp	—	—	Displays the Timestamp value when an event occurs.
	EventFVALStartFrameID	—	—	The FrameID value at the time of the event is displayed.
FVALEndEventData		—	—	When the event [FVALEnd] occurs, the following three data can be confirmed.
	EventFVALEnd	—	—	Display the EventID(9321).
	EventFVALEndTimestamp	—	—	Displays the Timestamp value when an event occurs.
	EventFVALEndFrameID	—	—	The FrameID value at the time of the event is displayed.
ExposureStartEventData		—	—	When the event [ExposureStart] occurs, you can check the following three data.
	EventExposureStart	—	—	Display the EventID(9003).
	EventExposureStartTimestamp	—	—	Displays the Timestamp value when an event occurs.
	EventExposureStartFrameID	—	—	The FrameID value at the time of the event is displayed.
ExposureEndEventData		—	—	When the event [ExposureEnd] occurs, you can check the following three data.
	EventExposureEnd	—	—	Display the EventID(9004).
	EventExposureEndTimestamp	—	—	Displays the Timestamp value when an event occurs.

EventExposureEndFrameID	—	—	The FrameID value at the time of the event is displayed.
LineXRisingEdgeEventData	—	—	When the following four events occur, three data can be confirmed respectively. Line1-TTLOut1-RisingEdge, Line2-OptOut1-RisingEdge, Line5-OptIn1-RisingEdge, Line6-OptIn2-RisingEdge
EventLineXRisingEdge	—	—	Display the EventID. Line1-TTLOut1-RisingEdge 9310 Line2-OptOut1-RisingEdge 9311 Line5-OptIn1-RisingEdge 9314 Line6-OptIn2-RisingEdge 9315
EventLineXRisingEdgeTimestamp	—	—	Displays the Timestamp value when an event occurs.
EventLineXRisingEdgeFrameID	—	—	The FrameID value at the time of the event is displayed.
LineXFallingEdgeEventData	—	—	When the following four events occur, three data can be confirmed respectively. Line1-TTLOut1-FallingEdge, Line2-OptOut1-FallingEdge, Line5-OptIn1-FallingEdge, Line6-OptIn2-FallingEdge
EventLineXFallingEdge	—	—	Display the EventID. Line1-TTLOut1-FallingEdge 9318 Line2-OptOut1-FallingEdge 9319 Line5-OptIn1-FallingEdge 931C Line6-OptIn2-FallingEdge 931D
EventLineXFallingEdgeTimestamp	—	—	Displays the Timestamp value when an event occurs.
EventLineXFallingEdgeFrameID	—	—	The FrameID value at the time of the event is displayed.
k) UserSetControl			Configure user settings.
UserSetSelector	Default, UserSet1, UserSet2, UserSet3	Default	Select the user settings.
UserSetLoad	0(default), 1, 2, 3	—	Load user settings. (If 0 is specified, the factory default setting is read.)
UserSetSave	1,2,3	—	Save the current setting values as user settings.
l) SequencerControl			Configure sequencer settings.
SequencerMode	Off, On	Off	Enable/disable [SequencerMode].
SequencerModeSelect	TriggerSequencerMode, CommandSequencerMode	TriggerSequencerMode	Select the sequencer mode.
SequencerConfigurationMode	Off, On	On	Select [On] to change the settings within the index.
SequencerSetSelector	1～128	1	Select the index number to configure.

SequencerFrameNumber	1～255	1	Set the number of frames to display for the selected SequencerIndex. (Enabled only for TriggerSequencer.)
SequencerSetNext	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.
SequencerWidth	SP-12401M-PGE SequencerBinningHorizontal 1:16～4112 Step 8 SequencerBinningHorizontal 2: 8～2056 Step 4 SP-12401C-PGE 16～4088 Step 8	SP-12401M-PGE SequencerBinningHorizontal 1:4112 SequencerBinningHorizontal 2:2056 SP-12401C-PGE 4088	Set the width of the selected SequencerIndex.
SequencerHeight	SP-12401M-PGE SequencerBinningVertical 1:8～3008 Step 4 SequencerBinningVertical 2:8～1504 Step 2 SP-12401C-PGE 8～3000 Step 2	SP-12401M-PGE SequencerBinningVertical 1:3008 SequencerBinningVertical 2:1504 SP-12401C-PGE 3000	Set the height of the selected SequencerIndex.
SequencerOffsetX	SP-12401M-PGE BinningVertical 1: 0 ～ 4096 step 8 BinningVertical 1: 0 ～ 2048 step 4 SP-12401C-PGE 0 ～ 4072 step 8	0	Set the horizontal offset value for the selected SequencerIndex.
SequencerOffsetY	SP-12401M-PGE BinningVertical 1: 0 ～ 3000 step 4 BinningVertical 1: 0 ～ 1496 step 2 SP-12401C-PGE 0 ～ 2992 step 4	0	Set the vertical offset value for the selected SequencerIndex.
SequencerGainAnalogAll	1.0 ～ 16.0	1.0	Set the GainAnalogAll value.
SequencerGainDigitalRed	0.447～5.624	1.0	SP-12401C-PGE only Set the DigitalRed Gain value for the selected SequencerIndex.
SequencerGainDigitalBlue	0.447～5.624	1.0	SP-12401C-PGE only Set the DigitalBlue Gain value for the selected SequencerIndex.
SequencerExposureTime	1μs ～	—	Set the exposure time for the selected SequencerIndex.
SequencerBinningHorizontal	1,2	1	SP-12401M-PGE only For the selected SequencerIndex, set the number of pixels in the vertical direction for which to perform binning. In binning mode, the setting value of BinningHorizontalMode is applied.

