See the possibilities

User Manual

AP-3200T-USB

Digital 3CMOS Progressive Scan RGB Color Camera

Document Version:1.1

AP-3200T-USB_Ver.1.1_Jan.2018

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-3200T-USB complies with the following provisions applying to its standards.
EN 61000-6-3 (Generic emission standard part 1)
EN 61000-6-2 (Generic immunity standard part 1)

FCC

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

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

Warning

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

Supplement

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

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

重要注意事项

有毒，有害物质或元素名称及含量表

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

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr (VI))	多溴联苯 (PPB)	多溴二苯醚 (PBDE)
棱镜	×	○	○	○	○	○
光学滤镜	×	○	×	○	○	○
连接插头	×	○	○	○	○	○
电路板	×	○	○	○	○	○
.....	.....	.....	.....	.....	.....	.....

○: 表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006规定的限量要求以下。
×: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006规定的限量要求。
（企业可在此处、根据实际情况对上表中打“×”的技术原因进行进一步说明。）

环保使用期限
电子信息产品中含有的有毒有害物质或元素在正常使用的条件下不会发生外泄或突变、电子信息产品用户使用该电子信息产品不会对环境造成严重污染或对基人身、财产造成严重损害的期限。
数字「15」为期限15年。

Usage Precautions

Notes on cable configurations

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

Notes on attaching the lens

Avoiding dust particles

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

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

Phenomena specific to CMOS image sensors

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

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

Notes on exportation

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

Features

The AP-3200T-USB is an industrial progressive scan camera that uses three 1/1.8-inch global shutter CMOS image sensors with 2064×1544 effective pixels.

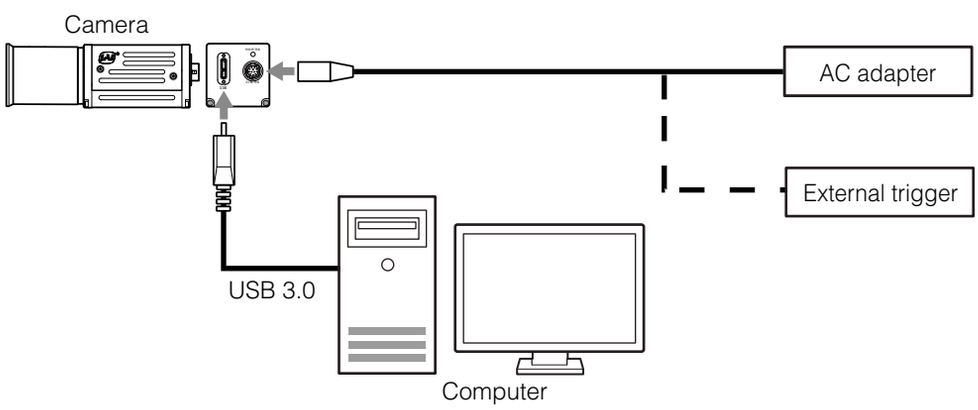
It allows maximum frame rates of 38.3 fps at full resolution.
Enhanced color reproduction is achieved via the newly-developed compact-designed 1/1.8-inch 3CMOS C-mount F4 prism optical system in addition to the internal color matrix circuit. Even higher definition imaging is made possible by the shading correction and gamma correction circuits.

The ROI and vertical 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.

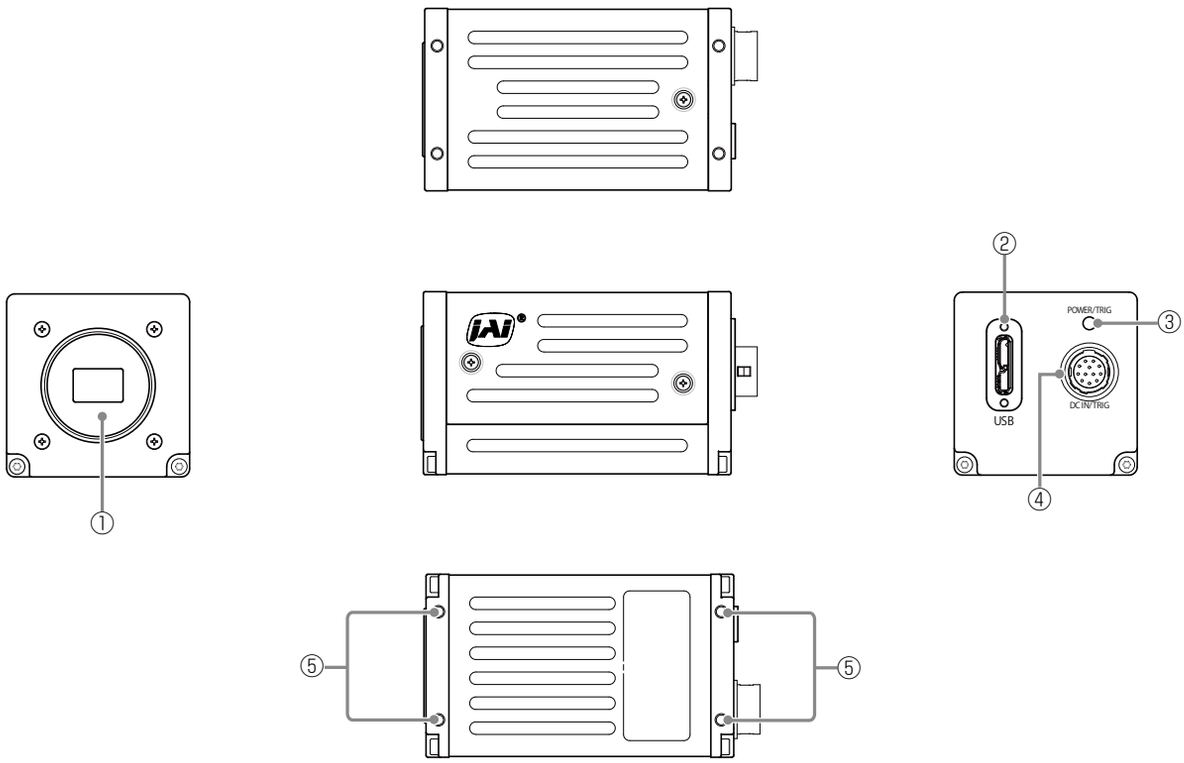
Features overview

- Compliance with USB3 Vision and GenICam standards
- 1/1.8-inch 3CMOS progressive RGB color camera
- Lens mount: C-mount (flange back: 17.526 mm)
- Effective pixels: 2064 (H) × 1544 (V); pixel size: 3.45 × 3.45 um
- Maximum frame rates of 38.3 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 11) and confirm the precautions for attaching a lens and the supported lens types.

② USB 3.0 connector

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

③ Power/trigger LED

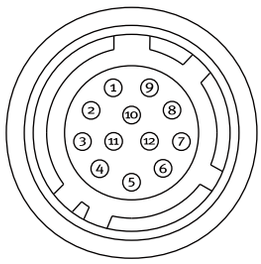
Indicates the power and trigger input status.

LED status and camera status

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

④ DC IN / trigger IN connector (12-pin round)

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

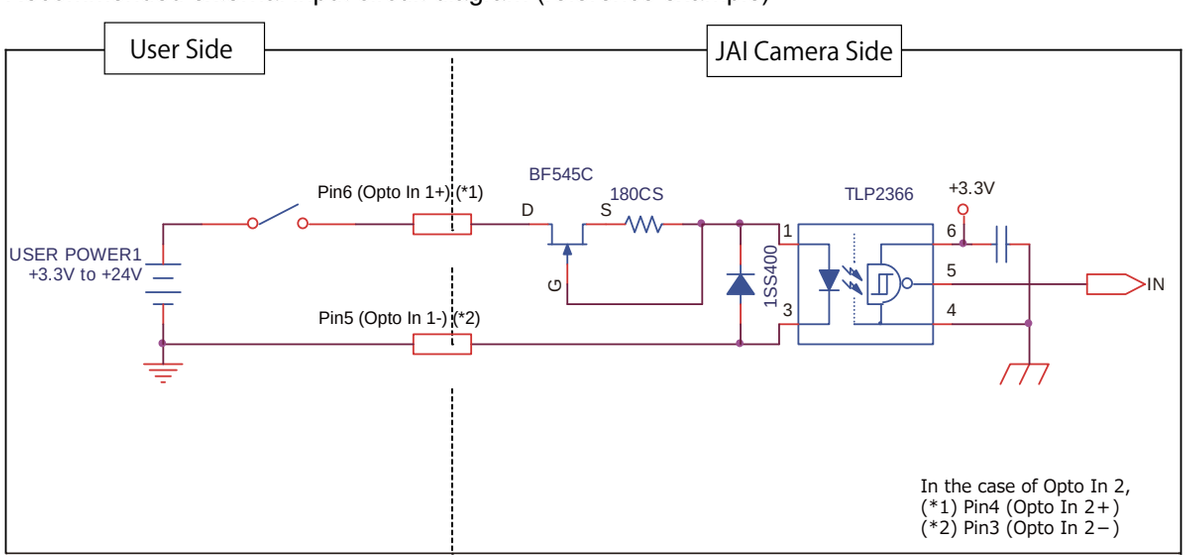


HR-10A-10R-12PB (71) (Hirose Electric or equivalent)

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	

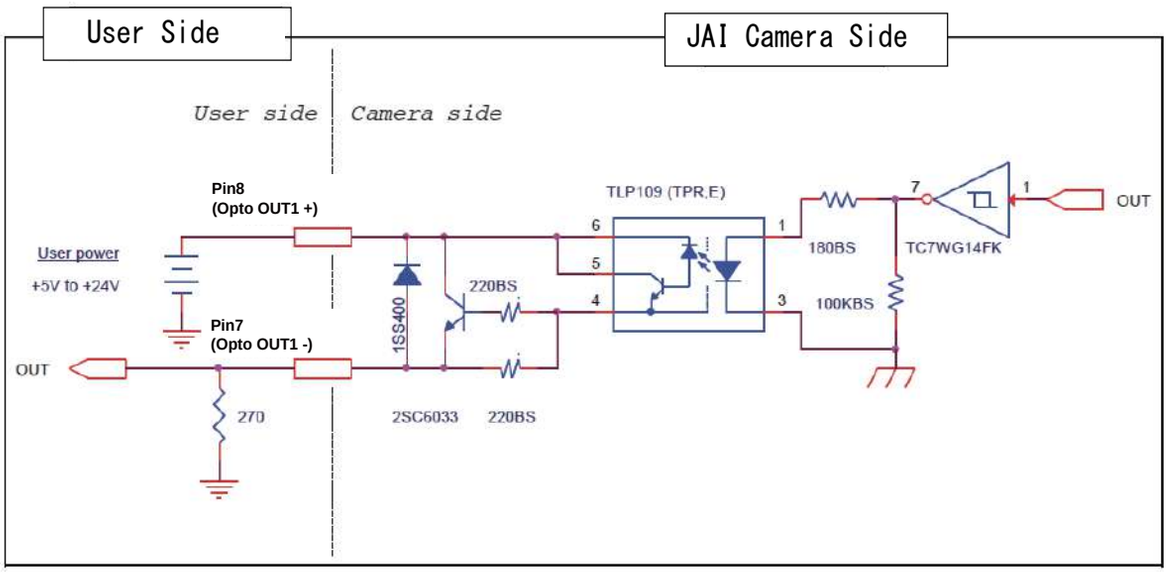
*) DC power operates with supply to either Pin1/Pin2 or Pin11/Pin12.

