See the possibilities

User Manual

AP-1600T-PGE

Digital 3CMOS Progressive Scan RGB Color Camera

Document Version: 1.2
AP-1600T-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 AP-1600T-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。

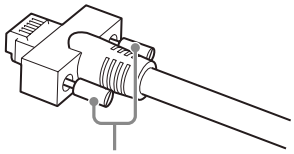
Usage Precautions

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 AP-1600T-PGE is an industrial progressive scan camera that uses three 1/2.9-inch global shutter CMOS image sensors with 1456×1088 effective pixels.

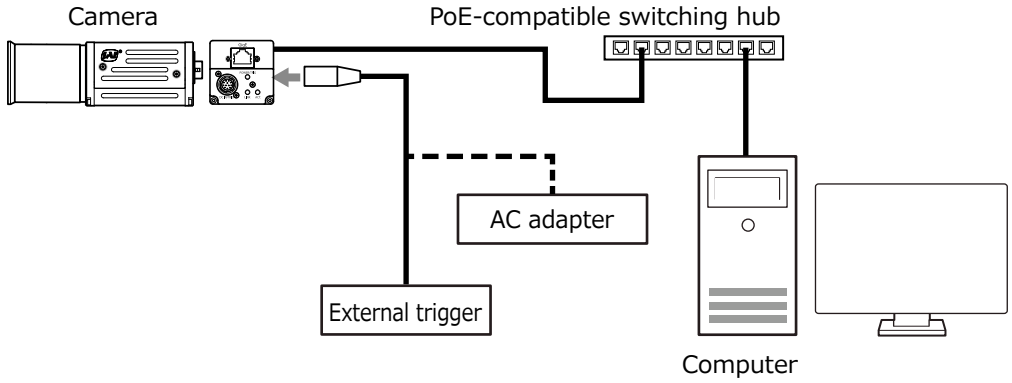
It allows maximum frame rates of 24.2 fps at full resolution.
Enhanced color reproduction is achieved via the newly-developed compact-designed 1/2.9-inch 3CMOS C-mount F1.8 prism optical system in addition to the internal color matrix circuit. Even higher definition imaging is made possible by the shading correction and gamma correction circuits.

The ROI and binning functions allow for even faster readout speeds.
The gain and exposure time can be configured individually for each CMOS sensor. A color space conversion function is also supported.

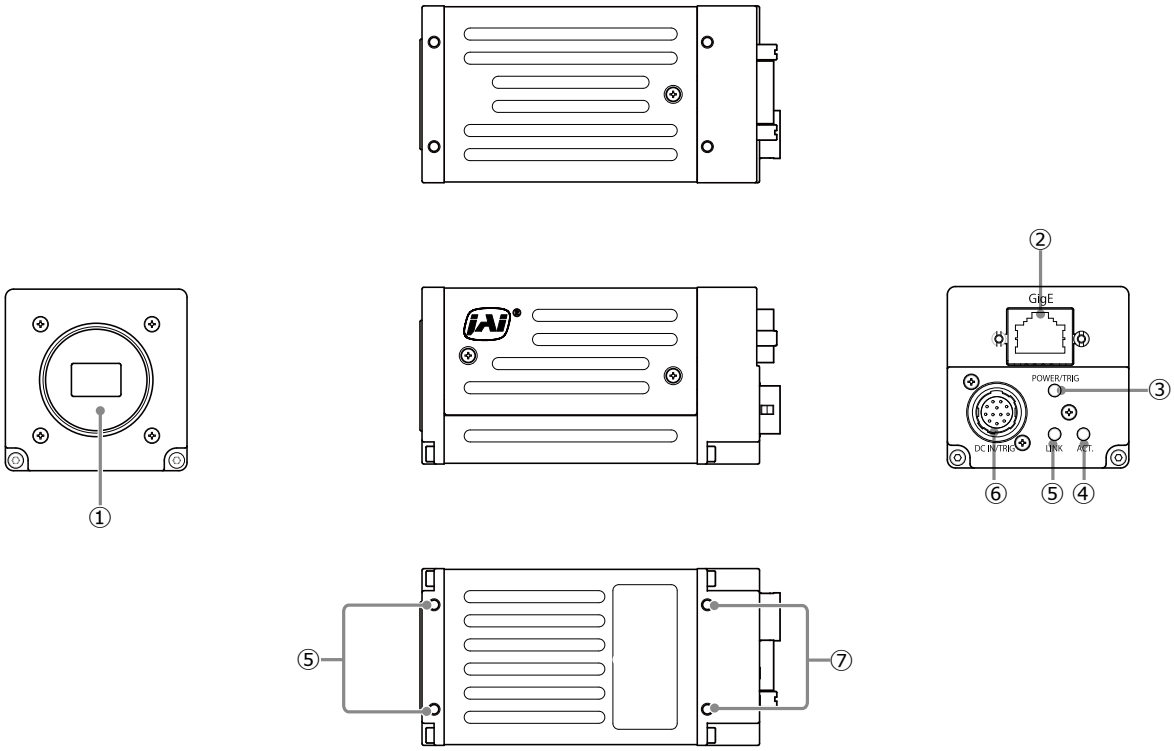
Features overview

- Compliance with GigE Vision and GenICam standards
- 1/2.9-inch 3CMOS progressive RGB color camera
- Lens mount: C-mount (flange back: 17.526 mm)
- Effective pixels: 1456 (H) × 1088 (V); pixel size: 3.45 × 3.45 um
- Maximum frame rates of 24.2 fps at full resolution possible
- 24-bit or 30-bit RGB output (36-bit RGB output possible in video process bypass mode)
- 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
- JAI SDK that supports Windows Vista, 7, 8, 10

Connection example:



Parts Identification



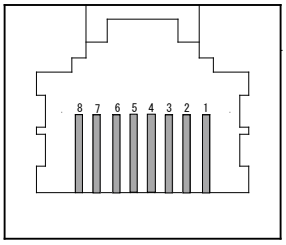
① **Lens mount (C-mount)**

Mount a C-mount lens, microscope adapter, etc. here.

❖ Before mounting a lens, be sure to refer to “Step 2: Connecting Devices” (page 12) 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.

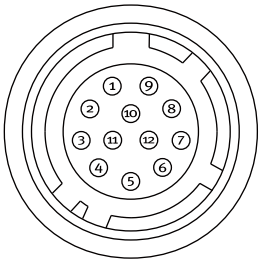
LED status and camera status

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.

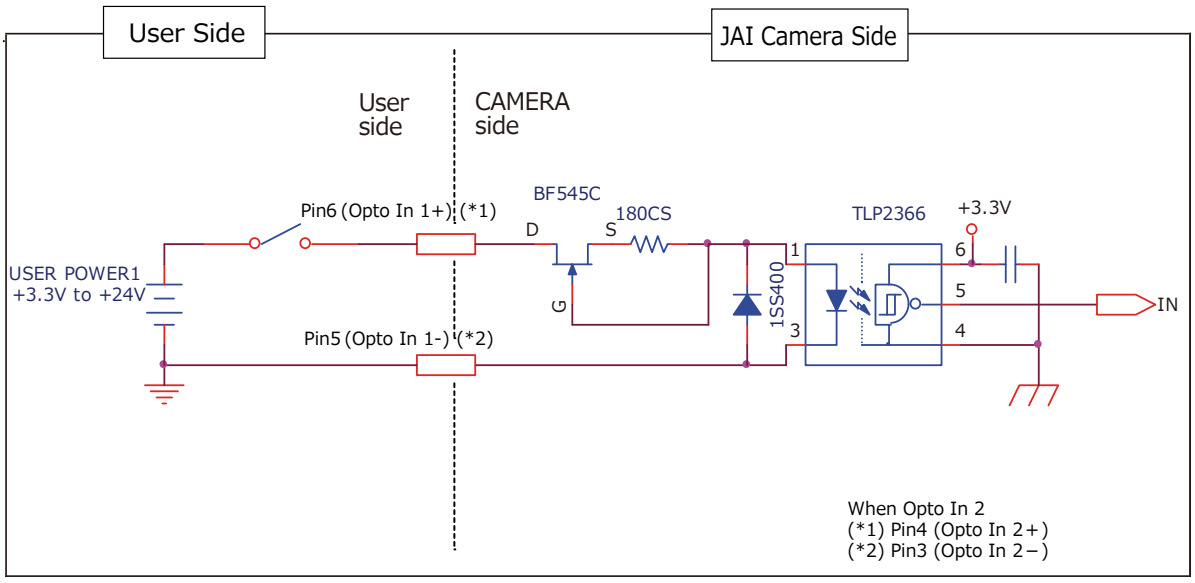


HR-10A-10R-12PB (71) (Hirose Electric or equivalent)

Pin No.	Input/ output	Signal	Description
1		GND	
2	Power IN	DC IN	DC 12 V to 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 to 24 V ±10%
12		GND	

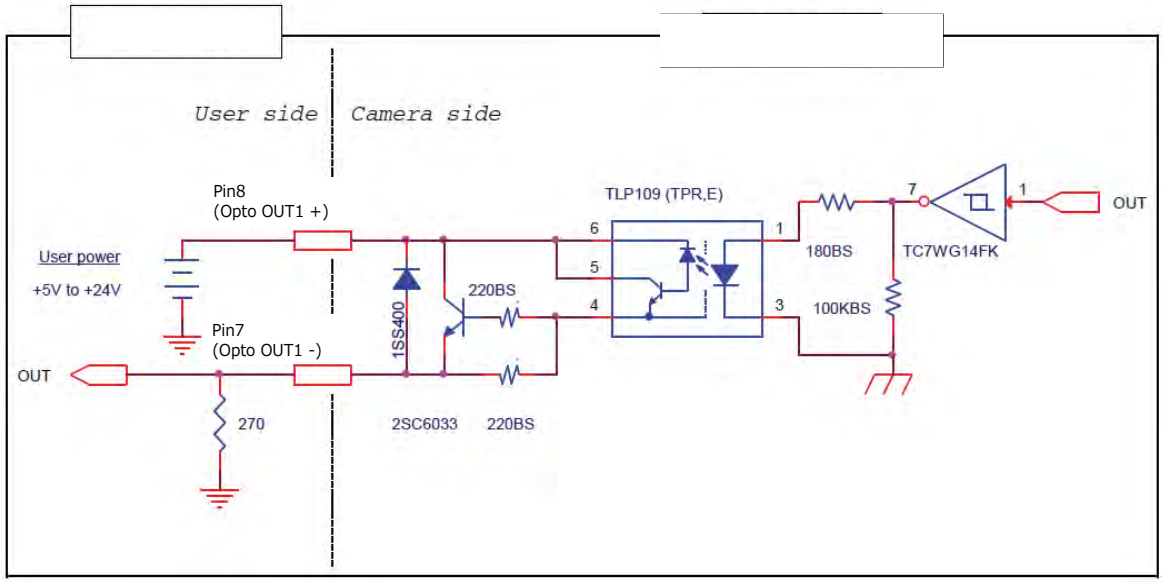
Note
When DC power is supplied to either Pin 1/Pin 2 or Pin 11/Pin 12, the camera operates.

Recommended external input circuit diagram (reference example)



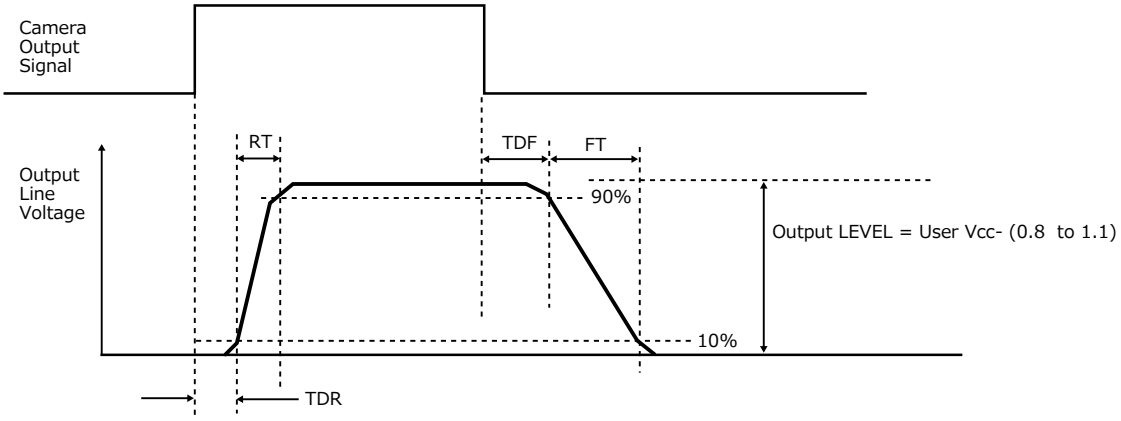
Recommended external output circuit diagram (reference example)

Standard circuit diagram example



Characteristics of the recommended circuits for Opto OUT

OUTPUT LINE RESPONSE TIME



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

⑦ **Camera locking screw holes (M3, 3 mm depth)**
Use these holes when attaching an MP-44 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 (JAI SDK) 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 (JAI SDK) on the computer.

❖ When you install JAI SDK, JAI Camera Control Tool will also be installed.

1 Download the "JAI - Getting Started Guide" and JAI SDK from the JAI website.

URL: http://www.jai.com/en/support/download-jai-software

2 Refer to the "JAI - Getting Started Guide," and install JAI SDK on the computer.

The computer will restart when installation is complete.

Note

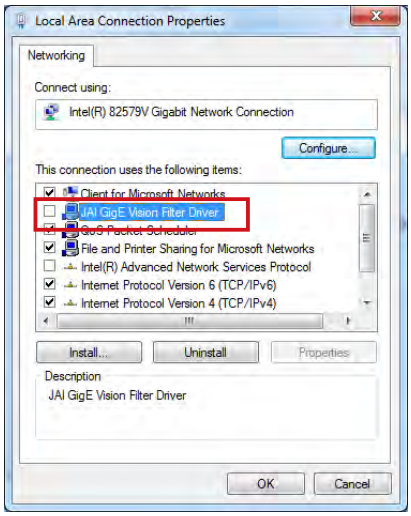
When the JAI SDK is installed, a camera driver for the GigE interface is also part of the default installation. This GigE Vision Filter Driver is added to every NIC/port on the host computer. As the driver is also added to the NIC/port for Internet connection, it may, on some systems, affect Internet access speed. If you think your Internet speed is affected, configure the following settings to disable the filter driver on that port.

❶ Open [Control Panel] → [Network and Internet] → [Connect to a network], and right-click the port used for Internet connection to open the properties dialog box.

Caution

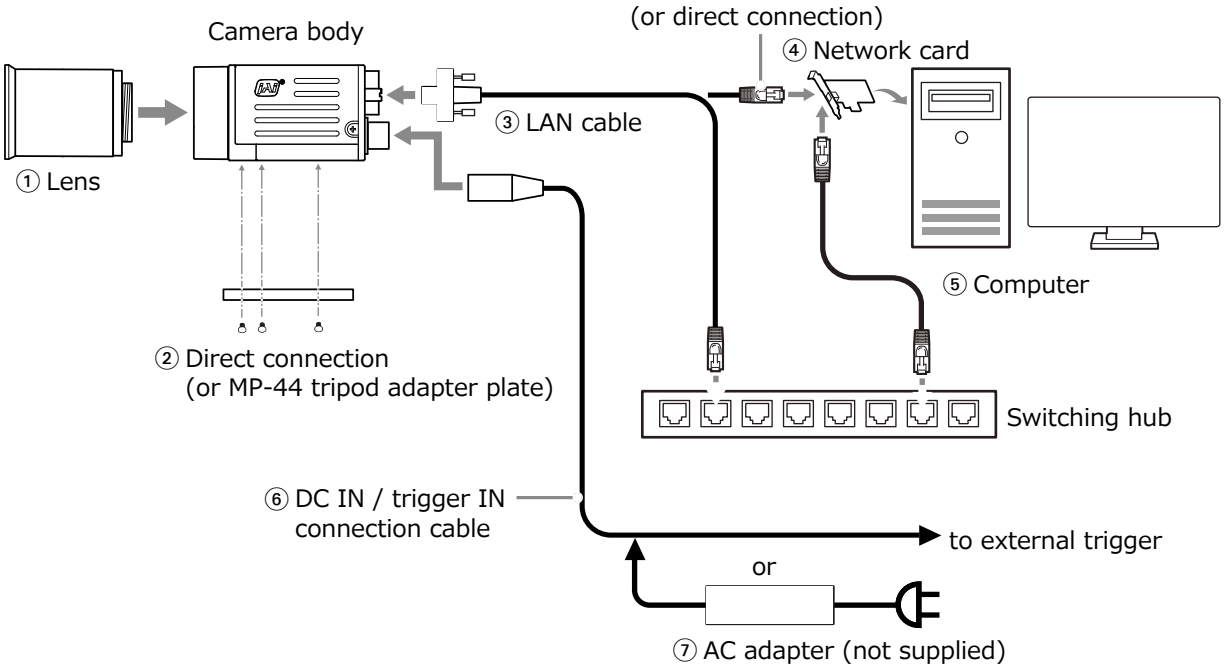
JAI SDK Version 3.0.2 or later is required to use this camera model.

