See the possibilities

User Manual

SP-12000M-CXP4
SP-12000C-CXP4

12M Digital Progressive Scan
Monochrome and Color Camera

Document Version: 1.2

SP-12000-CXP4_Ver.1.2_Jan.2021

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.

Contents

Notice

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

Company and product names mentioned in this manual are trademarks or registered trademarks of their respective owners.

Warranty

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

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that SP-12000M-CXP4 and SP-12000C-CXP4 comply 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 (PBB)	多溴二苯醚 (PBDE)
连接插头	×	○	○	○	○	○
电路板	×	○	○	○	○	○
镜头口	×	○	○	○	○	○
螺丝固定座	×	○	○	○	○	○
机体外壳	×	○	○	○	○	○
光学滤镜	×	○	×	○	○	○

○: 表示该有毒有害物质在该部件所有均质材料中的含量均在GB/T 26572-2011规定的限量要求以下。
×: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572-2011规定的限量要求。
（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。

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电路板	×	○	○	○	○	○
镜头口	×	○	○	○	○	○
螺丝固定座	×	○	○	○	○	○
机体外壳	×	○	○	○	○	○
.....	.....	.....	.....	.....	.....	.....	.....

○: 表示该有毒有害物质在该部件所有均质材料中的含量均在GB/T 26572-2011规定的限量要求以下。
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Usage Precautions

Notes on cable configurations

The presence of lighting equipment and television receivers nearby may result in video and audio 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.
- Blemishes
  Due to the sensor element (pixel) array inside the CMOS image sensor, blemishes may occur when strong light enters. However, this does not affect actual operation.
- Fixed pattern noise
  When shooting dark objects in high-temperature conditions, fixed pattern noise may occur throughout the entire video monitor screen.
- Defective pixels
  Defective pixels (white and black pixels) of the CMOS image sensor are minimized at the factory according to shipping standards. However, as this phenomenon can be affected by the ambient temperature, camera settings (e.g., high sensitivity and long exposure), and other factors, be sure to operate within the camera's specified operating environment.

Notes on exportation

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

Features

The SP-12000M-CXP4/SP-12000C-CXP4 is an industrial progressive scan camera equipped with an APS-C format global shutter CMOS image sensor with 12.58 effective megapixels (4096 × 3072). The unit is equipped with a CoaXPress Ver. 1.0 interface.

❖ The SP-12000M-CXP4 produces monochrome output while the SP-12000C-CXP4 produces Bayer output.

Coaxial cable interface supporting CoaXPress Ver. 1.0

- High-speed transfer at up to 25 Gbps of uncompressed data, the ideal format for image processing.
- Maximum cable lengths for the recommended cables are as follows.

	3.125G	6.25G
Belden 1694A	100 m	40 m
Belden 1855A	55 m	25 m

Note

The frame grabber board that you use must support CoaXPress. Power can also be supplied via the 12-pin connector using an optional +12 to +24V DC power supply. PoCXP is also supported.

Output formats

You can choose from 8-bit and 10-bit output for both monochrome and Bayer in normal mode. 12-bit output is possible in Video Process Bypass mode (see page 48).

High frame rate

The SP-12000M-CXP4 and SP-12000C-CXP4 are both capable of frame rates of up to 189 fps (8-bit format) for full 12-megapixel output. Even faster frame rates can be achieved when a smaller ROI (region of interest) is specified.

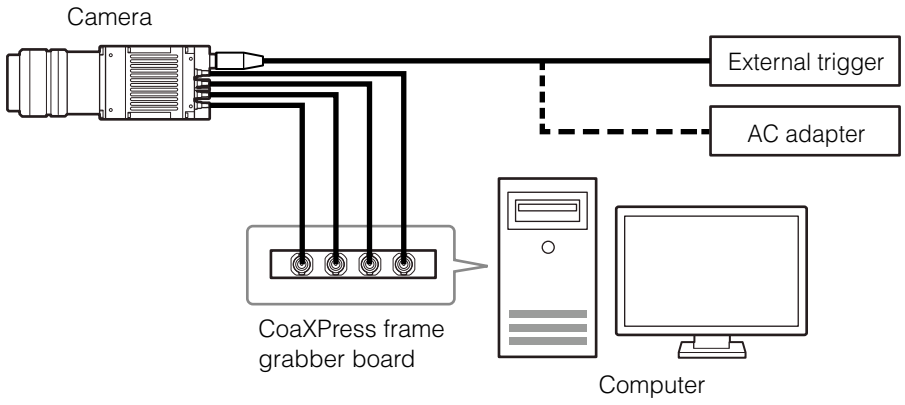
Automatic level control (ALC) function

Combine the automatic gain control and automatic exposure control functions to allow handling of changes in various brightnesses.

Variety of pre-process functions

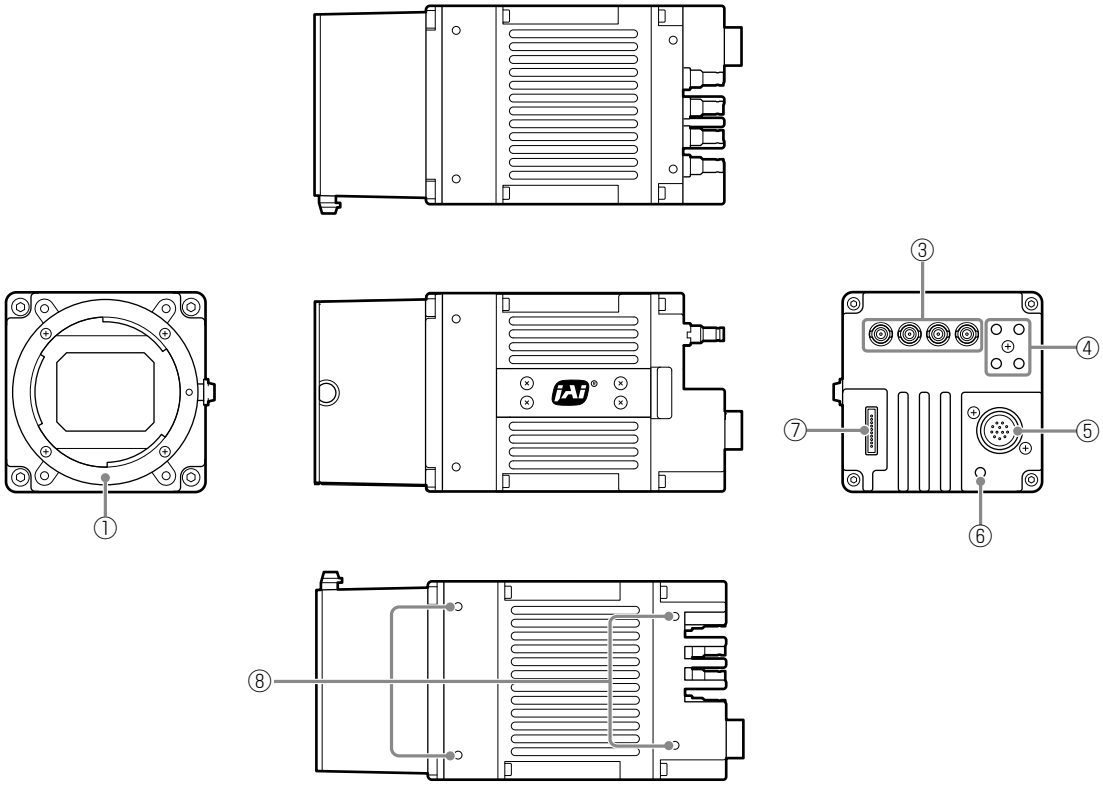
- LUT (lookup table)
  For programmable control over gamma and contrast.
- Gamma correction
  The gamma can be set to one of nine settings from 0.45 to 1.0.
- Bayer white balance (SP-12000C-CXP4 only)
  White balance can be automatically adjusted continuously. It can also be adjusted manually using R, G, and B gain.

Connection example:

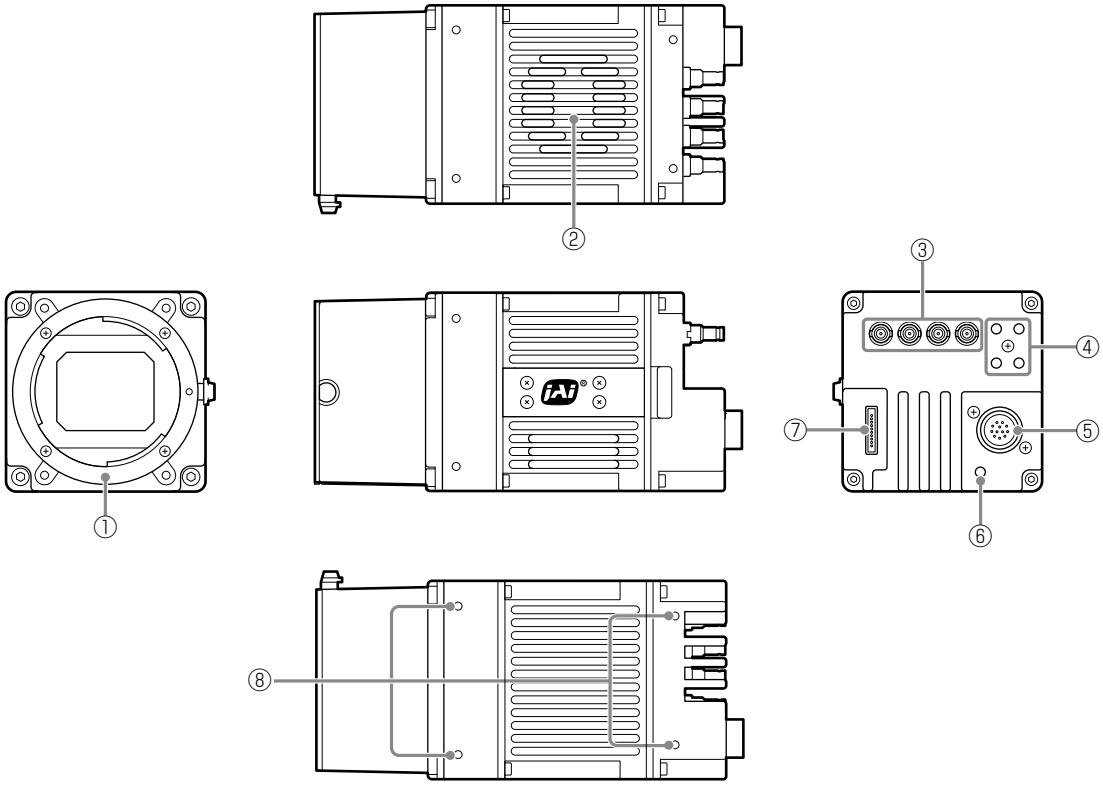


Parts Identification

SP-12000-CXP4



SP-12000-CXP4-XT (option)



① Lens mount (F-mount)
Mount an F-mount lens, microscope adapter, etc. here.

② Ventilation holes (SP-12000-CXP4-XT (option) only)

③ CXP (CoaXPress) connectors 1 to 4 (DIN)
Connect the coaxial cables for digital video output here. (Equivalent to Amphenol Connex ACX1785-ND. PoCXP is also supported.)

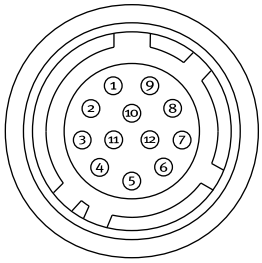
④ LINK LEDs 1 to 4
Indicates the CXP connection status.

LED status and camera status

LED	Light	Status
POWER/TRIG LED	🟢 Lit green	Power is on.
	Off	Power is off.
LINK LEDs 1 to 4	🟠 Lit amber	System starting up.
	✱ Blinking amber (rapid)	Detecting link (when PoCXP not in use). ❖ Blinks for 1 second even when detected immediately.
	✱ Blinking amber (slow)	Waiting for connection between device and host to be established or for event (trigger, exposure pulse, etc.) to occur.
	✱ / ✱ Alternating between green and amber (rapid)	Detecting link (when using PoCXP). ❖ Blinks for 1 s even when detected immediately.
	✱ / ✱ Alternating between green and amber (slow)	Sending connection test packet.
	✱ / ✱ / ✱ Blinking red, green, amber (slow)	Compliance test mode enabled (equipment only).
	🟢 Lit green	Connection between device and host is established, but there is no data being transmitted.
		An error occurred during data transmission (CRC error, single bit error, etc. detected). ❖ Lights for at least 200 ms before errors are displayed when multiple errors occur simultaneously.
	✱ Blinking green	Connection between device and host is established, and data is being transmitted.
	✱ Red pulse (slow)	No connection. ❖ Does not apply to devices using PoCXP.
	🔴 Lit red	PoCXP overcurrent (host side only).
	✱ / ✱ Alternating between red and green (slow)	PoCXP has been established, but a connection error between the device and host has occurred.
	✱ / ✱ Alternating between red and amber (slow)	A connection error between the device and host has occurred while PoCXP is not in use.
	Off	Power is off.

⑤ DC IN / TRIG connector (12-pin round)

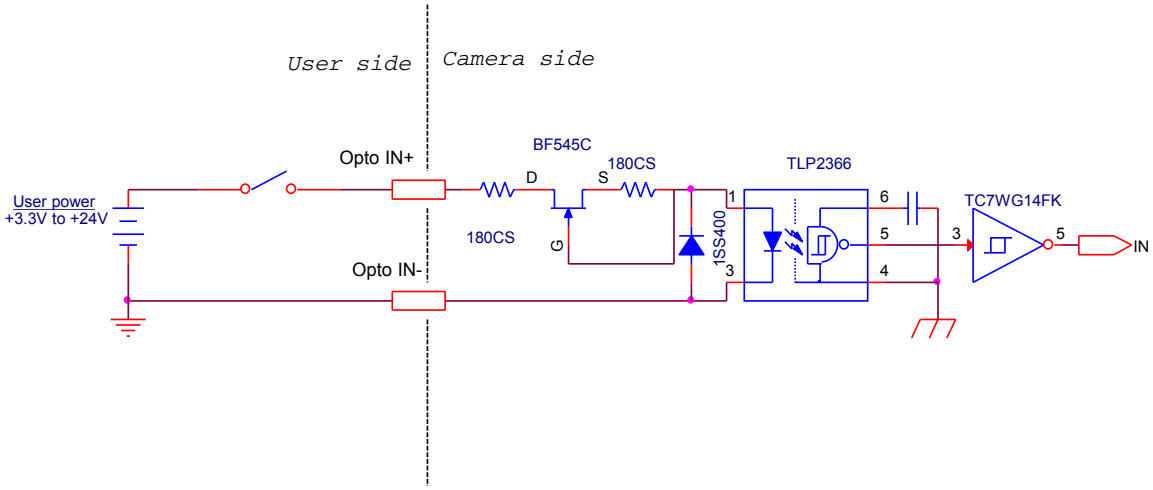
Connect the cable for a power supply (optional) or for DC IN / trigger IN here.



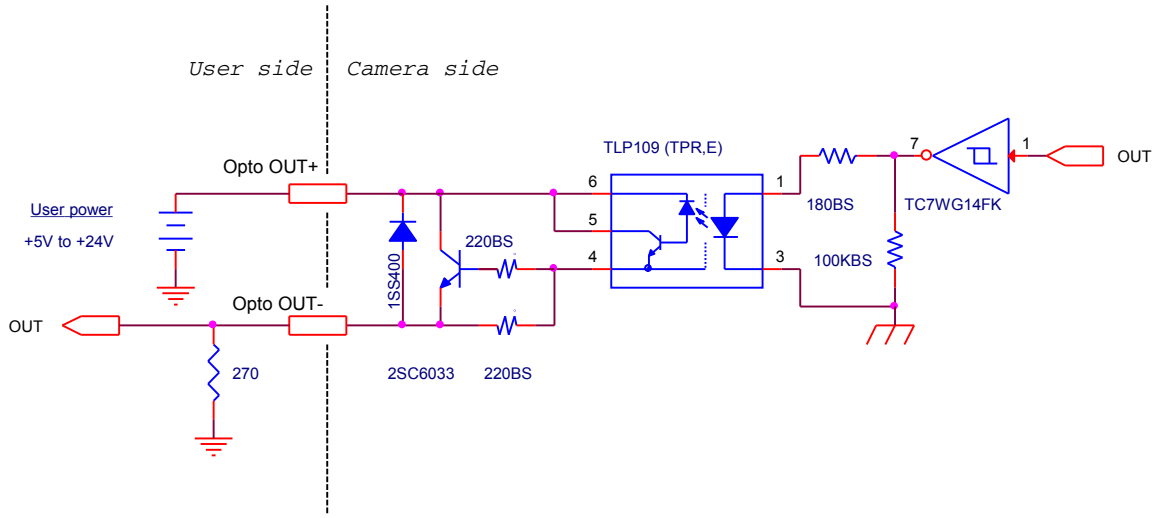
Camera side: Equivalent to Hirose Electronic HR-10A-10R-12PB(72)
Cable side: Equivalent to Hirose Electronic HR10A-10P-12S(73)

Pin No.	Attribute	Name	Note
1	GND	GND	
2	Power IN	DC (+12V) IN	DC 12 V to 24 V ±10%
3	GND	GND	
4		NC	
5	IN	Opto IN-	Line 5
6	IN	Opto IN+	
7	OUT	Opto OUT-	Line 2
8	OUT	Opto OUT+	
9	OUT	TTL OUT	Line 1
10	IN	TTL IN	Line 4
11	Power IN	DC (+12V) IN	
12	GND	GND	

Recommended internal circuits for Opto IN

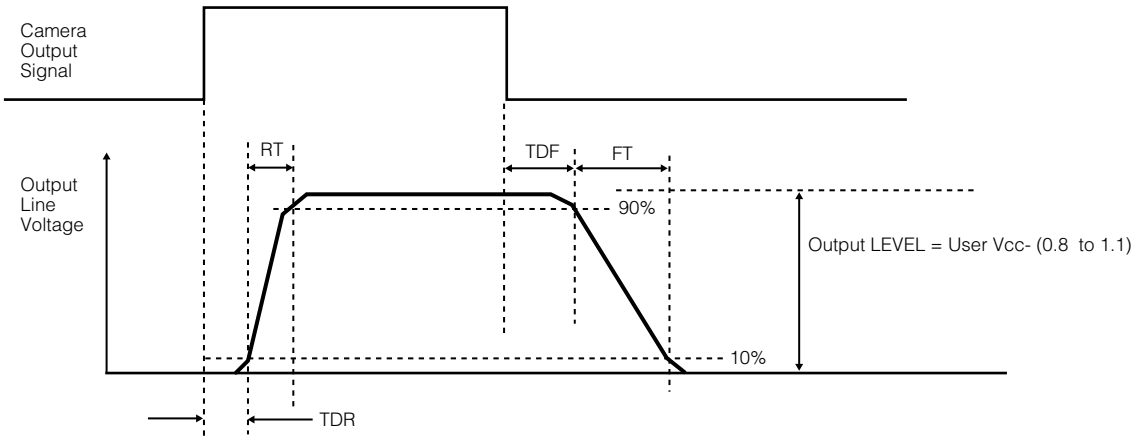


Recommended internal circuits for Opto OUT



Characteristics of the recommended circuits for Opto OUT

OUTPUT LINE RESPONSE TIME



When 270 Ω terminals are used		User power (Vcc)			
		3.3 V	5 V	12 V	24 V
Time Delay Rise	TDR (µs)	0.54	0.54	0.62	0.68
Rise Time	RT (µs)	1.2	1.2	2.0	3.0
Time Delay Fall	TDF (µs)	1.5	1.5	2.4	2.1
Fall Time	FT (µs)	3.6	3.4	4.5	6.8

⑥ POWER/TRIG LED

Indicates the power and trigger input status.