Recommended external input circuit diagram (reference example)



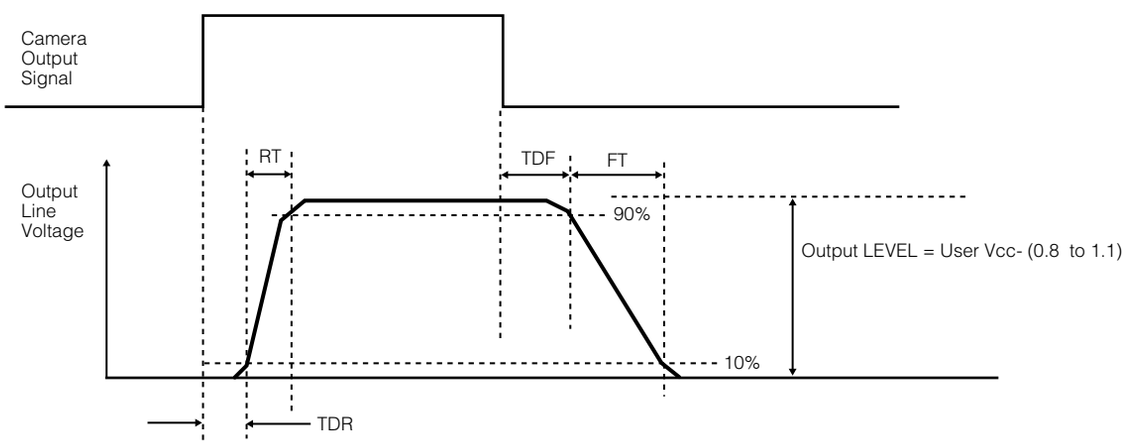
Recommended external output circuit diagram (reference example)

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

⑤ 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, USB cable, AC adapter, computer, and other devices.
⬇	
Step 3	Verifying Camera Operation Verify whether the camera is turned on and ready for use.
⬇	
Step 4	Verifying the Connection between the Camera and PC Verify whether the camera is properly recognized via 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

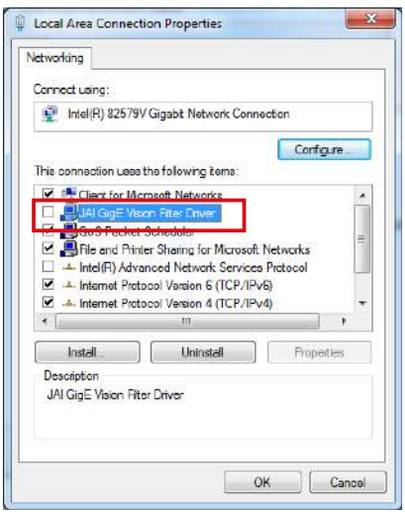
When the JAI SDK is installed, a camera driver for the GigE interface is also part of the default installation. This GigE Vision Filter Driver is added to every NIC/port on the host computer. As the driver is also added to the NIC/port for Internet connection, it may, on some systems, affect Internet 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

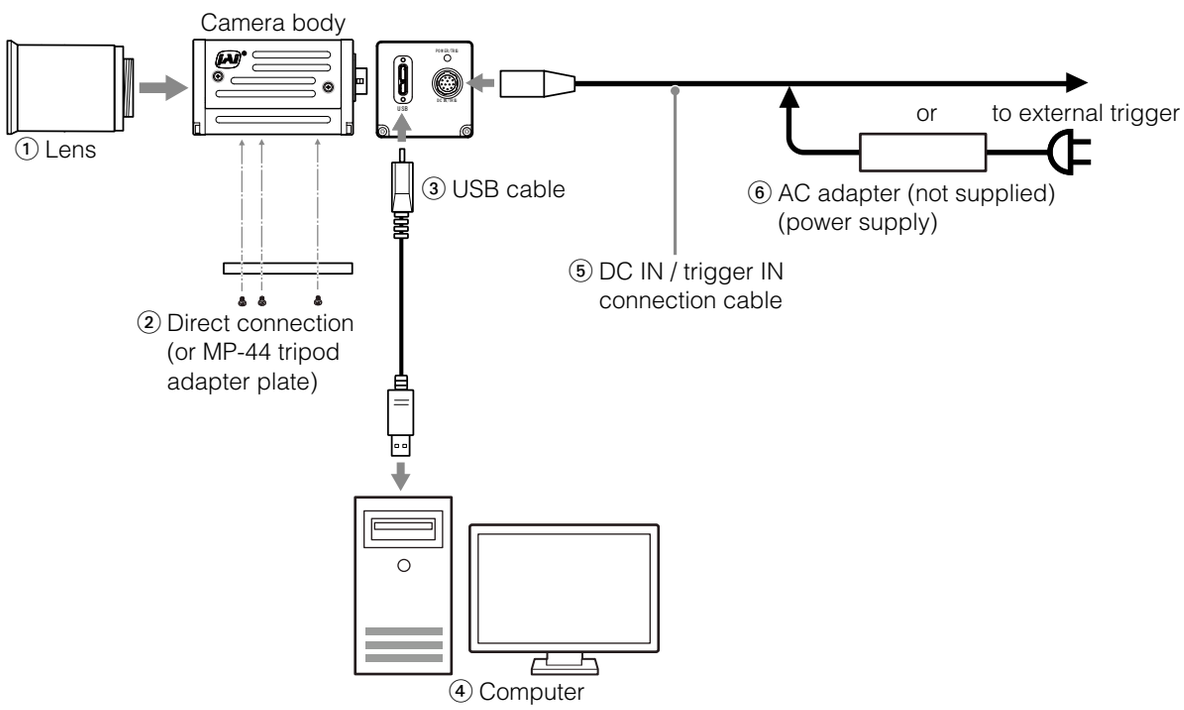
JAI SDK Version 3.0.2 or later is required to use this camera model.

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



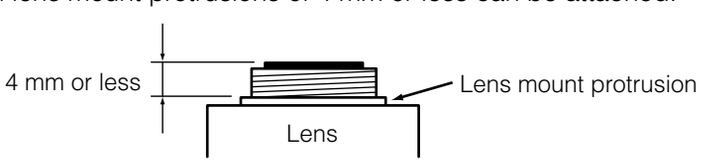
Step 2: Connecting Devices

Connect the lens, USB 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 8.89 mm, the size of standard 1/1.8-inch lenses. To prevent vignetting and to obtain the optimal resolution, use a lens that will cover the 8.89 mm diagonal. Some lens manufacturers offer lenses with an 8.89 mm format. If not, a 1/1.8-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 (7.12 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 USB cable
Connect a USB cable to the USB 3.0 connector.

Caution

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

④ Computer
Use a computer that meets the following requirements.
Operating system (OS):
Microsoft Windows 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
Interface: USB 3.0 compatible connector

⑤ DC IN / trigger IN connection cable

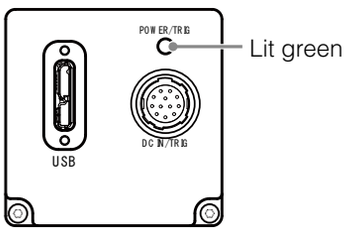
⑥ AC adapter (power supply) (if necessary)
Connect the AC adapter and the round connector of the connection cable to the DC IN / trigger IN connector on the camera.

Step 3: Verifying Camera Operation

When power is supplied to the camera while the necessary equipment is connected, the power / trigger LED at the rear of the camera lights amber, and initialization of the camera starts.
When initialization is complete, the power / trigger 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 7) 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

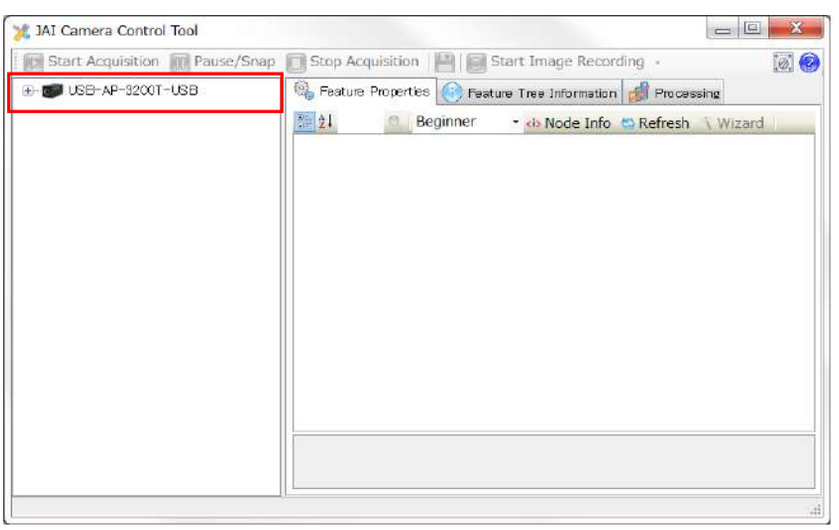
1 Start JAI Control Tool.

The JAI Control Tool startup screen appears.

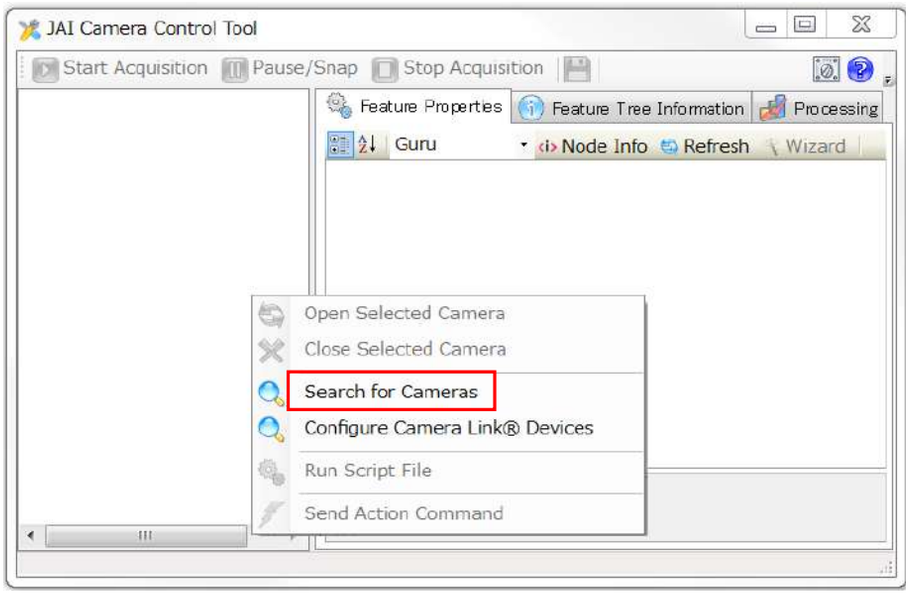
Cameras connected to the computer's USB 3.0 connectors are detected and appear in the left area.

Note

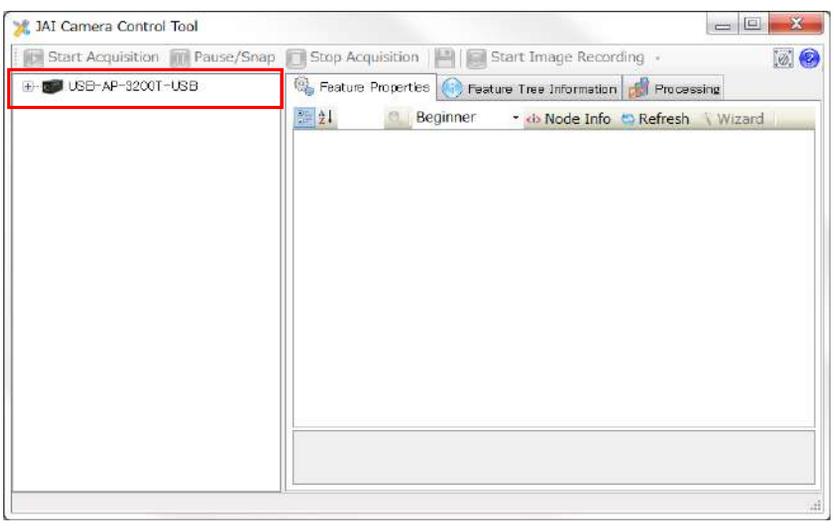
The USB driver is automatically installed when the camera and the computer are connected.



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

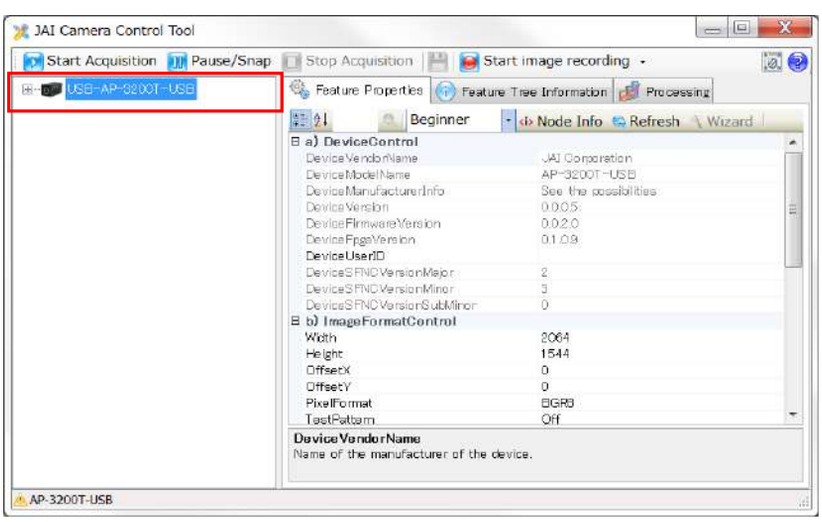


2 Select the camera you want to configure.



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.