❷ Clear the [JAI GigE Vision Filter Driver] checkbox, and save.



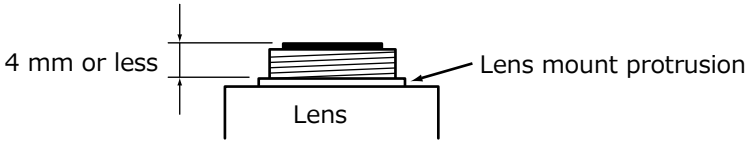
Step 2: Connecting Devices

Connect the lens, LAN cable, AC adapter, and other devices.
Attach the lens in a clean environment to prevent dust from adhering to the unit.



① Lens

- C-mount lenses with lens mount protrusions of 4 mm or less can be attached.



- Use a lens designed for three-sensor cameras. Using a lens for single-sensor cameras may hinder full performance of the camera.
- The diagonal of the camera's CMOS image sensor is 6.27 mm, the size of standard 1/2.9-inch lenses. To prevent vignetting and to obtain the optimal resolution, use a lens that will cover the 6.27 mm diagonal. Some lens manufacturers offer lenses with an 6.27 mm format. If not, a 1/2.9-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 4 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 (5.02 mm on this camera)

② **Direct connection (or MP-44 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.

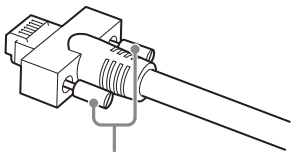
③ **LAN cable**

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 AP-1600T-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 Vista/7/8 32-bit/64-bit edition

CPU: Intel Core i3 or higher

Memory:
Windows Vista/7/8/10 32-bit edition: DDR3, 4 GB or higher
Windows Vista/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)**

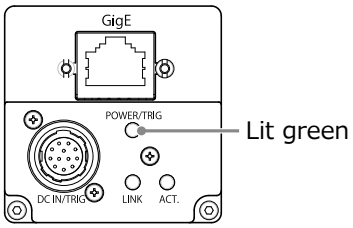
Connect the AC adapter and the round connector of the connection cable to the DC IN / trigger IN connector on the camera.

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



❖ For details on how to read the LEDs, see “LED status and camera status” (page 8) in the “Parts Identification” section.

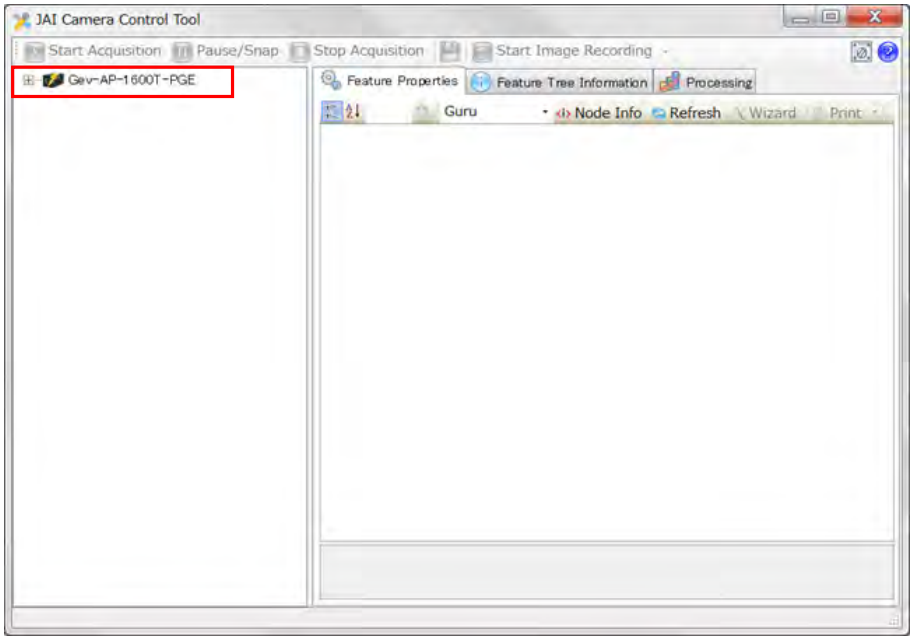
Step 4: Verifying the Connection between the Camera and PC

Verify whether the camera is properly recognized via Control Tool.

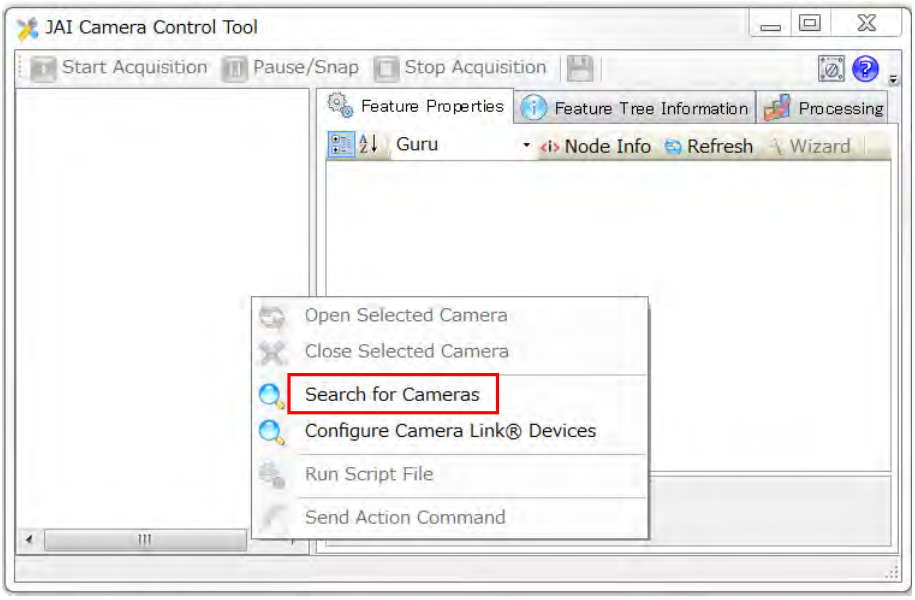
Connecting the Camera to Control Tool

1 Start JAI Control Tool.

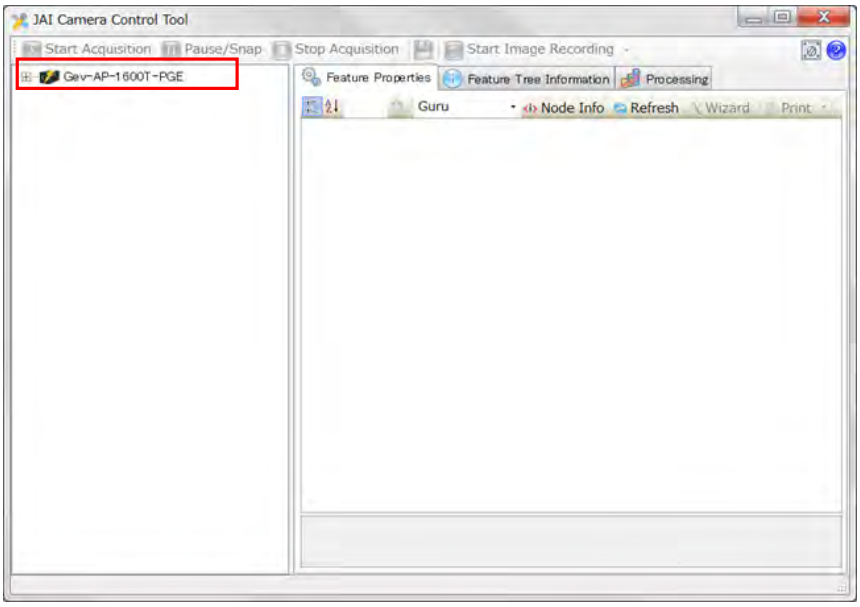
The JAI Control Tool startup screen appears.



If a camera is not detected, right-click within the window and select [Search for Cameras].

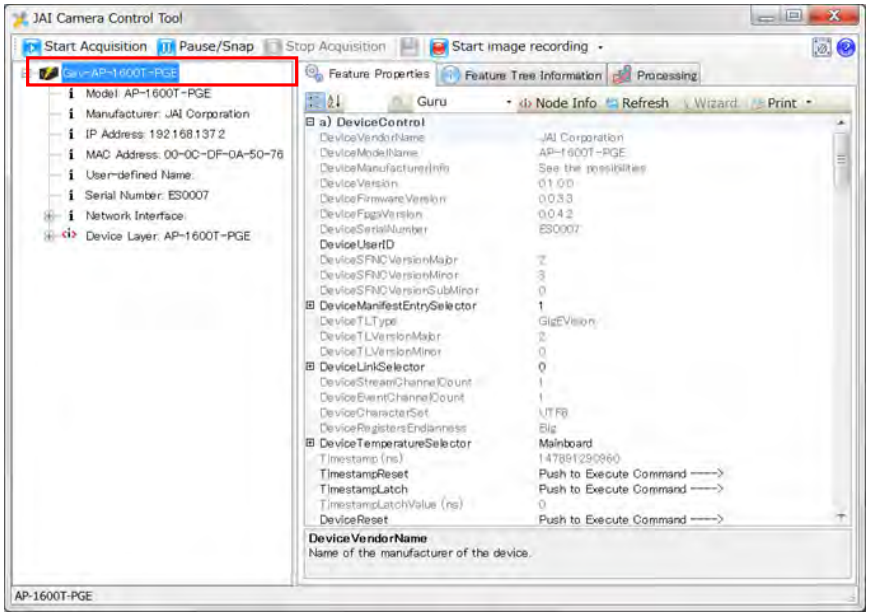


2 Select the camera you want to configure.



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

Check that the settings information of the selected camera appears in the right area.



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

Step 5: Changing the Camera Settings

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

Configuring the Output Format

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

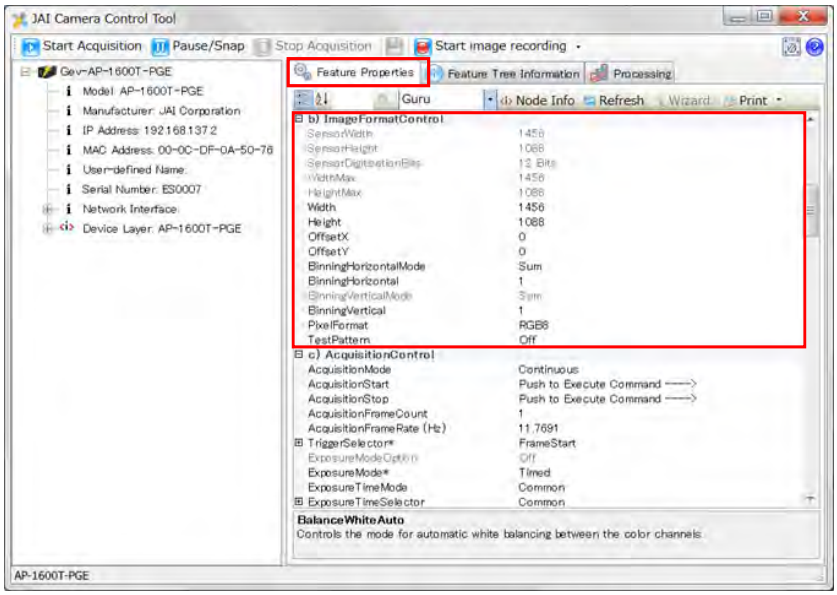
Factory default values

Item		Default value
ImageFormatControl	Width	1456
	Height	1088
	OffsetX (horizontal position)	0
	OffsetY (vertical position)	0
	Pixel Format	RGB8

❖ You can specify the image acquisition area. For details, see “ROI (Regional Scanning Function)” (page 35).

1 Select the [FeatureProperties] tab, and select the item you want to configure under [ImageFormatControl].

 when a configurable item is selected.



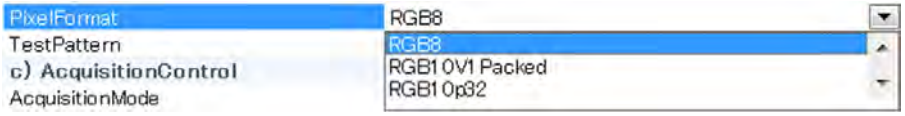
Note

Settings can only be changed when image acquisition on the camera is stopped. If an item is grayed out and  does not appear even when you select it, click  (Stop Acquisition) to stop image acquisition.

2 Click  and change the setting value.

Example: When changing [Width]

Example: When changing [PixelFormat]



Note

Direct entry of numerical and text values is possible for some setting items.

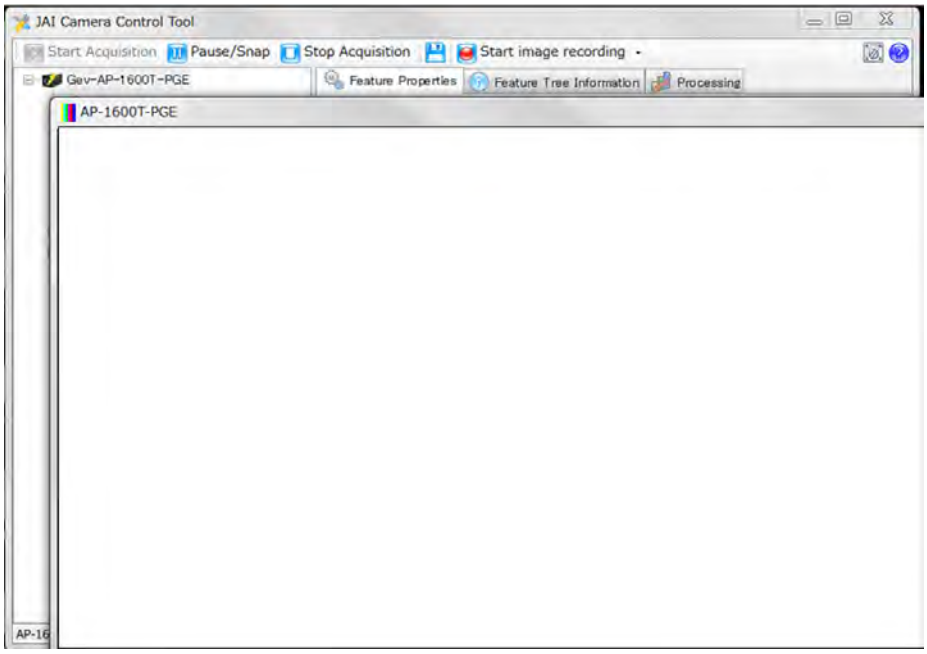
Step 6: Adjusting the Image Quality

Display the camera image and adjust the image quality.

Displaying the Image

Display the image captured by the camera.

When you select [StartAcquisition], the camera image appears in a separate window.

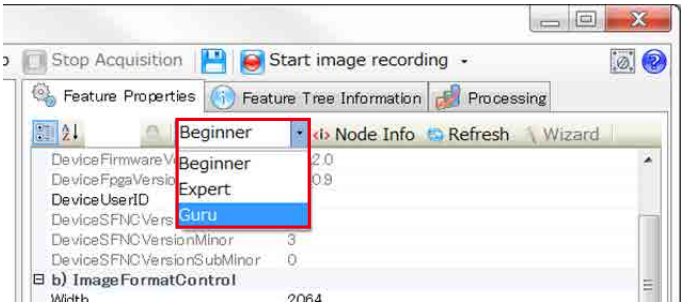


Adjusting the Gain

Adjust the image quality using the gain and white balance functions.

To adjust the image quality

The display level 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” (page 29) in the “Main Functions” section.

■ Manual adjustment

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

([Off] is the default setting.)