SequencerBinningVertical	1,2	1	SP-12401M-PGE only For the selected SequencerIndex, set the number of pixels in the vertical direction for which to perform binning. In binning mode, the setting of BinningVerticalMode is applied.
SequencerLUTEnable	True, False	False	Set the LUTEnable for the selected SequencerIndex.
SequencerBlackLevelDigitalAll	-133～255	0	Set the BlackLevelDigitalAll for the selected SequencerIndex.
SequencerRepetition	1～255	1	Set the repeat count for the sequencer.
SequencerLUTMode	Gamma, LUT	Gamma	Set the sequence LUT mode.
SequencerSetActive	1～128	1	Displays the sequencer set number.
SequencerCommandIndex	1～128	1	Set this to change the SequencerIndex. (Enabled only for CommandSequencer.)
SequencerSetStart	1～128	1	Specify the first index number to switch to when starting [TriggerSequencerMode].
SequencerReset	—	—	In [TriggerSequencerMode], reset the current index number to the number configured in [SequencerSetStart].
m) ChunkDataControl			Configure chunk control settings.
ChunkModeActive	True, False	False	Set whether to enable ChunkData.
ChunkSelector	OffsetX OffsetY Width Height ExposureTime GainAnalogAll GainDigitalRed GainDigitalBlue BlackLevelDigitalAll BlackLevelDigitalRed BlackLevelDigitalBlue BinningH/V LUTEnable SequencerSetActive FrameTriggerCounter ExposureStartCounter SensorReadOutStartCounter FrameTransferEndCounter PixelFormat LineStatusAll Timestamp LineStatusAllOnExposureStart LineStatusAllOnFVALStart DeviceSerialNumber DeviceUserID DeviceTemperature	OffsetX	Select the ChunkData to be added.
ChunkEnable	True, False	False	Select whether to output ChunkData. Default: Only [ChunkImage] is [True].

ChunkOffsetX	—	—	OffsetX (ChunkID 2000h : DataType Integer)
ChunkOffsetY	—	—	OffsetY (ChunkID 2001h : DataType Integer)
ChunkWidth	—	—	Width (ChunkID 2002h : DataType Integer)
ChunkHeight	—	—	Height (ChunkID 2003h : DataType Integer)
ChunkPixelFormat	—	—	OffsetX (ChunkID 2012h : DataType Enum.)
ChunkTimestamp	—	—	Timestamp (ChunkID 2014h : DataType Integer)
ChunkLineStatusAll	—	—	LineStatusAll (ChunkID 2013h : DataType Integer) [0] Line1 - TTL Out 1 [1] Line2 - OptOut1 [2], [3] (unused) [4] Line5 - Opt In 1 [5] Line6 - Opt In 2 [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 [16]～[31] (unused)
ChunkExposureTime (us)	—	—	Display the actual exposure time rather than the time set by the user. (ChunkID 2004h : DataType Float)
ChunkGainAnalogAll	—	—	AnalogGainAll (ChunkID 2005h : DataType Float)
ChunkGainDigitalRed	—	—	DigitalGainRed (ChunkID 2006h : DataType Float)
ChunkGainDigitalBlue	—	—	AnalogGainBlue (ChunkID 2007h : DataType Float)
ChunkBlackLevelDigitalAll	—	—	BlackLevelDigitalAll (ChunkID 2008h : DataType Float)
ChunkBlackLevelDigitalRed	—	—	BlackLevelDigitalRed (ChunkID 2009h : DataType Float)
ChunkBlackLevelDigitalBlue	—	—	BlackLevelDigitalRed (ChunkID 200Ah : DataType Float)
ChunkBinningHorizontalVertical_LUTEnable	—	—	(ChunkID 200Bh : DataType Integer) The set value of BinningHorizontal, BinningVertical and LUTEnable is displayed as follows with 32 bits. [0] : BinningHorizontal 0: OFF 1:ON [1] : BinningVertical 0: OFF 1:ON [2] : BinningMode 0:Sum 1:Average [3] : LUTEnable 0: OFF 1:ON [4]-[31] : (unused)