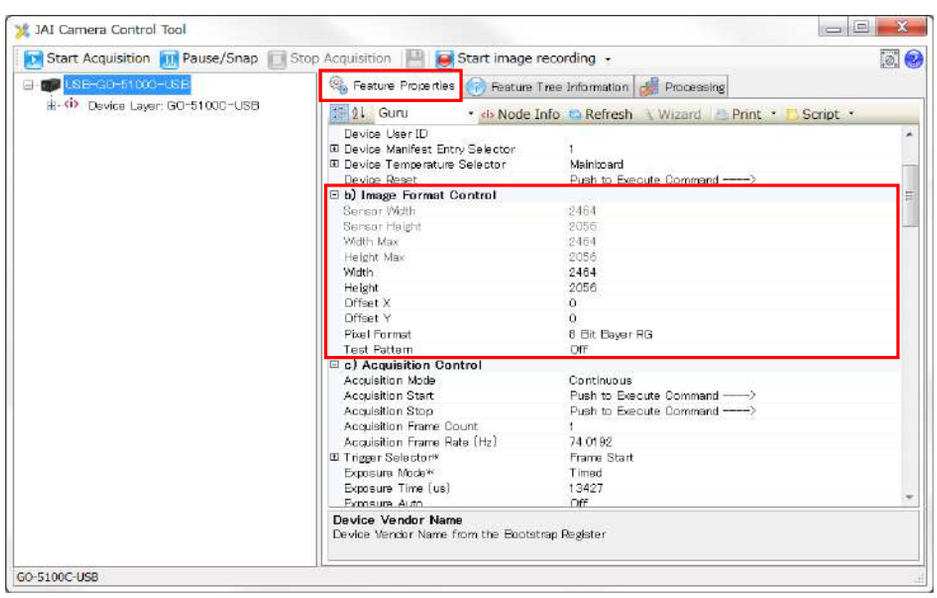
Factory default values

Item		Default value
ImageFormatControl	Width	2064
	Height	1544
	OffsetX (horizontal position)	0
	OffsetY (vertical position)	0
	Pixel Format	BGR8

❖ You can specify the image acquisition area. For details, see “ROI (Regional Scanning Function)” (page 33).

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

 when a configurable item is selected.



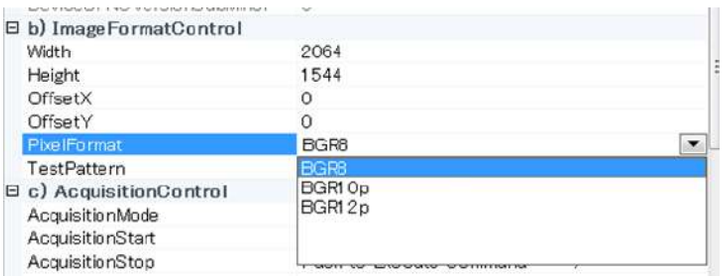
Note

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

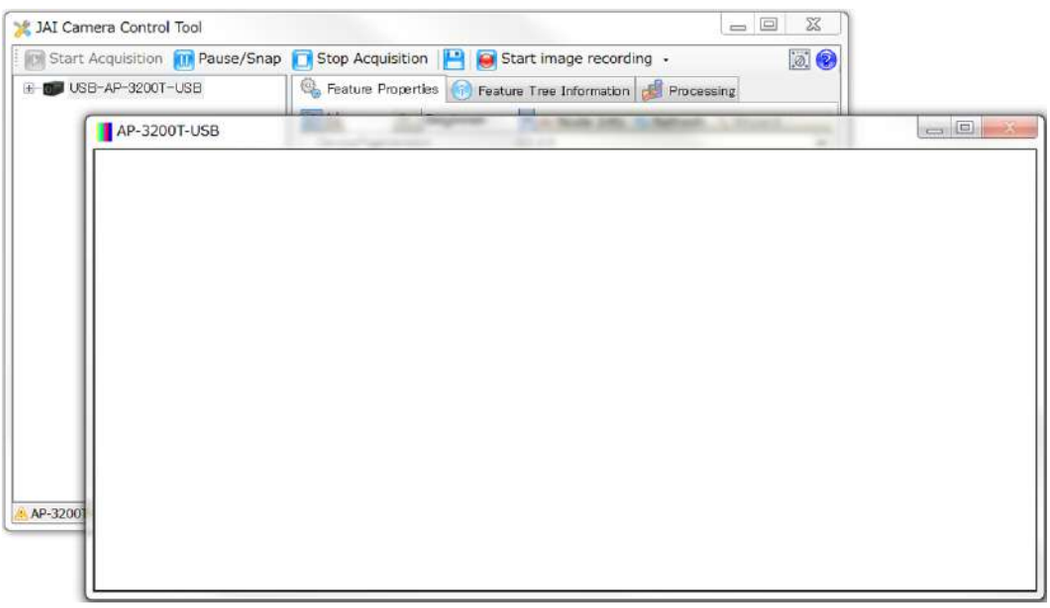
Direct entry of numerical and text values is possible for some setting items.

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.

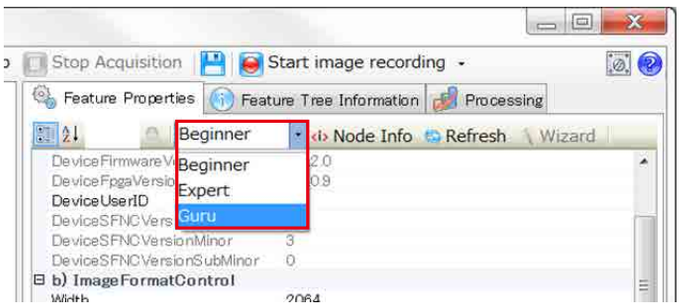


Adjusting the Gain

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 27) 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 [Analog Control], and select the gain you want to configure in [Gain Selector]. [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].

- [Analog All] (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.

- Master Mode (set IndividualGainMode to Off) (see the above)
- Individual Mode (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 [Balance White Auto] 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

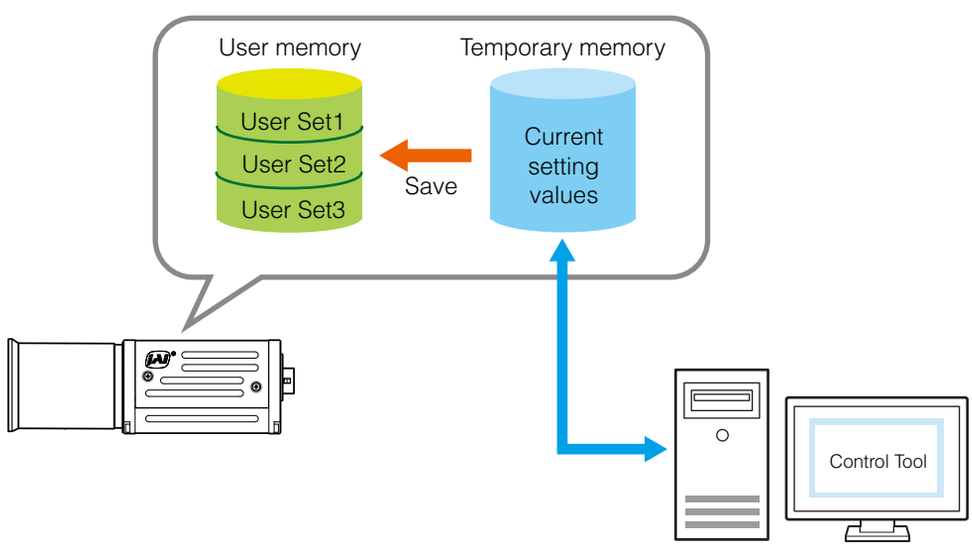
1 Expand [Analog Control], and select the black level you want to configure in [Black Level Selector].

[Digital All] (master black), [Digital Red] (digital R), and [Digital Blue] (digital B) can be configured.

2 Specify the adjustment value in [Black Level].

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)



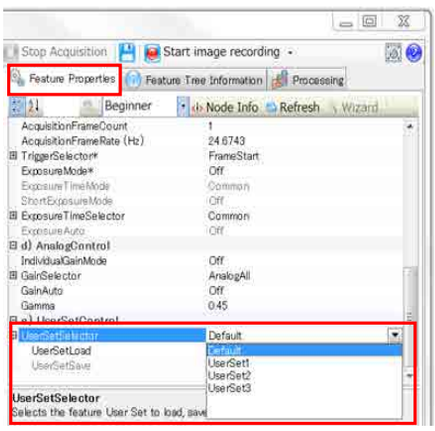
Note

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].



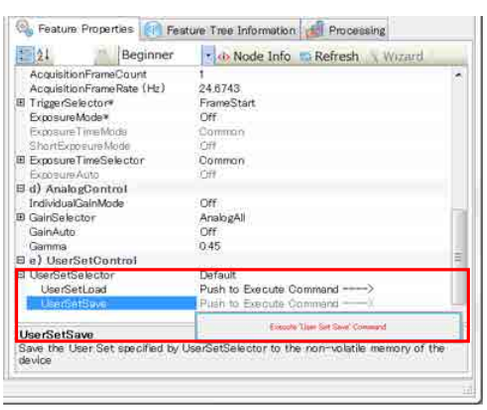
Note

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	Frame Start Trigger	BinningVertical	BinningHorizontal	ExposureTime	ROI	BalanceWhite Exposure Auto	BalanceWhite Gain Auto	GainAuto	ExposureAuto	Sequencer	
										Trigger Sequencer Mode	Command Sequencer Mode
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		○	○	○	○	○	○	○	○
Trigger Width	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												
		Trigger Selector				Line Selector					Pulse Generator Selector			
		AcquisitionStart	AcquisitionEnd	FrameStart	Acquisition TransferStart	Line1 (TTL Out1)	Line2 (Opto Out 1)	NAND0	NAND1	Time Stamp Reset	PulseGenerator0	PulseGenerator1	PulseGenerator2	PulseGenerator3
Signals to use as output	LOW	○	○	○	○	○	○	○	○	○	○	○	○	○
	HIGH	○	○	○	○	○	○	○	○	×	○	○	○	○
	Line5 - OptoIn1	○	○	○	○	○	○	○	○	○	○	○	○	○
	Line6 - OptoIn2	○	○	○	○	○	○	○	×	○	○	○	○	○
	User Output0-3	○	○	○	○	○	○	○	○	×	○	○	○	○
	PulseGenerator0	○	○	○	○	○	○	○	○	○	×	○	○	○
	PulseGenerator1	○	○	○	○	○	○	○	○	○	○	×	○	○
	PulseGenerator2	○	○	○	○	○	○	○	○	○	○	○	×	○
	PulseGenerator3	○	○	○	○	○	○	○	○	×	○	○	○	×
	Nand0out	○	○	○	○	○	○	×	○	○	○	○	○	○
	Nand1out	○	○	○	○	○	○	○	×	○	○	○	○	○
	ExposureActive	–	–	–	–	○	○	○	○	×	○	○	○	○
	AcquisitionActive	–	–	–	–	○	○	○	○	×	○	○	○	○
	AcquisitionTriggerWait	–	–	–	–	○	○	○	○	×	○	○	○	○
	FrameTriggerWait	–	–	–	–	○	○	○	○	×	○	○	○	○
	Frame Active	–	–	–	–	○	○	○	○	×	○	○	○	○
	FVAL	–	–	–	–	○	×	○	○	×	○	○	○	○
	LVAL	–	–	–	–	×	×	○	○	×	○	○	○	○
	Software	○	○	○	○	–	–	–	–	–	○	○	–	–
		Trigger Source				Line Source					Pulse Generator Clear Source			
		Use												

: Indicates default values for each selector.

Image Acquisition Controls (Acquisition Control)

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

The following acquisition modes are available on the camera.

Acquisition Mode	Description
Single Frame	Acquire a single frame when the [Acquisition Start] command is executed.
Multi Frame	Acquire the number of frames specified in [Acquisition Frame Count] when the [Acquisition Start] command is executed.
Continuous	Acquire images continuously until the [Acquisition Stop] command is executed.