2 Configure the gain.

❶ Expand [AnalogControl], and select the gain you want to configure in [GainSelector]. [AnalogAll] (master gain), [AnalogRed] (R gain), [AnalogBlue] (B 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 x8 (0 dB to about +18 dB) the analog gain value. The resolution is set in x0.1 steps. Values are configured by multipliers.
- The [AnalogRed] (R gain) and [AnalogBlue] (B gain) can be set to a value from x0.47 to x4.0 (−6.5 dB to +12 dB) the [AnalogAll] (master gain) value.
- The [DigitalRed] (digital R gain) and [DigitalBlue] (digital B gain) can be set to a value from x0.9 to x1.1 (−0.915 dB to +0.828 dB) the [AnalogAll] (master gain) value.

Note

The following two methods are available for adjusting the gain manually.

- MasterMode (set IndividualGainMode to Off) (see the above)
- IndividualMode (set IndividualGainMode to On)

❖ For details, see "Gain Control" (page 29).

Adjusting the White Balance

Adjust the white balance using the automatic adjustment function.

■ 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], [Once], [ExposureContinuous], or [ExposureOnce] for the adjustment method.

The white balance is automatically adjusted.

Note

- The white balance is adjusted via gain adjustment for [Continuous] and [Once].
- The white balance is adjusted via exposure time adjustment for [ExposureContinuous] and [ExposureOnce].

Adjusting the Black Level

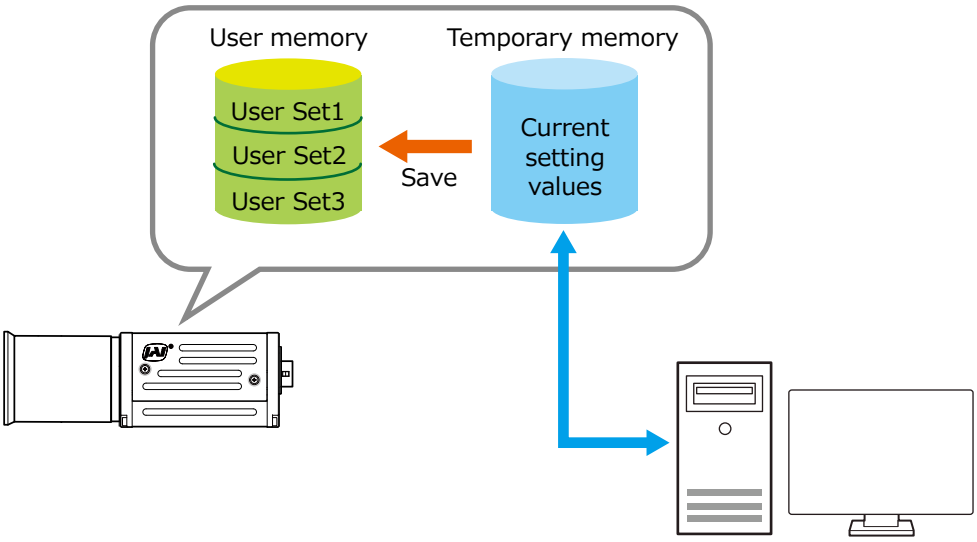
1 Expand [AnalogControl], and select the black level you want to configure in [BlackLevelSelector].

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

2 Specify the adjustment value in [BlackLevel].

Step 7: Saving the Settings

The setting values configured in Control Tool 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)



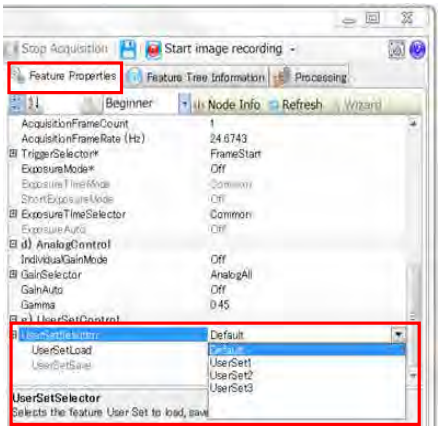
Note

Changes to settings are not saved to the computer (Control Tool).

■ To save user settings

1 Stop image acquisition.

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



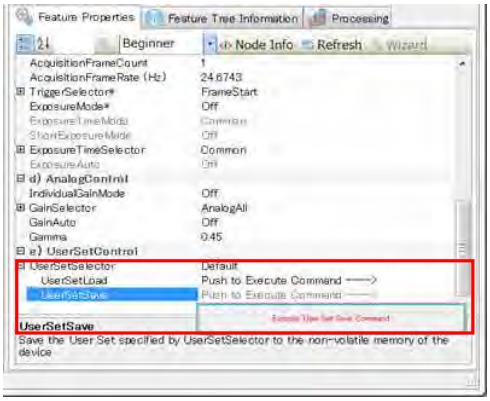
Note

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	BalanceWhiteExposureAuto	BalanceWhiteGainAuto	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		○	○	○	○	○	○	○	○
TriggerWidth	On	1 × 1 (Off)		×	○	×	○	○	×	×	×
		1 × 2		×	○	×	○	○	×	×	×
		2 × 1		×	○	×	○	○	×	×	×
		2 × 2		×	○	×	○	○	×	×	×
RCT	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	○	○	○	○	○	○	○FF	○	○	○	○	○	○	○	○
	High	○	○	○	○	○	○	×	○	○	○	○	○	○	○	○
	Line5-OptIn1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Line6-OptIn2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	UserOutput0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	UserOutput1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	UserOutput2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	UserOutput3	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Action1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Action2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	PulseGenerator0	○	○	○	○	○	○	○	○	○	○	○	×	○	○	○
	PulseGenerator1	○	○	○	○	○	○	○	○	○	○	○	○	×	○	○
	PulseGenerator2	○	○	○	○	○	○	○	○	○	○	○	○	○	×	○
	PulseGenerator3	○	○	○	○	○	○	○	○	○	○	○	○	○	○	×
	NAND0Out	○	○	○	○	○	○	○	×	×	○	○	○	○	○	○
	NAND1Out	○	○	○	○	○	○	○	○	○	×	×	○	○	○	○
	ExposureActive	–	–	–	–	○	○	×	○	○	○	○	○	○	○	○
	AcquisitionActive	–	–	–	–	○	○	×	○	○	○	○	○	○	○	○
	AcquisitionTriggerWait	–	–	–	–	○	○	×	○	○	○	○	○	○	○	○
	FrameTriggerWait	–	–	–	–	○	○	×	○	○	○	○	○	○	○	○
	FrameActive	–	–	–	–	○	○	×	○	○	○	○	○	○	○	○
	FVAL	–	–	–	–	○	○	×	○	○	○	○	○	○	○	○
	LVAL	–	–	–	–	x	x	×	○	○	○	○	○	○	○	○
	Software	○	○	○	○	–	–	–	–	–	–	–	–	–	–	–
		TriggerSelector				LineSelector							PulseGeneratorSelector			
		Use														

: Indicates default values for each selector.

Camera Output Formats

The AP-1600T-PGE supports the following output formats.

PixelFormat	Available only VideoProcessBypassMode
RGB8, RGB10V1Packed / RGB10p32, RGB12V1Packed	RGB12V1Packed

In VideoProcessBypassMode, saturated level of brightness decreases.

Image Acquisition Controls (Acquisition Control)

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

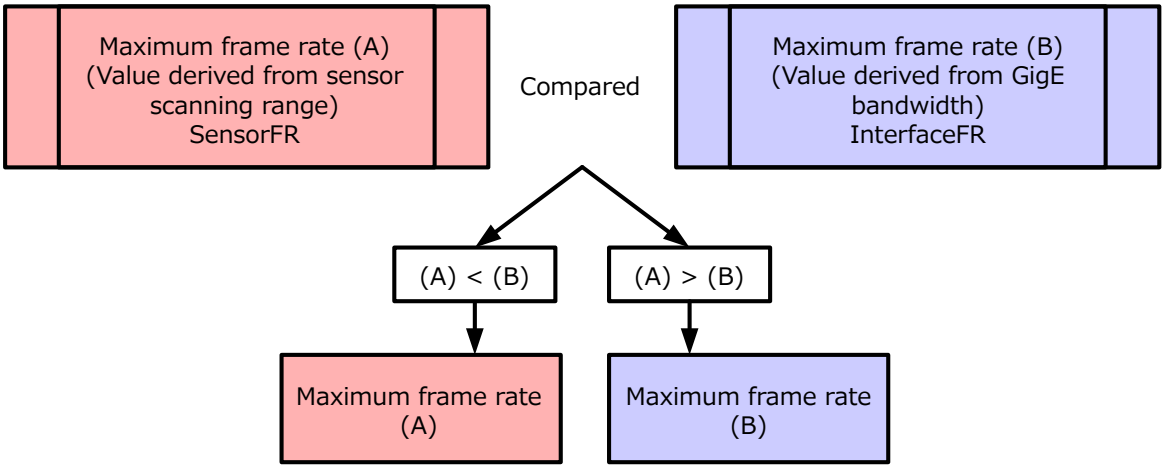
When [TriggerMode] is disabled, you can change the frame rate in [AcquisitionFrameRate].

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 (µs)
RGB8	36.51
RGB10V1Packed / RGB10p32	48.69
RGB12V1Packed	54.76

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

GIGE_H_Count_Max =
Max ((Width × PackValue / 920) × (Height / (Height + 44)) × PixelClock, (Width / 2 + 32))
H_Count = Max (Sensor_H_Count, GIGE_H_Count_Max)
H_Period = H_Count / PixelClock

PackValue: The following values depending on the PixelFormat.

PixelFormat	**PackValue**
RGB8	24
RGB10V1Packed / RGB10p32	30
RGB12V1Packed	36

Sensor_H_Count: The following values depending on the Binning.
Binning(1x1 ,2x1,1x2) : 612
Binning (2x2) : 396

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 + 44) × Hperiod)
- Maximum frame rate of GigE output bandwidth
  InterfaceFR = 920 × 1000000 / (Height_g × Width_g × Pack value)
- Maximum frame rate
  FR_Cont = Min (<SensorFR>, <InterfaceFR>)
  Exposure time possible within frames

- When the exposure time is longer than the frame interval
  MaxOverlapTime_longExp = (1 / FR_Cont) - (20 × H_Period)
- Exposure time outside of frame interval
  NonOverlapExposureTime = ExposureTime - MaxOverlapTime_long
  However, MaxOverlapTime_long 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 + 44)}
- 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 + 44)}
- 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) - (20 × 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" (page 26).

❖ When [ExposureTimeMode] is set to [Individual], you can set the exposure times for Red, Green, and Blue individually. To set the exposure time individually for Red, set [ExposureTimeSelector] to [Red], and configure the exposure time for Red in [ExposureTime]. Similarly, configure the exposure times individually for Green and Blue.

Actual Exposure Times

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

ExposureMode	Shortest exposure time
Timed	15.26 µs (8-bit)
TriggerWidth	15.26 µs (8-bit)

❖ 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.[1)]
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 15 frames 10 bit: Up to 7 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" (page 26).

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

Shortest Repetition Period for Triggers

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

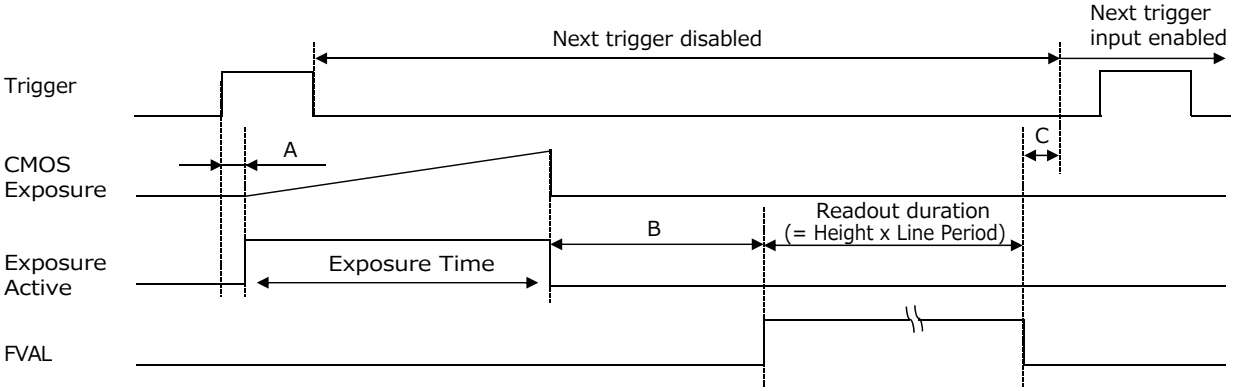
Scanning range	Shortest period of trigger		
	RGB8	RGB10V1Packed/ RGB10p32	RGB12V1Packed
Full	41.3 ms	55.2 ms	62.1 ms
ROI (Height=544)	20.7 ms	27.6 ms	31.0 ms
ROI (Height=272)	10.3 ms	13.8 ms	15.5 ms
BinningVertical2	20.7 ms	27.6 ms	31.0 ms

The above table indicates the shortest trigger periods for when [TriggerOverLap] is set to [Readout]. When [TriggerOverLap] is set to [Off], the exposure time is added to the period.

■ When [ExposureMode] is [Timed]

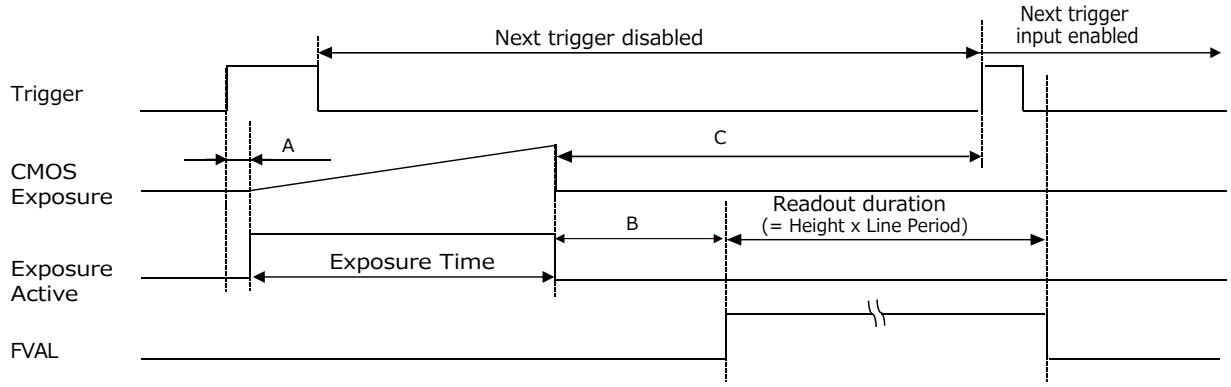
Example: When [TriggerSource] is set to [Line 5 - OptIn1] and [OptInFilterSelector] is set to [off]

• TriggerOverlap: Off



PixelFormat	Line period (µsec)	Period from Trigger start edge to Exposure start[A] (usec)	Period from Exposure end to FVAL start[B] (usec)	Period FVAL end to next trigger start[C] (usec)
RGB8	36.51	111	1365	320
RGB10V1Packed / RGB10p32	48.69	147	1816	351
RGB12V1Packed	54.76	165	2040	369

• TriggerOverlap: Readout



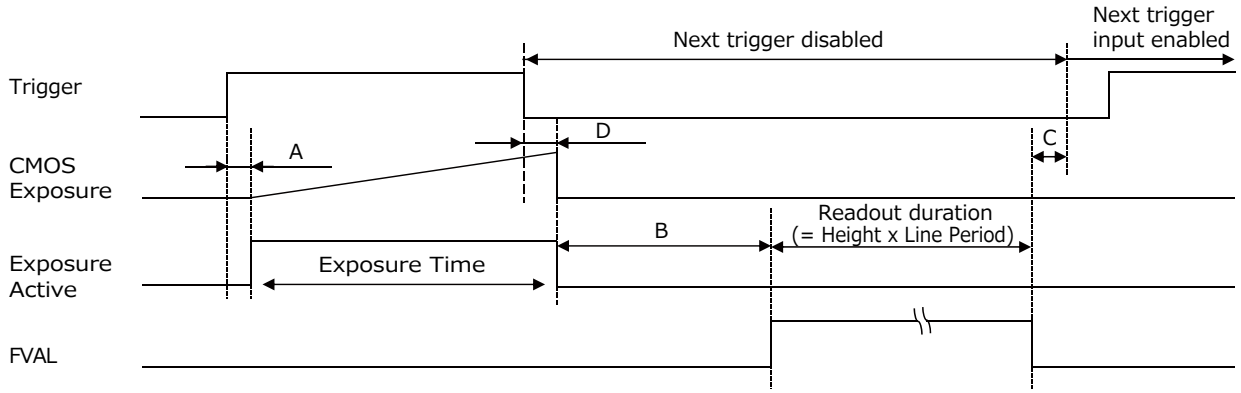
PixelFormat	Line period (µsec)	Period from Trigger start edge to Exposure start[A](usec)	Period from Exposure end to FVAL start[B](usec)	Period from Exposure end to next trigger start[C](usec)*
RGB8	36.51	111	1365	41383
RGB10V1Packed / RGB10p32	48.69	147	1816	55100
RGB12V1Packed	54.76	165	2040	61944