⑦ AUX connector (10-pin)

Camera side: Equivalent to Hirose Electronic 3260-10S3(55)
Cable side: Equivalent to Hirose Electronic 350-10P-C(50)

Pin No.	Attribute	Name	Note
1	OUT	TTL OUT2	Line 8
2	OUT	TTL OUT3	Line 9
3	IN	TTL_IN2	Line 10
4		NC	
5	GND	GND	
6	IN	LVDS_IN1+	Line 11
7	IN	LVDS_IN1-	
8		NC	
9	GND	GND	
10	GND	GND	

⑧ Camera locking screw holes (M3, 5 mm depth)
Use these holes when attaching an MP-42 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, CXP cable, AC adapter, computer, and other devices.
⬇	
Step 3	Verifying the Camera's Connection Status Verify whether the camera is ready for use via the LEDs at the rear of the camera.
⬇	
Step 4	Configuring Initial Settings for the Camera • Configure the output format. • Configure settings related to the exposure and external trigger.
⬇	
Step 5	Adjusting the Image Quality • Adjust the gain and white balance. • Adjust the exposure (shutter).
⬇	
Step 6	Configuring Various Other Settings Configure various other settings as necessary.
⬇	
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.

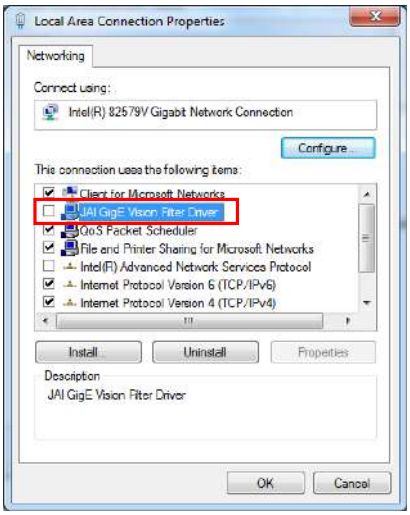
The computer will restart when installation is complete.

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.

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



■ Enabling the CXP frame grabber board

1 Start JAI Control Tool.

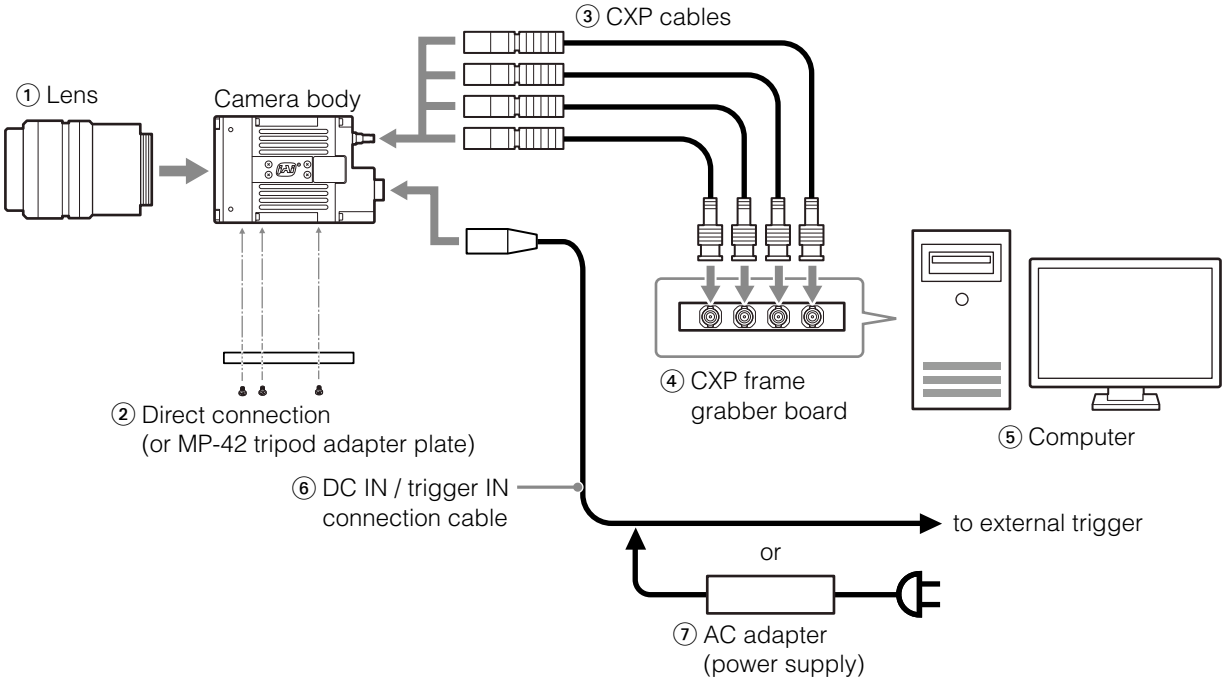
2 Click the settings icon at the top right of the window.
The [Settings] window appears.

3 Click the + icon for your CXP frame grabber board under [64-bit Factory Transport Layers] → [Available 64-bit Transport Layers] to display its settings.

4 Set [Enabled] to [True].

Step 2: Connecting Devices

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



① Lens
F-mount lenses can be used.

Caution

The maximum performance of the camera may not be realized depending on the lens.

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 (18.16 mm on this camera)

② Direct connection (or MP-42 tripod adapter plate)
When mounting the camera directly to a wall or other structural system, use screws that match the camera locking screw holes on the camera. (M3, 5 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 CXP cables
Connect the CXP cables to the CXP connectors on the camera and the frame grabber board.
- The number of cables you can connect varies depending on the number of connectors on your frame grabber board (1, 2, or 4).
- Be sure to connect each cable to matching connector numbers on the camera and the frame grabber board.
- Refer to the specifications of the cable for details on its bend radius.

④ CXP frame grabber board
Refer to the instruction manual of the CXP frame grabber board, and configure settings on the computer as necessary.

⑤ Computer
Use a computer that meets the following requirements.
Operating system (OS):
Microsoft Windows 7/8 32-bit/64-bit edition
CPU: Intel Core i5 or higher
Memory:
Windows 7/8 32-bit edition: DDR3, 4 GB or higher
Windows 7/8 64-bit edition: DDR3, 8 GB or higher
Graphics card: PCI-Express 3.0 or higher

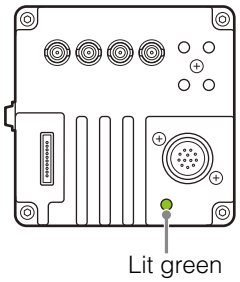
⑥ DC IN / trigger IN connection cable

⑦ AC adapter (power supply)
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 the Camera's Connection Status

When power is supplied to the camera while the necessary equipment is connected, the power / trigger LED and LINE LEDs at the rear of the camera light amber, and initialization of the camera starts. When initialization is complete, the power / trigger LED lights green. The CXP status indicators (LINK 1 to 4) light or blink according to the connection status.

Verify whether power is being supplied to the camera and whether connection has been established by checking the rear LEDs.



❖ For details on how to read the LEDs, see "LED status and camera status" (page 9) in the "Parts Identification" section.

Note

Initialization of the camera is not complete until connection with the host is established. If the power / trigger LED does not switch to green within minutes of supplying power, check the CXP cable and other connections. After initialization is completed once, the power / trigger LED will remain green, even if the host is disconnected.

Step 4: Configuring Initial Settings for the Camera

Start Control Tool, connect the camera to the CXP frame grabber board, and configure initial settings for the output format, exposure, external trigger, etc.

Connecting to the Camera to Control Tool

1 Start JAI Control Tool.

Cameras connected to the CXP frame grabber board are detected and displayed in a window. If they do not appear, right-click inside 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.

■ Configuring the optimal link configuration

Select the [Feature Properties] tab, and set [Device Control] → [Link Config] to [CXP6_X4] (when using a 4-cable connection).

Note

- When using a 1-cable or 2-cable connection, select [CXP6_X1] or [CXP6_X2] respectively.
- The [Link Config] setting cannot be stored and will reset to [CXP3_X4] each time the camera is disconnected. Be sure to manually switch to the optimal setting each time the camera is reconnected.

Configuring the Output Format

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

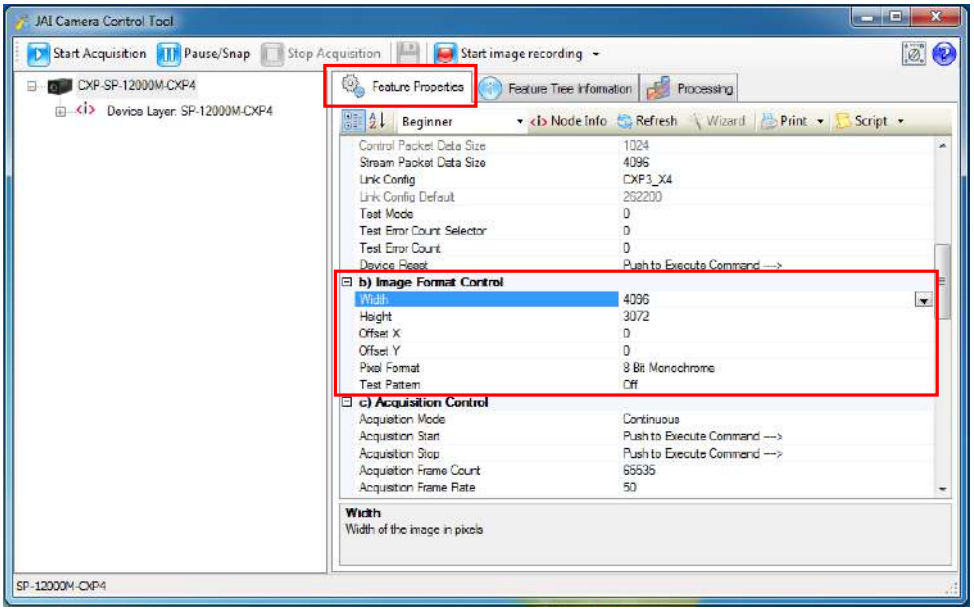
Factory default values

Item		Default value
Image Format Control	Width	4096 (pixels)
	Height	3072 (pixels)
	Offset X (horizontal position)	0 (pixels)
	Offset Y (vertical position)	0 (pixels)
	Pixel Format	SP-12000M-CXP4: 8 Bit Monochrome SP-12000C-CXP4: 8 Bit Bayer GB

❖ You can specify the image acquisition area. For details, see “ROI (Regional Scanning Function)” (page 39).

1 Select the [Feature Properties] tab, and select the item you want to configure under [Image Format Control].

 when a configurable item is selected.

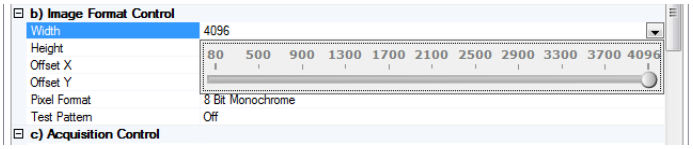


Note

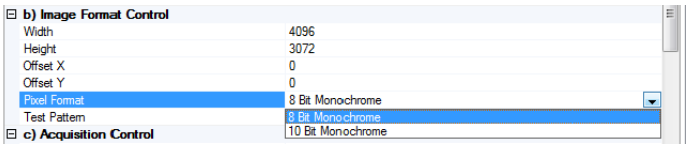
Settings can only be changed when image acquisition on the camera is stopped. If an item is grayed out and  does not appear even when you select it, click  (Stop Acquisition) to stop image acquisition.

2 Click  and change the setting value.

Example: When changing [Width]



Example: When changing [Pixel Format]



Note

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

Configuring Exposure and External Trigger Settings

Configure settings related to exposure control methods and trigger control.
The factory default settings are as follows. Change settings as necessary, according to the intended purpose or application.

Factory default values

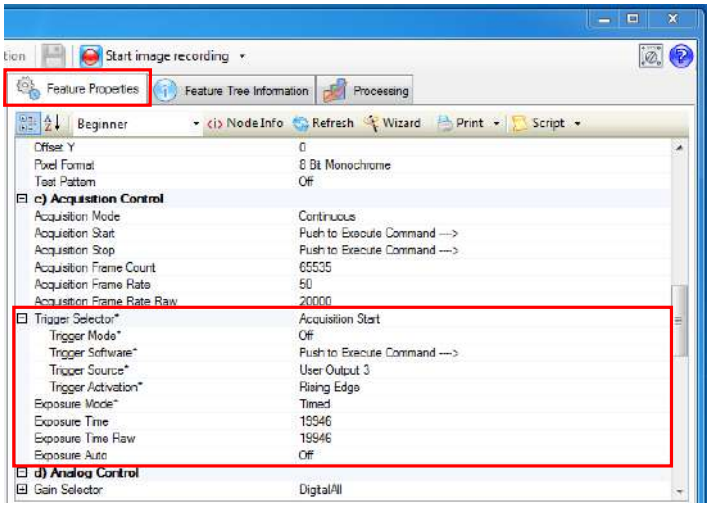
Item		Default value
Trigger Selector (trigger operation)		Frame Start
	Trigger Mode	Off
	Trigger Source (trigger signal source)	Line 4 - TTL In 1
	Trigger Activation (trigger polarity)	Rising Edge (rising edge of input signal)
	Trigger Overlap	Read Out
	Trigger Option	Off
Exposure Mode		Timed (control via exposure time)
Exposure Time		10486 (µs)
Exposure Auto*		Off

* This item is only enabled when [Exposure Mode] is set to [Timed].

Caution

When [Exposure Mode] is set to [Off], [Trigger Mode] cannot be set to [On]. Other settings may also be restricted depending on the exposure mode, so be sure to set the exposure mode before configuring the trigger settings.

Configure the settings by expanding [Acquisition Control] and configuring the following items.



Caution

Settings can only be configured when image acquisition on the camera is stopped. If an item is grayed out and the setting cannot be changed, stop image acquisition beforehand.

Control via External Triggers

When Controlling the Exposure Time Using Specified Exposure Times

Configure the settings as follows.

Item		Setting value / selectable range
Trigger Selector (trigger operation)		Frame Start
	Trigger Mode	On
	Trigger Source (trigger signal source)	Any
	Trigger Activation (trigger polarity)	Rising Edge (rising edge of input signal), Falling Edge (falling edge of input signal)
	Trigger Overlap	Read Out
	Trigger Option	Off
Exposure Mode		Timed (control via exposure time)
Exposure Time		15 or 20 to 7999892 (µs) (1 µs/step)*1
Exposure Auto		Off, Continuous

* 1 The maximum value for [Exposure Time] varies depending on the value configured for the [Acquisition Frame Rate Raw] setting.
Max. value for [Exposure Time] = [Acquisition Frame Rate Raw] value

1 Set [Exposure Mode] to [Timed].

([Timed] is the default setting.)

2 Specify the exposure time in [Exposure Time].

The setting value for the exposure time can only be changed when [Exposure Auto] is set to [Off]. If [Exposure Auto] is set to [Continuous], temporarily set it to [Off] before changing the exposure time.

3 Set [Trigger Selector] to [Frame Start].

([Frame Start] is the default setting.)

4 Set [Trigger Mode] to [On].

5 If necessary, change the [Trigger Source], [Trigger Activation], and [Exposure Auto] settings.

When Controlling the Exposure Time Using the Pulse Width of the Trigger Input Signal

Configure the settings as follows.