Changing the Frame Rate

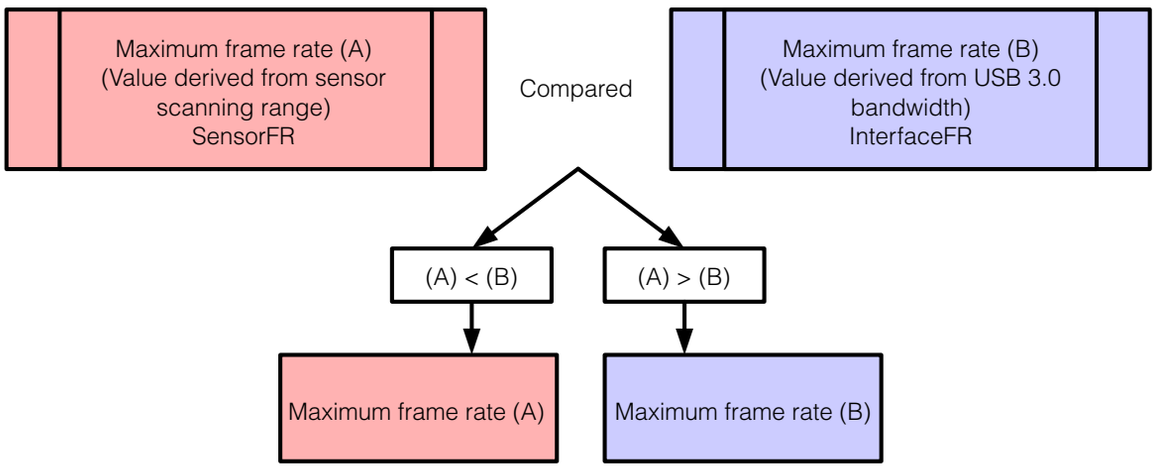
When [TriggerMode] is disabled, you can change the frame rate in [AcquisitionFrameRate].

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 Sensor_FR that is calculated from the readable range of the sensor and the Interface_FR that is limited by the USB 3.0 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)
BGR8	16.53
BGR10p	20.65
BGR12p	24.78

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

USB3_H_Period = Width × PackValue / 3000
USB3_H_Count_Max = Max (PixelClock × USB3_H_Period, (Width + BinningHorizontal) / 2 + 32)
H_Count = Max (Sensor_H_Count, USB_H_Count_Max)
H_Period = H_Count / PixelClock

PackValue: The following values depending on the PixelFormat.

PixelFormat	PackValue
BGR8	24
BGR10p	30
BGR12p	36

Sensor_H_Count : 846
PixelClock : 74.25 MHz
BinningHorizontal : 1 when using horizontal binning, 0 when not using horizontal binning

During continuous operation ([FrameStart] trigger is [Off] or [ExposureMode] is [Off])

- Maximum frame rate of sensor output
  SensorFR = 1 / {Hperiod × (Height + 34)}
- Maximum frame rate by interface
  InterfaceFR = 3000 × 1000000 / (Height × Width × Pack value)
- Maximum frame rate
  FR_Cont = Min (Sensor FR, Interface FR)

When the exposure time is longer than the frame interval

- Maximum exposure time at maximum frame rate
  MaxExposureTime_TrOlrd = (1 / FR_Cont) - (14 × H Period)

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

When TriggerMode[FrameStart] trigger is [On] and [TriggerOverLap] is [Off]

- Maximum frame rate of sensor output
  Sensor FR = 1 / {H Period × (Height + 34)}
- Maximum frame rate by interface
  Interface FR = 3000 × 1000000 / (Height × Width × Pack value)
- Maximum frame rate
  FR_Cont = Min (Sensor FR, Interface FR)

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

When TriggerMode[FrameStart] trigger is [On] and [TriggerOverLap] is [Readout]

- Maximum frame rate of sensor
  Sensor FR = 1 / {H Period × (Height + 34)}
- Maximum frame rate by interface
  Interface FR = 3000 × 1000000 / (Height × Width × Pack value)
- Maximum frame rate
  FR_Cont = Min (Sensor FR, Interface FR)

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

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 24).

Trigger Control

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

TriggerSelector	Description
FrameStart	Start exposure in response to the external trigger signal input. Select this to perform exposure control using external triggers.
AcquisitionStart	Start image acquisition in response to the external trigger signal input.
AcquisitionEnd	Stop image acquisition in response to the external trigger signal input.
AcquisitionTransferStart	Output acquired images at a specified timing in response to an external trigger signal input. ❖ There is a limit to the number of image frames that can be stored internally. The limits for each image format are as follows. Acquired images must be output to avoid exceeding these limits. 8 bit: Up to 16 frames 10 bit: Up to 8 frames 12 bit: Up to 8 frames

❖ The settings for exposure control and triggers are related to each other. Be sure to configure the settings described in “ExposureMode” (page 24).

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.

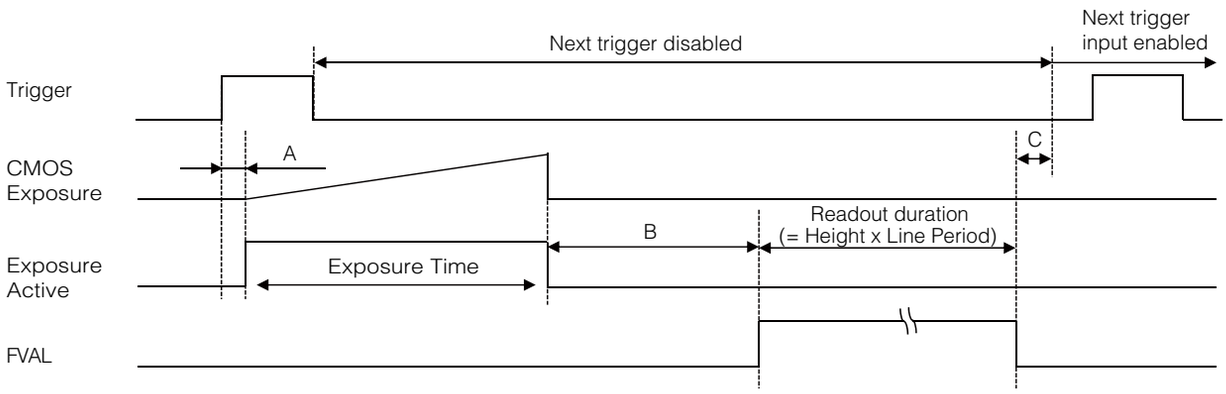
Scanning range	Shortest period of trigger		
	BGR 8 (8 bit)	BGR 10p (10 bit)	BGR 12p (12 bit)
Full	26.1 ms	32.6 ms	39.1 ms
ROI (Height=772)	13.3 ms	16.6 ms	20.0 ms
ROI (Height=386)	6.9 ms	8.7 ms	10.4 ms
BinningVertical2	26.1 ms	32.6 ms	39.1 ms

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

■ When [ExposureMode] is [Timed]

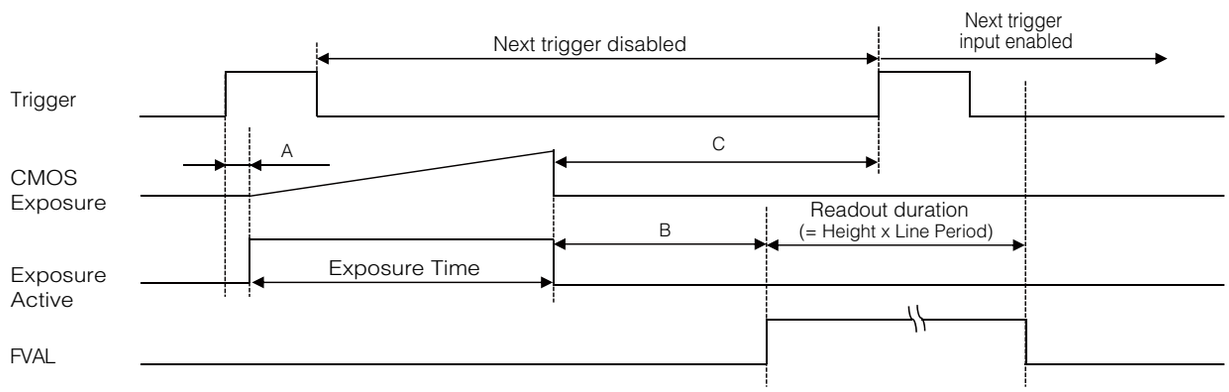
Example: When [Trigger Source] is set to [Line 5 - OptIn1] and [OptInFilterSelector] is set to [10 µs]

- **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)
BGR8	16.53	52	428	2296
BGR10p	20.65	63	532	3138
BGR12p	24.78	76	634	-

- **TriggerOverlap: Readout**

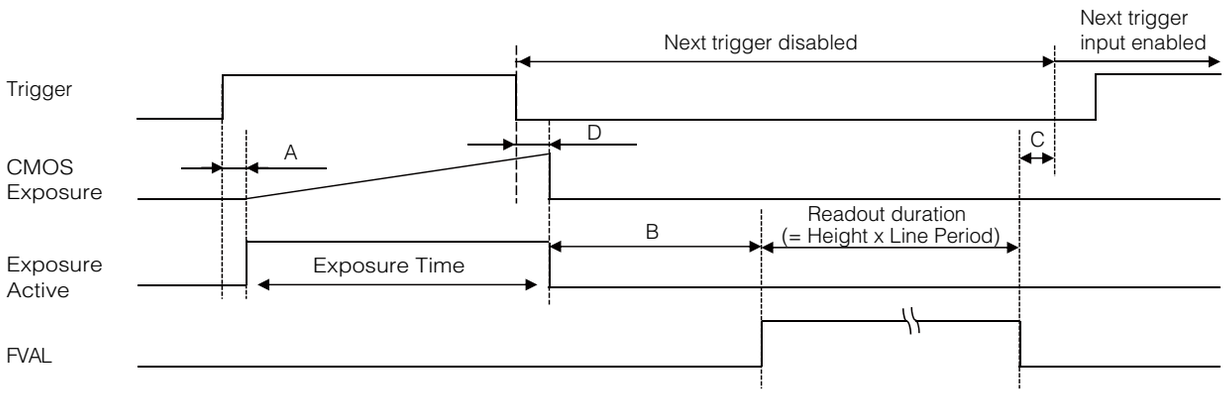


PixelFormat	Line period (µsec)	Period from Trigger start edge to Exposure start[A](usec)	Period from Exposure end to FVAL start[B] (usec)	Period from Exposure end to next trigger start[C] (usec)
BGR8	16.53	52	428	232 to 26060
BGR10p	20.65	63	530	290 to 32560
BGR12p	24.78	76	635	347 to 39079

■ When [ExposureMode] is [TriggerWidth]

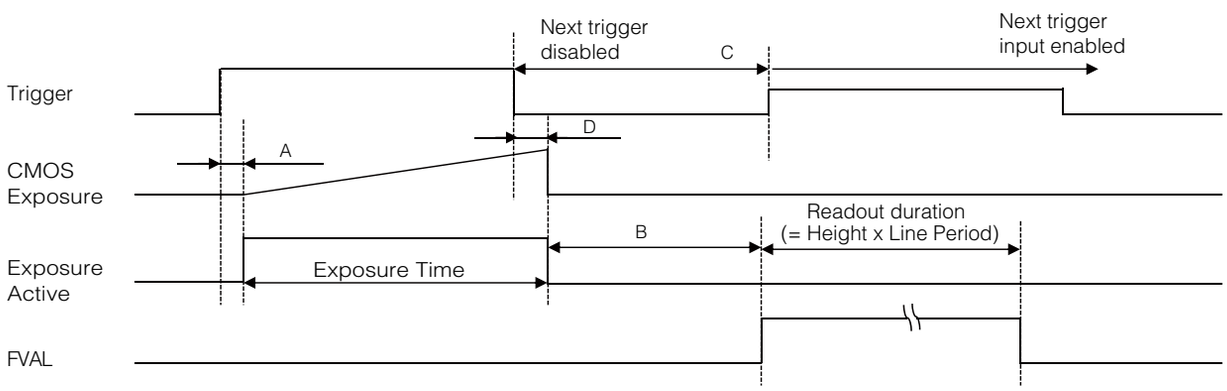
Example: When [TriggerSource] is set to [Line 5 - Optical In 1] and [OptInFilterSelector] is set to [10 µs]

- **TriggerOverlap: Off**



Pixel format	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)
BGR8	16.53	51	427	-	482
BGR10p	20.65	63	531	3114	598
BGR12p	24.78	75	635	-	714

- **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)
BGR8	16.53	51	428	177	428
BGR10p	20.65	64	530	222	530
BGR12p	24.78	77	635	269	635

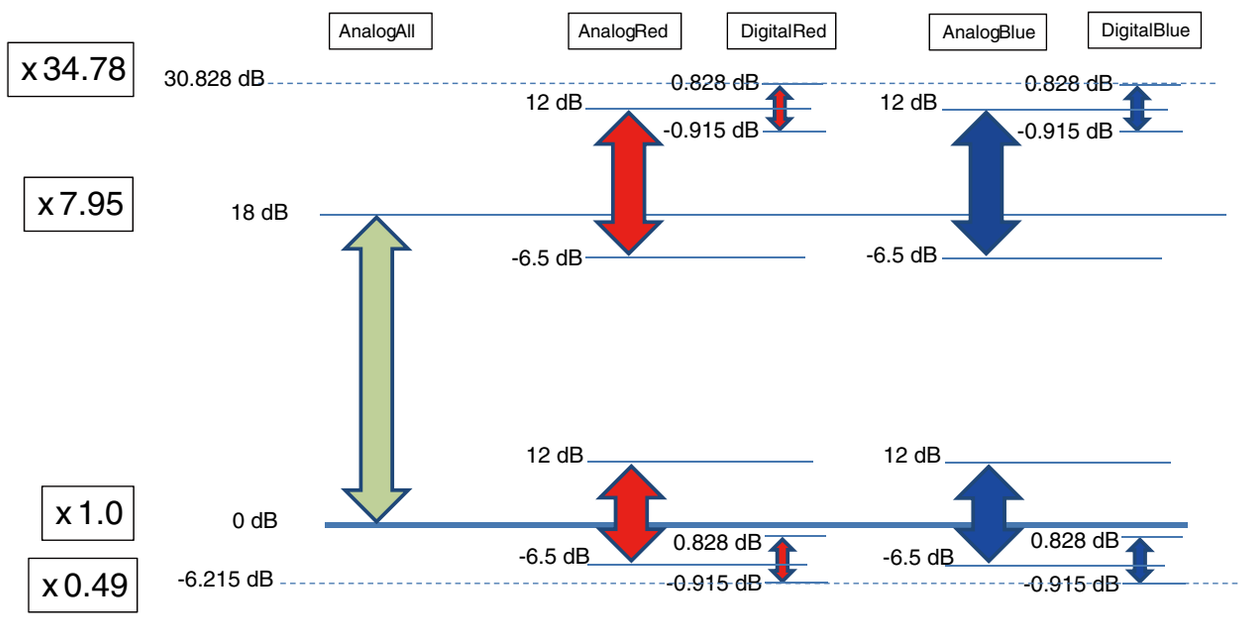
Gain Control

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.