ChunkSequencerSetActive	—	—	(ChunkID 200Ch : DataType Float) In Sequencer mode, The currently running SequencerSet number is displayed.
ChunkFrameTriggerCounter	—	—	Counter value of FrameTrigger (ChunkID 200Eh : DataType Integer)
ChunkExposureStartCounter	—	—	Counter value of ExposureStart (ChunkID 200Fh : DataType Integer)
ChunkSensorReadOutCounter	—	—	Counter value of SensorReadoutStart (ChunkID 2010h : DataType Integer)
ChunkFrameTransferEndCounter	—	—	Counter value of FrameTansferEnd (ChunkID 2011h : DataType Integer)
ChunkLineStatusAllOnExposureStart	—	—	Counter value of LineStatusAllOnExposureStart (ChunkID h : DataType Float)
ChunkLineStatusAllOnFVALStart	—	—	The status of Line is added in rising edge of FVAL. The details of the data are the same as [ChunkLineStatusAll]. (ChunkID 2016h : DataType Integer)
ChunkDeviceTemperature (C)	—	—	DeviceTemperature (ChunkID 2019h : DataType Float)
ChunkDeviceSerialNumber	—	—	DeviceSerialNumber (ChunkID 2017h : DataType String)
ChunkDeviceUserID	—	—	DeviceUserID (ChunkID 2018h : DataType String)
n) TestControl			
TestPendingAck (ms)	0～10000	0	PendingAck function test command. The camera waits for TestPendingAck (ms) time and returns an Ack response.
o) TransportLayerControl			Display information on transport layer control.
PlayloadSize (B)			Display the payload size.
DeviceTapGeometry	Geometry_1X_1Y	Geometry_1X_1Y	Set the transfer method (tap configuration) of images transferred from the camera at one time.
GevCurrentPhysicalLinkConfigration	SingleLink	SingleLink	Display the LinkConfiguration status. (fixed at [SingleLink] on this camera)

GevSupportedOptionSelector	SingleLink, MultiLink, StaticLAG, DynamicLAG, PAUSEFrameReception, PAUSEFrameGeneration, IPConfigurationLLA, IPConfigurationDHCP, IPConfigurationPersistentIP, StreamChannelSourceSocket, StandardIDMode, MessageChannelSourceSocket, CommandsConcatenation, WriteMem, PacketResend, Event, EventData, PendingAck, IEEE1588, Action, UnconditionalAction, ScheduledAction, PrimaryApplicationSwitchover, ExtendedStatusCodes, ExtendedStatusCodesVersion2_0, DiscoveryAckDelay, DiscoveryAckDelayWritable, TestData, ManifestTable, CCPApplicationSocket, LinkSpeed, HeartbeatDisable, SerialNumber, UserDefinedName, StreamChannel0BigAndLittleEndian, StreamChannel0MultiZone, StreamChannel0PacketResendDestination, StreamChannel0AllInTransmission, StreamChannel0UnconditionalStreaming, StreamChannel0ExtendedChunkData, StreamChannel1BigAndLittleEndian, StreamChannel1MultiZone, StreamChannel1PacketResendDestination, StreamChannel1AllInTransmission, StreamChannel1UnconditionalStreaming, StreamChannel1ExtendedChunkData, StreamChannel2BigAndLittleEndian, StreamChannel2MultiZone, StreamChannel2PacketResendDestination, StreamChannel2AllInTransmission, StreamChannel2UnconditionalStreaming, StreamChannel2ExtendedChunkData		Select the supported options for GigEVision.
GevSupportedOption	True, False	—	Display whether support for the function selected in GevSupportedOptionSelector is enabled or disabled.
GevInterfaceSelector	0	0	The value for this item is fixed at 0.
GevMACAddress	—	—	Display the MAC address.
GevPAUSEFrameReception	False	False	Not supported on this camera (fixed at [False]).
GevPAUSEFrameTransmission	False	False	Not supported on this camera (fixed at [False]).
GevCurrentIPConfigurationLLA	True	True	Display whether the current IP configuration is calibrated by LLA (link-local address). (fixed at [True])
GevCurrentIPConfigurationDHCP	True, False	True	Select whether to set the IP configuration to DHCP.
GevCurrentIPConfigurationPersistentIP	True, False	True	Select whether to set the IP configuration to Persistent IP.
GevCurrentIPAddress	—	—	Display the IP address.
GevCurrentSubnetMask	—	—	Display the subnet.
GevCurrentDefaultGateway	—	—	Display the default gateway.
GevIPConfigurationStatus	None, PersistentIP, DHCP, LLA, ForceIP,	—	Display the current IP configuration status. None, PersistentIP, DHCP, LLA, ForceIP
GevPersistentIPAddress	—	—	Set the persistent IP address.
GevPersistentSubnetMask	—	—	Set the persistent subnet mask.
GevPersistentDefaultGateway	—	—	Set the persistent default gateway.
GevGVCPPendingAck	True, False	False	Enable/disable to generate PENDING_ACK by the camera.
GevGVSPExtendedIDMode	Off, On	Off	

GevCCP	OpenAccess, ExclusiveAccess, ControlAccess, ControlAccessSwithoverActive	—	Control access rights.
GevPrimaryApplicationSocket	—	—	Set UDP SOURCE PORT for the primary application.
GevPrimaryApplicationIPAddress	—	—	Return the primary application IP Address.
GevMCPHostPort	0	0	Set the port number to send a message.
GevMCDA	0	0	Set the restoration IP Address for the message channel. (fixed at 0)
GevMCTT (ms)	0～4294967295	300	Set the timeout duration for the message channel. (unit: ms)
GevMCRC	0～4294967295	0	Sets the number of retransmissions when the message channel timeout occurs.
GevMCSP	—	0	Display the source port number for the message channel.
GevStreamChannelSelector	0	0	Select the stream channel. (fixed at 0)
GevSCCFGPacketResendDestination	True, False	False	Set whether to use Alternate IP as the transmission destination of the retransmission packet of the video stream.
GevSCCFGAllInTransmission	True, False	False	
GevSCCFGUnconditionalStreaming	True, False	False	
GevSCCFGExtendedChunkData	True, False	False	
GevSCPInterfaceIndex	0	0	Fixed at 0.
GevSCPHostPort	0	0	Set the port number for the stream channel.(fixed at 0)
GevSCPSFireTestPacket	True, False	False	
GevSCPSDoNotFragment	True, False	False	Specify whether to prohibit packet fragmentation.
GevSCPSPacketSize (B)	1476～12038 step 2	1476	
GevSCPD	0～4294967295	0	
GevSCDA	—	—	
GevSCSP	—	—	
p) PulseGenerator			Configure pulse generator settings.
ClockPreScaler	1～4096	165	Set the division value for the prescaler (12 bit) using PixelClock as the base clock.
PulseGeneratorClock (MHz)	0.0181274～74.25	0.45	Set the clock used for the pulse generator. This value is calculated using the [ClockPreScaler] value as a base.