Item		Setting value / selectable range
Trigger Selector (trigger operation)		Frame Start
	Trigger Mode	On
	Trigger Source (trigger signal source)	Any
	Trigger Activation (trigger polarity)	Level High (high-level duration), Level Low (low-level duration)
	Trigger Overlap	Read Out
Exposure Mode		Trigger Width (control via trigger width)

1 Set [Exposure Mode] to [Trigger Width] .

When you select [Trigger Width], [Trigger Mode] will automatically be set to [On].

2 Set [Trigger Selector] to [Frame Start].

([Frame Start] is the default setting.)

3 If necessary, change the [Trigger Source] and [Trigger Activation] settings.

Other controls

In addition to exposure time, the following can also be controlled by external triggers. Select these control operations in [Trigger Selector].

[Trigger Selector] setting	Description
Acquisition Start	Start image acquisition.
Acquisition End	Stop image acquisition.

Control Without External Triggers

When Controlling the Exposure Time Using Specified Exposure Times

Configure the settings as follows.

Item	Setting value / selectable range
Trigger Selector (trigger operation)	Frame Start
Trigger Mode	Off
Exposure Mode	Timed (control via exposure time)
Exposure Time	15 (8-bit) or 20 (10-bit) to 7999892 (µs) (1 µs/step)*1
Exposure Auto	Off, Continuous

*1 The maximum value for [Exposure Time] varies depending on the value configured for the [Acquisition Frame Rate Raw] setting.
Max. value for [Exposure Time] = [Acquisition Frame Rate Raw] value

1 Set [Exposure Mode] to [Timed].

([Timed] is the default setting.)

2 Specify the exposure time in [Exposure Time].

The setting value for the exposure time can only be changed when [Exposure Auto] is set to [Off]. If [Exposure Auto] is set to [Continuous], temporarily set it to [Off] before changing the exposure time.

3 Set [Trigger Mode] to [Off].

4 If necessary, change the [Exposure Auto] setting.

When not Controlling the Exposure Time

Configure the settings as follows.

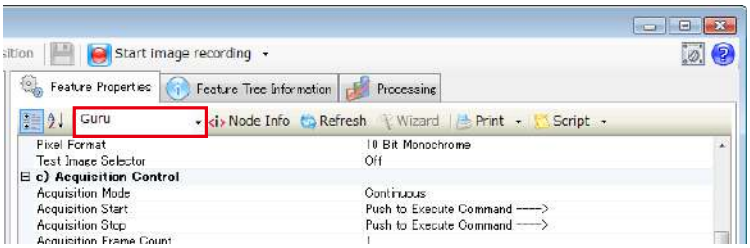
Item	Setting value / selectable range
Exposure Mode	Off

Step 5: Adjusting the Image Quality

Adjust the image quality using the gain and white balance (SP-12000C-CXP4 only) functions.

To adjust the image quality

The display level must be changed from [Beginner] to [Guru].



Adjusting the Gain

The digital gain is used for the master gain.

❖ For details on gain control, see “Gain Control” (page 36) in the “Main Functions” section.

■ Manual adjustment

1 Expand [Analog Control], and set [Gain Auto] to [Off].

([Off] is the default setting.)

2 Configure the digital gain.

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

- For the SP-12000M-CXP4, only [Digital All] (master gain) can be configured.
- For the SP-12000C-CXP4, [Digital All] (master gain), [Digital Red] (digital R gain), and [Digital Blue] (digital B gain) can be configured individually.

❷ Configure the gain value in [Gain].

- [Digital All] (master gain) can be set to a value from x1 to x16 (0 dB to +24 dB). The resolution is set in x0.01 steps (0.05 dB to 0.08 dB depending on the setting value).
- For the SP-12000C-CXP4, the [Digital Red] (digital R gain) and [Digital Blue] (digital B gain) can be set to a value from x0.45 to x5.62 (–7 dB to +15 dB) the [Digital All] (master gain) value. The resolution is set in x0.01 steps.

Adjusting the White Balance (SP-12000C-CXP4 only)

Adjust the white balance using R and B gain. The white balance can also be adjusted automatically.

■ Manual white balance adjustment

1 Expand [Analog Control], and set [Balance White Auto] to [Off].

([Off] is the default setting.)

2 Select the gain to configure in [Gain Selector], and set the gain value in [Gain].

■ 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 click [Continuous] or [Once] depending on your intended application.

The white balance is automatically adjusted.

Adjusting the Black Level

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

For the SP-12000M-CXP4, only [Digital All] (master black) can be configured.

For the SP-12000C-CXP4, [Digital All] (master black), [Digital Red] (digital R), and [Digital Blue] (digital B) can be configured individually.

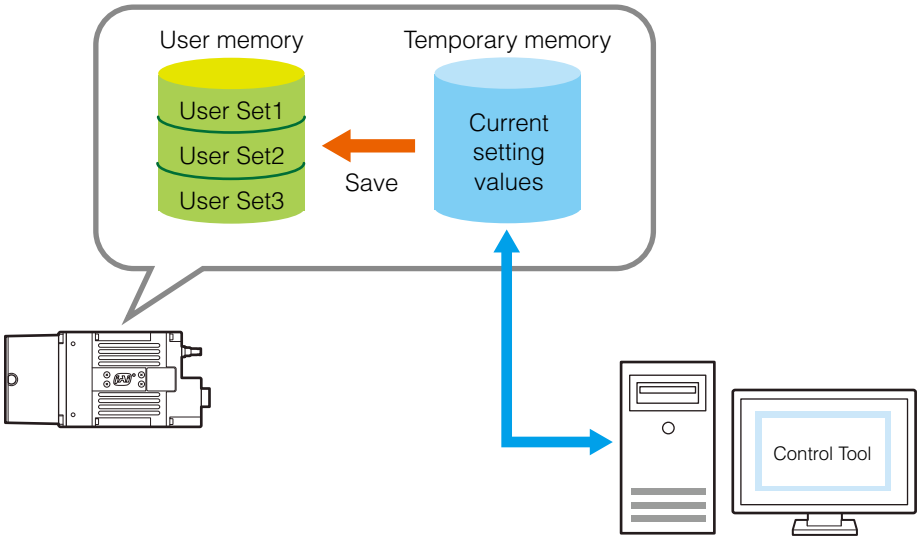
2 Specify the adjustment value in [Black Level].

Step 6: Configuring Various Other Settings

See “Settings List” (page 49) and configure settings as necessary.

Step 7: Saving the Settings

Setting values configured in Control Tool are maintained in the camera's temporary memory until 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 on the camera.



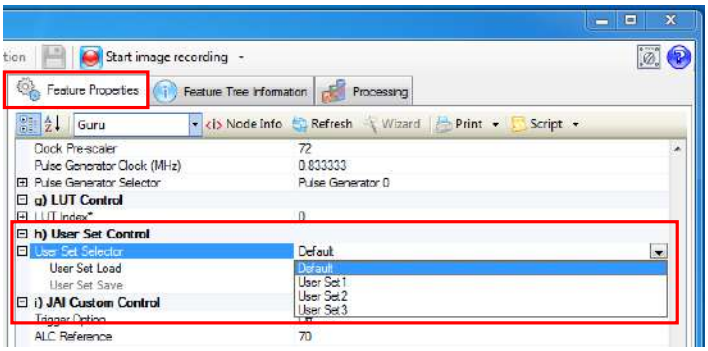
Note

The setting values are not saved to the computer (Control Tool). The setting values will be stored in the camera's temporary memory until the camera is turned off.

■ To save user settings

1 Stop image acquisition.

2 Expand [User Set Control], and select the save destination ([User Set1] to [User Set3]) in [User Set Selector].



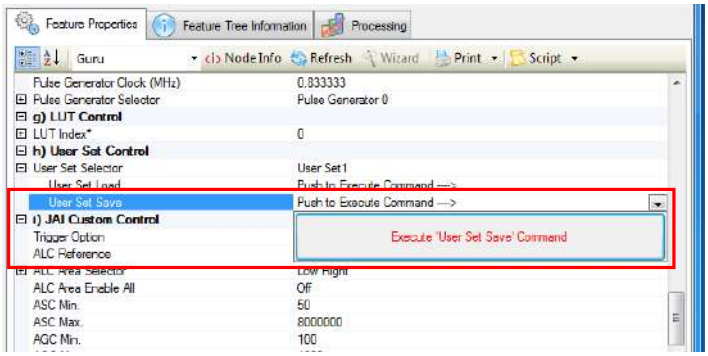
Note

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

Caution

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

3 Select [User Set Save], and click [Execute 'User Set Save' 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 (User Set1 to User Set3) in [User Set Selector].

3 Select [User Set Load], and click [Execute 'User Set Load' Command].

The selected user settings are loaded.

Basic Function Matrix

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

Exposure Mode	Trigger Mode	Trigger Option	Binning Vertical*1	Binning Horizontal*1	Exposure Time	ROI	AWB*2	Gain Auto	Exposure Auto	Video Send Mode		HDR*1
										Multi ROI	Sequence ROI	
Off	Off	Off	×1 (Off)	×1 (Off)	×	○	○	○	×	○	×	×
			×2	×2	×	○	×	○	×	○	×	×
Timed	Off	Off	×1 (Off)	×1 (Off)	○	○	×	○	○	○	×	○
			×2	×2	○	○	×	○	○	○	×	○
Timed (EPS)	On	Off	×1 (Off)	×1 (Off)	○	○	○	○	○	○	○	○
			×2	×2	○	○	×	○	○	○	○	○
Trigger Width	On	Off	×1 (Off)	×1 (Off)	×	○	○	○	×	○	×	×
			×2	×2	×	○	×	○	×	○	×	×
Timed (PIV)	On	PIV	×1 (Off)	×1 (Off)	○	○	○	○	×	○	×	×
			×2	×2	×	×	×	×	×	×	×	×

*1 Operates only on the SP-12000M-CXP4
*2 Operates only on the SP-12000C-CXP4

Main Functions

GPIO (Digital Input/Output Settings)

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

Valid Input/Output Combinations

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

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

Selector (Cross point switch output) / Source signal (Cross point switch input)		Output destination												
		Trigger Selector			Line Selector						Pulse Generator Selector			
		Acquisition Start	Acquisition End	Frame Start	Line 1	Line 2	Line 8	Line 9	NAND 0	NAND 1	Pulse Generator 0	Pulse Generator 1	Pulse Generator 2	Pulse Generator 3
Signals to use as output	LOW	○	○	○	○	○	○	○	○	○	○	○	○	○
	HIGH	○	○	○	○	○	○	○	○	○	○	○	○	○
	Line 4 (TTL Input)	○	○	○	○	○	○	○	○	○	○	○	○	○
	Line 5 (Opto Input)	○	○	○	○	○	○	○	○	○	○	○	○	○
	Line7 (Trigger packet)	○	○	○	○	○	○	○	○	○	○	○	○	○
	Line 10 (TTL Input2)	○	○	○	○	○	○	○	○	○	○	○	○	○
	Line 11 (LVDS Input)	○	○	○	○	○	○	○	○	○	○	○	○	○
	User Output 0	○	○	○	○	○	○	○	○	○	○	○	○	○
	User Output 1	○	○	○	○	○	○	○	○	○	○	○	○	○
	User Output 2	○	○	○	○	○	○	○	○	○	○	○	○	○
	User Output 3	○	○	○	○	○	○	○	○	○	○	○	○	○
	Software	○	○	○	×	×	×	×	×	×	×	×	×	×
	Pulse Generator 0	○	○	○	○	○	○	○	○	○	×	○	○	○
	Pulse Generator 1	○	○	○	○	○	○	○	○	○	○	×	○	○
	Pulse Generator 2	○	○	○	○	○	○	○	○	○	○	○	×	○
	Pulse Generator 3	○	○	○	○	○	○	○	○	○	○	○	○	×
	NAND 0 Out	○	○	○	○	○	○	○	×	○	○	○	○	○
	NAND 1 Out	○	○	○	○	○	○	○	○	×	○	○	○	○
	Exposure Active				○	○	○	○	○	○	○	○	○	○
	Acquisition Active				○	○	○	○	○	○	○	○	○	○
	Acquisition Trigger Wait				○	○	○	○	○	○	○	○	○	○
	Frame Trigger Wait				○	○	○	○	○	○	○	○	○	○
	Frame Active				○	○	○	○	○	○	○	○	○	○
	FVAL				○	○	○	○	○	○	○	○	○	○
	LVAL				×	×	×	×	○	○	○	○	○	○
		Trigger Source			Line Source						Pulse Generator Clear Source			
		Use												

: Under the factory default settings (page 18), the external input signal from the 12-pin connector (OPT 1 In) is connected as the source signal for the Frame Start trigger signal.

Acquisition Control (Image Acquisition Controls)

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. When the PIV function is enabled, the number of frames can be set to an even value.
Continuous	Acquire images continuously until the [Acquisition Stop] command is executed.

Changing the Frame Rate

When [Trigger Mode] is disabled, you can change the frame rate in [Acquisition Frame Rate].

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 [Trigger Mode] is enabled, the [Acquisition Frame Rate] setting is disabled.

Maximum Frame Rate

The maximum frame rate is as follows depending on the sensor's scanning range and the CXP bandwidth.

■ Necessary parameters

Parameter	Description	Configurable ranges
H_Binning	Horizontal binning	1 or 2
V_Binning	Vertical binning	1 or 2
Width	Width	See "Configurable ranges" (page 29).
Height	Height	
Digital Bit	Pixel format	8-, 10-, or 12-bit
LinkSpeed	CoaXPress speed	3 or 6 G
Packet_ Size	CoaXPress packet size	16 to 4096
Lane	CoaXPress lane count	1, 2, or 4

Sensor_Reso & Sensor_Clock

Digital Bit	Sensor_Reso	Sensor_Clock	ParameterX	ParameterY
8	10	400000000	128	12
10	12	600000000	244	7
12	12	600000000	244	7

CXP Clock

LinkSpeed	CXP_clock_Hz	CXP_clock_MHz
3	78125000	78.125
6	156250000	156.25

■ Calculation of frame rate

Sensor_Width = Width* H_Binning
Sensor_Height = Height* V_Binning
CXP_clocks = ((Sensor_Width / 16) × (Digital_bit / 8) + 9) × (4 / Lane)

A = MAX (ROUNDUP ((2 × CXP_clocks) × (1 / CXP_clock_Hz) × (Sensor_Clock / Sensor_Reso) - 1), ParameterX)
Line_Time = (A + 1) × (1 / Sensor_Clock) × Sensor_Reso
FOT = Line_Time × (ParameterY + 2)
Readout_Time = Line_Time × Sensor_Height / 2
Camera_FR = 1 / (FOT + Readout_Time)
B = ((2 × Height) + (Width × (Digital_bit / 8) × Height / 4)) / (Packet_Size / 4)
C = (26 + (((Packet_Size / 4) + 13) × B)) / Lane
FR_for_CXP_Packet = 1 / (C / ((CXP_clock_MHz) × (1 - 0.026) × 1000000)) + FOT
Frame_Rate = MIN (FR_for_CXP_Packet, Camera_FR)

* MAX (a, b): Larger of a and b
MIN (a, b): Smaller of a and b
ROUNDUP(a): Round up decimal values of a

Configurable ranges

	Width*2		Height*1	
	Monochrome	Color	Monochrome	Color
Binning Off 1	128 to 4096		16 to 3072	
Binning On 2	128 to 2048	—	16 to 1536	—

*1 Refer to the “Height” values in the “Configurable ranges” table above.
- Be careful of the maximum value during [Binning Horizontal].
- Only Monochrome is available during Binning On.

*2 Refer to the “Width” values in the “Configurable ranges” table above.
- Be careful of the maximum value during [Binning Vertical].
- Only Monochrome is available during Binning On.

Caution

- Although the maximum frame rate value is determined by the CXP bandwidth range, when ROI is configured, the frame rate cannot exceed the sensor output's allowable frame rate value.
- If the packet size setting is small, the value may smaller than the value which was obtained from Calculation of frame rate.

Exposure Mode

The following exposure modes are available on the camera.

Exposure Mode	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.
Trigger Width	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 “Configuring Exposure and External Trigger Settings” (page 18).

In addition, exposure operations that support PIV (particle image velocimetry) can be specified in [Trigger Option]. This function is enabled when [Exposure Mode] is set to [Timed].

Trigger Option	Description
Off	When an edge signal is input at the frame start trigger, a single exposure operation is performed.
PIV	Operate using functions commonly referred to as PIV. When an edge signal is input at the frame start trigger, the exposure operation is performed continuously in the Shutter Off state according to the exposure time configured with [Exposure Time]. When [PIV] is specified, [Exposure Time] can be set from the fastest speed value to 10 ms.

Trigger Control

The camera allows the following controls to be performed via external trigger signals. The trigger settings can be configured separately for each of the following modes and function simultaneously with each other.

Trigger Selector	Description
Frame Start	Start exposure in response to the external trigger signal input. Select this to perform exposure control using external triggers.
Acquisition Start	Start image acquisition in response to the external trigger signal input.
Acquisition End	Stop image acquisition in response to the external trigger signal input.

❖ The settings for exposure control and triggers are related to each other. Be sure to configure the settings described in “Configuring Exposure and External Trigger Settings” (page 18).