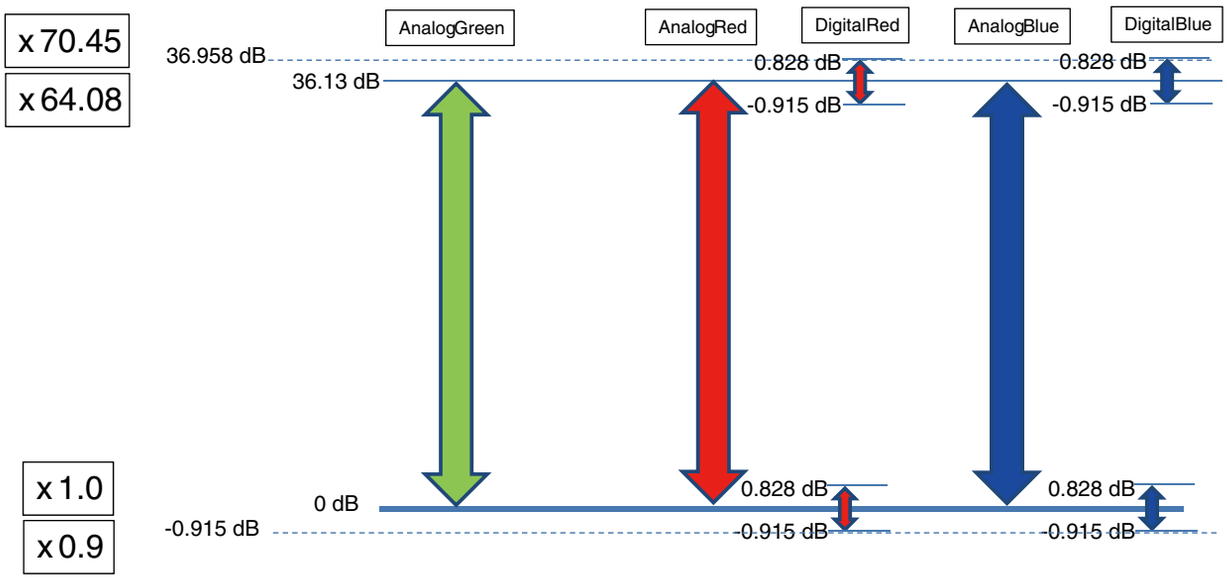
When IndividualGainMode is set to Off



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 [Gain Auto] 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 [ALC Area Selector], 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.)

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).

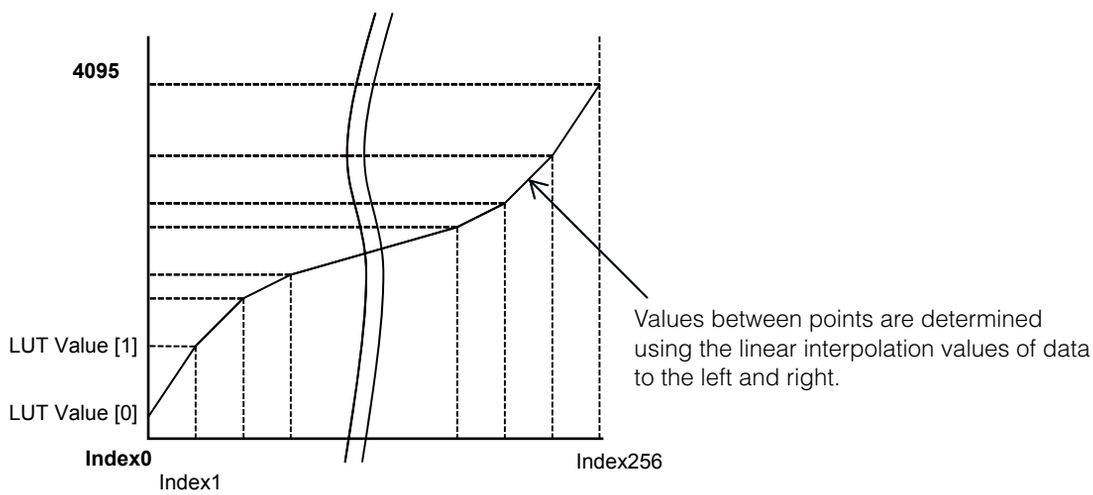
■ To use the LUT function

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.

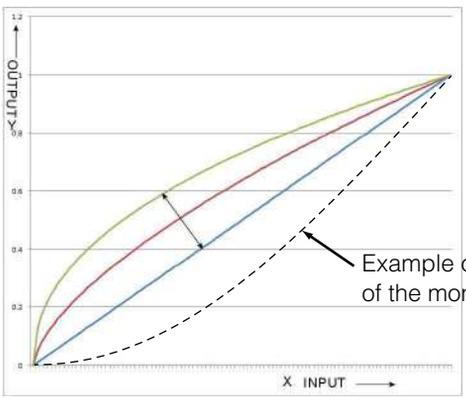
■ LUT values

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.



■ 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 29).

Line Status

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
- NANDGate0In1, NANDGate0In2, NANDGate1In1, NANDGate1In2

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.

Each point is saved to the camera's internal memory as you configure them.

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] allows you to return a specific pixel correction setting to the default value (storage not required).

3 Execute [BlemishStore], and Blemish compensation data will be stored.

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

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

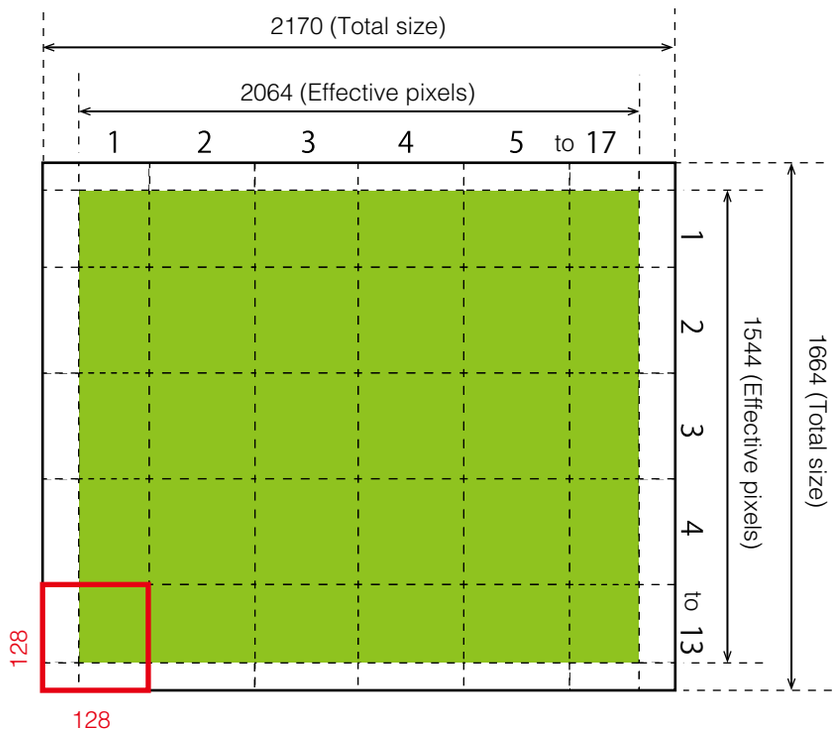
ShadingCorrection

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

This function can be used even when the effective image area is limited by the ROI function. In such cases, the correction area is included in the image area reduced by the ROI.

For a full image, the number of correction blocks is 17 (H) × 13 (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 2170 (H) × 1644 (V), but the actual number of effective pixels for the camera is 2064 (H) × 1554 (V). The ineffective peripheral areas will be deleted internally on the camera

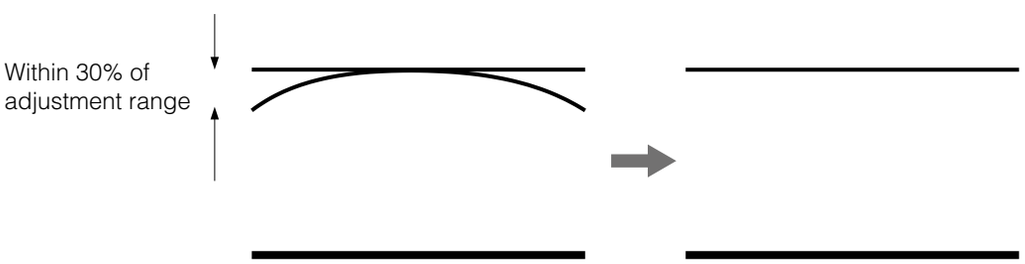
automatically.



The following shading correction modes are available on the camera.

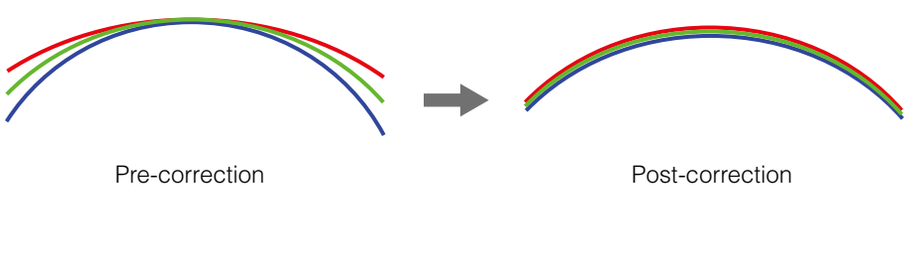
■ FlatShading

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



■ 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 300 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.
This camera performs vertical binning and horizontal binning via digital addition or averaging processing.

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 [Image FormatControl].

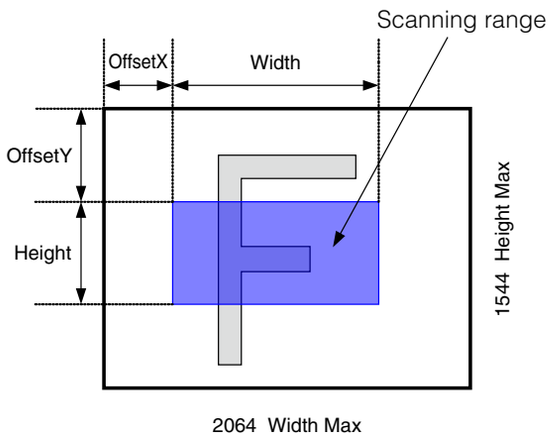
❖ For details on how to configure the settings, see “Configuring the Output Format” (page 15).