PulseGeneratorSelector	PulseGenerator0, PulseGenerator1, PulseGenerator2, PulseGenerator3	PulseGenerator0	Select the pulse generator.
PulseGeneratorLength	1～1048575	30000	Set the maximum count-up value as a clock count.
PulseGeneratorLengthMs (ms)	1 / PulseGeneratorClock (MHz) ～1048575 / PulseGeneratorClock (MHz)	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.
PulseGeneratorFrequency (Hz)	PulseGeneratorClock (MHz) ÷ 1048575 x 1000000 ～ PulseGeneratorClock (MHz) x 1000000		Set the maximum count-up value as a frequency. This value is calculated using the [PulseGeneratorLength] value as a base.
PulseGeneratorStartPoint	0 ～ 1048574	0	Set the start point of the High interval as a clock count. When the counter reaches this value, the output will be 1.
PulseGeneratorStartPointMs (ms)	0 ～ 1048575 / PulseGeneratorClock (MHz)	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.
PulseGeneratorEndPoint	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.
PulseGeneratorEndPointMs (ms)	1/ PulseGeneratorClock (MHz) ～ 1048575 / PulseGeneratorClock (MHz)		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.
PulseGeneratorPulseWidth (ms)	—	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.
PulseGeneratorRepeatCount	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.
PulseGeneratorClearActivation	Off, LevelHigh, LevelLow, RisingEdge, FallingEdge	Off	Set the clear signal condition for the count clear input of the pulse generator.

PulseGeneratorClearSource	Low High AcquisitiionTriggerWait AcquisitionActive FrameTriggerWait FrameActive ExposureActive FVAL LVAL PulseGenerator0 PulseGenerator1 PulseGenerator2 PulseGenerator3 UserOutput0 UserOutput1 UserOutput2 UserOutput3 Line5 - OptIn1 Line6 - OptIn2 NAND0Out NAND1Out Action1	Low	Select the count clear input signal source.
PulseGeneratorClearInverter	True, False	False	Select whether to invert the polarity of the count clear input signal.
PulseGeneratorClearSyncMode	AsyncMode, SyncMode	AsyncMode	Select the sync mode for the count clear input signal.
q) JAICustomControlALC			Configure JAI ALC settings. These settings are also used for AGC (auto gain control).
ALCReference	30～95	50	Set the target level for ALC. (unit: %)
ALCAreaSelector	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].
ALCAreaEnable	True, False	True	Enable/disable the photometry area selected in [ALCAreaSelector].
ALCAreaEnableAll	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 ～	100	Set the minimum value for the ExposureAuto(ASC) control range.

AutoShutterControlExposureMax	—	—	Set the maximum value for the ExposureAuto(ASC) control range.
AutoGainControlGainRawMin	100 ～	100	Set the minimum value for the GainAuto(ASC) control range.
AutoGainControlGainRawMax	～ 1600	1600	Set the maximum value for the GainAuto(ASC) control range.
ALCControlSpeed	1 ～ 8	4	Set the response speed for AGC/ASC. (8 is the fastest.)
ALCStatus	Off, ASC, AGC	Off	Allows confirmation of the current operation area during ALC operation.
AutoControlStatus	ExecutingASC, ExecutingAGC, ExecutingASCandAGC, ExecutingAWB, ExecutingASCandAWBExecut ingAGCandAWB, ExecutingASCandAGCandAW B, Convergent, ConditionError, Idle	Idle	Allows confirmation of the AGC, ASC, and AWB convergence status.
r) JAICustomControlAWB			Configure AWB settings.
AWBAreaSelector	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 [AWBAreaEnable].
AWBAreaEnable	True, False	True	Enable/disable the photometry area selected in [AWBAreaSelector].
AWBAreaEnableAll	True, False	True	True: Operate AWB with all areas designated as photometry areas, regardless of the individual enabled/disabled photometry area states configured in [AWBAreaSelector]. False: Operate AWB according to the individual enabled/disabled photometry area states configured in [AWBAreaSelector].
AWBControlSpeed	1 ～ 8	4	Set the AWB control speed. (8 is the fastest.)