*) ExposureTime is minimum

■ When [ExposureMode] is [TriggerWidth]

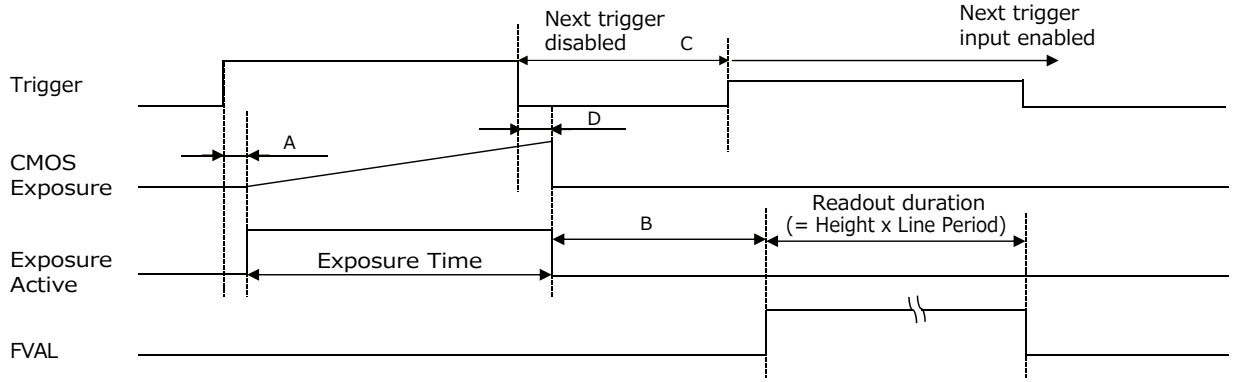
Example: When [TriggerSource] is set to [Line 5 - Optical In 1] and [OptInFilterSelector] is set to [off]

• TriggerOverlap: Off



PixelFormat	Line period (µsec)	Period from Trigger start edge to Exposure start[A](usec)	Period from Exposure end to FVAL start[B](usec)	Period FVAL end to next trigger start[C](usec)	Period from Trigger end edge to Exposure end[D](usec)
RGB8	36.51	111	1365	311	111
RGB10V1Packed / RGB10p32	48.69	147	1816	344	147
RGB12V1Packed	54.76	165	2040	362	165

● **TriggerOverlap: Readout**



PixelFormat	Line period (µsec)	Period from Trigger start edge to Exposure start[A](usec)	Period from Exposure end to FVAL start[B](usec)	Next trigger start prohibited period[C] (usec)*	Period from Trigger end edge to Exposure end[D](usec)
RGB8	36.51	111	1365	733	111
RGB10V1Packed / RGB10p32	48.69	147	1816	983	147
RGB12V1Packed	54.76	165	2040	1097	165

*)ExposureTime is minimum

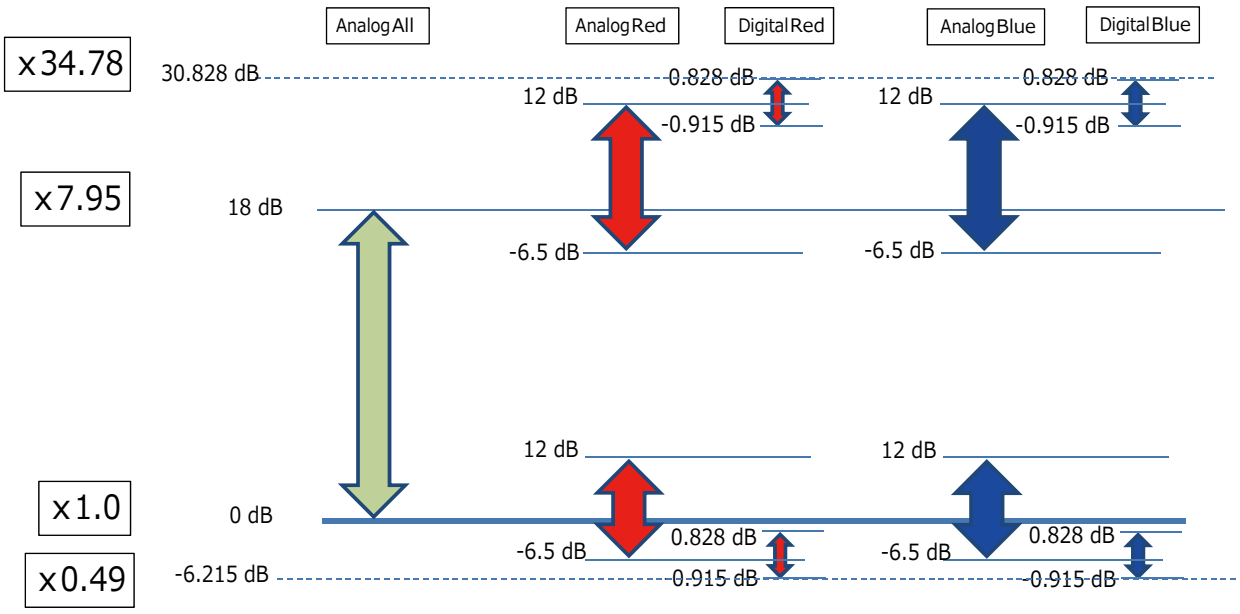
Gain Control

Gain control can be performed in the following two modes on this camera.

Adjusting the Master Gain and Performing Fine Adjustment with R and B (Master Mode)

When using this mode, set IndividualGainMode to Off.
Adjust the [AnalogAll] (master gain) setting first, and then adjust the [AnalogRed], [DigitalRed], [AnalogBlue], and [DigitalBlue] setting values to perform fine adjustment.

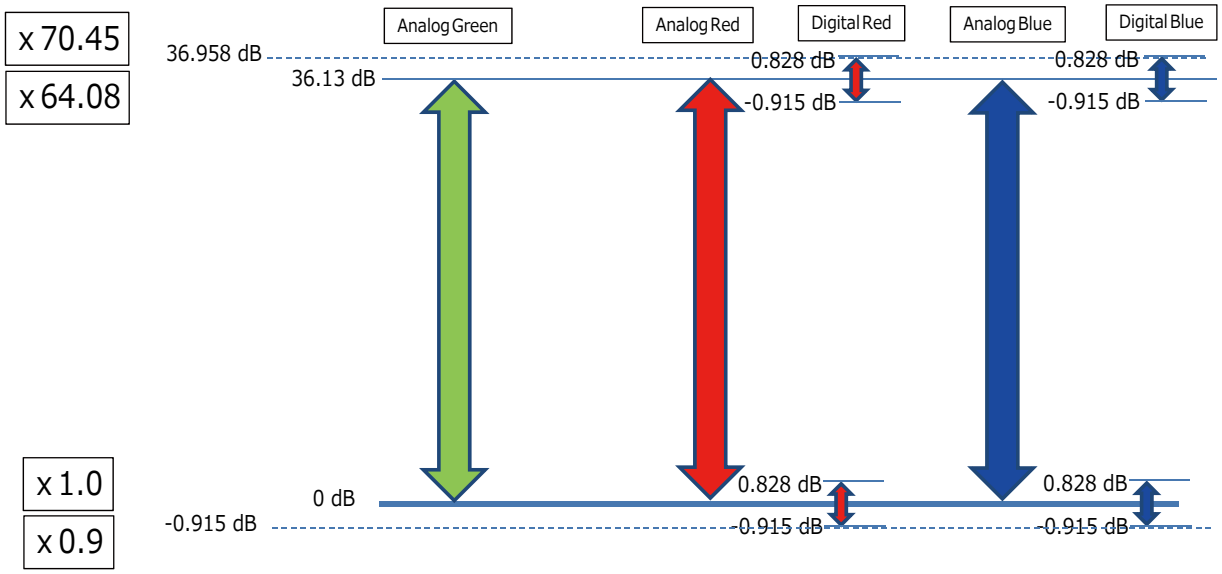
When IndividualGainMode is set to Off



Adjusting the Gain Individually for RGB (Individual Mode)

When using this mode, set IndividualGainMode to On.
Adjust the [AnalogGreen], [AnalogRed], [DigitalRed], [AnalogBlue], [DigitalBlue] setting values to adjust the gain.
This mode allows a wider range of adjustment by the user when compared to Master Mode.

When IndividualGainMode is set to On



Note

The baseline for 0 dB is different between MasterMode and IndividualMode. 0 dB in MasterMode is about 6 dB higher than 0 dB in IndividualMode.

Automatic Gain Level Control

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

Note

When [IndividualGainMode] is set to [On], [GainAuto] will be fixed at [Off].

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).

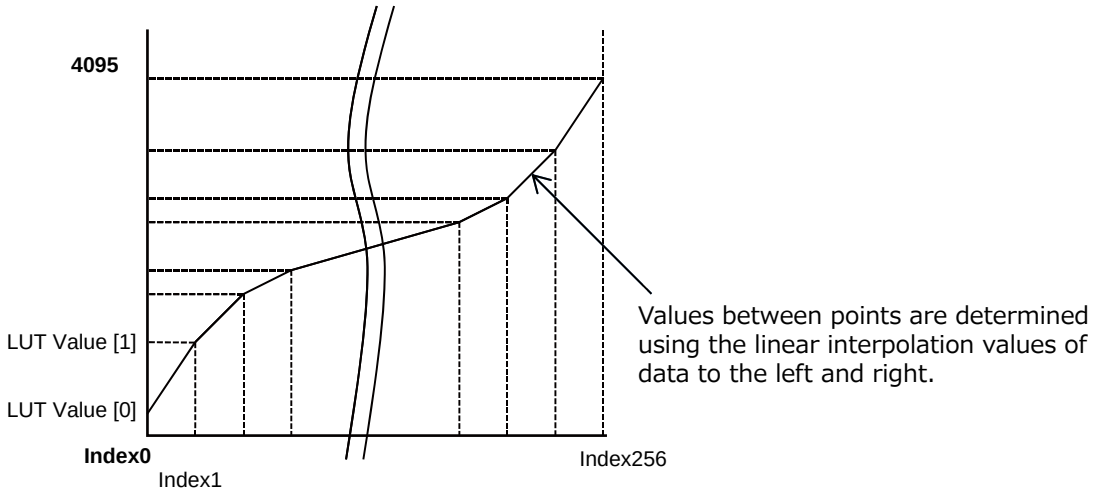
■ To use the LUT function

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 to 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 to 4095	Set the LUT output value for the selected index.

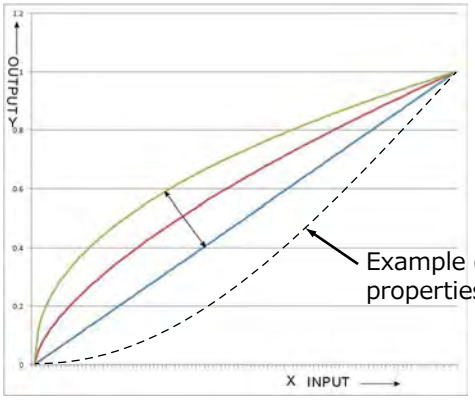
■ LUT values

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.



Example of the light-emitting properties of the monitor display

■ 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.
JAI 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)” (page 31).

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.

- Line1-TTLOut1, Line2-OptOut1
- Line5-OptIn1, Line6-OptIn2
- TimeStampReset
- NAND0In1, NAND0In2, NAND1In1, NAND1In2

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 200 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 200 pixels can be corrected for each of the three sensors.

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 200. 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[specify sensor][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.

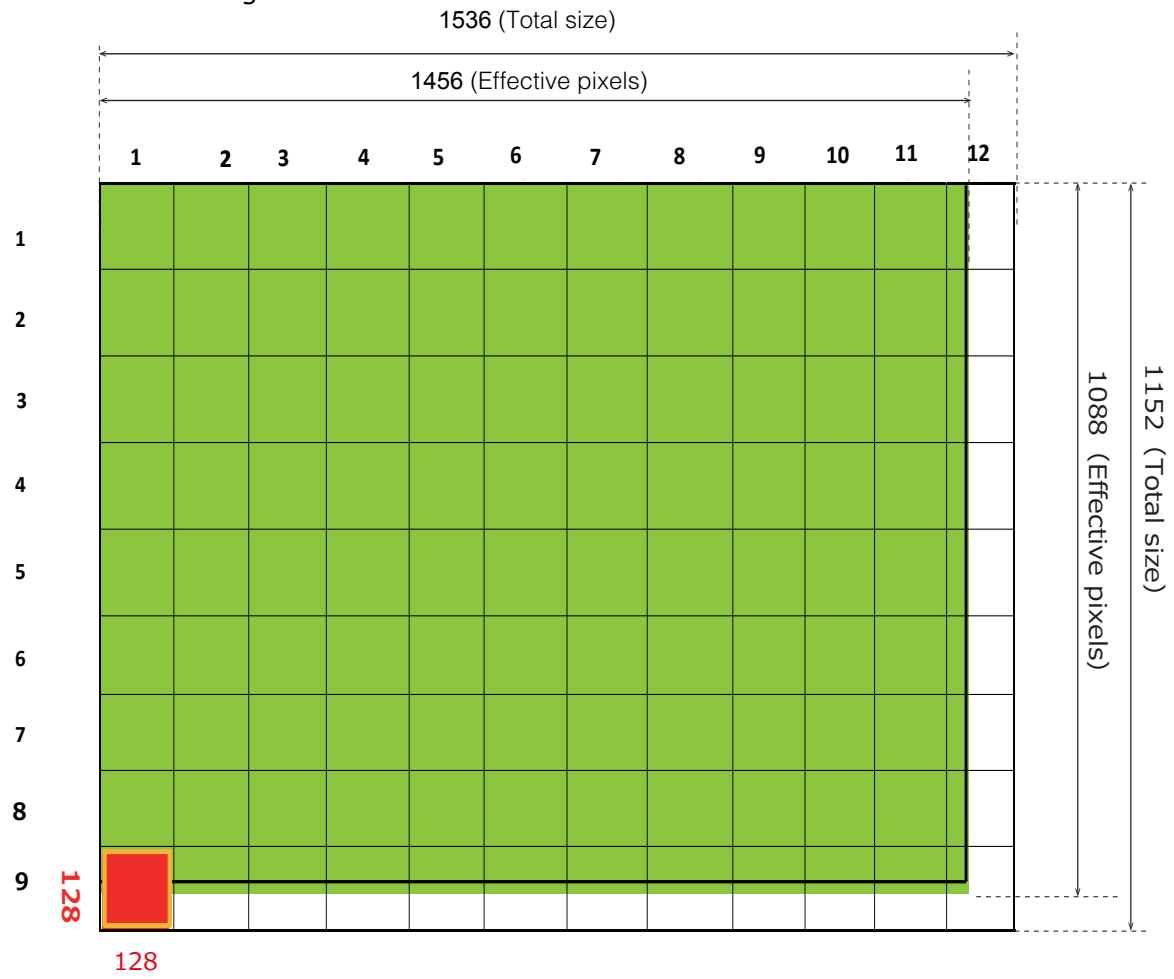
ShadingCorrection

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 must be configured) by the ROI function. In such cases, the correction area is included in the image area configured by the ROI.

For a full image, the number of correction blocks is 12 (H) × 9 (V) blocks and calculation errors in the correction data are minimized due to the small interpolation areas. Each block is 128 × 128 pixels. The total size of the blocks is 1536 (H) × 1152 (V), but the actual number of effective pixels for the camera is 1456 (H) × 1088 (V). The ineffective peripheral areas will be deleted internally on the camera automatically.