Shortest Repetition Period for Triggers

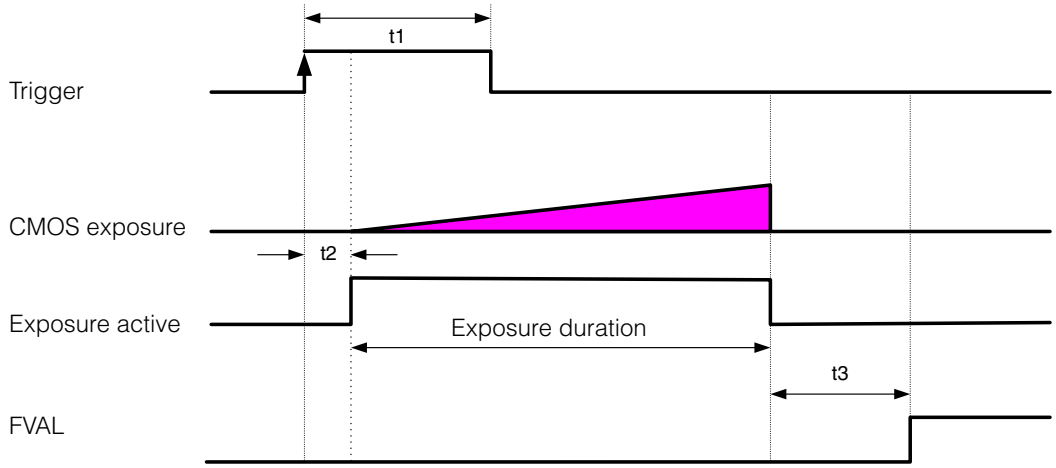
Depending on the exposure mode and image scanning range, the shortest repetition periods for triggers are as follows.

1. Timed - Trigger Mode

Example: When [Frame Start Trigger] is [On] and [Exposure Mode] is [Timed]

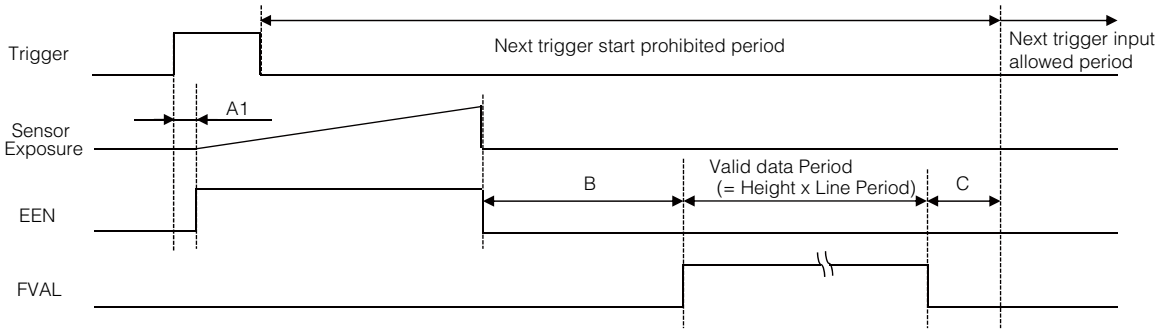
Selector	Value
Trigger Option	Off
Trigger Source	Line4-TTL in 1
Opt In Filter Selector	Off
Overlap	Read Out
Pixel Format	8-bit
Exposure Time	15 µs

Scanning range	Shortest period trigger (ms)
Full	5.275
ROI 2/3	3.355
ROI 1/2	2.528
ROI 1/4	1.289
ROI 1/8	0.670

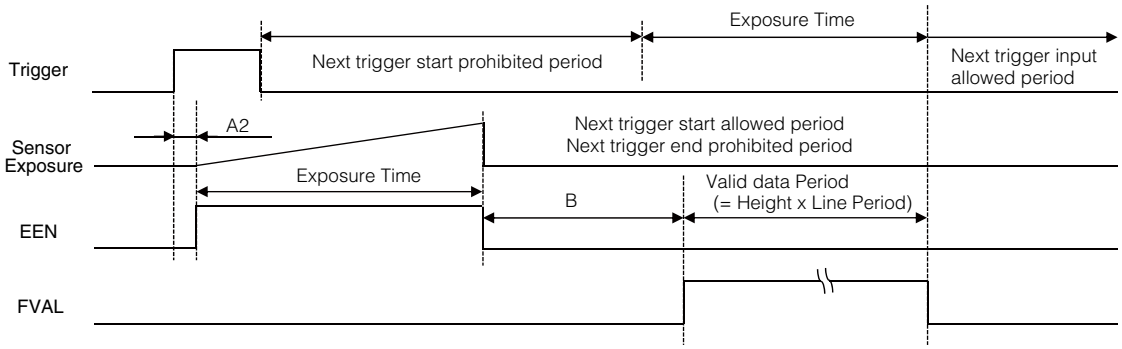


t1	t2	t3
10 µs (minimum)	2.4 µ to 2.4 µ + 1L	14L to 15L

Trigger overlap: Off



Trigger overlap: Readout



Example: When the max. frame rate is used

Link Config	Dig Bit	Sensor Dig Bit	Frame Rate (frequency (fps))	Period from trigger start to exposure start [A1] (usec)	Period from trigger start to exposure start [A2] (usec)	Period from FVAL end to FVAL start [B] (usec)	Period from FVAL end to next trigger start [C] (usec)
6G-4	8	10	189	2.4	2.4 to 5.8	53.2	-4.2
6G-4	10	12	132	2.4	2.4 to 7.5	47.3	-1.9
6G-2	8	10	94	2.4	2.4 to 6.9	100.8	-0.8
6G-2	10	12	76	2.4	2.4 to 7.5	80.8	1.4
6G-1	8	10	47	2.4	2.4 to 5.9	195.6	7.0
6G-1	10	12	38	2.4	2.4 to 19.5	156.5	9.9
3G-4	8	10	94	2.4	2.4 to 9.1	101.1	-4.4
3G-4	10	12	76	2.4	2.4 to 11	81.0	16.3
3G-2	8	10	47	2.4	2.4 to 15.8	196.0	3.2
3G-2	10	12	38	2.4	2.4 to 19.5	156.8	19.3
3G-1	8	10	23	2.4	2.4 to 29.4	385.9	18.7
3G-1	10	12	19	2.4	2.4 to 15.8	306.4	24.1

Formulas for each Link Config

Link Config	Dig Bit	Sensor Dig Bit	Frame Rate [Hz]	Period from trigger start to exposure start [A1]	Period from trigger start to exposure start [A2]	Period from exposure end to FVAL start [B]	Period from FVAL end to next trigger start [C]
6G-4	8	10	(14 + Height / 2) × H*	2.4	2.4 + (0 to 1H*)	14H (8 bit) 9H (10 bit)	0.0
6G-4	10	12					
6G-2	8	10					
6G-2	10	12					
6G-1	8	10					
6G-1	10	12					
3G-4	8	10					
3G-4	10	12					
3G-2	8	10					
3G-2	10	12					
3G-1	8	10					
3G-1	10	12					

* H (Line Time) is the horizontal synchronization period and will differ depending on the camera's settings. Refer to the maximum frame rate formula on page 27 for the formula used to calculate Line Time.

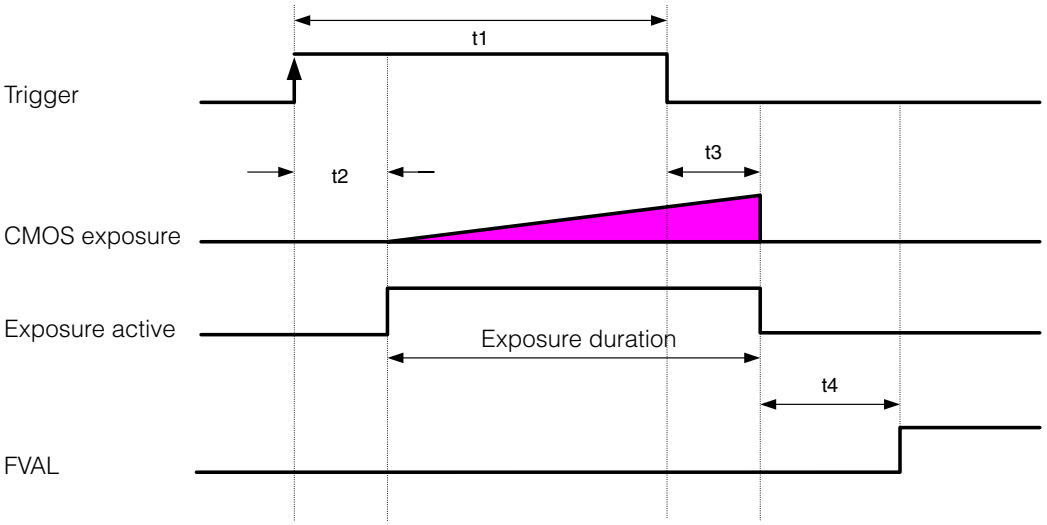
2. Trigger Width - Trigger Mode

Example: When [Frame Start Trigger] is [On] and [Exposure Mode] is [Trigger Width]

Selector	Value
Trigger Source	Line4-TTL in 1
Opt In Filter Selector	Off
Overlap	Read Out
Pixel Format	8-bit
Exposure Time	15 µs

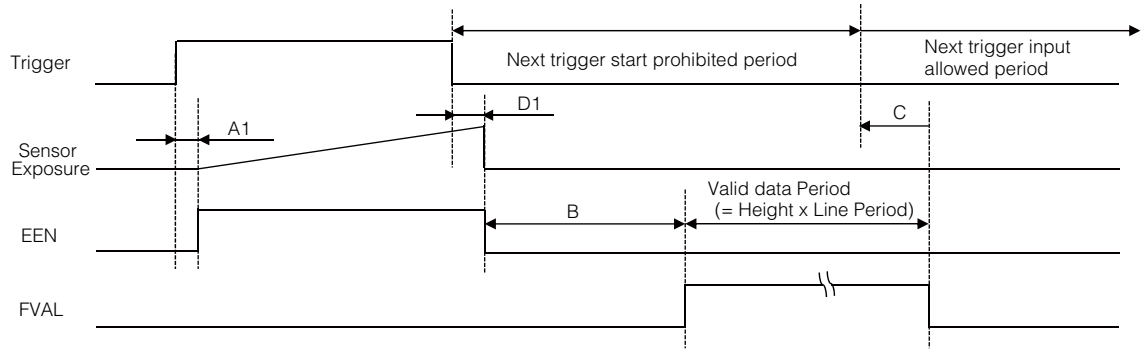
Scanning range	Shortest period trigger
Full	5.275 ms
ROI 2/3	3.351 ms
ROI 1/2	2.534 ms
ROI 1/4	1.296 ms
ROI 1/8	0.885 ms

* SP-12000M-CXP4 only

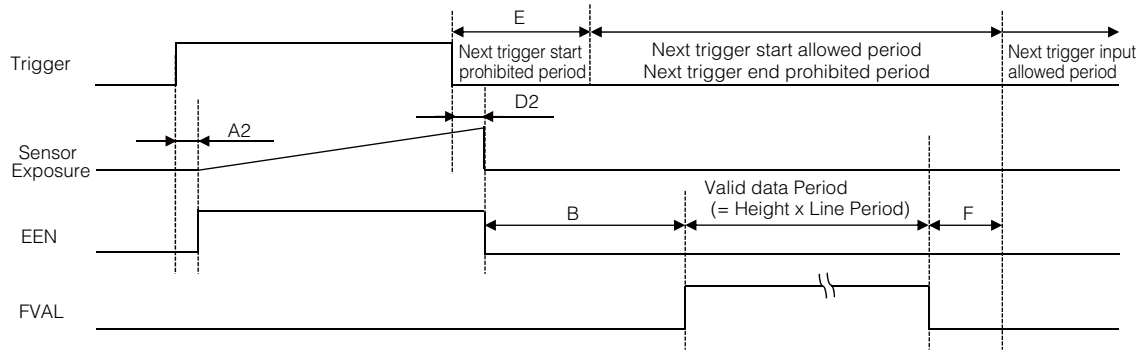


t1	t2	t3	t4
10 µs (8-bit), 15 µs (10-bit) (minimum)	4.0 µ to 4.0 µ + 1L	0.6 µ to 0.6 µ + 1L	14L to 15L

Trigger overlap: Off



Trigger overlap: Readout



Example: When the max. frame rate is used

Link Config	Dig Bit	Sensor Dig Bit	Frame Rate (frequency (fps))	Period from trigger start to exposure start [A1] (usec)	Period from trigger start to exposure start [A2] (usec)	Period from FVAL end to next trigger start [B] (usec)	Period from FVAL end to next trigger start [C] (usec)
6G-4	8	10	189	2.40	2.4 to 6	53.2	-4.2
6G-4	10	12	132	2.40	2.4 to 7.4	47.3	-5.4
6G-2	8	10	94	2.40	2.4 to 8.8	100.8	-0.8
6G-2	10	12	76	2.40	2.4 to 11.1	80.7	-4.9
6G-1	8	10	47	2.40	2.4 to 8.8	195.6	6.7
6G-1	10	12	38	2.40	2.4 to 10.2	157.8	-5.4
3G-4	8	10	94	2.40	2.4 to 9.4	101.1	4.4
3G-4	10	12	76	2.40	2.4 to 11.1	81.0	-9.3
3G-2	8	10	47	2.40	2.4 to 8.8	195.9	3.2
3G-2	10	12	38	2.40	2.4 to 10.2	155.2	-9.1
3G-1	8	10	23	2.40	2.4 to 29.8	385.9	1.6
3G-1	10	12	19	2.40	2.4 to 15.8	306.8	-1.9

Formulas for each Link Config

Link Config	Dig Bit	Sensor Dig Bit	Frame Rate (frequency (fps))	Period from trigger start to exposure start [A1] (usec)	Period from trigger start to exposure start [A2] (usec)	Period from exposure end to FVAL start [B] (usec)	Period from FVAL end to next trigger start [C] (usec)	Period from trigger end to exposure end [D1] (usec)	Period from trigger end to exposure end [D2] (usec)	Trigger start prohibited period [E] (usec)	Period from FVAL end to next trigger start [F] (usec)
6G-4	8	10	(14 + Height / 2) × H*	4.0	4.0 + (0 to 1H*)	14H (8 bit) 9H (10 bit)	0.0	0.60	0.60 + (0 to 1H)	50.0	15.0
6G-4	10	12									
6G-2	8	10									
6G-2	10	12									
6G-1	8	10									
6G-1	10	12									
3G-4	8	10									
3G-4	10	12									
3G-2	8	10									
3G-2	10	12									
3G-1	8	10									
3G-1	10	12									

* H (Line Time) is the horizontal synchronization period and will differ depending on the camera's settings. Refer to the maximum frame rate formula on page 27 for the formula used to calculate Line Time.

3. PIV-Trigger Mode

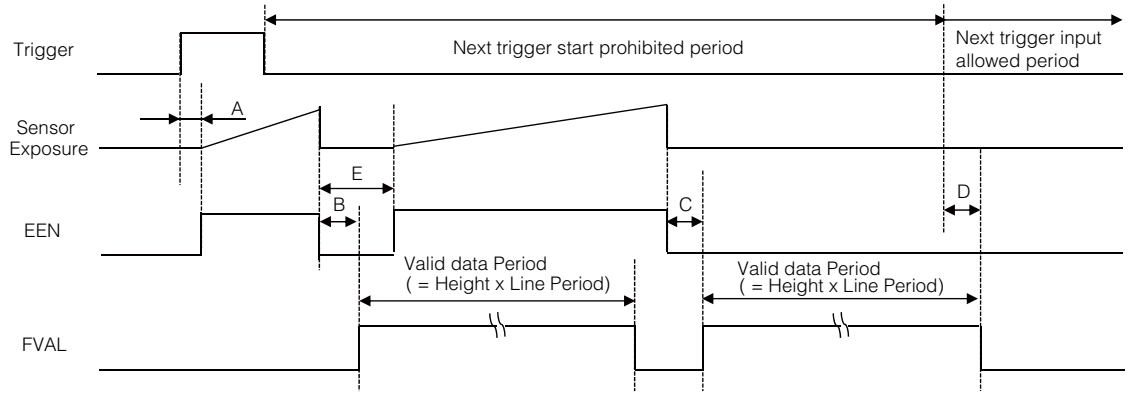
Example: When [Frame Start Trigger] is [On] and [Exposure Mode] is [Timed]

Selector	Value
Trigger Option	PIV
Trigger Source	Line4-TTL in 1
Opt In Filter Selector	Off
Overlap	Off
Pixel Format	8-bit
Exposure Time	15 µs

Scanning range	Shortest period trigger
Full	10.555 ms
ROI 2/3 (Height 2048 × Width 2720)	4.964 ms
ROI 1/2 (Height 1536 × Width 2048)	3.380 ms
ROI 1/4 (Height 768 × Width 1024)	1.728 ms
ROI 1/8 (Height 384 × Width 512)	0.903 ms
Binning 2 x 1, 2 x 2, 1 x 2* Full	10.555

* SP-12000M-CXP4 only

Trigger overlap: Off



Link Config	Dig Bit	Sensor Dig Bit	Frame Rate[Hz]	Period from trigger start to exposure start [A] (usec)	Period from 1st exposure end to 1st FVAL start [B] (usec)	Period from 2nd exposure end to 2nd FVAL start [C] (usec)	Period from FVAL end to next trigger start [D] (usec)	Period from 1st exposure end to 2nd exposure start [E] (usec)
6G-4	8	10	(14 + Height / 2) × H*	4.0	14H* (8 bit) 9H* (10 bit)	15H* (8 bit) 10H* (10 bit)	11.0	14H* –3.0 (8 bit) 9H* –3.0 (10 bit)
6G-4	10	12						
6G-2	8	10						
6G-2	10	12						
6G-1	8	10						
6G-1	10	12						
3G-4	8	10						
3G-4	10	12						
3G-2	8	10						
3G-2	10	12						
3G-1	8	10						
3G-1	10	12						

* H (Line Time) is the horizontal synchronization period and will differ depending on the camera's settings. Refer to the maximum frame rate formula on page 27 for the formula used to calculate Line Time.