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

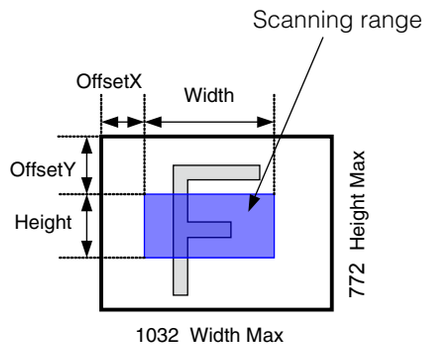
Width (pixels)	Height (pixels)
BinningHorizontal Off: 16 to 2064,16 pxels / step	BinningVerticall Off: 2 to 1544, 2 lines / step
BinningHorizontal On: 16 to 1032, 8 pxels / step	BinningVertical On: 2 to 722, 2 lines / step

Offset X (pixels)	Offset Y (pixels)
BinningHorizontal Off: 0 to 2048, 16 pxels / step	BinningVertical Off: 0 to 1542, 2 lines / step
BinningHorizontal On: 0 to 1024, 8 pxels / step	BinningVertical On: 0 to 770, 2 lines / step

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



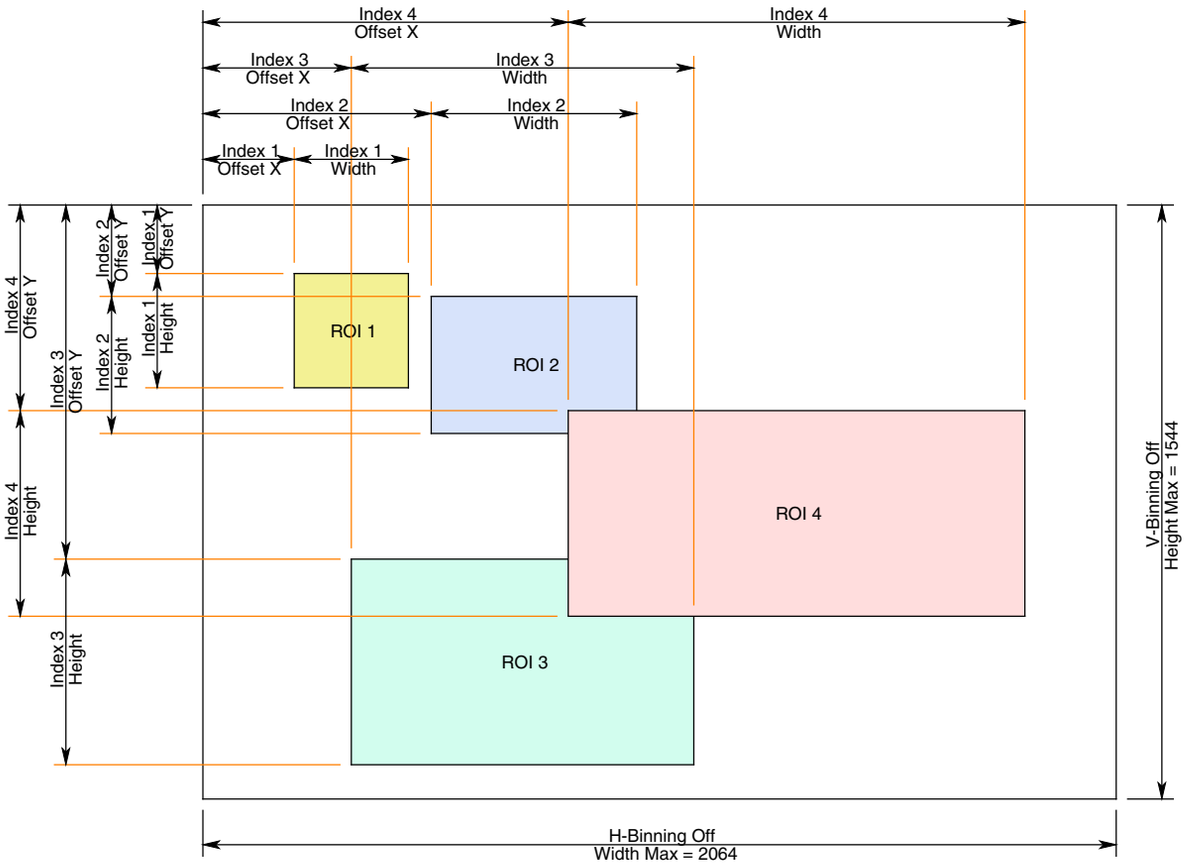
Example 2: With binning
[BinningHorizontal] *: 2
[BinningVertical] *: 2



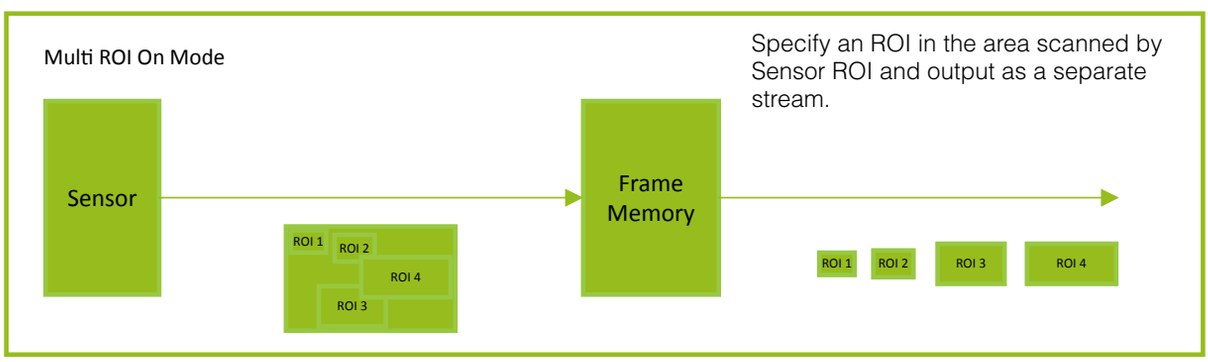
❖ For details on the frame rates for common ROI sizes, see “Frame Rate Reference” (page 59).

Multi ROI Mode

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



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



Sequencer Function

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

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

Note

Sequencer function cannot be used together with Sensor Multi ROI function (page 35).

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 2064 SequencerBinningHorizontal 2: 8 to 1032	2064	Set the width of the selected SequencerIndex.
○	○	SequencerHeight	SequencerBinningVertical 1: 2 to 1544 SequencerBinningVertical 2: 2 to 772	1544	Set the Height of the selected SequencerIndex.
○	○	SequencerOffsetX	SequencerBinningHorizontal 1: 0 to 2048 step 16 SequencerBinningHorizontal 2: 0 to 1024 step 8	0	Set the horizontal offset value for the selected SequencerIndex.
○	○	SequencerOffsetY	SequencerBinningVertical 1: 0 to 1542 SequencerBinningVertical 2: 0 to 770	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.

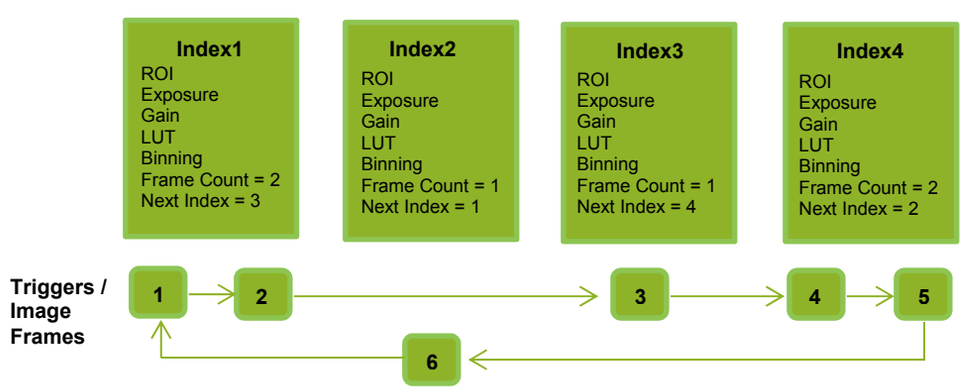
[SequencerLUTMode]
This defines whether to apply gamma or LUT to the sequence.
When gamma is selected, the gamma setting defined in [AnalogControl] is applied to all exposures in the sequence. When LUT is selected, the LUT characteristics defined in [AnalogControl] are applied to indexes for which [SequencerLUT 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 Trigger Sequencer patterns which include an index whose [Sequencer ROI Next Index] is set to OFF.
When the index whose [Sequencer ROI Next Index] is set to 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 Trigger Sequencer 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

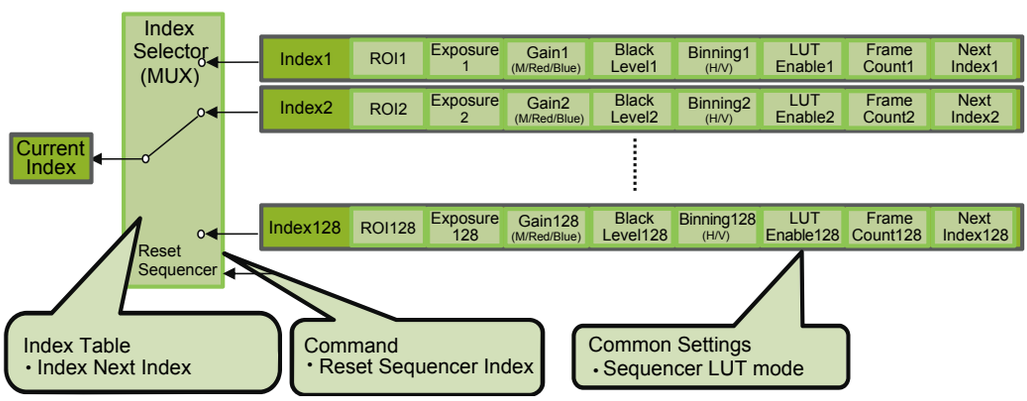
indicates the end of TriggerSequencer mode) in [SequencerSetNext] of index 2, and specify the number of repetitions in [SequencerRepetition].

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 [Frame Start] 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

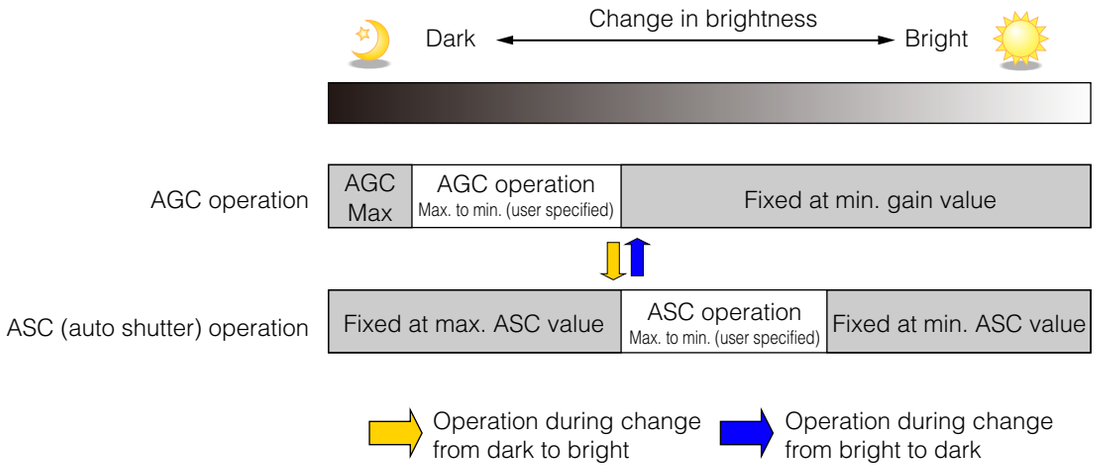
This function imposes a heavy processing load on the USB 3.0 bandwidth, as images from multiple cameras are read out simultaneously. The delayed readout buffer is 16 frames in length for 8-bit, 8 frames for 10-bit, and 8 frames for 12-bit.

❖ For details, see “Trigger Control” (page 24).

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.

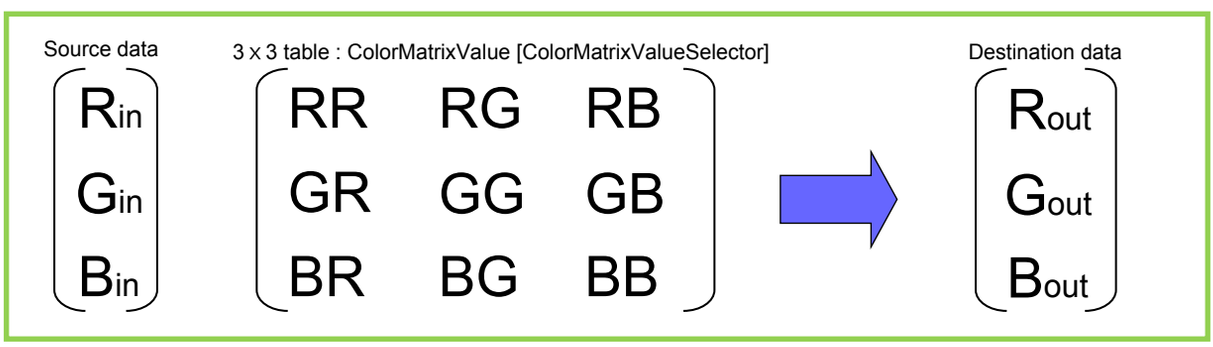
Color Space Conversion (Color Transformation Control)

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.