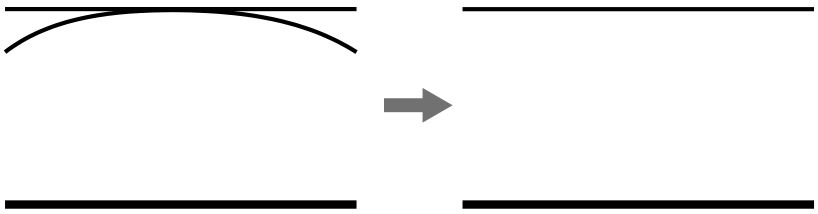
When using ROI, the number of blocks and the number of pixels that comprise each block differ from a full image.



The following shading correction modes are available on the camera.

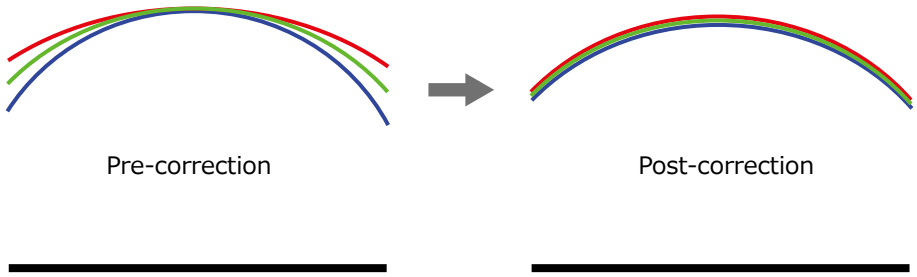
■ FlatShading

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

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 twice the amount of gain before correction. (The amount of gain cannot be increased to more than twice 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

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.

- Horizontal Binning: Digital addition or averaging processing.
- Vertical Binning: Analog addition in the image sensor.
- Horizontal and Vertical Binning: Analog addition in the image sensor.

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” (page 16).

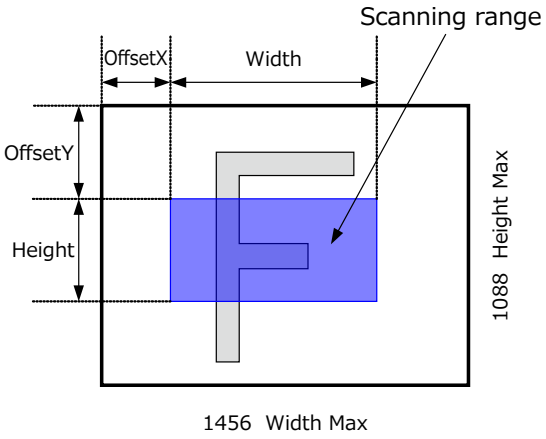
You can increase the frame rate by specifying a lower height, as the number of lines scanned decreases.

The setting ranges for the ROI function's readable area based on the Binning setting (BinningHorizontal, BinningVertical) are as follows.

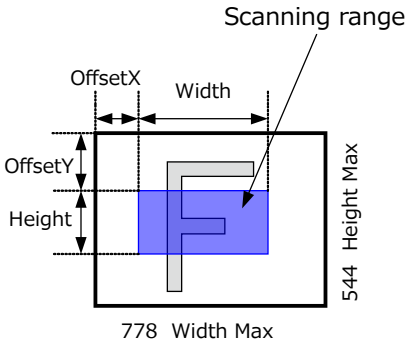
Width (pixels)	Height (pixels)
BinningHorizontal Off: 16 to 1456,16 pxels / step	BinningVertical Off: 2 to 1088, 2 lines / step
BinningHorizontal On: 16 to 728, 8 pxels / step	BinningVertical On: 2 to 544, 2 lines / step

Offset X (pixels)	Offset Y (pixels)
BinningHorizontal Off: 0 to 1440, 16 pxels / step	BinningVertical Off: 0 to 1086, 2 lines / step
BinningHorizontal On: 0 to 720, 8 pxels / step	BinningVertical On: 0 to 542, 2 lines / step

Example 1: Without binning
[BinningHorizontal] *: 1
[BinningVertical] *: 1



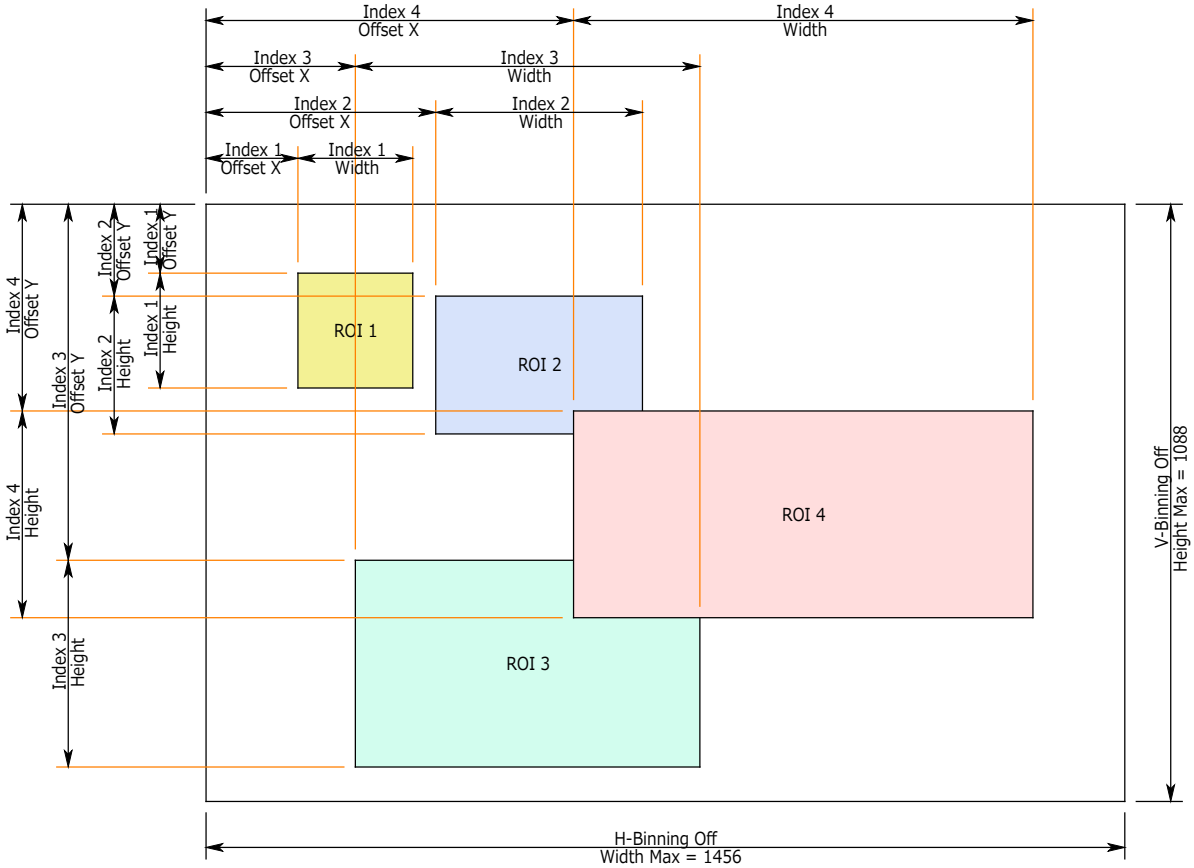
Example 2: With binning
[BinningHorizontal] *: 2
[BinningVertical] *: 2



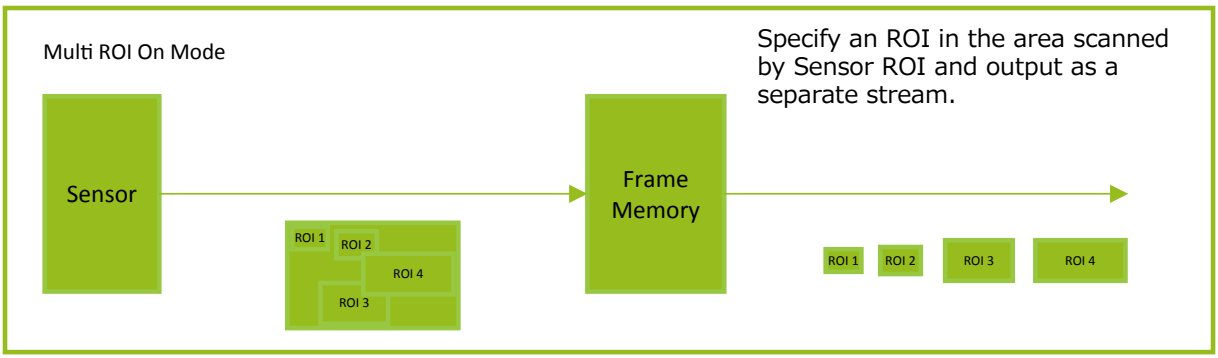
❖ For details on the frame rates for common ROI sizes, see “Frame Rate Reference” (page 63).

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].



Sensor Multi ROIMode

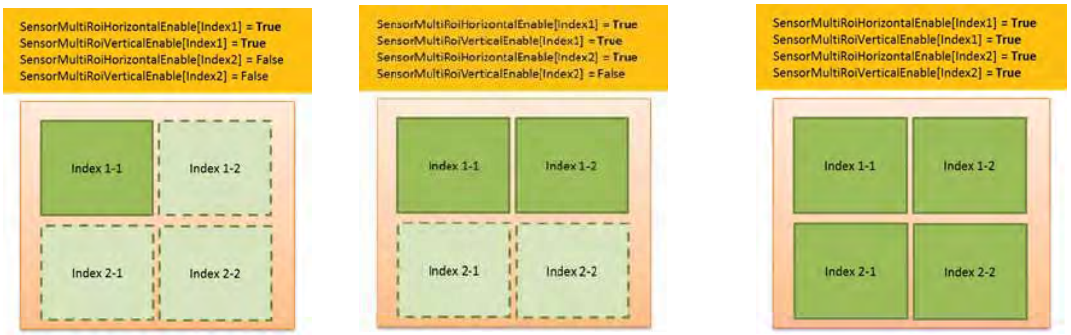
In this mode, the Multi ROI function built into the image sensor is used. Up to 4 areas can be specified. In this mode, areas can not be overlapped. Please use Overlap Multi ROI mode, if you need area overlap.

*) Binning mode (BinningVertical = 2 and BinningHorizontal = 2) and SensorMultiROI mode can not be used at the same time.
Binning mode and SensorMultiROI mode can be used at the same time, if BinningVertical = 1 or BinningHorizontal =1.

*) Sequencer mode and SensorMultiROI mode can not be used at the same time.

The setting is [JAICustomControlSensorMultiROI]. Specify width, height, horizontal / vertical offset value for each index.

Please refer to the example in the figure below and set SensorMultiRoiHorizontalEnable, SensorMultiRoiVerticalEnable.
For Index 1, both SensorMultiRoiHorizontalEnable and SensorMultiRoiVerticalEnable are fixed to True.



*). When using SensorMultiROI mode, if EdgeEnhancer is enabled, the boundaries of each area may be edge-emphasized depending on the acquired image.

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.

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 cannot be used together with Sensor Multi ROI function (page 37).

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 Sequenceer Mode	Command Sequenceer Mode	Item	Setting range	Default value	Description
○	-	SequencerFrameNumber	1 to 255	1	Set the number of frames to display for the selected SequencerIndex. (Enabled only for TriggerSequencer.)
○	-	SequencerSetNext	1 to128	1	Set the next index to be displayed for the selected SequencerIndex. (Enabled only for TriggerSequencer.)
○	○	SequencerWidth	SequencerBinningHorizontal 1: 16 to 1456 SequencerBinningHorizontal 2: 8 to 728	1456	Set the width of the selected SequencerIndex.
○	○	SequencerHeight	SequencerBinningVertical 1: 2 to 1088 SequencerBinningVertical 2: 2 to 544	1088	Set the Height of the selected SequencerIndex.
○	○	SequencerOffsetX	SequencerBinningHorizontal 1: 0 to 1440 step 16 SequencerBinningHorizontal 2: 0 to 720 step 8	0	Set the horizontal offset value for the selected SequencerIndex.
○	○	SequencerOffsetY	SequencerBinningVertical 1: 0 to 1086 SequencerBinningVertical 2: 0 to 542	0	Set the vertical offset value for the selected SequencerIndex.
○	○	SequencerGainAnalogAll	1.0 to 8.0	1.0	Set the GainAnalogAll value.
○	○	SequencerGainAnalogRed	0.47 to 4.0 / 1.0 to 64.0	1.0	
○	○	SequencerGainAnalogGreen	1.0 fixed / 1.0 to 64.0	1.0	
○	○	SequencerGainAnalogBlue	0.47 to 4.0 / 1.0 to 64.0	1.0	
○	○	SequencerExposureTimeCommon			
○	○	SequencerExposureTimeRed			
○	○	SequencerExposureTimeGreen			
○	○	SequencerExposureTimeBlue			
○	○	SequencerBinningHorizontal	1, 2	1	For the selected SequencerIndex, set the number of pixels in the horizontal direction for which to perform binning.
○	○	SequencerBinningVertical	1, 2	1	For the selected SequencerIndex, set the number of pixels in the vertical direction for which to perform binning.
○	○	SequencerLUTEnable	True, False		

○	○	SequencerBlackLevelDigitalAll	-133 to 255	0	Set the black level value for the selected SequencerIndex.

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.

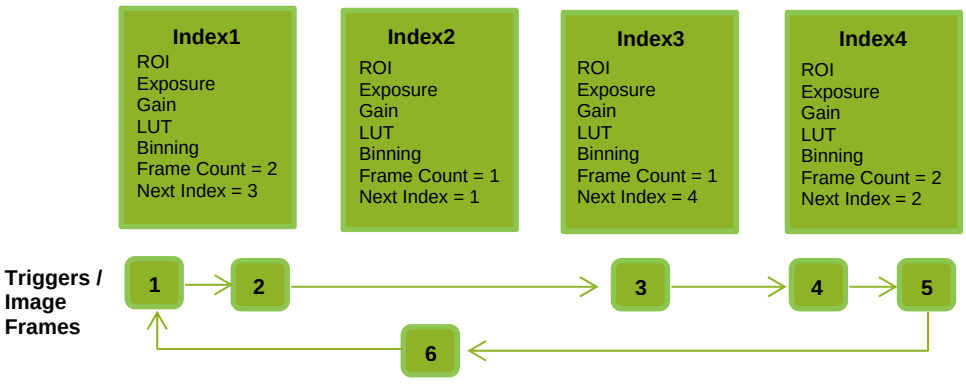
[SequencerLUTMode]
This defines whether to apply gamma or LUT to the sequence.
When gamma is selected, the gamma setting defined in [AnalogControl] is applied to all exposures in the sequence. When LUT is selected, the LUT characteristics defined in [AnalogControl] are applied to indexes for which [SequencerLUT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

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

[Sequencer Repetition]
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

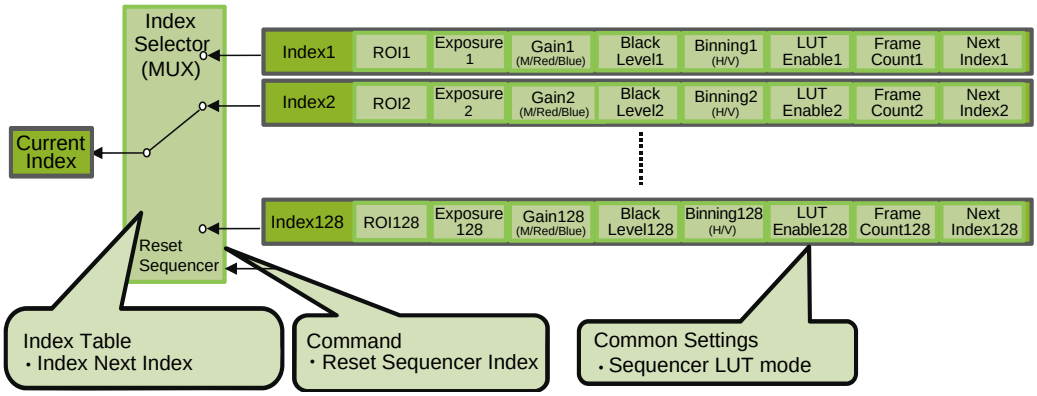
In addition to repeating multiple conditions as in the above example, you can specify "0" (which indicates the end of TriggerSequencer mode) in [SequencerSetNext] of index 2, and specify the number of repetitions in [SequencerRepetition].

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 delayed readout buffer is 15 frames in length for 8-bit, 7 frames for 10-bit, and 7 frames for 12-bit.