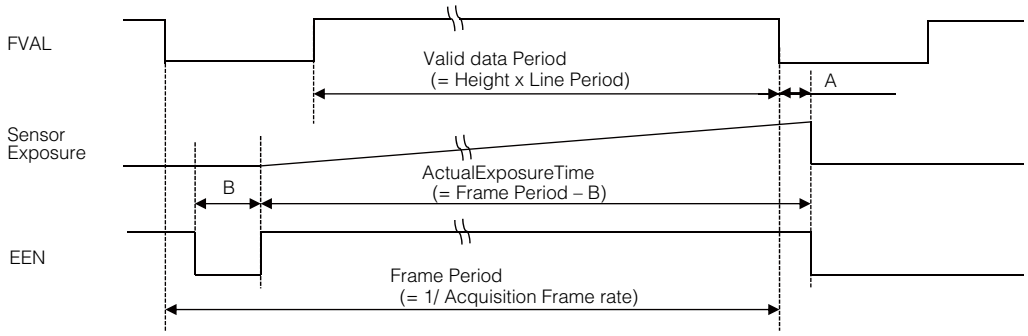
Example: When the max. frame rate is used

Link Config	Dig Bit	Sensor Dig Bit	Frame Rate[Hz]	Period from trigger start to exposure start [A] (usec)	Period from 1st exposure end to 1st FVAL start [B] (usec)	Period from 2nd exposure end to 2nd FVAL start [C] (usec)	Period from FVAL end to next trigger start [D] (usec)	Period from 1st exposure end to 2nd exposure start [E] (usec)
6G-4	8	10	189.753	4.0	51.9	52.7	5.8	42.2
6G-4	10	12	132.083	4.0	48.9	50.8	6.7	45.8
6G-2	8	10	94.8767	4.0	99.4	103.7	5.8	96.8
6G-2	10	12	76.6871	4.0	80.7	86.2	6.8	77.6
6G-1	8	10	47.4947	4.0	194.4	205.5	5.6	191.8
6G-1	10	12	38.3892	4.0	156.5	170.4	6.7	153.4
3G-4	8	10	94.8767	4.0	99.7	104.0	10.0	96.8
3G-4	10	12	76.6871	4.0	80.9	86.5	10.8	77.6
3G-2	8	10	47.4947	4.0	194.6	205.7	9.9	191.8
3G-2	10	12	38.3892	4.0	156.7	170.7	10.8	153.4
3G-1	8	10	23.7626	4.0	390.6	409.2	7.6	387.7
3G-1	10	12	19.206	4.0	308.3	339.0	1.1	305.0

❖ For details on the PIV function, see “PIV Function” (page 45).

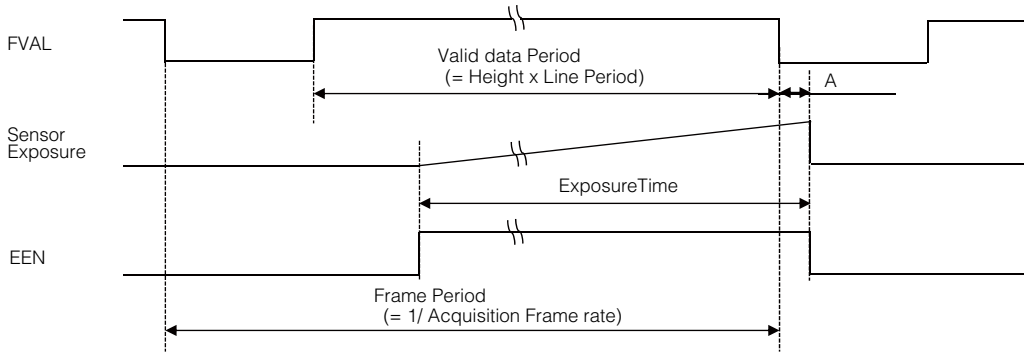
Timing chart (Trigger Off, Exposure Mode Off)

Continuous, Shutter Off



Timing chart (Trigger Off, Exposure Mode Timed)

Continuous, Shutter Mode



Timing chart (Trigger Off, Exposure Mode Off/Timed)

Continuous, Shutter Off / Shutter Mode

Example: When the max. frame rate is used

Link Config	Dig Bit	Sensor Dig Bit	Frame Rate (frequency (fps))	FVAL Blanking	FVAL ↓ - EEN ↓	Shutter Off Exposure stop period
6G-4	8	10	189	0.0514	0.50	59.20
6G-4	10	12	132	0.0508	3.26	59.31
6G-2	8	10	94	0.1051	5.60	115.69
6G-2	10	12	76	0.0926	11.92	100.63
6G-1	8	10	47	0.2069	17.04	228.54
6G-1	10	12	38	0.1733	16.81	198.88
3G-4	8	10	94	0.1024	2.01	115.68
3G-4	10	12	76	0.0890	7.94	100.67
3G-2	8	10	47	0.2036	13.44	228.60
3G-2	10	12	38	0.1696	12.82	198.90
3G-1	8	10	23	0.4162	36.31	454.81
3G-1	10	12	19	0.3334	25.04	395.37

Formulas for each Link Config

Link Config	Dig Bit	Sensor Dig Bit	Frame Rate [Hz]	Period from FVAL end to exposure end [A]	Period of exposure stop [B]
6G-4	8	10	(14 + Height / 2) × H	0 to 1H	16H to 17H (8-bit) 11H to 12H (10-bit)
6G-4	10	12			
6G-2	8	10			
6G-2	10	12			
6G-1	8	10			
6G-1	10	12			
3G-4	8	10			
3G-4	10	12			
3G-2	8	10			
3G-2	10	12			
3G-1	8	10			
3G-1	10	12			

* H (Line Time) is the horizontal synchronization period and will differ depending on the camera's settings. Refer to the maximum frame rate formula on page 27 for the formula used to calculate Line Time.

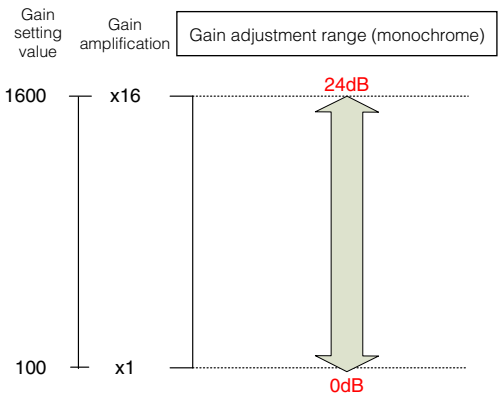
Gain Control

Digital gain is used for gain control on the camera. R and B can be configured individually for the SP-12000C-CXP4. The digital gain is used for the master gain.

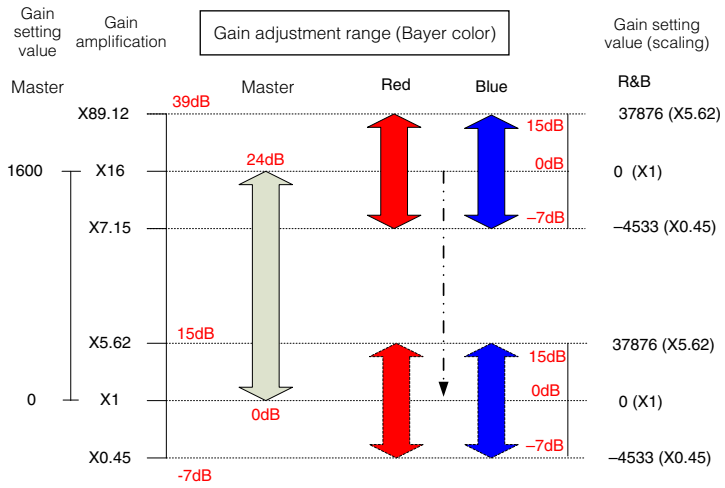
❖ For details on how to configure the settings, see “Adjusting the Gain” (page 21).

The relationship between the gain setting value, gain amplification, and dB value is as follows. For example, a gain amplification of x5.62 will be 15 dB.

Monochrome



Bayer color



LUT (Lookup Table)

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 256 setting points (indexes).

■ To use the LUT function

Configure the settings as follows.

Item	Setting value / selectable range	Description
JAI LUT Mode	LUT	Use LUT.
LUT Selector*	R, G, B	Select the LUT channel to control.
LUT Index	SP-12000M-CXP4: 0 to 255 SP-12000C-CXP4: 0 to 255	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 255). For example, Index 0 represents a full black pixel and Index 255 represents a full white pixel.
LUT Value	0 to 4095	Set the LUT output value for the selected index.

* SP-12000C-CXP4 only

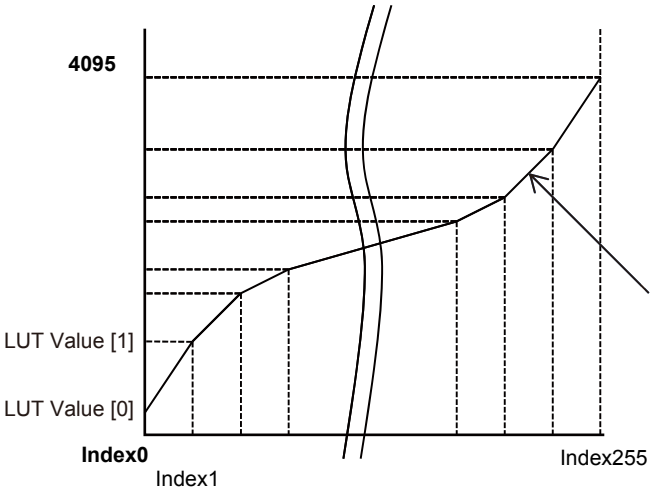
Note

R, G, and B are configured separately on the SP-12000C-CXP4.

■ LUT values

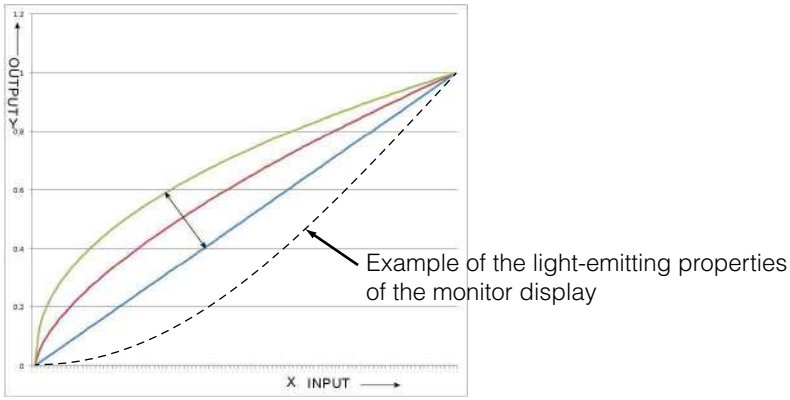
LUT values range from 0 at the lowest to 4095 at the highest. Linear interpolation is used to calculate LUT values between the index points.

Color



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 (9 steps)	Select the gamma correction value.
JAI LUT Mode	Gamma	Use gamma.

Note

You can use the LUT function to configure a curve with more detailed points. For details, see “LUT (Lookup Table)” (page 37).

ROI (Regional Scanning Function)

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

ROI Settings

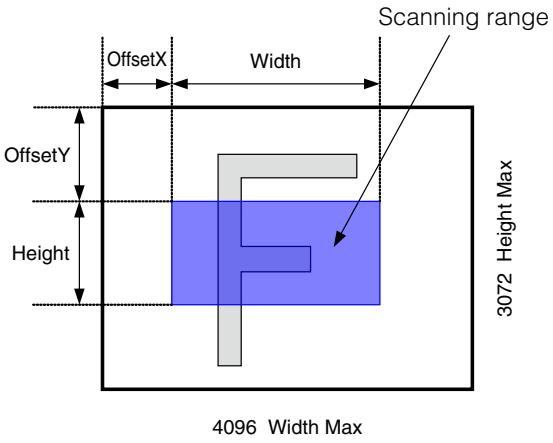
Specify the area to scan by specifying width, height, and horizontal/vertical offset values under [Image Format Control].

❖ For details on how to configure the settings, see “Configuring the Output Format” (page 17).

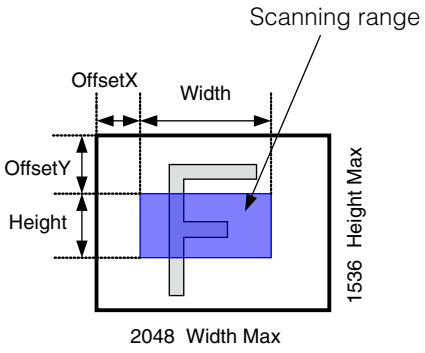
You can increase the frame rate by specifying a lower height, as the number of lines scanned decreases.
The minimum area is as follows.

	Width (pixels)	Height (pixels)
SP-12000M-CXP4	Binning Off: 128 Binning 2 On: 256 ❖ The minimum value for Monochrome varies depending on the [Binning] setting.	16
SP-12000C-CXP4	128	16

Example 1: Without binning
[Binning Horizontal] *: 1
[Binning Vertical] *: 1



Example 2: With binning
[Binning Horizontal] *: 2
[Binning Vertical] *: 2



* SP-12000M-CXP4 only

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

Video Send Mode

Switch the video send mode to configure and operate Multi ROI, Sequence Trigger, and other JAI Custom Control functions.

Video Send Mode

■ To switch the video send mode

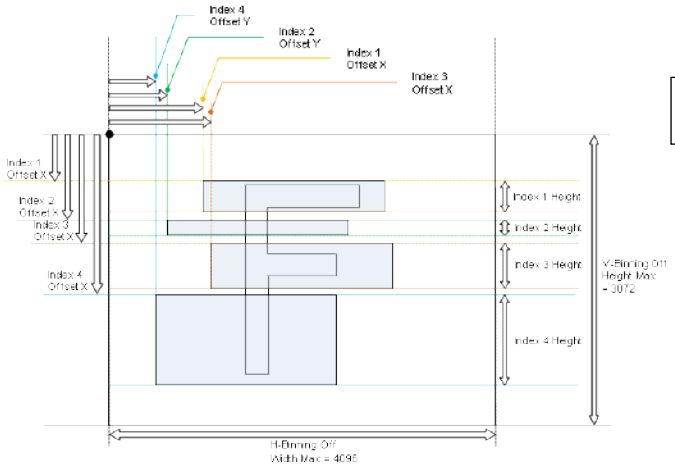
Select the video send mode in [Video Send Mode Selector].

[Video Send Mode Selector] option	Description
Normal Mode	Normal camera operation.
Multi Mode (Multi ROI)	Multi ROI mode that allows you to configure ROI settings for up to 5 images.
Trigger Sequence Mode	Sequence Trigger mode that executes presets in a predefined order based on [Sequence Roi Frame Count] and [Sequence Roi Next Index]. Starts at Index #1.
Command Sequence Mode	Sequence Trigger mode that executes the preset listed in [Command Sequence Index] each time a trigger is received. Can jump to new preset by sending a new index value to [Command Sequence Index].

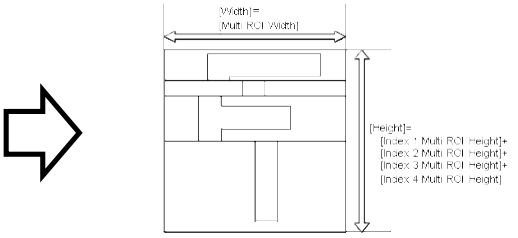
■ Multi ROI function

When the multi ROI function is enabled, you can split a frame to 32 areas, and scan specific areas. However, as the up to 32 ROI areas are output as one frame, the [Width] setting will be common. To enable the multi ROI function, set [Video Sending Mode Selector] to [Multi Mode].

ROI area configuration overview when Multi ROI Index Max = 4



Video output for Multi ROI configuration example



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

Note

The width must be common among all ROI indexes.

■ Sequence Trigger function

The Sequence Trigger function lets you define up to 128 preset 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. The order of execution and the repetition of particular presets are based on user-defined parameters stored in the sequence, as well as the sequence mode selected in the [Video Send Mode Selector].

Two operation modes (Trigger Sequence and Command Sequence) are available for the Sequence Trigger function.

Trigger Sequence mode

With this mode, the Sequence Trigger "pattern" is predetermined by the user. The user defines up to 128 different "indexes." Each index represents a combination of the following parameters:

- ROI (width, height, offset X, and offset Y)
- Exposure Time
- Gain Level (R/B Gain can also be configured on the color model)
- Black Level
- Binning Mode (monochrome only)
- LUT Enable (whether or not to enable the use of LUT for this index)
- Frame Count (the number of times to repeat this index before moving to the next)
- Next Index to execute in the predetermined pattern

In addition to these individual index parameters, two other parameters are applied to the entire sequence:

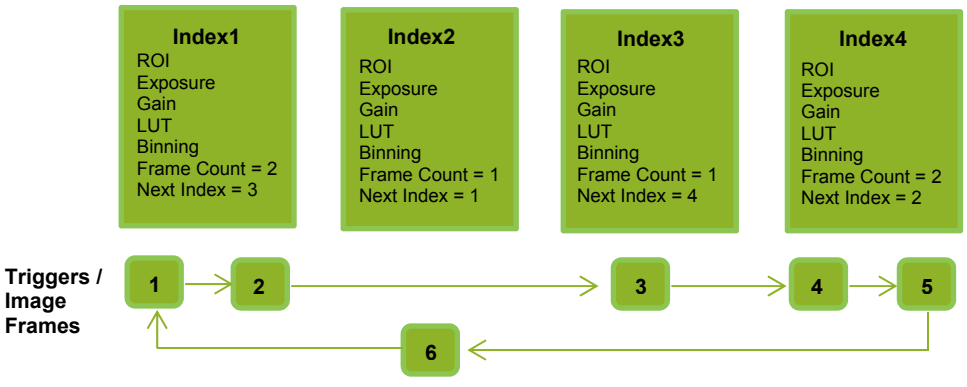
[Sequence LUT Mode] defines whether Gamma or LUT is to be applied to the sequence. If Gamma is selected, the Gamma setting defined in the camera's Analog Control section will be applied to all exposures in the sequence. If LUT is selected, the LUT characteristics defined in Analog Control will be applied to any index where [Sequence LUT enable] has been set to ON.