AWBControlStatus	Complete, TooBright, TooDark, Timeout, Executing, TriggerError, Convergent, ConditionError, Idle	Idle	Displays the operation status of the AWB.
s) JAICUstomControlBlemish			Configure settings for JAI white blemish correction.
BlemishEnable	True, False	True	Enable/disable blemish correction.
BlemishDetect	—	—	Execute blemish detection. This command can not be executed under the following conditions. ・When no image is output ・Outputting TestPattern ・In Sequencer mode ・In Overlap MultiRoi mode ・In single ROI mode
BlemishStore	—	—	Save the location information of detected blemishes.
BlemishDetectThreshold	1 ～ 100	10	Set the blemish detection threshold.
BlemishCompensationIndex	1 ～ 800	1	Select the index for the target blemish coordinates (BlemishDataPosition X/Y).
BlemishCOmpensationPositionX	SP-12401M-PGE -1～4111 SP-12401C-PGE -1～4087	-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.
BlemishCOmpensationPositionY	SP-12401M-PGE -1～3007 SP-12401C-PGE -1～2999	-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.
BlemishCOmpensationDataClear	—	—	Delete detected or specified blemish information selected in [BlemishCompensationIndex].
BlemishCompensationNumber	0 ～ 800	0	Display the number of target blemishes.
t) JAICustomControlShading			Configure shading correction settings.
ShadingCorrectionMode	FlatShading, ColorShading	FlatShading	Select the shading correction method.
ShadingMode	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.

PerformShadingCalibration	—	—	Execute shading correction. This command can not be executed under the following conditions. ・When no image is output ・Outputting TestPattern ・In Sequencer mode ・In Overlap MultiRoi mode ・When the ROI setting is under the following conditions (Width or Height is less than 128)
ShadingDetectResult	Condition Error, TooDark, TooBright, Correction Limit, Complete	—	Display the shading correction results.
u) JAICustomControlOverlapMultiROI			Configure settings for overlap Multi ROI.
MultiRoiMode	Off, On	Off	Enable/disable overlap Multi Roi.
MultiRoiIndex	1 ～ 5	1	Select the index for the overlap Multi Roi mode.
MultiRoiWidth	SP-12401M-PGE BinningHorizontal 1: 16～4112 step 8 BinningHorizontal 2: 8～2056 step 4 SP-12401C-PGE 16～4088 step 8	SP-12401M-PGE 4112 SP-12401C-PGE 4088	Set the width for the selected overlap Multi Roi index.
MultiRoiHeight	SP-12401M-PGE BinningVertical 1: 8 ～ 3008 step 4 BinningVertical 2: 8 ～ 1504 step 2 SP-12401C-PGE 8 ～ 3000 step 4	SP-12401M-PGE 3008 SP-12401C-PGE 3000	Set the height for the selected overlap Multi Roi index.
MultiRoiOffsetX	SP-12401M-PGE BinningVertical 1: 0 ～ 4096 step 8 BinningVertical 1: 0 ～ 2048 step 4 SP-12401C-PGE 0 ～ 4072 step 8	0	Set the horizontal offset for the selected overlap Multi Roi index.
MultiRoiOffsetY	SP-12401M-PGE BinningVertical 1: 0 ～ 3000 step 4 BinningVertical 2: 0 ～ 1496 step 2 SP-12401C-PGE 0 ～ 2992 step 4	0	Set the vertical offset for the selected overlap Multi Roi index.
MultiRoiIndexMax	1 ～ 5	1	Specify the number of areas for which to use overlap Multi Roi.
v) JAICustomControlMisc			Configure settings for other JAI functions.
VideoProcessBypassMode	Off, On	Off	Enable/disable VideoProcessBypass mode.

EnhancerSelect	SP-12401M-PGE Edge SP-12401C-PGE Edge, Color		Specify the operation mode for Enhancer. This function is invalid when [ColorTransformationMode] is XYZ.
EnhancerEnable	True, False	False	Enable/disable EdgeEnhancer and ColorEnhancer.
ColorEnhancerSelector	Red, Cyan, Green Magenta, Blue Yellow	Red	Index for advanced ColorEnhancer settings.
ColorEnhancerValue	0 ～ 1.0 step 0.1	0	Specify the ColorEnhancer emphasis levels for each color component. 0: no emphasis 1: About twice the level before emphasis
EdgeEnhancerLevel	Low, Middle, High, Strong	Middle	Set the Level for EdgeEnhancer.
VideoSendMode	NormalMode, TriggerSequencerMode, CommandSequencerMode, MultiRoiMode	NormalMode	Set the [VideoSendMode].