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.

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.

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.

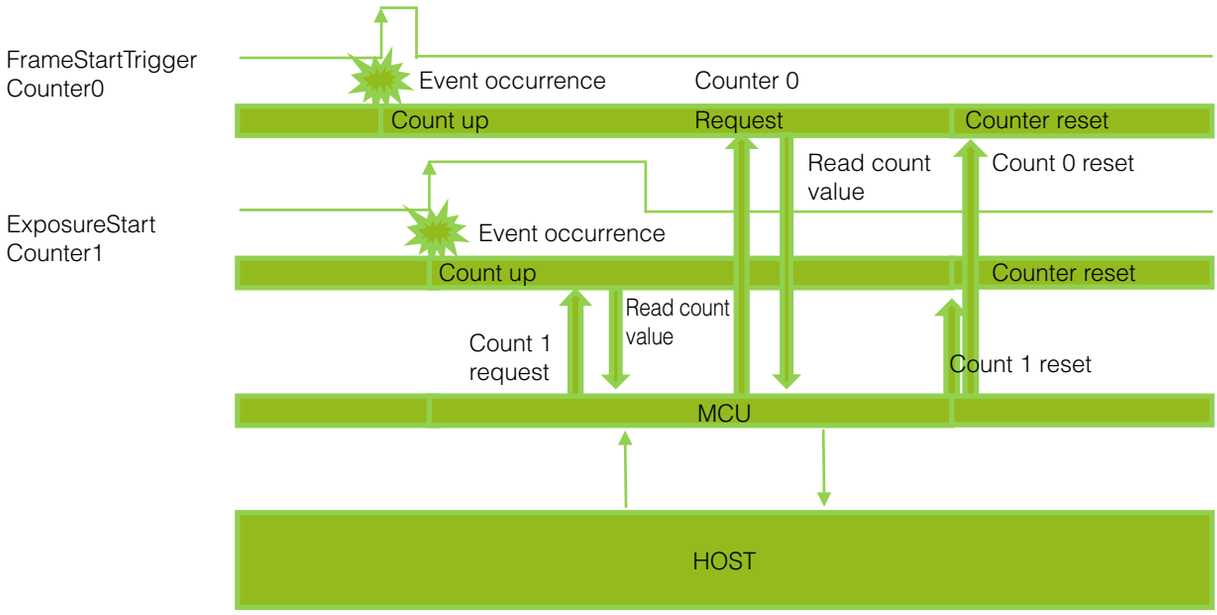
Color enhancer function
The color enhancer function is enabled when EnhancerEnable[Color] is set to True.
Set a value from 0 to 1 (0.1 steps) for ColorEnhancerValue[ColorEnhancerSelector] to set the enhancement to one of ten levels.
(0: no enhancement; 1: approx. x2 the color level of the original data)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

Counter and Timer Control 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 FrameStart 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.

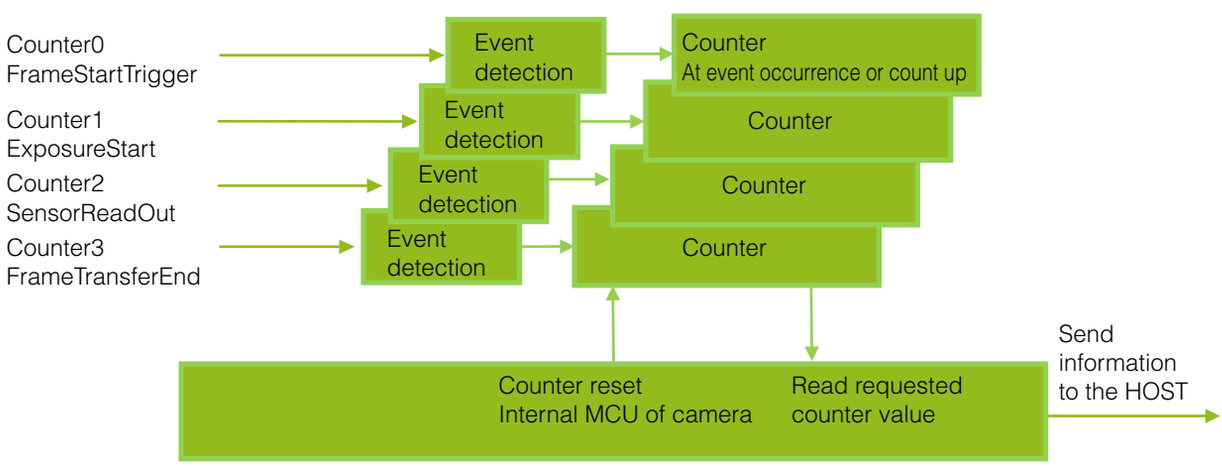
■ Counter occurrence diagram



Note

You can reset a specific counter's count value by executing Counter Reset [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.

Video Process Bypass Mode

The video process bypass mode is a function that bypasses internal video processing on the camera. When bypass is enabled, the sensor output and camera output data can be set to the same bit width. 12-bit outputs (BGR 12p) 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(BGR8) / 10bit(BGR10p) / 12bit(BGR12p)	8bit(BGR8) / 10bit(BGR10p)

■ 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.

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
ChunkExposureTimeRed	201Ch	Integer	
ChunkExposureTimeBlue	201Dh	Integer	
ChunkIndividualGainMode	201Eh	Enumeration	IndividualGainMode value

Genicam Name	Chunk ID	Data type	Description
ChunkGainAll (Green)	2005h		GainAll or GainGreen value
ChunkGainRed	2006h	Float	GainRed value
ChunkGainBlue	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
ChunkPixelFormat	2012h	Float	PixelFormat value
ChunkLineStatusAll	2013h	Float	LineStatusAll value
ChunkTimestamp	2014h	Float	Timestamp value
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].
ChunkDeviceSerial Number	2017h	String	DeviceSerialNumber value
ChunkDeviceUserID	2018h	String	DeviceUserID value
ChunkDevice Temperature	2019h	Float	DeviceTemperature value

■ Configuring Chunk Data

1 Set [Chunk Mode Active] to [True].

2 Select the items of information you want added to image data with [Chunk Selector], and set [Chunk Enable] from [False] to [True].

Note

When [Chunk Mode Active] is set to [True], [Chunk Image] 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-3200T-USB	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	2064	2064	Display the maximum image width.
SensorHeight	1544	1544	Display the maximum image height.
SensorDigitizationBits	12 Bits	12 Bits	Display the number of bits at which the sensor is operating.
WidthMax	2064	2064	Display the maximum image width. (This value will vary depending on the HorizontalBinning setting.)
HeightMax	1544	1544	Display the maximum image height. (This value will vary depending on the VerticalBinning setting.)
Width	BinningHorizontal 1: 16 to 2064 BinningHorizontal 2: 8 to 1032	2064	Set the image width.
Height	BinningVertical 1: 2 to 1544 BinningVertical 2: 2 to 772	1544	Set the image height.
OffsetX	BinningHorizontal 1: 0 to 2048 (steps of 16) BinningHorizontal 2: 0 to 1024 (steps of 8)	0	Set the horizontal offset.
OffsetY	BinningVertical 1: 0 to 1542 BinningVertical 2: 0 to 770	0	Set the vertical offset.
BinningHorizontalMode	Sum, Average	Sum	Set the addition process to be used during horizontal binning.
BinningHorizontal	1, 2	1	Set the number of pixels in the horizontal direction for which to perform binning.
BinningVerticalMode	Sum, Average	Sum	Display the addition process to be used during vertical binning.

Item	Setting range	Default value	Description
BinningVertical	1, 2	1	Set the number of pixels in the vertical direction for which to perform binning.
PixelFormat	BGR8 BGR10p BGR12p	BGR8	Set the pixel format. [BGR12p] 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 38.3 (Full)	38.3	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 (rising edge of input signal)	Select the polarity of the trigger signal (i.e., location of signal at which trigger is applied).
TriggerOverLap	Off Readout	TriggerOverlap [Acquisition Start]: Off TriggerOverlap [Acquisition End]: Off TriggerOverlap [FrameStart]: ReadOut TriggerOverlap [Acquisition Transfer Start]: Off	Select the trigger overlap operation.
TriggerDelay	0 to 500000	0	Set the time of exposure start from trigger input.
ExposureMode	Off, Timed, TriggerWidth	Timed (control via exposure time)	Select the exposure mode.
ExposureTimeMode	Common, Individual	Common	When set to Individual, ExposureTime can be adjusted for RGB individually.
ExposureTimeSelector	Common, Red, Green, Blue	Common	

Item	Setting range	Default value	Description
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			
ColorTransformation Mode	RGB, XYZ, HSI	RGB	Set the output image format.
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.

Item	Setting range	Default value	Description
g) DigitalI/OControl			Configure settings for digital input/ output.
LineSelector	Line1-TTLOut1, Line2-OptOut1, Line5-OptIn1, Line6-OptIn2, TimeStampReset, NAND0 In1, NAND0 In2, NAND1 In1, NAND1 In2	Line2-OptOut1	Select the input/output to configure.
LineMode	Input, Output	–	Display the input/output status (whether it is input or output).
LineInverter	True, False	False	Enable/disable polarity inversion for the selected input signal or output signal.
LineStatus	True, False	–	Display the status of the input signal or output signal (True: High, False: Low).
LineSource	Low, High, AcquisitionTriggerWait, AcquisitionActive, FrameTriggerWait, FrameActive, ExposureActive, FVAL, LVAL, PulseGenerator0-3, UserOutput0-3, Line5OptIn1, Line6OptIn2, NAND0Out, NAND1Out, 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) CounterAndTimer Control			Configure counter settings. (This camera only supports counter functions.)
CounterSelector	Counter 0 to 3	Counter 0	Select the counter.
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.

Item		Setting range	Default value	Description
	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 2064 SequencerBinning Horizontal 2: 8 to 1032	2064	Set the width of the selected SequencerIndex.
SequencerHeight	SequencerBinning Vertical 1: 2 to 1544 SequencerBinning Vertical 2: 2 to 772	1544	Set the height of the selected SequencerIndex.
SequencerOffsetX	SequencerBinning Horizontal 1: 0 to 2048 (steps of 16) SequencerBinning Horizontal 2: 0 to 1024 (steps of 8)	0	Set the horizontal offset value for the selected SequencerIndex.
SequencerOffsetY	SequencerBinning Vertical 1: 0 to 1542 (steps of 2) SequencerBinning Vertical 2: 0 to 770 (steps of 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	–	
SequencerGain AnalogGreen	1.0 fixed / 1.0 to 64.0	–	
SequencerGain AnalogBlue	0.47 to 4.0 / 1.0 to 64.0	–	
SequencerExposure TimeCommon (us)			Set the exposure time for the selected SequencerIndex.
SequencerExposure TimeRed (us)			
SequencerExposure TimeGreen (us)			
SequencerExposure TimeBlue (us)			
SequencerBlackLevel DigitalAll	-133 to 255	0	Set the black level value for the selected SequencerIndex.
SequencerLUTEnable	True, False		
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].
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.

Item	Setting range	Default value	Description
ChunkSelector	ChunkOffsetX、 ChunkOffsetY、 ChunkWidth、 ChunkHeight、 ChunkPixelFormat ChunkTimestamp ChunkLineStatusAll ChunkExposureTimeMode、 ChunkExposureTimeGreen、 ChunkExposureTimeRed、 ChunkExposureTimeBlue、 ChunkIndividualGainMode、 ChunkGainAnalogAll (Green)、 ChunkGainAnalogRed、 ChunkGainAnalogBlue、 ChunkBlackLevelDigitalAll、 ChunkBlackLevelDigitalRed、 ChunkBlackLevelDigitalBlue、 ChunkBinningHV_LUTEnable、 ChunkSequencerSetActive、 ChunkFrameTriggerCounter、 ChunkExposureStartCounter、 ChunkSensorReadOut StartCounter、 ChunkFrameTransferEnd Counter、 ChunkLineStatusAllOn Expo sureStart、 ChunkLineStatusAllOn FVALStart、 ChunkDeviceTemperature、 ChunkDeviceSerialNumber、 ChunkDeviceUserID、	Image	Select the ChunkData to be added.
ChunkEnable	True, False	–	Select whether to output ChunkData. Default: Only [ChunkImage] is [True]
l) TestControl			
TestPendingAck	–	–	Test command for USBPendingAck function.
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.
n) JAI CustomControlPulseGenerators			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 (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 PointMs(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 PointMs(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. [Line4 TTL In] can be used on the Standard Model.
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.
o) JAI CustomControlALC			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: %)

Item	Setting range	Default value	Description
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.
p) JAI CustomControlAWB			Configure AWB settings.