[Reset Sequence Index] causes the index selector to be reset to Index 1. Thus, the sequence pattern will start over at the next trigger.

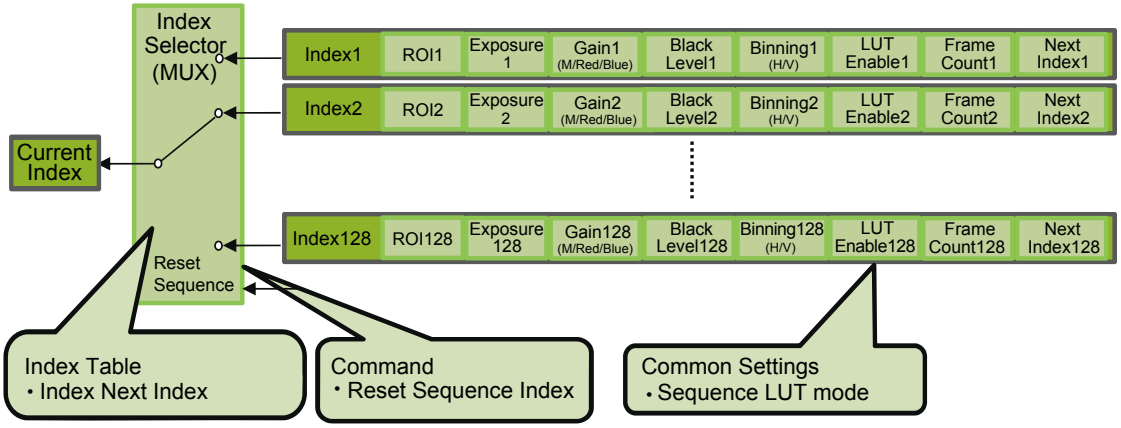
In Trigger Sequence mode, patterns always begin with Index1. Subsequent triggers follow the user-defined values in [Sequence Index Frame Count] and [Sequence ROI Next Index].
Assigning a Next Index value of "1" to an index creates a loop back to the start of the sequence pattern. As there is no defined "end" to a sequence, the parameter called [Sequence Repetition] has no effect.

Trigger Sequence example

User-defined Indexes (up to 128)



Index structure for Trigger Sequence



Command Sequence mode

This mode allows the user to vary the “pattern” of the sequence in response to external factors. Changes in the sequence can be initiated manually or in a programmatic fashion as the result of data from sensors/controllers or from the analysis of previous images.

In this mode, the user can define up to 128 different “indexes” each incorporating a combination of:

- ROI (width, height, offset X, and offset Y)
- Exposure Time
- Gain Level (R/B Gain can also be configured on the color model)
- Black Level
- Binning Mode (monochrome only)
- LUT Enable (whether or not to enable the use of LUT for this index)

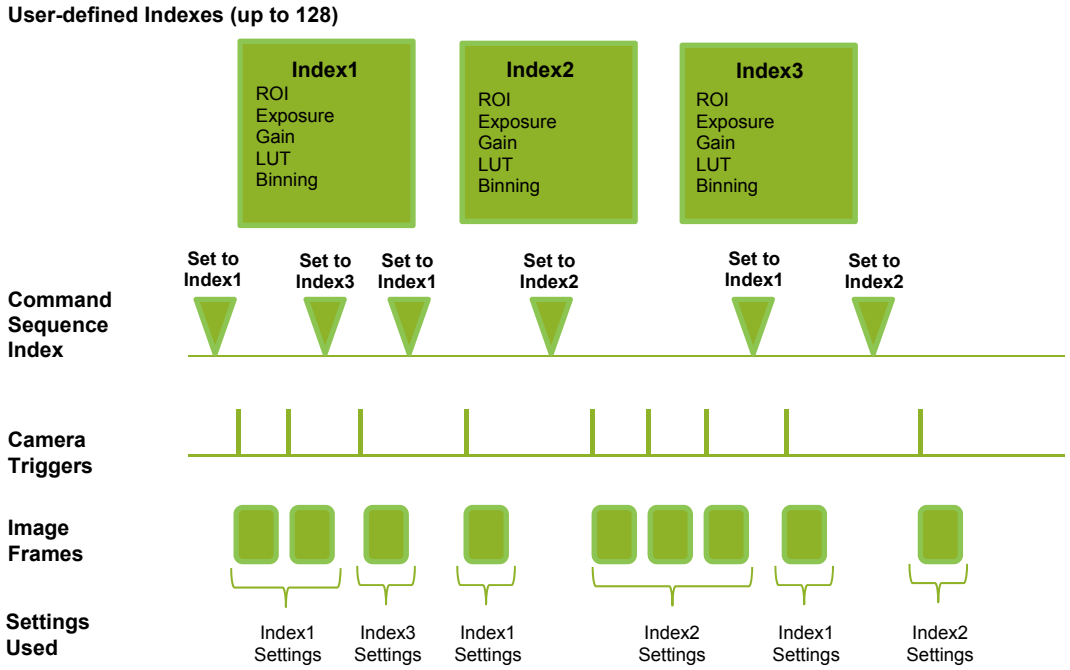
The user must also enter a value from 1 to 128 in [Command Sequence Index]. This indicates which index to execute each time a trigger is received. The same index will continue to be executed for all subsequent triggers as long as the value of [Command Sequence Index] remains unchanged.

Changing the value of [Command Sequence Index] to one of the other predefined indexes causes that index to be executed in response to subsequent triggers. This mode of operation enables users to develop applications that continually send new values to [Command Sequence Index] in response to external factors such as changing light conditions, different types or sizes of objects being inspected, or other factors. This allows applications to change ROI, exposure, gain, etc., without being restricted to a predefined pattern.

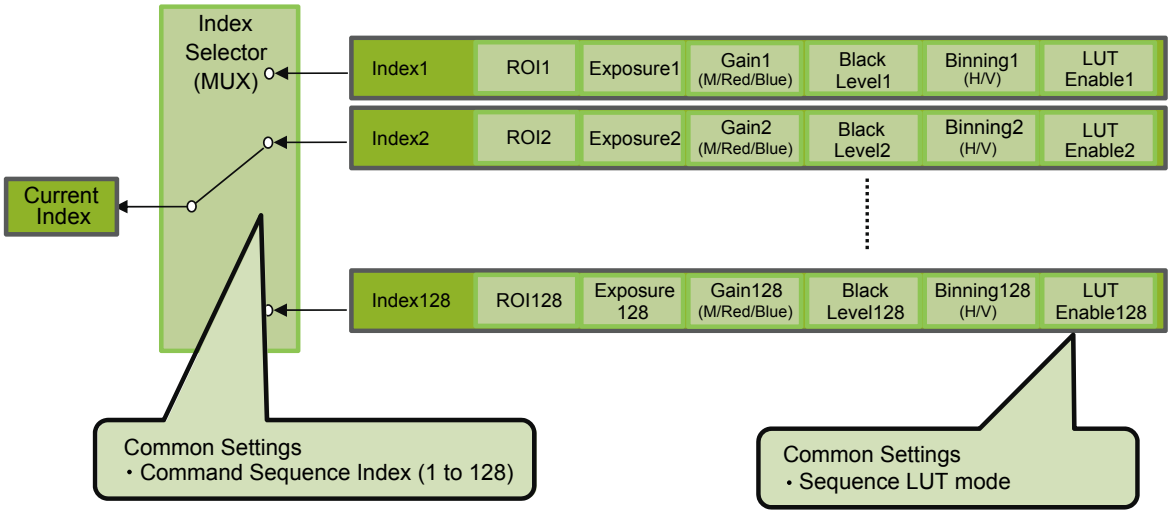
As with Trigger Sequence, [Sequence LUT Mode] defines whether Gamma or LUT is to be applied to the sequence. If Gamma is selected, the Gamma setting defined in the camera’s Analog Control section will be applied to all exposures in the sequence. If LUT is selected, the LUT characteristics defined in Analog Control will be applied to any index where [Sequence LUT enable] has been set to ON.

[Sequence Index Frame Count], [Sequence ROI Next Index], and [Reset Sequence Index] are not used in Command Sequence mode and entered values are ignored.

Command Sequence Example



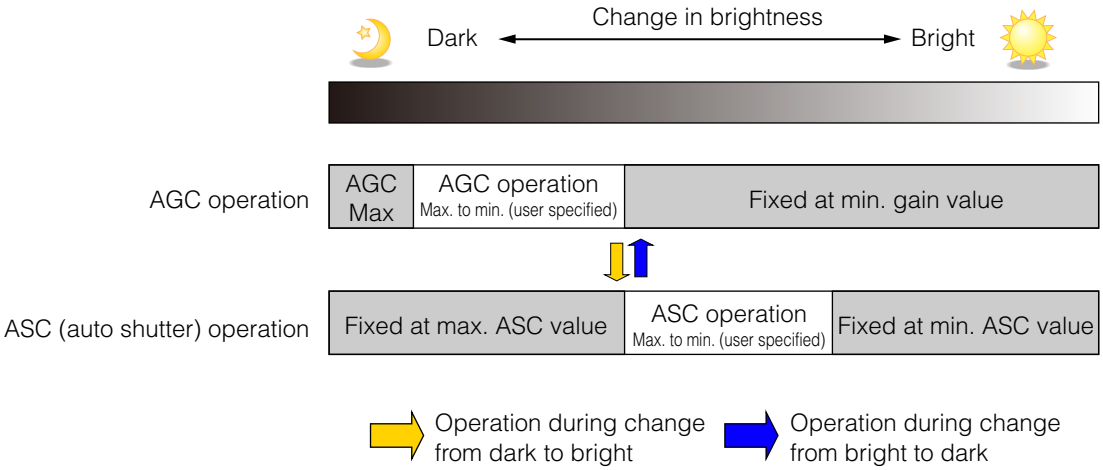
Index structure for Command Sequence



ALC (Automatic Level Control) Function

The ALC (automatic level control) function combines the automatic gain control and automatic exposure control functions, and is capable of handling changes in various brightnesses.
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 [Gain Auto] or [Exposure Auto] or both to [Continuous] mode. Configure the minimum value, maximum value, etc. for AGC and ASC under [JAI Custom Control].
The target video levels for AGC and ASC are configured in [ALC Reference]. For example, when [ALC Reference] is set to 100%, video levels will be maintained at 100% for AGC and ASC.

■ Automatic gain level control

Set [Gain] to [Continuous].

Detailed Settings for Gain Auto (Automatic Gain Level Control)

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

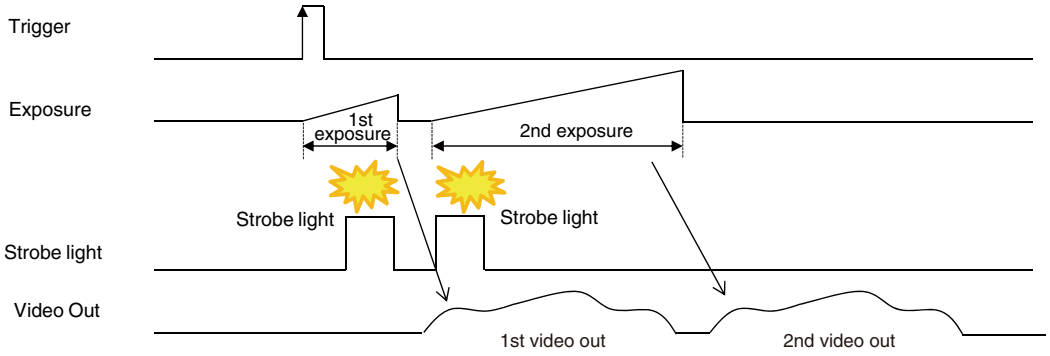
Item	Description
ALC Reference	Specify the target level for automatic gain control. (This setting is also used for automatic exposure control.)
ALC Area Enable All	Select whether to specify all areas as auto gain metering areas or whether to specify the areas individually. [0]: Specify areas as auto gain metering areas (16 areas) individually. [1]: Specify all areas as auto gain metering areas.
ALC Area Selector	Individually select any of 16 areas for automatic gain metering. (This setting is also used for automatic exposure control.)
ALC Area Enable	Select [True] to enable the metering area selected in [ALC Area Selector], or select [False] to disable it.
AGC Max.	Specify the maximum value for the automatic gain control range.
AGC Min.	Specify the minimum value for the automatic gain control range.
AGC/ASC Control Speed	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

PIV Function

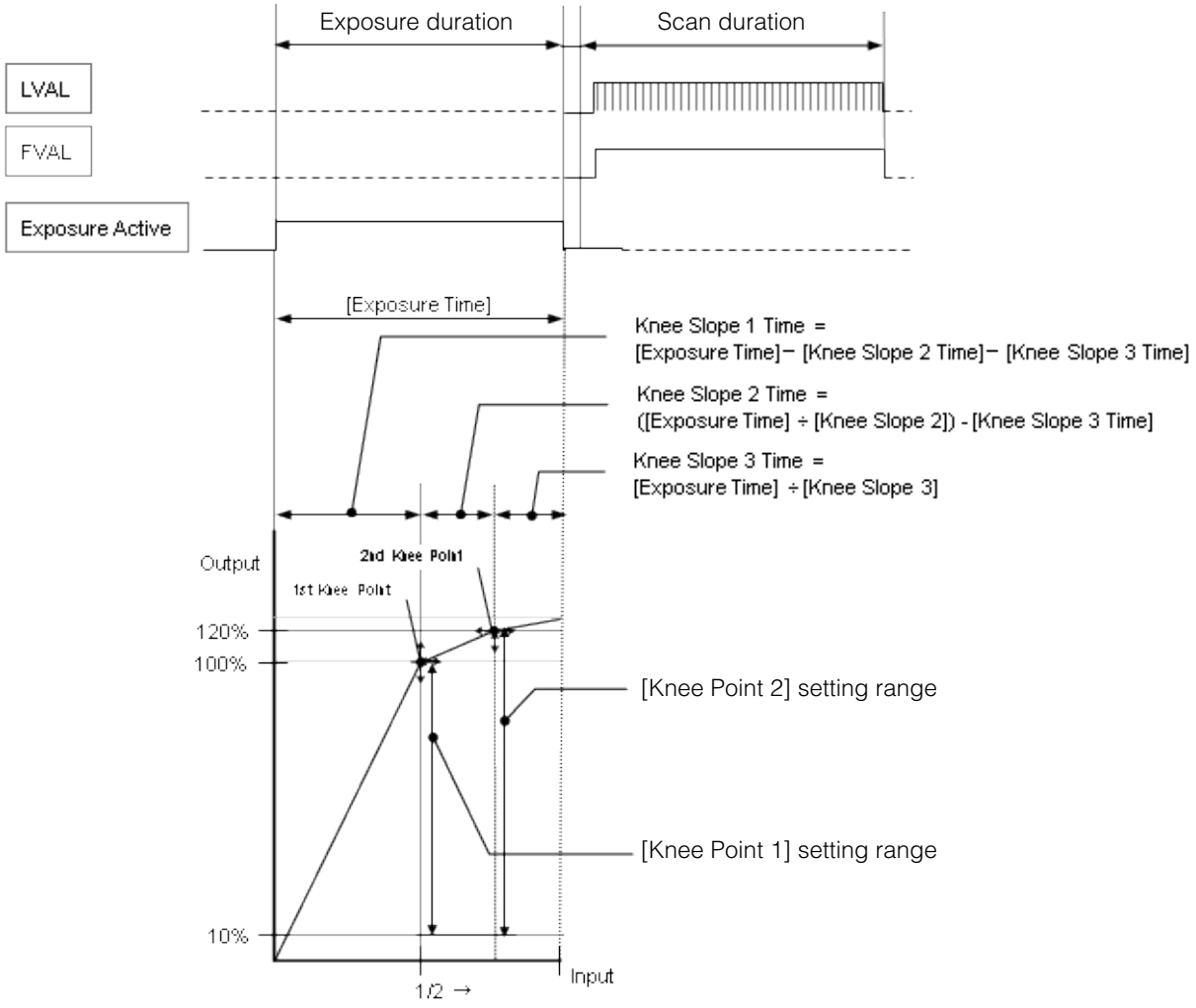
The PIV function allows you to perform exposure and scanning twice in succession in response to a single trigger. This is useful in situations that require quick successive image scans.
The durations for the first and second exposures are different. The first exposure time can be configured freely by the user. After a minimum interval, the second exposure time lasts for one frame.
To capture two images of the same brightness, use a strobe light in a dark room, for example.



HDR (High Dynamic Range) Mode (SP-12000M-CXP4 only)

HDR (high dynamic range) mode is a function that uses the exposure time configured with [Exposure Time] as a base, and allows you to determine input level positions for knee points. You can change the number of knee points from 1 to 2.
Adjust the [Knee Point 1], [Knee Point 2], [Knee Slope 2], and [Knee Slope 3] settings to configure the settings.