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			SP-12401M-PGE	SP-12401C-PGE
Scanning system			Progressive scan, 1 tap	
Synchronization			Internal	
Interface			1000BASE-T Ethernet (GigE Vision 1.1), IEEE 802.3af	
Image sensor			Monochrome CMOS	Bayer color CMOS
image size (effective image)			1.1-inch 14.2mm(H) x 10.4mm(V) : 17.6mm(diagonal)	
Pixel size			3.45 μm (H) x 3.5μm(V)	
Effective image pixel (Image sensor)			4112(H) x 3008(V)	
Acquisition Frame Rate (max)	8bit	Mono8	9.3 fps	-
		BayerRG8	-	9.3 fps
	10/12bit Packed	Mono10Packed, Mono12Packed,	6.2 fps	-
		BayerRG10Packed, BayerRG12Packed	-	6.2 fps
	10/12bit UnPacked	Mono10, Mono12	4.6 fps	-
		BayerRG10, BayerRG12	-	4.6 fps
	RGB8bit	RGB8	-	3.1 fps
	RGB10bit	RGB10V1Packed, RGB10p32	-	2.3 fps
EMVA1288 parameters Absolute sensitivity Maximum SN ratio			At 12-bit output 3.47p (λ=525nm) 40.09dB	At 12-bit output 4.15p (λ=525nm) 40.27dB
Digital image output format	Full		4112(H) x 3008(V)	4088(H) x 3000(V)
	ROI	Width	16 ～ 4112 pixels 8 pixels/step	16 ～ 4088 pixels 8 pixels/step
		Offset X	0 ～ 4096 pixels 8 pixels/step	0 ～ 4072 pixels 8 pixels/step
		Height	8 ～ 3008 line 4 line/step	8 ～ 3000 line 4 line/step
		Offset Y	2 ～ 3004 line 4 line/step	2 ～ 2992 line 4 line/step
	Binning (H)	1	4112(H)	-
		2	2056(H)	-
	(V)	1	3008(V)	-
		2	1504(V)	-
	Pixel Format		Mono8,Mono10, Mono10Packed, Mono12,Mono12Packed	BayerRG8, BayerRG10, BayerRG10Packed, BayerRG12, BayerRG12Packed RGB8,RGB10V1Packed, RGB10p32
Acquisition Mode			Continuous / SingleFrame / MultiFrame（1 ～ 65535）	
Trigger Selector	Acquisition		AcquisitionStart / AcquisitionStop	
	Exposure		FrameStart	
	Transfer		AcquisitionTransferStart（delayed readout）	
Opto filter			Off(Default), 10μs, 100 μs, 500 μs, 1 ms, 5 ms, 10 ms	
Trigger overlap			Off / Readout	
Trigger input signals			Low, High, Software,PulseGenerator0-3, UserOutput0-3, Line5-Opt In 1, Line6-Opt In 2, NAND 0 Out, NAND 1 Out	
Exposure Mode	Timed		15.26 μs*（min） ～ 8 s（max） ❖ erformance verified for up to 1 second.	
	Trigger Witdh		15.26 μs*（min） ～ ∞ s（max） ❖ erformance verified for up to 1 second.	
Auto Exposure (Exposure Auto)			Off / Continuous / Once	
Auto exposure response speed （AGC/ASC Control Speed）			1 ～ 8	
Video send mode			NormalMode, TriggerSequencerMode, CommandSequencerMode, MultiRoiMode	
Digital I/O			LineSelector（12P） : GPIO IN / GPIO OUT	
Black Level adjustment	Default level		8LSB@8bit	
	Video level adjustment range		DigitalAll : -133 ~ +255 LSB @12bit DigitalRed : -64 ~ +64 LSB @12bit DigitalBlue : -64 ~ +64 LSB @12bit	
	Resolution adjustment		1LSB@12bit	

Gain adjustment	Manual adjustment range		AnalogAll : 0dB ～ 24dB DigitalRed : -7dB ～ 15dB DigitalBlue : -7dB ～ 15dB
	Auto gain		Off, Continuous, Once
White balance	WBA		DigitalRed, DigitalBlue : -7dB ～ 15dB
	BalanceWhiteAuto		Off, Continuous, Once, Preset3200K, Preset5000K, Preset6500K, Preset7500K
	Area		16 (4 x 4) Area
	Adjustment range		3000K ～ 9000K
Blemish correction	Detection		Detect white blemishes using threshhold values (100 steps available) (black blemish correction performed only at factory)
	Correction		Interpolation using adjacent pixels (continuous blemishes not corrected)
	Correctable pixels		800 pixels
ALC			Can be adjusted automatically together with AGC and auto
Gamma			0.45, 0.5, 0.55, 0.6, 0.65, 0.75, 0.8, 0.9, 1.0 (9 steps available)
LUT			OFF : γ= 1.0, ON = 257 points can be set
Vibration resistance			10G（20 Hz ～ 200 Hz X-Y-Z direction）
Impact resistance			80G
Power supply	12-pin Connector	Input range	DC + 12 V ～+ 24 V ± 10%（Via input terminal）
		Consumption	4.0 W（typ.）(at 12 V input, default setting, 25 ℃ environment) 6.1 W（max.）
	PoE	Input range	DC + 36 V ～+ 57 V
		Consumption	5.1 W（typ.）(default setting, 25 ℃ environment) 7.7 W（max.）
Lens mount			C-mount Lens mount protrusion length of 9 mm or less is supported
Flange back			17.526, tolerance: 0 mm to -0.05 m
Optical filter			IR cut filter (SP-12401C-PGE only)
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)			44 × 44 × 54 mm（WHD）（excluding mount protrusions）
Weight			160 g

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

Optional accessories (not supplied)
MP-45 tripod mount

Design and specifications are subject to change without notice.

Approximately 30 minutes of warm-up are required to achieve these specifications.