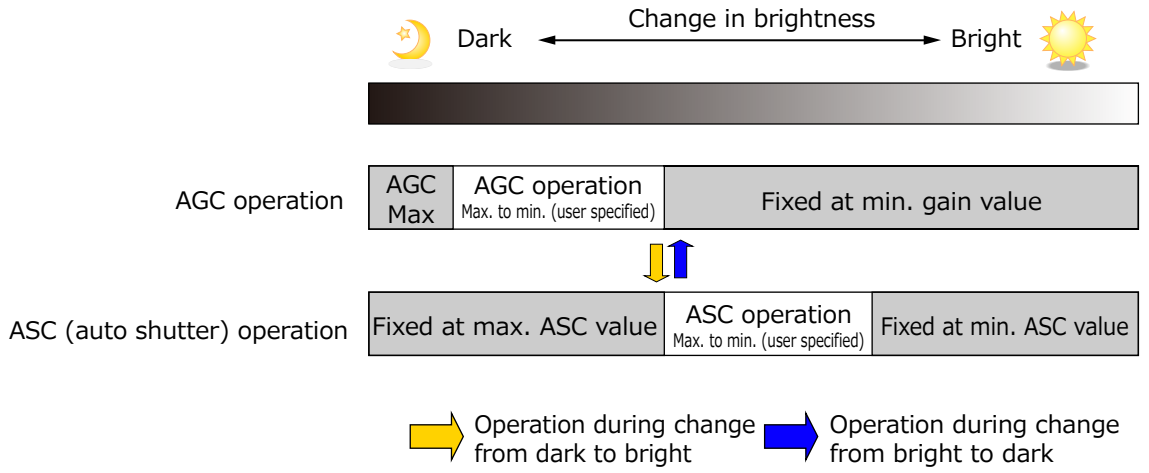
❖ For details, see “Trigger Control” (page 26).

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.

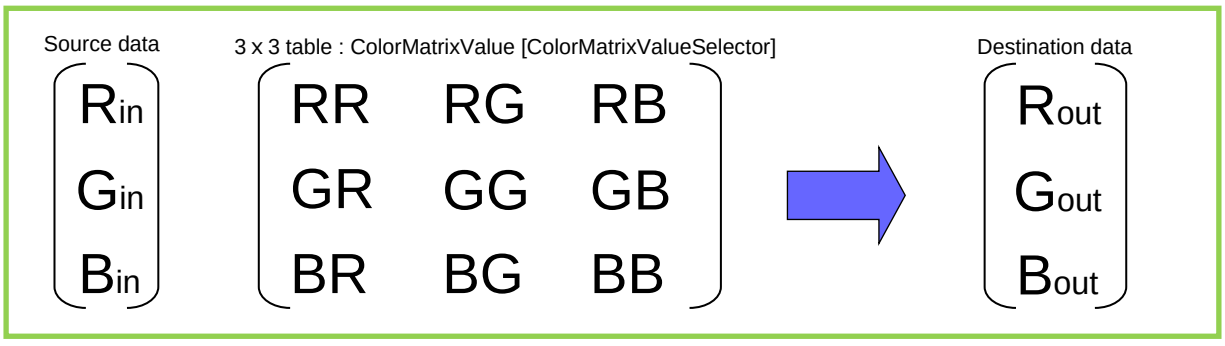
Color Space Conversion (ColorTransformationControl)

This camera 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.

ColorTransformation	ColorTransformationMode	ColorTransformationRGBMode
RGB(sRGB)	RGB	sRGB
RGB(AdobeRGB)	RGB	AdobeRGB
RGB(UserCustom)	RGB	UserCustom
XYZ	XYZ	Off
HSI	HSI	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	-2.0 to 2.0	Set the Color Matrix value.

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.

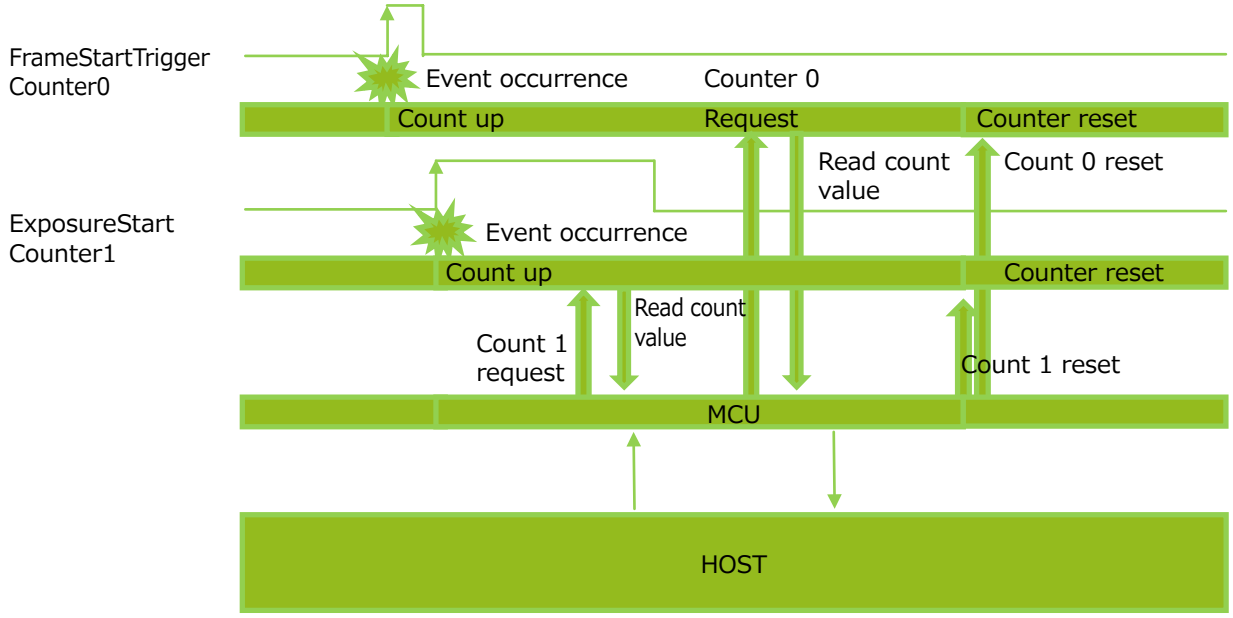
Color enhancer function
The color enhancer function is enabled when EnhancerEnable[Color] is set to True.
Set a value from 0 to 1 (0.1 steps) for ColorEnhancerValue[ColorEnhancerSelector] to set the enhancement to one of ten levels.
(0: no enhancement; 1: approx. x2 the color level of the original data)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

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.

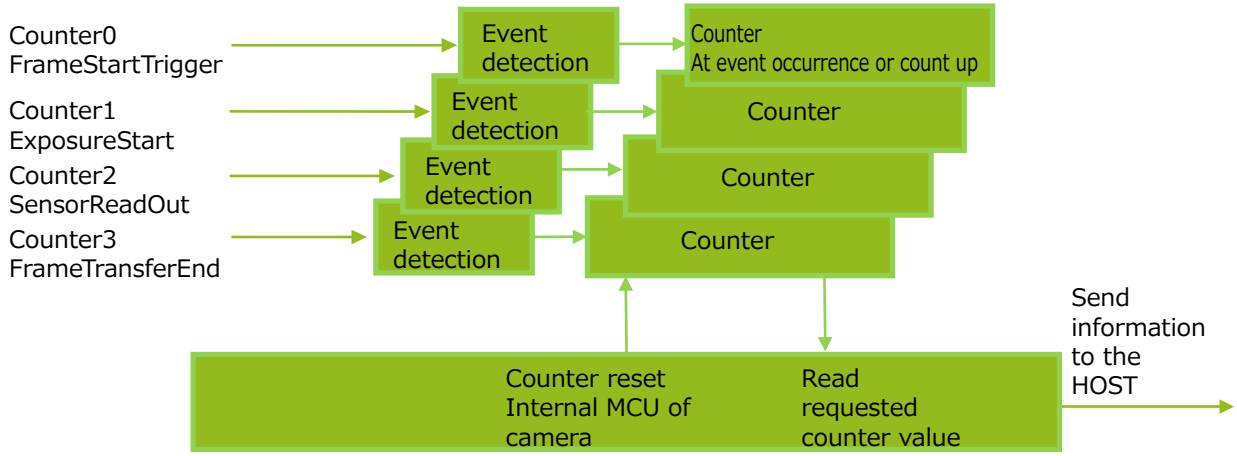
■ Counter occurrence diagram



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 to 3		Counter 0 to 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 (RGB12V1Packed) 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	8bit(RGB8)/10bit(RGB10V1Packed, RGB10p32)/12bit(RGB12V1Packed)	8bit(RGB8)/10bit(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

■ To enable VideoProcessBypassMode

Item	Setting value / selectable range	Description
VideoProcessBypassMode	On	Enable VideoProcessBypassMode.

In VideoProcessBypassMode, saturated level of brightness decreases.

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.

Genicam Name	Chunk ID	Data type	Description
ChunkOffsetX	2000h	Integer	OffsetX value
ChunkOffsetY	2001h	Integer	OffsetY value
ChunkWidth	2002h	Integer	Width value
ChunkHeight	2003h	Integer	Height value
ChunkExposureTimeMode	201Bh	Enumeration	
ChunkExposureTimeGreen	2004h	Integer	ExposureTime value for when ExposureMode is set to Timed

Genicam Name	Chunk ID	Data type	Description
ChunkExposureTimeRed	201Ch	Integer	
ChunkExposureTimeBlue	201Dh	Integer	
ChunkIndividualGainMode	201Eh	Enumeration	IndividualGainMode value
ChunkAnalogGainAll(Green)	2005h		GainAll or GainGreen value
ChunkAnalogGainRed	2006h	Float	GainRed value
ChunkAnalogGainBlue	2007h	Float	GainBlue value
ChunkBlackLevel DigitalAll	2008h	Float	BlackLevelAll value
ChunkBlackLevel DigitalRed	2009h	Float	BlackLevelRed value
ChunkBlackLevel DigitalBlue	200Ah	Float	BlackLevelBlue value
ChunkBinning HorizontalVertical_ LUTEnable	200Bh	Integer	BinningHorizontal, BinningVertical, LUTEnable values
ChunkSequencerSet Active	200Ch	Integer	Value indicating the Sequencer status
ChunkFrametrigger Counter	200Eh	Integer	Counter value for FrameTrigger
ChunkExposureStart Counter	200Fh	Integer	Counter value for ExposureStart
ChunkSensorReadOutStart Counter	2010h	Integer	Counter value for FrameStart
ChunkFrameTransfer EndCounter	2011h	Integer	Counter value for FrameTransferEnd
ChunkLineStatusAll OnExposureStart		Float	LineStatusAllOnExposureStart value
ChunkLineStatusAll OnFVALStart	2016h	Integer	The line status is added when FVAL is established. The content of the data is identical to [ChunkLineStatusAll].
ChunkDevice Temperature(C)	2019h	Float	DeviceTemperature value
ChunkDeviceSerial Number	2017h	String	DeviceSerialNumber value
ChunkDeviceUserID	2018h	String	DeviceUserID value

■ 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.

Settings List

Feature Properties

: Settings that can only be configured when image acquisition on the camera is stopped.

Item	Setting range	Default value	Description
a) DeviceControl			Display/configure information related to the device.
DeviceVendorName	–	"JAI Corporation"	Display the manufacturer name.
DeviceModelName	–	AP-1600T-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 for the camera.
DeviceTemperature Selector	Mainboard	Mainboard	Select the area of the camera's interior for which to display the temperature sensor's reading.
DeviceTemperature(C)	–	–	Display the internal temperature (°C) of the camera.
Timestamp	–	0 or higher	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	–	–	
DeviceReset	–	–	Reset the device.
b) ImageFormatControl			Configure image format settings.
SensorWidth	1456	1456	Display the maximum image width.
SensorHeight	1088	1088	Display the maximum image height.
SensorDigitizationBits	12 Bits	12 Bits	Display the number of bits at which the sensor is operating.
WidthMax	1456	1456	Display the maximum image width. (This value will vary depending on the HorizontalBinning setting.)
HeightMax	1088	1088	Display the maximum image height. (This value will vary depending on the VerticalBinning setting.)
Width	BinningHorizontal 1: 16 to 1456 BinningHorizontal 2: 8 to 728	1456	Set the image width.
Height	BinningVertical 1: 2 to 1088 BinningVertical 2: 2 to 544	1088	Set the image height.
OffsetX	BinningHorizontal 1: 0 to 1440 step 16 BinningHorizontal 2: 0 to 1024 step 8	0	Set the horizontal offset.
OffsetY	BinningVertical 1: 0 to 1086 steps 2 BinningVertical 2: 0 to 542 step 2	0	Set the vertical offset.
BinningHorizontalMode	Sum, Average	Sum	Set the addition process to be used during horizontal binning.

Item	Setting range	Default value	Description
BinningHorizontal	1, 2	1	Set the number of pixels in the horizontal direction for which to perform binning.
BinningVerticalMode	Sum	Sum	Display the addition process to be used during vertical binning.
BinningVertical	1, 2	1	Set the number of pixels in the vertical direction for which to perform binning.
PixelFormat	RGB8, RGB10V1Packed, RGB10p32, RGB12V1Packed	RGB8	Set the pixel format. [RGB12V1Packed] is enabled when [Video Process Bypass] is set to [On].
TestPattern	Off, GreyHorizontalRamp, GreyVerticalRamp, GreyHorizontalRamp Moving, HorizontalColorBar, VerticalColorBar, HorizontalColorBarMoving	Off	Select the test image.
c) AcquisitionControl			Configure image capture settings.
AcquisitionMode	Single Frame, Multi Frame, Continuous	Continuous	Select the image capture mode.
AcquisitionStart	–	–	Start image capture.
AcquisitionStop	–	–	Stop image capture.
AcquisitionFrameCount	1 to 65535	1	In [MultiFrame] mode, set the number of frames to capture.
AcquisitionFrameRate (Hz)	0.125 to 24.2 (Full)	24.2	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, PulseGenerator0-3, User Output 0-3, Line 5 - OptIn1, Line 6 - OptIn2, NAND0Out, NAND1Out	AcquisitionStart: Low AcquisitionEnd: Low FrameStart: Line5 - OptiIn1 AcquisitionTransfer Start: 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	0 to 500000	0	Set the time of exposure start from trigger input.
ExposureModeOption	Off、RCT	Off	Set whether to enable RCT mode.
ExposureMode	Off, Timed, TriggerWidth	Timed	Select the exposure mode.

Item	Setting range	Default value	Description
ExposureTimeMode	Common, Individual	Common	When set to Individual, ExposureTime can be adjusted for RGB individually.
ExposureTimeSelector	Common, Red, Green, Blue	Common	
ExposureTime	–	–	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.
IndividualGainMode	Off, On	Off	In IndividualGainMode, RGB can be configured individually for the entire gain adjustment range of the sensor.
GainSelector	DigitalRed, DigitalBlue When IndividualGainModeOn: AnalogRed, AnalogGreen, AnalogBlue When IndividualGainModeOff: AnalogAll, AnalogRed, AnalogBlue	AnalogAll	Select the gain to configure.
Gain	–	×1	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, ExposureContinuous, ExposureOnce, Preset3200K, Preset5000K, Preset6500K, Preset7500K	Off	Enable/disable auto white balance. WB adjustment via gain adjustment: Continuous, Once WB adjustment via exposure time: ExposureContinuous, ExposureOnce
BlackLevelSelector	DigitalAll, DigitalRed, DigitalBlue	DigitalAll	Select the black level to configure.
BlackLevel	DigitalAll: -133 to 255 DigitalRed: -64 to 64 DigitalBlue: -64 to 64	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 to 256	0	Set the LUT index table number.
LUTValue	0 to 4095	0	Set the LUT value.
f) ColorTransfromationControl			XXXXX
ColorTransformation Mode	RGB, XYZ, HSI	RGB	Set the output image format.