Overview of knee point configurations during HDR mode



[Exposure Time] → [Knee Slope 2] or lower

Item	Setting value / selectable range		Description
HDR Mode	On / Off		When [Exposure Mode] is set to [Timed] and [HDR Mode] is set to [On], HDR mode is enabled.
Exposure Time	15 µs (8-bit), 20 µs (10-bit) to 7999999	[Unit: us]	Specify the exposure duration for HDR mode. The knee points during HDR mode are determined by the [Exposure Time] value.
Knee Slope 2	2 to 16 (step=1)		Use this to determine the position of knee point 1 based on the [Exposure Time] value. The knee slope 2 value is a value by which the [Exposure Time] will be divided.

Item	Setting value / selectable range		Description
Knee Slope 3	2 to 16 (step=1)		Use this to determine the position of knee point 2 based on the [Exposure Time] value. The knee slope 3 value is a value by which the [Exposure Time] will be divided.
Knee Point 1	10 to 120 (step =1)	[Unit: %]	Adjust the output level for knee point 1. The [Knee Point 1] setting value must always be less than or equal to that of [HDR Knee Point 2]. You can determine the knee point 1 value using the following formula: [Exposure Time] - ([Exposure Time] ÷ [Knee Slope 2]).
Knee Point 2	10 to 120 (step =1)	[Unit: %]	Adjust the output level for knee point 2. You can determine the knee point 2 value using the following formula: [Exposure Time] - ([Exposure Time] ÷ [Knee Slope 3]).
			The relationship between the number of knee points and knee slope 2 and 3 is as follows.
			(1) Settings for two knee points and three knee slopes [Knee Slope 2] ≤ [Knee Slope 3]
			(2) Settings for one knee point and two knee slopes [Knee Slope 2] > [Knee Slope 3] and [Knee Point1] > [Knee Point 2]
			(3) Settings for no knee points and one knee slope [HDR Mode] = [Off]
Read Slope Number Command	—		Use this command to read the number of knee points generated via the [Knee Point 1], [Knee Point 2], [Knee Slope 2], and [Knee Point 3] settings from the camera.

Video Process Bypass Mode

The Video Process Bypass mode is a function that bypasses internal image processing on the camera. On the SP-12000, DSNU correction and shading, gain, blemish, and black level adjustment are normally performed on the sensor output signal. However, when the Video Process Bypass mode is used, images can be imported to the system without image processing* being performed internally on the camera. The Video Process Bypass mode is ideally used in cases where image processing is performed by the system.
In addition, images are output from the camera in 12-bit format only when the Video Process Bypass function is used.

* Excluding DSNU correction and black level adjustment.

■ Available bit-depth options

CXP output / Sensor output	8-bit	10-bit	12-bit
10-bit	○	○	×
12-bit	○	○	○

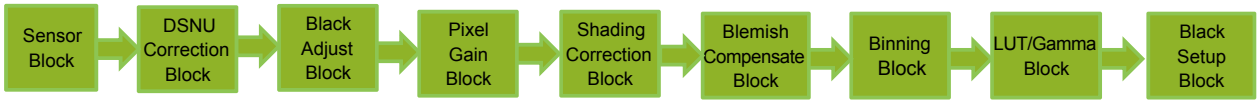
When bypass is enabled, the sensor output and camera output data can be set to the same bit width. Operating using 12-bit outputs must be performed in bypass mode.

CXP output / Sensor output	Video Process Bypass Off	Video Process Bypass On
DSNU Correction	○	○
Black Adjust Set	○	○
Pixel Gain	○	×
Shading Correction	○	×
Blemish Compensation	○	○
Binning	○	×
LUT/Gamma	○	×
Black SETUP	○	○
Test Pattern	○	○
Camera output	8/10 bit	8/10/12 bit

Differences in camera operation

■ When Video Process Bypass mode is disabled

All video processes are enabled.



■ When Video Process Bypass mode is enabled

All video processes except DSNU Correction Block, Black Adjust Block, Blemish Compensate Block and Black Setup Block are disabled.

Settings List

Feature Properties

Regarding the bold and underlined “selector” settings in this list, the various related settings will be stored separately for each selector option.

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

Item	Setting range	Default value	Description
a) Device Control		—	Displays/configure information related to the device.
Standard	—	0xC0A79AE5(3,232,209,637)	Displays the magic number which indicates that the CoaXPress standard is implemented.
Revision	—	0x00010000(65,536)	Displays revisions to the CoaXPress standard.
XmlManifestSize	—	1	Displays the number of XML manifests that can be used.
XmlManifestSelector	0	0	Select the XML to use.
XmlMajorVersion	—	1	Displays the XML version.
XmlMinorVersion	—	0	Displays the XML version.
XmlSubMinorVersion	—	—	Displays the XML version.
XmlSchemaVersion	—	0×00010100(65792)	Displays the XmlSchema version.
XmlUrlAddress	—	0×00007000(28672)	Displays the XML URL string starting address.
IidcPointer	—	0	Displays the IIDC register area starting address. As this is not supported, 0 is displayed.
DeviceVendorName	—	JAI Ltd, Japan	Displays the manufacturer name.
DeviceModelName	—	SP-12000M-CXP4 or SP-12000C-CXP4	Displays the model name.
DeviceManufactureInfo	—	See the possibilities	Displays the device information.
DeviceVersion	—	—	Displays the hardware version.
DeviceFirmwareVersion	—	—	Displays the firmware version.
DeviceFpgaVersion	—	—	Displays the FPGA version.
DeviceFirmware2Version	—	—	Displays the CPU2 firmware version. (not used)
DeviceFpga2Version	—	—	Displays the FPGA2 firmware version. (not used)
DeviceID	—	—	Displays the device ID.
DeviceUserId	Any	—	Set the user ID for the camera.
LinkReset	1	—	Reset the link.
DeviceLinkId		0	Displays the device link ID.
MasterHostLinkId	—	1	Displays the host link ID.
ControlPacketDataSize	2	2	Configure the maximum control data packet size that the host can scan from the device and that can be written to the device (4-byte increments).
StreamPacketDataSize	16 to 4096	3072	Set the packet size for the stream.
LinkConfig	CXP6_X4(0x00040048) CXP6_X2(0x00020048) CXP6_X1(0x00010048) CXP3_X4(0x00040038) CXP3_X2(0x00020038) CXP3_X1(0x00010038)	CXP3_X4(0x00040038)	Configure the LinkConfig settings.
LinkConfigDefault	"CXP3_X4 0x00040038(262200)"	"CXP3_X4 0x00040038(262200)"	Displays the LinkConfig value for operation in the device's default mode.
TestMode	0,1	0	When 0x00000001 entered, enable/ disable transmission of test packets from the device to the host. When enabled, the packet of the current 1024 test word is transmitted.
TestErrorCountSelector	—	0	Set the TestErrorCount register that will be required.
TestErrorCount	—	0	Displays the error count for the current link in regards to the device-side link ID stored on the TestErrorCountSelector register.
DeviceTemperatureSelector	SensorBoard, MainBoard, InterfaceBoard	SensorBoard	Select the area of the camera's interior for which to display the temperature sensor's reading.

Item	Setting range	Default value	Description
DeviceTemperature	—	—	Displays the internal temperature (°C) of the camera.
DeviceReset	—	—	Reset the device.
b) Image Format Control			Configure image format settings.
SensorWidth	—	4096	Displays the maximum image width.
SensorHeight	—	3072	Displays the maximum image height.
SensorDigitizationTaps	10bit 12bit	10bit	Displays the digital tones output from the sensor.
WidthMax	4096	4096	Displays the maximum image width.
HeightMax	3072	3072	Displays the maximum image height.
Width	128 to 4096	4096	Set the image width.
Height	16 to 3072	3072	Set the image height.
OffsetX	0 to 3968	0	Set the horizontal position.
OffsetY	0 to 3056	0	Set the vertical position.
BinningHorizontal	1, 2	1	Set the number of pixels in the horizontal direction for which to perform binning.
BinningVertical	1, 2	1	Set the number of pixels in the vertical direction for which to perform binning.
PixelFormat	SP-12000M-CXP4: 8 Bit Monochrome, 10 Bit Monochrome, 12 Bit Monochrome (Video Process Bypass mode only) SP-12000C-CXP4: 8 Bit BayerGB, 10 Bit BayerGB, 12 Bit BayerGB (Video Process Bypass mode only)	SP-12000M-CXP4: 8 Bit Monochrome SP-12000C-CXP4: 8 Bit BayerGB	Set the pixel format.
TestPattern	Off, Grey Horizontal Ramp, Grey Vertical Ramp, Grey Horizontal RampMoving, HorizontalColorBar (color only), VerticalColorBar (color only), MovingColorBar (color only)	Off	Select the test image.
TapGeometry	0: Tap_1X_1Y	0: Tap_1X_1Y	Displays the TapGeometry settings.
c) Acquisition Control			Configure image acquisition settings.
AcquisitionMode		Continuous	Select the image acquisition mode.
AcquisitionStart	—	—	Start image acquisition.
AcquisitionStop	—	—	Stop image acquisition.
AcquisitionFrameCount	1 to 65535	153	In [Multi Frame] mode, set the number of frames to acquire.
Acquisition Frame Rate* * Frame period depends on ROI, pixel format, and binning mode selected."	0.125 to 189.7*	94.8767	In [Multi Frame] mode, set the number of frames to acquire. * The fastest value depends on the setting of the Link Config.
AcquisitionStatusSelector			
AcquisitionStatus			
TriggerSelector	Acquisition Start, Acquisition End, Frame Start	Frame Start	Select the trigger operation.
TriggerMode	Off, On	Off	Select the trigger mode.
TriggerSoftware	—	—	Execute a software trigger
TriggerSource	Low, High, Software, P ulse Generator 0, User Output 0, User Output 1, Line 4, Line 5, Line 10, Line11, NAND0 Out, NAND1 Out	Line 4	Select the trigger signal source.
TriggerActivation	Rising Edge, Falling Edge, Level High, Level Low	Rising Edge	Select the polarity of the trigger signal (i.e., location of signal at which trigger is applied).
TriggerOverlap	Off, On	Off	Select the trigger overlap operation.
ExposureMode	Off, Timed, Trigger Width	Timed	Select the exposure mode.

Item	Setting range	Default value	Description
ExposureTime	15@8bit 20@10bit to 7999999	10486	Set the exposure time. The maximum value varies depending on the [Acquisition Frame Rate Raw] value.
ExposureTimeRaw	15@8bit 20@10bit to 7999999	10486	Set the raw exposure time.
ExposureAuto	Off, Continuous	Off	Set whether to enable auto exposure.
d) Analog Control			Configure analog control settings.
GainSelector	SP-12000M-CXP4: Digital All SP-12000C-CXP4: Digital All, Digital Red, Digital Blue	Digital All (master gain)	Select the gain to configure.
Gain	DigitalAll: 1 to 16 DigitalRed,Blue: 0.4467 to 56235	Master gain: 1 R, B: 1	Set the gain value.
GainRaw	DigitalAll: 100 to 1600 DigitalRed: –4533 to 37876	Digital All: 100 Digital Red & Blue: 0	Set the raw gain value.
BlackLevelSelector	SP-12000M-CXP4: RawDigital All SP-12000C-CXP4: RawDigital All, RawDigital Red, RawDigital Blue	RawDigital All (master black)	Select the black level to configure.
BlackLevel	RawDigitalAll -133 to 255 l,RawDigitalRed, RawDigitalBlue -133 to 255	0	Set the black level value.
GainAuto	Off, Once, Continuous	Off	Enable/disable gain auto control.
BalanceWhiteAuto	Off, On	Off	Enable/disable auto white balance.
LutMode	Off, Gamma, LUT	Off	Select the JAI LUT mode.
Gamma	1.0 to 0.45	0.45	Set the gamma value.
e) Digital IO Control			Configure settings for digital input/output.
LineSelector	Line1 - TTL Out 1, Line2 - Opt Out 1, Line4 - TTL In 1, Line5 - Opt In 1, Line7 - CXP In, Line8 - TTL Out 2, Line9 - TTL Out 3, Line10 - TTL In 2, Line11 - LVDS In, NAND Gate 0 In 1, NAND Gate 0 In 2, NAND Gate 1 In 1, NAND Gate 1 In 2	Line1 - TTL Out 1	Select the input/output to configure.
LineMode	—	Output	Displays 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	—	—	Displays the status of the input signal or output signal (True: High, False: Low).
LineSource	Low, High, Acquisition Trigger Wait, Frame Trigger Wait, Frame Active, Exposure Active, FVAL, User Output 0 to 3, Line 4 - TTL In 1, Line 5 - Opt In 1, Line10 - TTL In 2, Line11 - LVDS In, Pulse Generator 0 to 3, Nand 0 Out, Nand 1 Out	Low	Select the line source signal for the item selected in [Line Selector].
LineFormat	—	TTL Out	Displays the current I/F type.
UserOutputSelector	User Output 0, User Output 1, User Output 2, User Output 3	User Output 0	Set the user output signal.
UserOutputValue	True, False	False	
f) Pulse Generators			Configure pulse generator settings.

Item	Setting range	Default value	Description
PreScaler	1 to 4096	1	Set the division value for the prescaler (12-bit) using the pixel clock as the base clock.
PulseGeneratorSelector	Pulse Generator 0, Pulse Generator 1, Pulse Generator 2, Pulse Generator 3	Pulse Generator 0	Select the pulse generator.
PulseGeneratorLength	1 to 1048575	1	Set the count-up value (clock value) for the pulse generator.
PulseGeneratorStartPoint	0 to 1048574	0	Set the active output start count value for the pulse generator.
PulseGeneratorEndPoint	1 to 1048574	1	Set the active output stop count value for the pulse generator.
PulseGeneratorRepeatCount	0 to 255	0	Set the repeat count for the pulse generator.
PulseGeneratorClearActivation	Off, High Level, Low Level, Rising Edge, Falling Edge	Off	Set the clear signal condition for the count clear input of the pulse generator.
PulseGeneratorClearSource	Low, High, Acquisition Trigger Wait, Frame Trigger Wait, Frame Active, Exposure Active, FVAL, User Output 0, User Output 1, Line4 - TTL In 1, Line5 - Opt In 1, Line7 - CXP In, Line10 - TTL In 2, Line11 - LVDS In, Nand 0 Out, Nand 1 Out	Low	Select the count clear input signal source.
PulseGeneratorInverter	True, False	False	Select whether to invert the polarity of the count clear input signal.
PulseGeneratorClearSyncMode	Async Mode, Sync Mode	Async Mode	Select the sync mode for the count clear input signal.
g) LUTControl			Configure LUT settings.
LutSelector	R, G, B	R	Select the LUT channel to control.
LutIndex	0 to 255	0	Set the LUT index table number.
LutValue	0 to 4095	0	Set the LUT value.
h) UserSetControl			
UserSetSelector	Default, User Set1 to 3	Default (factory default values)	Select the user settings.
UserSetLoad	—	—	Load user settings.
UserSetSave	—	—	Save the current setting values as user settings.
i) JAICustomControl			Configure JAI ALC settings. These settings are also used for AGC (auto gain control).
TriggerOption	Off,PIV	Off	When [ExposureMode] is set to [Timed], select from normal trigger operation or PIV operation.
ALCReference	10 to 100	50	Set the target level for ALC. (unit: %)
ALCAreaSelector	Low Right to High Left	Low Right	Select an ALC metering area.
ALCAreaEnable	True, False	False	"Enable/disable the metering area where selected metering area."
ALCAreaEnableAll	0 to 1	1	Set whether to enable ALC for all areas.
AutoShutterControlExposureMin	100 to 7999998	100	Set the minimum value for the ASC range.
AutoShutterControlExposureMax	101 to 7999999	7999999	Set the maximum value for the ASC range.
AutoGainControlGainRawMin	100 to 1599	100	Set the minimum value for the AGC range.
AutoGainControlGainRawMax	101 to 1600	1600	Set the maximum value for the AGC range.
ALCControlSpeed	Min(1) to Max(8)	4	"Set the reaction speed for AGC/ASC. These settings are also used for auto exposure control."
AWBAreaSelector	Low Right to High Left	Low Right	Select the AWB (auto white balance) measurement area.
AWBAreaEnable	True, False	False	Enable/disable the selected measurement area.