Caution

About the verified performance temperatureMake sure the following temperature conditions are met when operating the unit.
1) The camera's internal temperature sensor detects temperatures of 72°C or less during operation.
2) The top surface of the camera's casing is 57°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]

■ **SP-12401M-PGE**

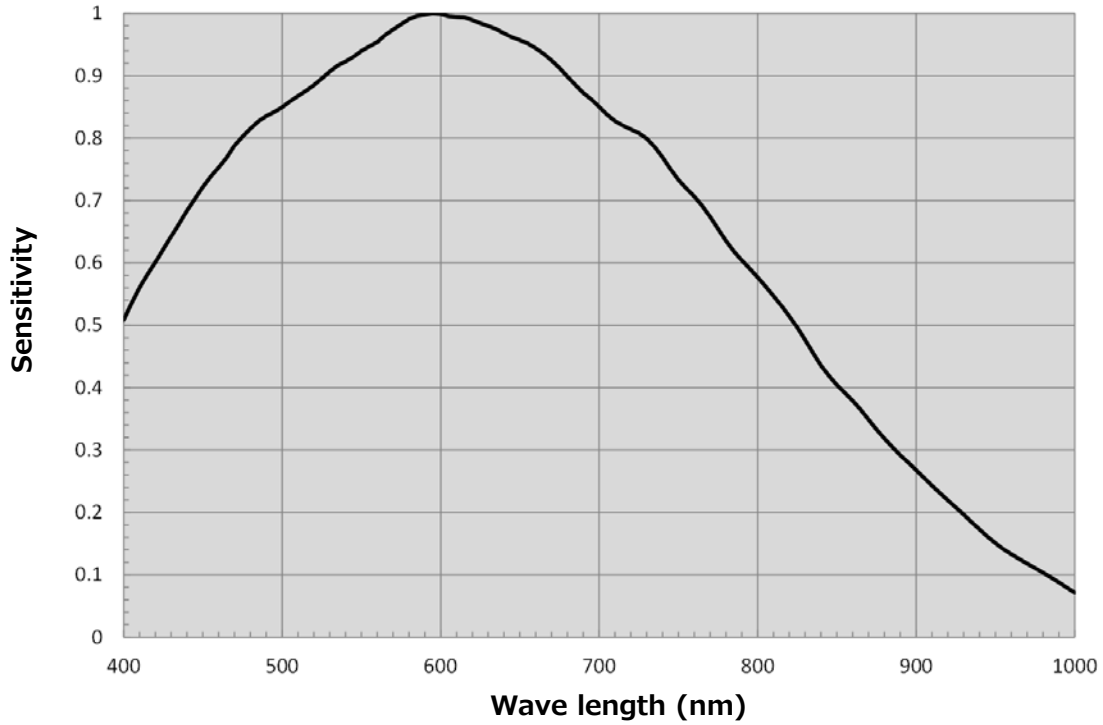
Pixel count (MP)	Resolution (screen size)	ROI/Binning	Pixel size (um)	Imge size (mm)	Frame rate (fps @8bit)
12.37	4112 x 3008	Full pixel	3.45 x 3.45	14.19 x 10.38 (17.58)	9.3fps
3.08	2048 x 1504	ROI	3.45 x 3.45	7.07 x 5.19 (8.77)	37.34fps
1.97	1920 x 1024	ROI	3.45 x 3.45	6.62 x 3.53 (7.51)	58.49fps
1.97	1920 x 1024	ROI + 2x2 Binning	6.9 x 6.9	13.25 x 7.07 (15.01)	58.49fps

■ **SP-12401C-PGE**

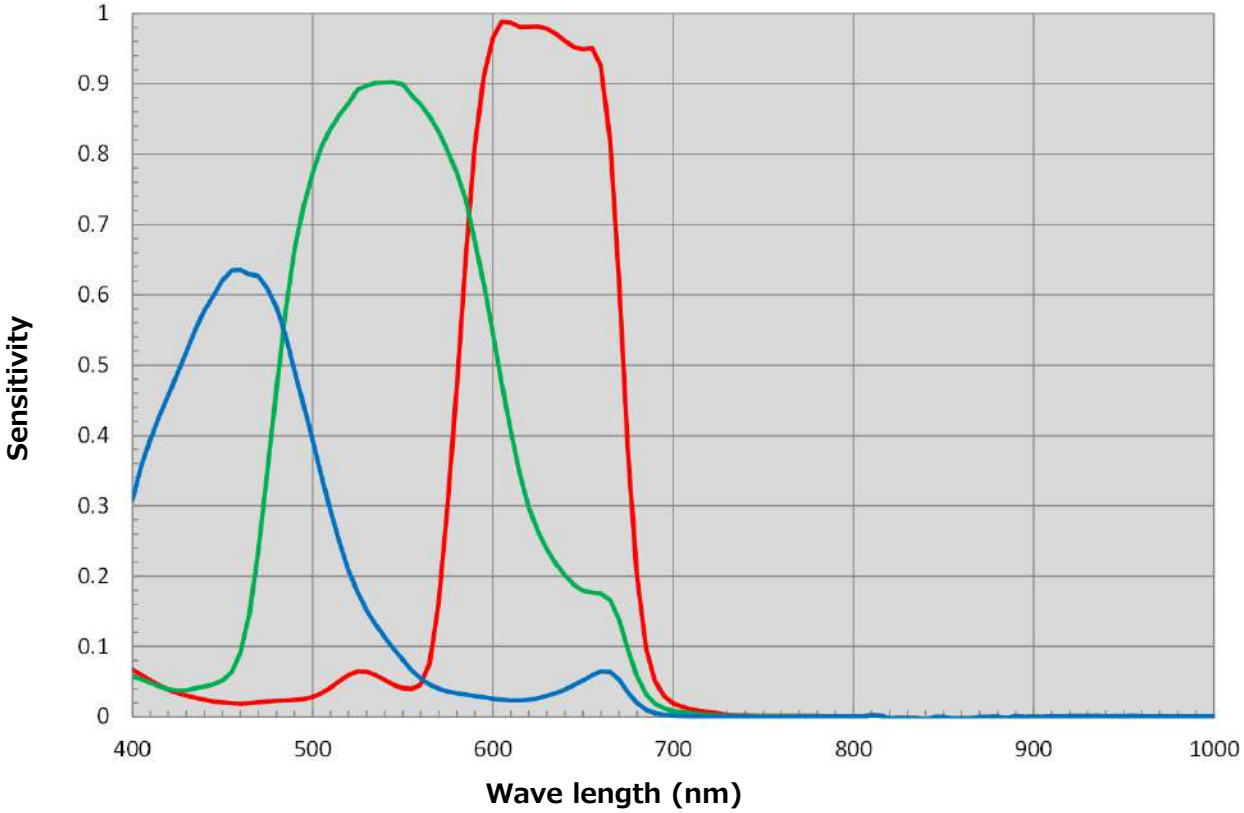
Pixel count (MP)	Resolution (screen size)	ROI/Binning	Pixel size (um)	Imge size (mm)	Frame rate (fps @8bit)
12.26	4088 x 3000	Full pixel	3.45 x 3.45	14.10 x 10.35 (17.49)	9.3fps
3.06	2040 x 1500	ROI	3.45 x 3.45	7.04 x 5.18 (8.74)	37.58fps
1.97	1928 x 1024	ROI	3.45 x 3.45	6.65 x 3.53 (7.53)	58.25fps