Item	Setting range	Default value	Description
ColorTransformationRGB Mode	Off, sRGB, AdobeRGB, User Custom	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	–	Select the ColorMatrix setting component.
ColorMatrixValue	-2.0 to 2.0	–	Set the Color Matrix value.
g) DigitalI/OControl			Configure settings for digital input/ output.
LineSelector	Line1-TTLOut1, Line2-OptOut1, Line5-OptIn1, Line6-OptIn2, TimeStampReset, NAND0In1, NAND0In2, NAND1In1, NAND1In2	Line2-OptOut1	Select the input/output to configure.
LineMode	Input, Output	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	False	Display the status of the input signal or output signal (True: High, False: Low).
LineSource	Low, High, AcquisitionTriggerWait, AcquisitionActive, FrameTriggerWait, FrameActive, ExposureActive, FVAL, LVAL, PulseGenerator0-3, UserOutput0-3, Line5OptIn1, Line6OptIn2, NAND0Out、 NAND1Out、 Action1、 Action2、 Off	Low	Select the line source signal for the item selected in [LineSelector].
LineFormat	NoConnect, TTL, OptoCoupled, InternalSignal	–	Display the signal format.
LineStatus All	–	–	Display the input/output signal status.
OptInFilterSelector	Off, 10µs, 100µs, 500µs, 1ms, 5ms, 10ms	Off	Remove noise from the OptIn input signal of Digital I/O.
UserOutputSelector	UserOutput0, UserOutput1, UserOutput2, UserOutput3	0: 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	Counter 0 to 3	Counter 0	Select the counter.

Item		Setting range	Default value	Description
	CounterEventSource	Counter0: Off, Frame Trigger Counter1: Off, ExposureStart Counter2: Off, SensorReadOut Counter3: Off, Frame TransferEnd	Off	Assign the counter event signal for which you want to read the count value to a dedicated counter, and read the value.
	CounterEvent Activation	RisingEdge, FallingEdge	–	Set the count timing.
	CounterReset	–	–	Reset the counter.
	CounterRefresh	–	–	Update the count value.
	CounterValue	–	–	Display the count value.
	CounterStatus	CounterIdle, CounterActive, CounterOverflow	CounterActive	Display the counter status. CounterIdle: Idle CounterActive: Counting CounterOverflow: Count value exceeded the maximum value
i) UserSetControl				Configure user settings.
UserSetSelector		Default, UserSet1 to 3	Default (factory default values)	Select the user settings.
	UserSetLoad	–	–	Load user settings.
	UserSetSave	–	–	Save the current setting values as user settings.
j) SequencerControl				Configure sequencer settings.
SequencerMode		On, Off	Off	Enable/disable [SequencerMode].
SequencerModeSelect		TriggerSequencermode, CommandSequencer mode	Trigger Sequencermode	Select the sequencer mode.
SequencerConfiguration Mode		On, Off	On	Select [On] to change the settings within the index.
SequencerSetSelector		1 to 128	1	Select the [TriggerSequencer] mode and [CommandSequencer] mode index.

Item		Setting range	Default value	Description
	SequencerFrame Number	1 to 255	1	Set the number of frames to display for the selected SequencerIndex. (Enabled only for TriggerSequencer.)
	SequencerSetNext	1 to 128	–	Set the next index to be displayed for the selected SequencerIndex. (Enabled only for TriggerSequencer.)
	SequencerWidth	SequencerBinning Horizontal 1: 16 to 1456 SequencerBinning Horizontal 2: 8 to 728	1456	Set the width of the selected SequencerIndex.
	SequencerHeight	SequencerBinning Vertical 1: 2 to 1088 SequencerBinning Vertical 2: 2 to 544	1088	Set the height of the selected SequencerIndex.
	SequencerOffsetX	SequencerBinning Horizontal 1: 0 to 1440 step16 SequencerBinning Horizontal 2: 0 to 720 step 8	0	Set the horizontal offset value for the selected SequencerIndex.
	SequencerOffsetY	SequencerBinning Vertical 1: 0 to 1086 step 2 SequencerBinning Vertical 2: 0 to 542 step 2	0	Set the vertical offset value for the selected SequencerIndex.
	SequencerGain AnalogAll	1.0 to 8.0	1.0	Set the GainAnalogAll value.
	SequencerGain AnalogRed	0.47 to 4.0 / 1.0 to 64.0	1.0	
	SequencerGain AnalogGreen	1.0 fixed / 1.0 to 64.0	1.0	
	SequencerGain AnalogBlue	0.47 to 4.0 / 1.0 to 64.0	1.0	
	SequencerExposure TimeCommon(µs)			Set the exposure time for the selected SequencerIndex.
	SequencerExposure TimeRed(µs)			
	SequencerExposure TimeGreen(µs)			
	SequencerExposure TimeBlue(µs)			
	SequencerLUTEnable	True, False		
	SequencerBlackLevel DigitalAll	-133 to 255	0	Set the black level value for the selected SequencerIndex.
	SequencerBinning Horizontal	1, 2	1	For the selected SequencerIndex, set the number of pixels in the horizontal direction for which to perform binning.
	SequencerBinning Vertical	1, 2	1	For the selected SequencerIndex, set the number of pixels in the vertical direction for which to perform binning.
SequencerRepetition		1 to 255	1	Set the repeat count for the sequencer.
SequencerLUTMode		Gamma, LUT	Gamma	Set the sequence LUT mode.
SequencerSetActive		–	–	Displays the active LUT number.
SequencerCommand Index		–	1	Set this to change the SequencerIndex. (Enabled only for CommandSequencer.)
SequencerSetStart		–	1	Specify the first index number to switch to when starting [TriggerSequencerMode].

Item	Setting range	Default value	Description
SequencerReset	–	–	In [TriggerSequencerMode], reset the current index number to the number configured in [SequencerSetStart].
k) ChunkDataControl			Configure chunk control settings.
ChunkModeActive	True, False	False	Set whether to enable ChunkData.
ChunkSelector	ChunkImage, ChunkOffsetX, ChunkOffsetY, ChunkWidth, ChunkHeight, ChunkExposureTimeMode, ChunkExposureTime Common(Green), ChunkExposureTimeRed, ChunkExposureTimeBlue, ChunkIndividualGainMode, ChunkGainAnalogAll(Green), ChunkGainAnalogRed, ChunkGainAnalogBlue, ChunkBlackLevelDigitalAll, ChunkBlackLevelDigitalRed, ChunkBlackLevelDigitalBlue, ChunkBinningH/V, ChunkLUTEnable, ChunkSequencerSetActive, ChunkFrameTriggerCounter, ChunkExposureStartCounter, ChunkSensorReadOutStart Counter, ChunkFrameTransferEnd Counter, ChunkPixelFormat, ChunkLineStatusAll, ChunkTimestamp, ChunkLineStatusAllOn ExposureStart, ChunkLineStatusAllOn FVALStart, ChunkDeviceSerial Number, ChunkDeviceUserID, ChunkDeviceTemperature	Image	Select the ChunkData to be added.
ChunkEnable	True, False	–	Select whether to output ChunkData. Default: Only [ChunkImage] is [True]
l) TestControl			
TestPendingAck	–	–	PendingAck function test command.
m) TransportLayerControl			Display information on transport layer control.
PayloadSize	–	–	Display the payload size.
DeviceTapGeometry	–	Geometry_1X1_1Y	Set the transfer method (tap configuration) of images transferred from the camera at one time.
GevCurrentPhysicalLinkConfiguration	SingleLink	SingleLink	Display the LinkConfiguration status (fixed at [SingleLink] on this camera).

Item		Setting range	Default value	Description
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	False	Select whether to set the IP configuration to Persistent IP.
	GevCurrentIPAddres	–	–	Display the IP address.
	GevCurrentSubnetMask	–	–	Display the subnet.
	GevCurrentDefaultGateway	–	–	Display the default gateway.
	GevIPConfigurationStatus	–	–	Display the current IP configuration status. None, PersistentIP, DHCP, LLA, ForceIP
	GevPersistentIPAddres	–	–	Set the persistent IP address.

Item	Setting range	Default value	Description
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.
GevCCP	OpenAccess, ExclusiveAccess, ControlAccess, ControlAccessSwitchoverActive	OpenAccess	Control access rights.
GevPrimaryApplicationSocket	–	–	Set UDP SOURCE PORT for the primary application.
GevPrimaryApplicationIPAddress	–	–	Return the primary application IP Address.
GevMCPHostPort	–	–	Set the port number to send a message.
GevMCDA	–	–	Set the restoration IP Address for the message channel.
GevMCTT	0 to 424967295	300	Set the timeout duration for the message channel. (unit: ms)
GevMCRC	0 to 424967295	0 to 424967295	Sets the number of retransmissions when the message channel timeout occurs.
GevMCSP	–	–	Display the source port number for the message channel.
GevStreamChannelSelector	0	0	Select the stream channel.
GevSCCFGPacketResendDestination	True, False	False	
GevSCCFGAllInTransmission	True, False	False	
GevSCCFGUnconditionalStreaming	True, False	False	
GevSCCFGExtendedChunkData	True, False	False	
GevSCPInterfaceIndex	0	0	Fixed at 0.
GevSCPHostPort	–	0	Set the port number for the stream channel.
GevSCPSFireTestPacket	True, False	False	
GevSCPSDoNotFragment	True, False	False	Specify whether to prohibit packet fragmentation.
GevSCPSPacketSize	1476 to 1620 Step 2	1476	
GevSCPD	0 to 424967295	0	
GevSCDA	–	–	
GevSCSP	–	–	
n) JAICustomControl PulseGenerators			Configure pulse generator settings.
ClockPreScaler	1 to 4096	165	Set the division value for the prescaler (12 bit) using PixelClock as the base clock.
PulseGeneratorClock (MHz)	0.018127 to 74.25	0.45	Set the clock used for the pulse generator. This value is calculated using the [ClockPreScaler] value as a base.
PulseGeneratorSelector	PulseGenerator 0 to 3	PulseGenerator 0	Select the pulse generator.

Item		Setting range	Default value	Description
	PulseGeneratorLength	1 to 1048575	30000	Set the maximum count-up value as a clock count.
	PulseGeneratorLength (ms)	1 / PulseGeratorClock (MHz) to 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.
	PulseGenerator Frequency(Hz)	((PulseGeneratorClock (MHz)) ÷ 1048575) x 1000000 to (PulseGeneratorClock (MHz) x 1000000)	15	Set the maximum count-up value as a frequency. This value is calculated using the [PulseGeneratorLength] value as a base.
	PulseGeneratorStart Point	0 to 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.
	PulseGeneratorStart Point(ms)	0 to (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.
	PulseGeneratorEnd Point	1 to 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.
	PulseGeneratorEnd Point(ms)	(1 / PulseGeneratorClock (MHz)) to (1048575 / PulseGeneratorClock (MHz))	33.3333	Set the start point of the Low interval in milliseconds. When the counter reaches this value, the output will be 0. The setting range varies depending on the [ClockPreScaler] value.
	PulseGeneratorPulse width(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.
	PulseGenerator RepeatCount	0 to 255	0	Set the repeat count for the counter. When this is set to [0], a free counter is enabled with no repeat limit.
	PulseGeneratorClear Activation	Off, LevelHigh, LevelLow, RisingEdge, FallingEdge	Off	Set the clear signal condition for the count clear input of the pulse generator.
	PulseGeneratorClear Source	Low, High, AcquisitionTriggerWait, AcquisitionActive, FrameTriggerWait, FrameActive, ExposureActive, FVAL, LVAL, PulseGenerator0-3, User Output0-3, Line5-OptIn1, Line6-OptIn2, Nand0Out, Nand1Out	Low	Select the count clear input signal source.
	PulseGeneratorClear Inverter	True, False	False	Select whether to invert the polarity of the count clear input signal.
	PulseGeneratorClear SyncMode	AsyncMode, SyncMode	AsyncMode	Select the sync mode for the count clear input signal.

Item	Setting range	Default value	Description
o) JAICustomControlALC			Configure JAI ALC settings. These settings are also used for AGC (auto gain control).
ALCReference	30 to 95	50	Set the target level for ALC. (unit: %)
ALCAreaSelector	LowRight, LowMid-Right, LowMid-Left, LowLeft, Mid-LowRight, Mid-LowMid-Right, Mid-LowMid-Left, Mid-LowLeft, Mid-HighRight, Mid-HighMid-Right, Mid-HighMid-Left, Mid-HighLeft, HighRight, HighMid-Right, HighMid-Left, HighLeft	Low Right	Select the area for which to configure [ALCAreaEnable].
ALCAreaEnable	True, False	False	Enable/disable the photometry area selected in [ALCAreaSelector].
ALCAreaEnableAll	True, False	True	On: Operate ALC with all areas designated as photometry areas, regardless of the individual enabled/disabled photometry area states configured in [ALCAreaSelector]. Off: Operate ALC according to the individual enabled/disabled photometry area states configured in [ALCAreaSelector].
AutoShutterControl ExposureMin	100 to 13426	100	Set the minimum value for the ExposureAuto(ASC) control range.
AutoShutterControl ExposueMax	101 to 13427	–	Set the maximum value for the ExposureAuto(ASC) control range.
AutoGainControlGainRaw Min	100 to 1599	100	Set the minimum value for the GainAuto(ASC) control range.
AutoGainControlGainRaw Max	101 to 800	800	Set the maximum value for the GainAuto(ASC) control range.
ALCControlSpeed	1 (slow) to 8 (fast)	4	Set the response speed for AGC/ ASC. (8 is the fastest.)
ALCStatus	Off, ASC, AGC	–	Allows confirmation of the current operation area during ALC operation.
AutoControlStatus	ExecutingASC, ExecutingAGC, ExecutingASCandAGC, ExecutingAWB, ExecutingASCandAWB, ExecutingAGCandAWB, ExecutingASCandAGCand AWB, Convergen, Idle	–	Allows confirmation of the AGC, ASC, and AWB convergence status.

Item		Setting range	Default value	Description
p) JAICustomControlAWB				Configure AWB settings.
	AWBAreaSelector	LowRight, LowMid-Right, LowMid-Left, LowLeft, Mid-LowRight, Mid-LowMid-Right, Mid-LowMid-Left, Mid-LowLeft, Mid-HighRight, Mid-HighMid-Right, Mid-HighMid-Left, Mid-HighLeft, HighRight, HighMid-Right, HighMid-Left, HighLeft	LowRight	Select the area for which to configure [AWBAreaEnable].
	AWBAreaEnable	True, False	False	Enable/disable the photometry area selected in [AWBAreaSelector].
	AWBAreaEnableAll	True, False	False	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 (slow) to 8 (fast)	4	Set the AWB control speed. (8 is the fastest.)
q) JAICustomControlBlemish				Configure settings for JAI white blemish correction.
BlemishEnable		True, False	True	Enable/disable blemish correction.
BlemishDetect		–	–	Execute blemish detection.
BlemishStore		–	–	Save the location information of detected blemishes.
BlemishSelector		Red, Green, Blue	–	Specify the sensor for which to configure Blemish.
	BlemishDetect Threshold	0 to 100	10	Set the blemish detection threshold.
	BlemishCompensation Index	1 to 200	–	Select the index for the target blemish coordinates (BlemishDataPosition X/Y).
	BlemishCompensation PositionX	−1 to 2063	–	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.
	BlemishCompensation PositionY	−1 to 1543	–	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.
BlemishCompensation DataClear		–	–	Delete detected or specified blemish information.
BlemishCompensation Number		–	–	Display the number of target blemishes.
r) JAICustomControlShading				Configure shading correction settings.
ShadingCorrectionMode		FlatShading, ColorShading	FlatShading	Select the shading correction method.