Item	Setting range	Default value	Description
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.)
AWBControlStatus	–	–	Display the AWB Control Status.
q) JAICustomControl Blemish			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) JAICustomControl Shading			Configure shading correction settings.
ShadingCorrectionMode	FlatShading, ColorShading	FlatShading	Select the shading correction method.
ShadingMode	Off, User1, User2, User3	Off	Set the area to which to save shading correction data. When this is set to [Off], shading correction data is not saved.

Item	Setting range	Default value	Description
PerformShading Calibration	–	–	Execute shading correction.
ShadingDetectResult	–	–	Display the shading correction results.
s) JAICustomControl OverlapMultiROI			Configure settings for sensor Multi ROI.
MultiRoiMode	On, Off	Off	Enable/disable sensor Multi Roi.
MultiRoiIndex	Index 1 to 5	Index 1	Select the index for the sensor Multi Roi mode.
MultiRoiWidth	16 to 2064	2064	Set the width for the selected sensor Multi Roi index.
MultiRoiHeight	2 to 1544	1544	Set the height for the selected sensor Multi Roi index.
MultiRoiOffsetX	0 to 2048	0	Set the horizontal offset for the selected sensor Multi Roi index.
MultiRoiOffsetY	0 to 1542	0	Set the vertical offset for the selected sensor Multi Roi index.
MultiRoiIndexMax	1 to 5	1	Specify the number of areas for which to use Multi Roi.
t) JAICustomControl FeatureMisc.			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 / trigger 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 30).

■ 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				AT-3200T-USB
Scanning system				Progressive scan, 1 tap
Synchronization				Internal
Interface				USB 3.0 Vision (Specification V1.0 RC4.02) compatible
Image sensor				CMOS×3
Image size (effective image)				7.12 (H) × 5.33 (V), 8.89 mm diagonal
Pixel size				3.45 (H) × 3.45 (V) µm
Effective image pixel output				2064 (H) × 1544 (V)
Acquisition Frame Rate (max)	8 bit (BGR8)	H1, V1		38.3 fps
		Binning	H1, V2	38.3 fps
			H2, V1	44.2 fps
			H2, V2	44.2 fps
	10 bit packed (BGR10p)	H1, V1		30.7 fps
		Binning	H1, V2	30.7 fps
			H2, V1	44.2 fps
			H2, V2	44.2 fps
	12-bit packed (BGR12p)	H1, V1		25.6 fps
		Binning	H1, V2	25.6 fps
			H2, V1	44.2 fps
			H2, V2	44.2 fps
EMVA 1288 parameters Absolute sensitivity Maximum SN ratio				At 12-bit output 3.77p (λ = 525 nm) 40.39dB
Digital image output format	Full pixel			2064 (H) × 1544 (V)
	ROI	Width		16 to 2064, 16 pixels/step
		Offset X		0 to 2048, 16 pixels/step
		Height		2 to 1544, 2 line/step
		Offset Y		0 to 1542, 2 lines/step
	Binning	H	1	2064 (H)
			2	1032 (H)
		V	1	1544 (V)
			2	772 (V)
	Pixel Format			BGR8, BGR10p, BGR12p
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			17 µs (8 bit), 21 µs (10 bit) (min) to 8 s (max), Performance verified for up to 1 second.
	Trigger Width			17 µs (8 bit), 21 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
Digital I/O				Line Selector (12P): GPIO IN / GPIO OUT

Item			AT-3200T-USB
Black level adjustment	Default level		8LSB@8bit
	Video level adjustment range		DigitalAll : -133 ~ +255 LSB @12bit DigitalRed :- 64 ~ +64 LSB @12bit DigitalBlue : -64 ~ +64 LSB @12bit
	Resolution adjustment		1LSB@12bit
Gain adjustment	Manual adjustment range		MasterMode AnalogAll : 0dB ~ 18dB AnalogRed: -6.5dB ~ 12dB AnalogBlue:-6.5dB ~ 12dB DigitalRed:-0.915dB ~ 0.828dB DigitalBlue:-0.915dB ~ 0.828dB IndividualMode AnalogAll:0dB ~ 36.13dB AnalogRed:0dB ~ 36.13dB AnalogBlue:0dB ~ 36.13dB DigitalRed:-0.915dB ~ 0.828dB DigitalBlue:-0.915dB ~ 0.828dB
	Auto gain		Off, Continuous, Once
White balance	WBA		AnalogRed, AnalogBlue: -6.5dB ~ 12dB DigitalRed, DigitalBlue: -0.915dB ~ 0.828dB
	BalanceWhiteAuto		Off, Continuous, Once, ExposureContinuous, ExposureOnce, Preset3200K, Preset5000K, Preset6500K, Preset7500K
	Area		16 (4 x 4) Area
	Adjustment range		3000K ~ 9000K
Blemish correction	Detection		Detect white blemishes using threshhold values (100 steps available) (black blemish correction performed only at factory)
	Correction		Interpolation using adjacent pixels (continuous blemishes not corrected)
	Correctable pixels		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	5.52 W (at 12 V input, full pixel) (Typical)
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 × 74 mm (WHD) (excluding mount protrusions)
Weight			170 g

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.

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

Optional accessories (not supplied)
MP-44 tripod mount
AC adapter

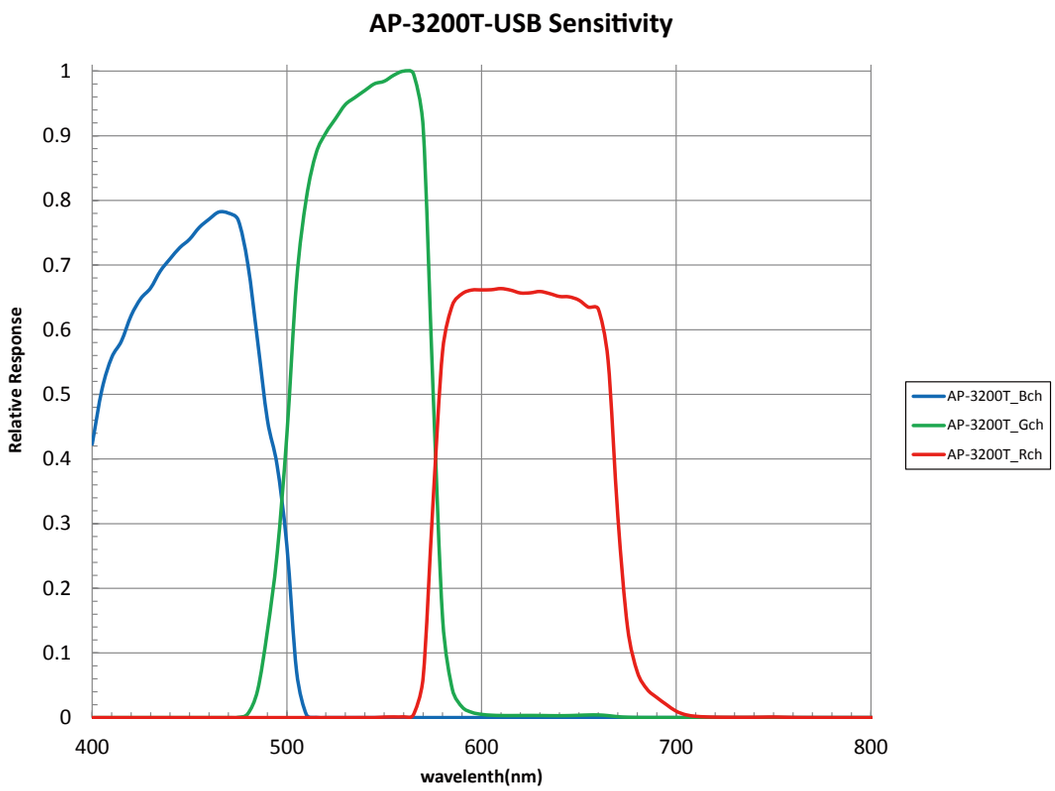
Design and specifications are subject to change without notice.

Frame Rate Reference

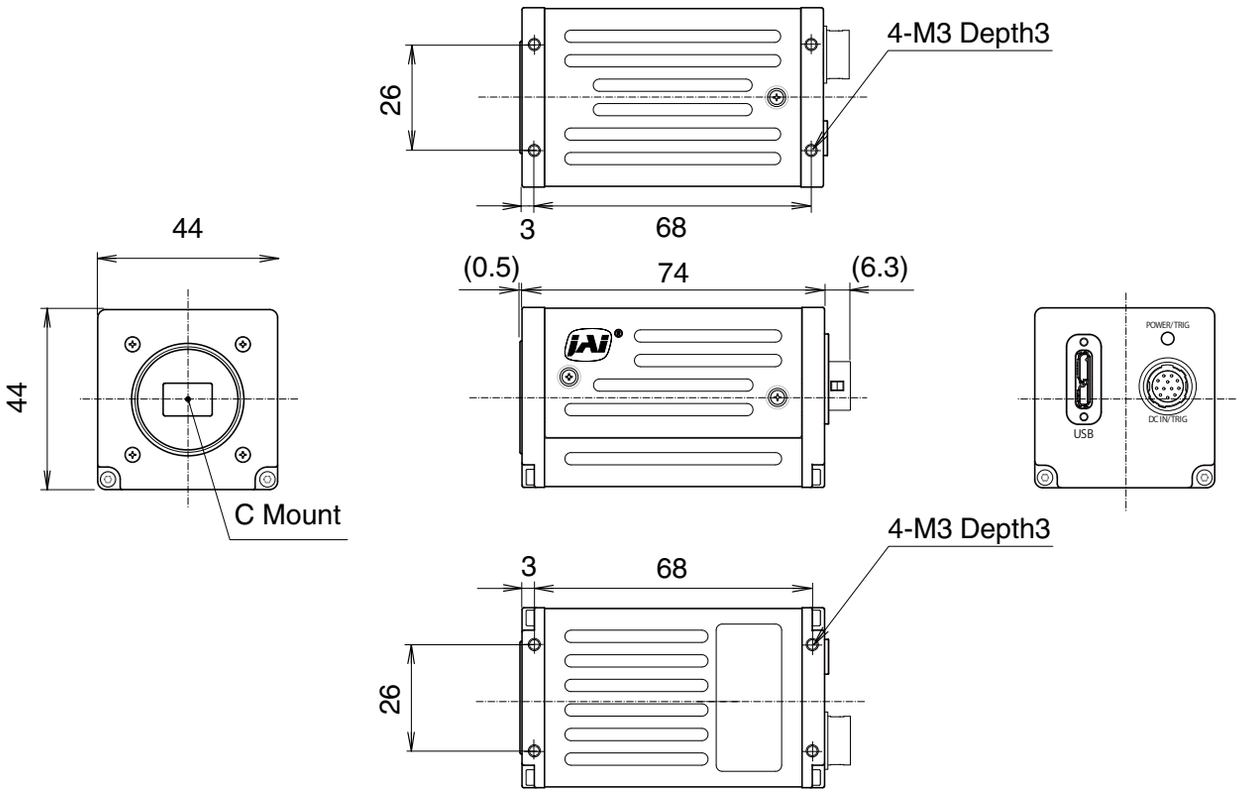
(Theoretical value: decimal values are dropped)

Pixel count	Resolution (screen size)	ROI/Binning	Pixel size(μm)	Image size	Frame rate
3.2 MP	2064×1544	Full pixel	3.45×3.45	1/1.8" (8.89 mm)	38.3 fps (@24 bit)
2 MP	1920×1080	ROI	3.45×3.45	1/2" (7.6 mm)	58.4 fps (@24 bit)
1.3 MP	1280×1024	ROI	3.45×3.45	1/2.8" (5.66 mm)	83 fps (@24 bit)
0.5 MP	800×600	ROI	3.45×3.45	1/4.6" (3.45 mm)	138.4 fps (@24 bit)
0.5 MP	800×600	ROI+2×2 Binning	6.9×6.9	1/2.3" (6.9 mm)	71.1 fps (@24 bit)
0.3 MP	640×480	ROI	3.45×3.45	1/5.75" (2.76 mm)	170.8 fps (@24 bit)
0.3 MP	640×480	ROI+2×2 Binning	6.9×6.9	1/2.9" (5.52 mm)	88.3 fps (@24 bit)

Spectral Response



Dimensions



Dimensional tolerance: ±0.3 mm
Unit: mm

User's Record

Camera type: AP-3200T-USB

Revision: ……..

Serial No. ……..

Firmware version. ……..

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

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Index

Revision history

Revision	Date	Changes
1.0	Oct. 2017	First draft
1.1	Jan.2017	Recommended external input circuit diagram, Setting List