Spectral Response

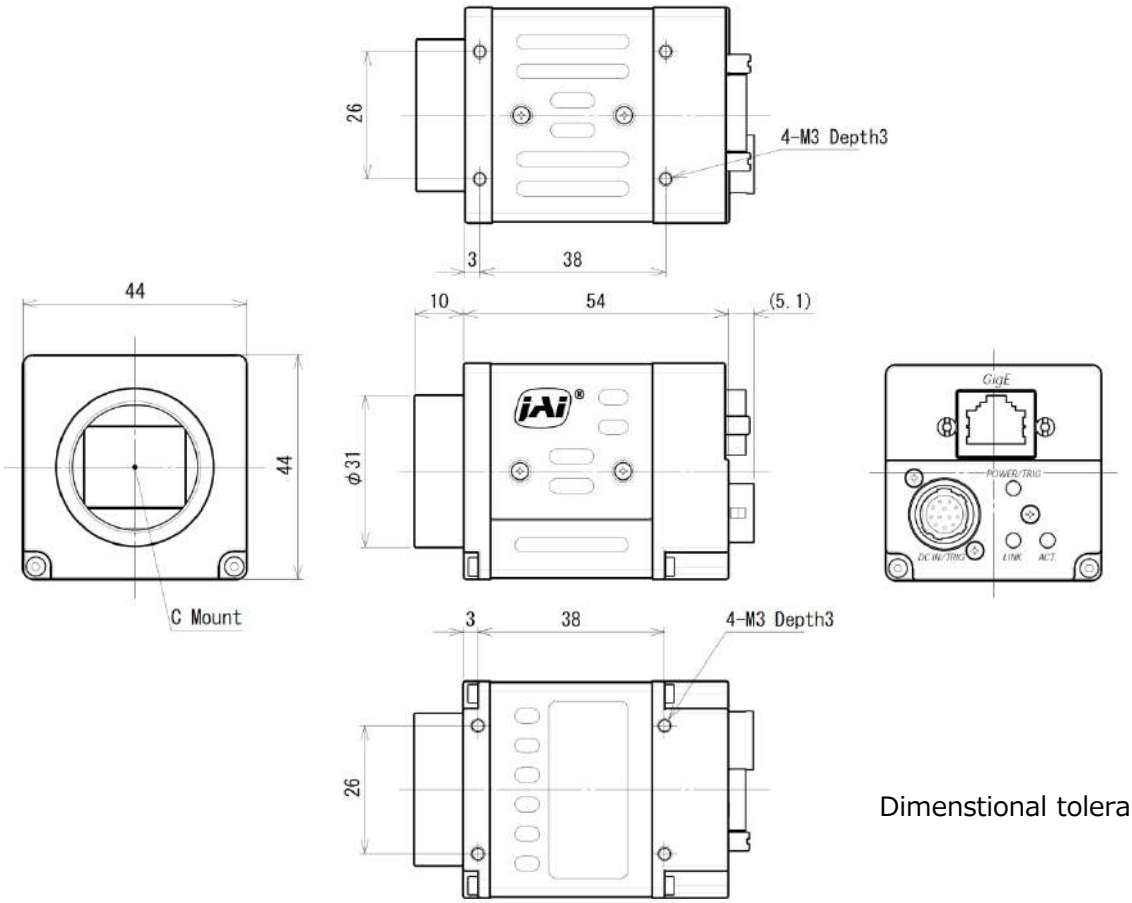
SP-12401M-PGE Sensitivity



SP-12401C-PGE Sensitivity



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: SP-12401M-PGE / SP-12401C-PGE

Revision: ……

Serial No: ……

Firmware version: ……

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

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Index

Revision history

Revision	Date	Changes
1.1	Jan.2021	China RoHS
1.2	July 2022	Corrected China RoHS, added the Non-Volatile Flash Memory topic.