Item	Setting range	Default value	Description
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.
PerformShading Calibration	–	–	Execute shading correction.
ShadingDetectResult	–	–	Display the shading correction results.
s) JAICustomControlOverlapMultiROI			Configure settings for overlap Multi ROI.
MultiRoiMode	On, Off	Off	Enable/disable overlap Multi Roi.
MultiRoiIndex	Index 1 to 5	Index 1	Select the index for the overlap Multi Roi mode.
MultiRoiWidth	16 to 1456	1456	Set the width for the selected overlap Multi Roi index.
MultiRoiHeight	2 to 1088	1088	Set the height for the selected overlap Multi Roi index.
MultiRoiOffsetX	0 to 1440	0	Set the horizontal offset for the selected overlap Multi Roi index.
MultiRoiOffsetY	0 to 1086	0	Set the vertical offset for the selected overlap Multi Roi index.
MultiRoiIndexMax	1 to 5	1	Specify the number of areas for which to use overlap Multi Roi.
t) JAICustomControl SensorMultiROI			Configure settings for sensor Multi ROI.
SensorMultiRoiMode	On、Off	Off	Enable/disable overlap Multi Roi. *)This function can be enabled only when SequecerMode is Off and MultiRoiMode is Off.
SensorMultiRoiIndex	Index1, Index2	Index 1	Select the index for the sensor Multi Roi mode.
SensorMultiRoiWidth	16 to 1456	–	Set the width for the selected sensor Multi Roi index.
SensorMultiRoiHeight	2 to 1088	–	Set the height for the selected sensor Multi Roi index.
SensorMultiRoiOffsetX	0 to 1440 The index 2 depends on the setting value of index 1.	–	Set the horizontal offset for the selected sensor Multi Roi index.
SensorMultiRoiOffsetY	0 to 1086 The index 2 depends on the setting value of index 1.	0	Set the vertical offset for the selected sensor Multi Roi index.
SensorMultiRoi HorizontalEnable	True, False	–	For each SensorMultiRoiIndex, enable / disable is set.
SensorMultiRoi VerticalEnable	True, False	–	For each SensorMultiRoiIndex, enable / disable is set.
u) JAICustomControlFeatureMisc.			Configure settings for other JAI functions.
VideoProcessBypassMode	On, Off	Off	Enable/disable VideoProcessBypass mode.
EnhancerSelector	Edge, Color	–	Specify the operation mode for Enhancer.
EnhancerEnable	True, False	–	Enable/disable EdgeEnhancer and ColorEnhancer.
ColorEnhancerSelector	Red, Cyan, Green, Magenta, Blue, Yellow	–	Index for advanced ColorEnhancer settings.
ColorEnhancerValue	0 to 1	0	Specify the ColorEnhancer emphasis levels for each color component.
EdgeEnhancerLevel	Low, Middle, High, Strong	Middle	Set the Level for EdgeEnhancer.
VideoSendMode	NormalMode, TriggerSequencerMode, CommandSequencer Mode, 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” (page 32).

■ 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				AP-1600T-PGE
Scanning system				Progressive scan, 1 tap
Synchronization				Internal
Interface				1000BASE-T Ethernet (GigE Vision 1.1), IEEE 802.3af
Image sensor				CMOS×3
Image size (effective image)				5.02 (H) × 3.75 (V), 6.27 mm diagonal
Pixel size				3.45 (H) × 3.45 (V) µm
Effective image pixel output				1456 (H) × 1088 (V)
Acquisition Frame Rate (max)	8 bit (RGB8)	H1, V1		24.2 fps
		Binning	H1, V2	48.4 fps
			H2, V1	48.4 fps
			H2, V2	96.7 fps
	10 bit packed (RGB10V1Packed, RGB10p32)	H1, V1		18.2 fps
		Binning	H1, V2	36.3 fps
			H2, V1	36.3 fps
			H2, V2	72.6 fps
	12-bit packed (RGB12V1Packed)	H1, V1		16.1 fps
		Binning	H1, V2	32.3 fps
			H2, V1	32.3 fps
			H2, V2	64.5 fps
EMVA 1288 parameters Absolute sensitivity Maximum SN ratio				At 12-bit output 5.47p (λ = 525 nm) 40.60 dB
Digital image output format	Full pixel			1456 (H) × 1088 (V)
	ROI	Width		16 to 1456, 16 pixels/step
		Offset X		0 to 1440, 16 pixels/step
		Height		2 to 1088, 2 line/step
		Offset Y		0 to 1086, 2 lines/step
	Binning	H	1	1456 (H)
			2	728 (H)
		V	1	1088 (V)
			2	544 (V)
	Pixel Format			RGB8, RGB10V1Packed, RGB10p32, RGB12V1Packed
AcquisitionMode				Continuous, SingleFrame, MultiFrame (1 to 65535)
TriggerSelector	Acquisition			AcquisitionStart, AcquisitionStop
	Exposure			FrameStart
	Transfer			AcquisitionTransferStart (delayed readout)
ExposureMode				Off, Timed, TriggerWidth (PWC)
Trigger overlap				Off / Readout
Trigger input signals				Low, High, Software, PulseGenerator0-3, UserOutput0-3, Line5-OptIn1, Line6-OptIn2, NAND0Out, NAND1Out
Opto filter				Off (default), 100 µs, 500 µs, 1ms, 5ms, 10ms
Exposure Mode	Timed			15.26 µs (8 bit), 15.26 µs (10 bit) (min) to 8 s (max) ❖ Performance verified for up to 1 second.
	Trigger Width			15.26 µs (8 bit), 15.26 µs (10 bit) (min) to 8 s (max) ❖ Performance verified for up to 1 second.
Auto exposure (Exposure Auto)				Off, Continuous, Once
Auto exposure response speed (AGC/ASC Control Speed)				1 to 8
Video send modes				NormalMode, TriggerSequencerMode, CommandSequencerMode, MultiRoiMode, SensorMultiMode

*) The actual exposure time will be consist of the image sensor's offset duration (14.26 µs) added to the setting configured on the camera.

Item			AP-1600T-PGE
Digital I/O			Line Selector (12P): GPIO IN / GPIO OUT
Black level adjustment	Default level		8LSB@8bit
	Video level adjustment range		DigitalAll : -133 to +255 LSB @12bit DigitalRed :- 64 to +64 LSB @12bit DigitalBlue : -64 to +64 LSB @12bit
	Resolution adjustment		1LSB@12bit
Gain adjustment	Manual adjustment range		MasterMode AnalogAll : 0dB to 18dB AnalogRed: -6.5dB to 12dB AnalogBlue:-6.5dB to 12dB DigitalRed:-0.915dB to 0.828dB DigitalBlue:-0.915dB to 0.828dB IndividualMode AnalogAll:0dB to 36.13dB AnalogRed:0dB to 36.13dB AnalogBlue:0dB to 36.13dB DigitalRed:-0.915dB to 0.828dB DigitalBlue:-0.915dB to 0.828dB
	Auto gain		Off, Continuous, Once
White balance	WBA		AnalogRed, AnalogBlue: -6.5dB to 12dB DigitalRed, DigitalBlue: -0.915dB to 0.828dB
	BalanceWhiteAuto		Off, Continuous, Once, ExposureContinuous, ExposureOnce, Preset3200K, Preset5000K, Preset6500K, Preset7500K
	Area		16 (4 x 4) Area
	Adjustment range		3000K to 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		200 pixels per sensor
ALC			Can be adjusted automatically together with AGC and auto exposure control
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			3 G (20 Hz to 200 Hz X-Y-Z direction)
Impact resistance			50 G
Power supply	12-pin connector	Input range	DC +12 V to +24 V ±10% (via input terminal)
		Consumption	5.4 W (at 12 V input, full pixel, Default setting, Environmental temperature 25°C) (Typical) 7.0W (Maximum)
	PoE	Input range	DC +36 V to +57 V
		Consumption	7.5 W (at full pixel, Default setting, Environmental temperature 25°C) (Typical) 8.7W (Maximum)
Lens mount			C-mount Lens mount protrusion length of 4 mm or less is supported
Flange back			17.526, tolerance: 0 mm to -0.05 m
Optical filter			IR cut filter
Verified performance temperature* / humidity			−5°C to +45°C / 20% to 80% (non-condensing)
Storage temperature / humidity			−25°C to +60°C / 20% to 80% (non-condensing)
Regulations			CE (EN61000-6-2 and EN61000-6-3), FCC part 15 class B, RoHS, WEEE
Dimensions (housing)			44 × 44 × 84 mm (WHD) (excluding mount protrusions)
Weight			200 g

Package contents
Camera body (1)
Sensor protection cap (1)
Dear Customer (sheet) (1)

Optional accessories (not supplied)
MP-44 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 temperature
Make 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.

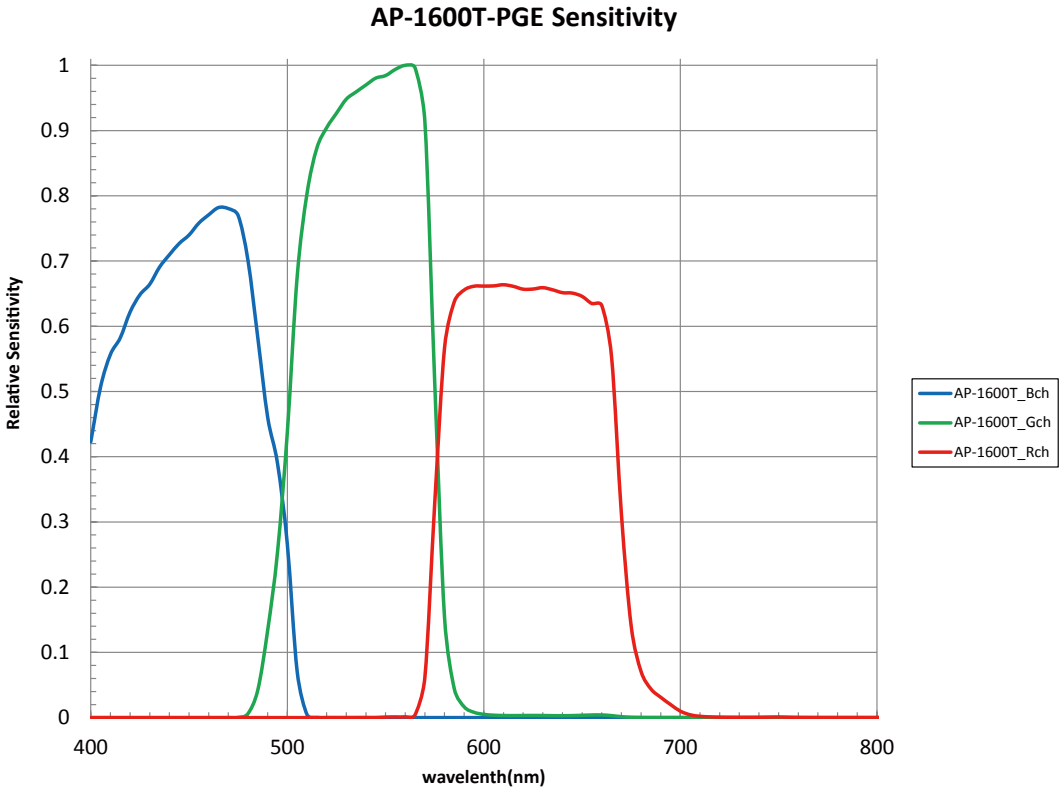
If the above temperature conditions are exceeded, take measures to dissipate heat according to your installation environment and conditions.

Frame Rate Reference

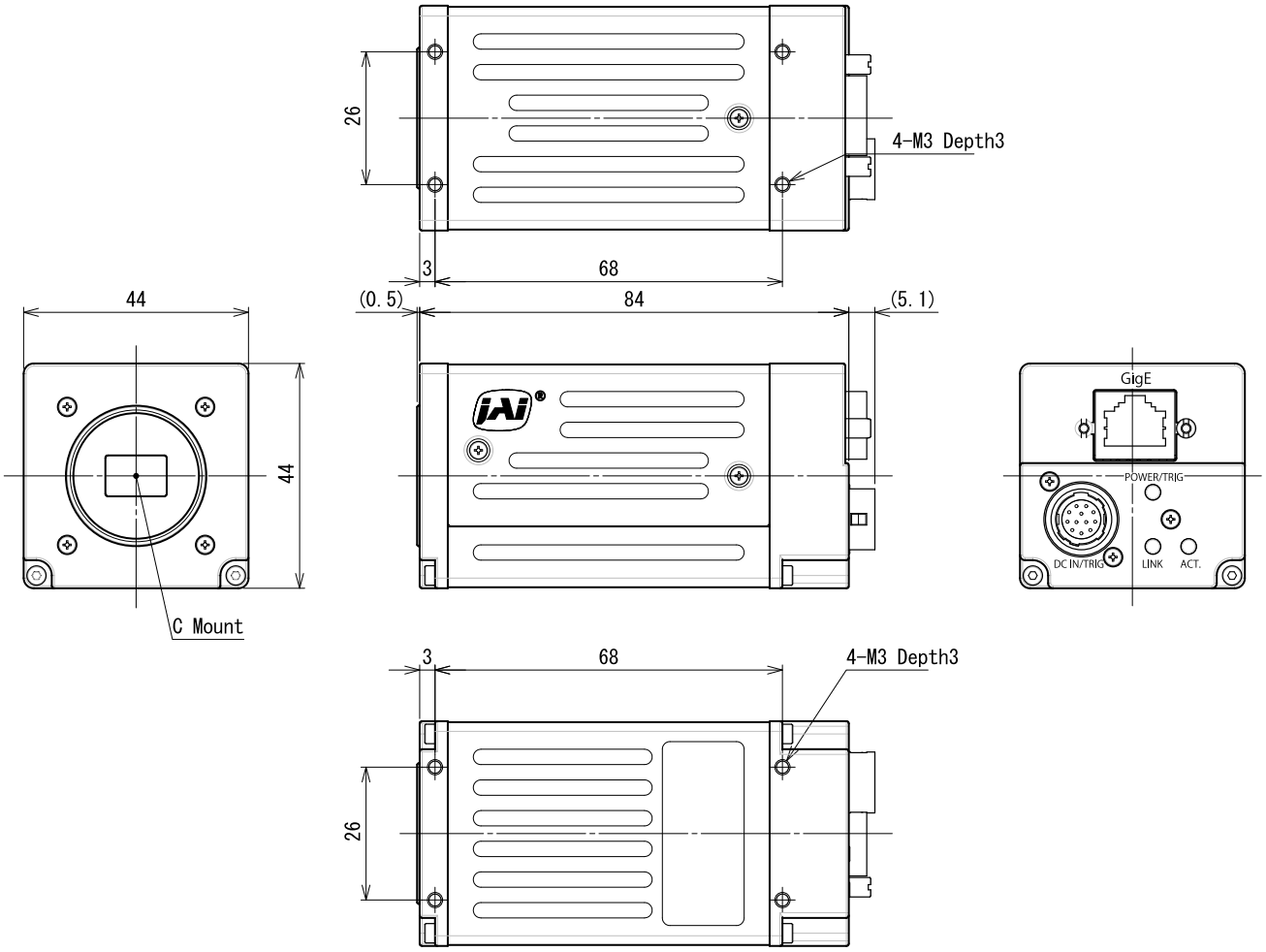
(Theoretical value)

Pixel count	Resolution (screen size)	ROI/Binning	Pixel size(µm)	Image size(mm)	Frame rate
1.6 MP	1456 × 1088	Full pixel	3.45 × 3.45	5.02 x 3.75 (6.27)	24.2 fps (@24 bit)
1.3 MP	1280 × 1024	ROI	3.45 × 3.45	4.42 x 3.53 (5.66)	29.2 fps (@24bit)
0.5 MP	800 × 600	ROI	3.45 × 3.45	2.76 x 2.07 (3.45)	79.8 fps (@24bit)
0.3 MP	640 × 480	ROI	3.45 × 3.45	2.21 x 1.66 (2.76)	124.8 fps (@24bit)
0.3 MP	640 × 480	ROI + 2x2 Binning	6.9 × 6.9	4.42 x 3.31 (5.52)	124.8 fps (@24bit)

Spectral Response



Dimensions



Dimensional tolerance: ±0.3 mm
Unit: mm

Comparison of the Decibel Display and Multiplier Display

Decibels (dB)	Multipliers (×)	Remarks
-6	0.501	Near minimum value of Gain[AnalogRed/AnalogBlue] 1)
-5	0.562	
-4	0.631	
-3	0.708	
-2	0.794	
-1	0.891	Near minimum value of Gain[DigitalRed/DigitalBlue] 2)
0	1	Minimum value of Gain[AnalogAll] Minimum value of Gain[AnalogIndividualRed/Green/Blue]
1	1.122	Near maximum value of Gain[DigitalRed/DigitalBlue] 3)
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	Near maximum value of Gain[AnalogRed/AnalogBlue] 4)
13	4.467	
14	5.012	
15	5.623	
16	6.31	
17	7.079	
18	7.943	Near maximum value of Gain[AnalogAll] 5)
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	Near maximum value of Gain[AnalogIndividualRed/Green/Blue] 6)

1) Actual minimum value is 47 (×0.47, -6.558 dB).
2) Actual minimum value is 90 (×0.9, -0.915 dB).
3) Actual maximum value is 110 (×1.1, +0.828 dB).
4) Actual maximum value is 400 (×4.0, +12.041 dB).
5) Actual maximum value is 800 (×8.0, +18.06 dB).
6) Actual maximum value is 6400 (×64.0, +36.123 dB).

User's Record

Camera type: AP-1600T-PGE

Revision: ……..

Serial No. ……..

Firmware version. ……..

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

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Revision history

Revision	Date	Changes
1.0	Apr. 2018	First version
1.1	Jan. 2020	Timing chart
1.2	July 2022	Corrected China RoHS, added the Non-Volatile Flash Memory topic.