Item	Setting range	Default value	Description
AWBAreaEnableAll	0 to 1	1	Enable/disable the all measurement area.
BlemishReductionEnable	True, False	True	Set whether to enable white blemish correction.
BlemishReductionCalibration	—	—	Set whether to enable white blemish correction.
BlemishDetectThreshold	0 to 100	0	Set the white blemish detection threshold.
BlemishDataIndex	0 to 1000	0	Select the index table for the white blemish detection position.
BlemishDataPositionX	–1 to 4095	–1	Set the horizontal position.
BlemishDataPositionY	–1to 3071	–1	Set the vertical position.
BlemishDataNum	0 to 1000	—	Displays the number of blemish correction points executed.
ShadingMode	SP-12000M-CXP4 Flat Shading (fixed) SP-12000C-CXP4 Flat Shading, Color Shading	Flat Shading	Select the shading correction mode.
ShadingCorrectionMode	Off, User 1, User 2, User 3	Off	Select whether to use shading correction. When using the function, select the user area to which to save the shading correction value.
ShadingCalibration	0	—	Execute shading correction. After execution, the shading correction value is automatically saved to the selected user area.
DsnuCorrect	Off, On	Off	Enable/disable DSNU correction.
DsnuDetect	0	—	Re-adjust the correction data for DSNU correction.
VideoSendModeSelector	Normal Mode, Trigger Sequence Mode, Command Sequence Mode, Multi Mode	Normal Mode	Select the video send mode.
SequenceRoiIndex	Index 1to 128	Index 1	Select the sequence ROI index table.
SequenceRoiFrameCount	1 to 255	1	Set the frame count.
SequenceRoiNextIndex	Index 1 to 128, Off	Index 1	Select the next index. When [Off] is selected, sequence operation will stop with this index.
SequenceRoiWidth	128 to 4096/16 steps	4096	Set the width.
SequenceRoiHeight	16 to 3072/2 steps	3072	Set the heigh.
SequenceRoiOffsetX	0 to 3968/16 steps	0	Set the horizontal position.
SequenceRoiOffsetY	0 to 3056/2 steps	0	Set the vertical position.
SequenceRoiGain	100 to 1600	100	Set the gain value.
SequenceRoiGainR	0.4467 to 56235	0	
SequenceRoiGainB	0.4467 to 56235	0	
SequenceRoiExposureTime	15@8bit 20@10bit to 7999999	10486	Set the exposure time.
SequenceRoiBlackLevel	–133 to 255	0	Set the black level.
SequenceRoiLutEnable	Off, On	Off	Set whether to enable the LUT.
SequenceRoiHBinning (SP-12000M-CXP4 only)	1 to 2	1	Set the number of pixels in the horizontal direction for which to perform binning.
SequenceRoiVBinning (SP-12000M-CXP4 only)	1 to 2	1	Set the number of pixels in the vertical direction for which to perform binning.
SequenceRoiRepetition	1 to 255	1	Set the repeat count for the sequence.
NextSequenceIndex	Index 1 to 128	Index 1	Set the sequence index command.
MultiRoiIndex	Index 0 to 31	Index 1	Set the Multi ROI index table.
MultiRoiWidth	128 to 4096/16 steps	4096	Set the width. When binning is enabled on the SP-12000M-CXP4, the maximum value will change.
MultiRoiHeight	16 to 3072/2 steps	3072	Set the height. When binning is enabled on the SP-12000M-CXP4, the maximum value will change.
MultiRoiOffsetX	0 to 3968/16 steps	0	Set the horizontal position. When binning is enabled on the GO-5000M-USB, the maximum value will change.
MultiRoiOffsetY	0 to 3056/2 steps	0	Set the vertical position. When binning is enabled on the SP-12000M-CXP4, the maximum value will change.
MultiRoiIndexMax	Index 0 to 31	Index 1	Set the Multi ROI index count.
Video Process Bypass	Off, On	Off	Set whether to bypass the areas on which DigitalGain is applied within the FPGA.
HDRModeSelector	0, 1	0	Enable/disable HDR.

Item	Setting range	Default value	Description
HDRKneeSlope2	2 to 16	2	Set the second HDR slope.
HDRKneeSlope3	2 to 16	2	Set the third HDR slope.
HDRKneePoint1	10 to 120	100	Set the level at which to switch the first and second HDR slopes.
HDRKneePoint2	10 to 120	100	Set the level at which to switch the second and third HDR slopes.
BinningGainEnable	0, 1	0	Set whether to add pixels or average pixels during Binning.
OptInFilterSelector	0 to 6	0	Set the digital filter time for the Opto input.
StreamOption	0, 1	0	Set whether to optimize the stream packet interval according to the frame rate or use the fastest interval.
j)CounterAndTimer Control			Configure counter settings. (This camera only supports counter functions.)
Counter0 to 3	Counter 0 to 3	—	Select the counter.
Counter0 to 3 EventSource	Off, Frame Trigger, Frame Start, Exposure Start, Exposure Transfer End	Off	Select the counter event signal for which to read the count value.
Counter0 to 3 EventActivation	Rising Edge, Falling Edge	—	Specify the timing at which to count.
Counter0 to 3 Reset	—	—	Reset the counter.
Counter0 to 3 Refresh	—	—	Update the count value.
Counter0 to 3 Value	—	0	Displays the count value.
Counter0 to 3 Status	—	Counter Active	Displays the counter status.

Settings

❖ For details on the setting items, refer to the JAI Control Tool User's Guide

Item	Setting range	Default value
32-bit Factory Transport Layers		
Available 32-bit Transport Layers	—	Transport Layers
Active_Silicon_FireBird	—	TLActiveSilicon
Transport name		Active_Silicon_FireBird
Full path to cti file	—	TLActiveSilicon.cti
Enabled	True, False	False
Display name	—	TLActiveSilicon
AvalData	—	AvalData
Transport name		AvalData
Full path to cti file	—	avaldata.tf.GenTL.cti
Enabled	True, False	False
Display name	—	AvalData
BitFlow_CXP_Framegrabber	—	BitFlow_CXP
Transport name		BitFlow_CXP_Framegrabber
Full path to cti file	—	BFGTL.cti
Enabled	True, False	False
Display name	—	BitFlow_CXP
64-bit Factory Transport Layers		
Active_Silicon_FireBird	—	TLActiveSilicon
Transport name		Active_Silicon_FireBird
Full path to cti file	-	C:\program Files\Active Silicon\ FireBird CXP\GenTL\win64\ TLActiveSilicon.cti
Enabled	True, False	False
Display name	-	TLActiveSilicon
AvalData	—	AvalData
Transport name		AvalData
Full path to cti file	—	avaldata.tf.GenTL.cti
Enabled	True, False	False
Display name	—	AvalData
BitFlow_CXP_Framegrabber	—	BitFlow_CXP
Transport name		BitFlow_CXP_Framegrabber
Full path to cti file	—	BFGTL.cti
Enabled	True, False	False
Display name	—	BitFlow_CXP
Asynchronous Image Recording		
Recording Count	—	025
Recording Skip Count	—	000

Item	Setting range	Default value
Recording mode	List, CyclicBuffer	List
Optimize the AVI-file creation for Mono8	True, False	True
Prompt user for AVI Encoder	True, False	True
CXP Transport Layer		
Sync Remote And Local Devices	True, False	True
File Save		
File Format	Tiff, Jpeg, Bmp, Jai, RAW	Tiff
Encoder parameter	—	075
Look-and-feel		
Visibility Level	Beginner, Expert, Guru	Beginner
HEX display	True, False	False
Display ToolTips	True, False	True
Floating-Point Display Notation	Automatic, Fixed, Scientific	Automatic
Floating-Point Display Precision	—	005
Display the Remote device layer at the top of the tree (transport at the bottom)	True, False	True
Refresh Property Grid After Editing	True, False	False
Override TrackBar Floating-point display precision settings	True, False	False
Make the control tool appear on top of images	True, False	False
Timestamp display format	Ticks, MSec, PTP	Ticks
Plugins		
Search path for plugin DLLs	—	.\plugins
Enable the plug-in button on the menu tab	True, False	False
Support		
Open settings file after save	True, False	True
Support EMail Address	—	camerasupport@jai.com
Logging Properties		
Enable logging	True, False	False
Use custom properties file	True, False	False
Custom logging properties file path		
Output log file path		
Enable GenApi logging	True, False	False
Enable GenTL logging	True, False	False
Enable CIProtocol logging	True, False	False
Enable USB logging	True, False	False
Log Level	FATAL, ALERT, CRIT, ERROR, WARN, NOTICE, INFO, DEBUG, NOTEST	INFO
Format string	—	LOG %d %x: %c :%m%n
Append To Log file	True, False	FALSE
Video Display		
Stretch Live Video	True, False	True
Restore Live Video Window	True, False	True
Skip image display when busy	True, False	True
Enable Color Interpolation	True, False	True
Color Interpolation	BayerStandard, BayerStandardMultiprocessor, BayerExtended, BayerExtendedMultiprocessor, BayerSimple, BayerSimpleMultiprocessor, BayerFast, BayerFastMultiprocessor	BayerStandard
Show Zoom Navigation window	True, False	True
Show Cursor Information window	True, False	False
Enable Mouse Zoom	True, False	True
Enable Mouse Cursor Display	True, False	False

Miscellaneous

Troubleshooting

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

■ Power supply and connections

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

■ 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 38).

■ Settings and operations

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

Specifications

Item				SP-12000M-CXP4	SP-12000C-CXP4
Scanning system				Progressive scan, 1 tap	
Synchronization				Internal	
Interface				CoaXPress Ver. 1.0	
Image sensor				APS-C monochrome CMOS	APS-C Bayer color CMOS
Aspect ratio				4:3	
Image size (effective image)				22.5 (H) × 16.9 (V), 28.16 mm diagonal	
Pixel size				5.5 (H) × 5.5 (V) µm	
Effective image pixel output				4096 (H) × 3072 (V)	4096 (H) × 3072 (V)
Acquisition Frame Rate (max) ❖ The minimum value is 0.125 fps for all.	8-bit	H1, V1		189 fps	189 fps
		Binning	H1, V2	189 fps	N/A
			H2, V1	189 fps	N/A
			H2, V2	189 fps	N/A
	10-bit	H1, V1		132 fps	132 fps
		Binning	H1, V2	132 fps	N/A
			H2, V1	132 fps	N/A
			H2, V2	132 fps	N/A
EMVA 1288 parameters Absolute sensitivity Maximum SN ratio				At 10-bit output 35.54p (λ = 525 nm) 40.45 dB	At 10-bit output 49.24p (λ = 525 nm) 36.63 dB
SN ratio (traditional method)				53 dB (typical) (0 dB gain, Black)	50 dB (typical) (0 dB gain, Green Black)
Digital image output format	Full pixel			4096 (H) × 3072 (V)	Bayer 4096 (H) × 3072 (V)
	ROI	Width		128 to 4096, 16 pixels/step	128 to 4096, 16 pixels/step
		Offset X		0 to 3968, 16 pixels/step	0 to 3968, 16 pixels/step
		Height		16 to 3072, 2 lines/step	16 to 3072, 2 lines/step
		Offset Y		0 to 3056, 2 lines/step	0 to 3056, 2 lines/step
	Binning	H	1	4096 (H)	4096 (H)
			2	2048 (H)	—
		V	1	3072 (V)	3072 (V)
			2	1536 (V)	—
	Pixel Format			Mono8, Mono10	BayerGB8, BayerGB10
Acquisition modes				Continuous, Single Frame, Multi Frame (1 to 65535)	
Trigger selector	Acquisition			Acquisition Start, Acquisition Stop	
	Exposure			Frame Start	
Exposure modes				Off, Timed (EPS), Trigger Width (PWC)	
Trigger options				OFF, PIV	
Trigger overlap				Read Out, Off	
Trigger input signals				Line 4 (TTL Input1), Line 5 (Opto Input), Line7 (CXP In), Line 10 (TTL Input2), Line 11 (LVDS Input), Software, PG (0-3), NAND Out (0-1)	
Option filter				7 steps (Off, 10 µs (Typ), 100 µs, 500 µs, 1ms, 5ms, 10ms)	
Exposure modes	Timed			15 or 20 µs (min) to 8 s (max), variable unit: 1 µs ❖ Performance verified for up to 1 second.	
	Trigger Width			15 µs (8 bit) or 20 µs (10 bit) (min) to ∞ (max) ❖ Performance verified for up to 1 second.	
Auto exposure (Exposure Auto)				Off, Continuous	
Auto exposure response speed (AGC/ASC Control Speed)				1 to 8	
Video Send Mode Selector				Normal ROI, Multi ROI (1 to 32), Trigger Sequence, Command Sequence	
Digital I/O				Line Selector (12P/AUX): GPIO IN / GPIO OUT	
Black level adjustment	Reference level			33.5LSB (during 10-bit output) (average value of 100 × 100)	
	Video level adjustment range			0 to 100 (during 10-bit output)	
	Adjustment range			±64LSB against reference level (during 10-bit output)	
	Resolution adjustment			1 STEP = 0.25LSB	

Item			SP-12000M-CXP4	SP-12000C-CXP4
Gain adjustment	Manual adjustment range		0 dB to +24 dB 1 step = x0.01 (0.005 dB to 0.08 dB) (varies by setting value)	0 dB to +24 dB 1 step = x0.01 (0.005 dB to 0.08 dB) (varies by setting value)
	Auto gain		Off, Continuous	Off, Continuous
	WB gain		—	R / B: –7 dB to +15 dB, 1 step = 0.01 dB
	WB area		—	16 (4 × 4) Area
	WB range		—	3000 K to 9000 K
	White balance		—	Off, Continuous, Once
Blemish correction	Detection		Detect white blemishes using threshold values (black blemish correction performed only at factory)	
	Correction		Interpolation using adjacent pixels (continuous blemishes not corrected)	
	Correctable pixels		1000 pixels	
ALC			Can be adjusted automatically together with AGC and auto exposure	
Gamma			0.45, 0.5, 0.55, 0.6, 0.65, 0.75, 0.8, 0.9, 1.0 (9 steps)	
Dark compression			Linear	
LUT			OFF: γ = 1.0, ON = 256 points can be set	
HDR modes			Slope: x2 to x16, Knee point (range: 10 to 120)	—
Power supply	12-pin connector	Input range	DC +12 V to +24 V ±10% (via input terminal)	
		Current	1000 mA ±20 mA (at 12 V input, full pixel) (Typical) (Option: XT model with fan: 1040 mA)	
		Power consumption	12.0 W (at 12 V input, full pixel) (Typical) (Option: XT model with fan: 12.48 W)	
	PoCXP	Input range	DC 24 V ±2 V	
		Current	500 mA (at 24 V input, full pixel) (Typical) (Option: XT model with fan: 520 mA)	
		Power consumption	12.0 W (at 24 V input, full pixel) (Typical) (Option: XT model with fan: 12.48 W)	
Lens mount			F-mount	
Flange back			46.5, tolerance: 0 mm to –0.05 m	
Optical filter			Protective glass: Not provided	IR cut filter (half value of 670 nm)
Verified performance temperature / humidity			–5°C to +30°C / 20% to 80% (non-condensing) (Option: XT model with fan: –5°C to +40°C)	
Operating temperature / humidity			–5°C to +40°C / 20% to 80% (Option: XT model with fan: –5°C to +45°C)	
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)			62 × 62 × 127.5 mm (WHD) (excluding mount protrutions)	
Weight			510 g	

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

Package contents

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

Optional accessories (not supplied)

MP-42 tripod mount
AC adapter

Design and specifications are subject to change without notice.

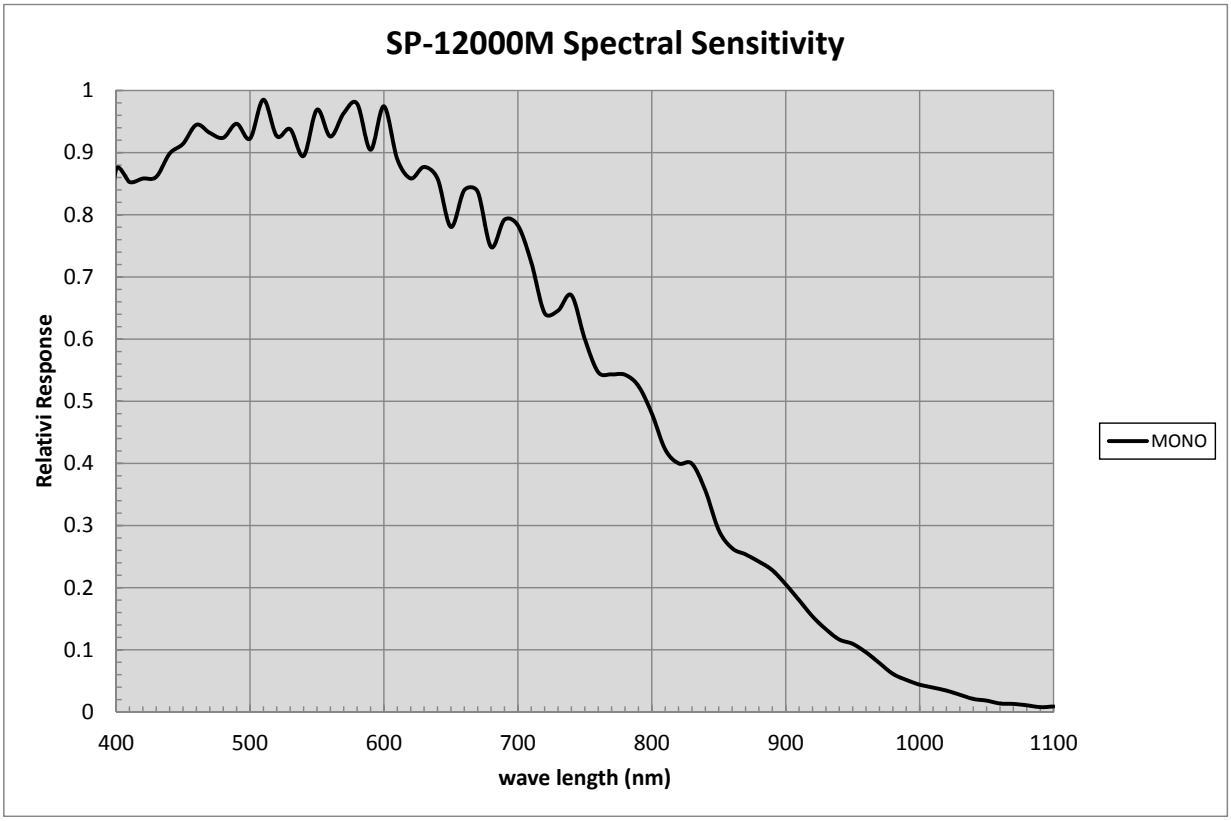
Frame Rate Reference

(Theoretical value: decimal values are dropped)

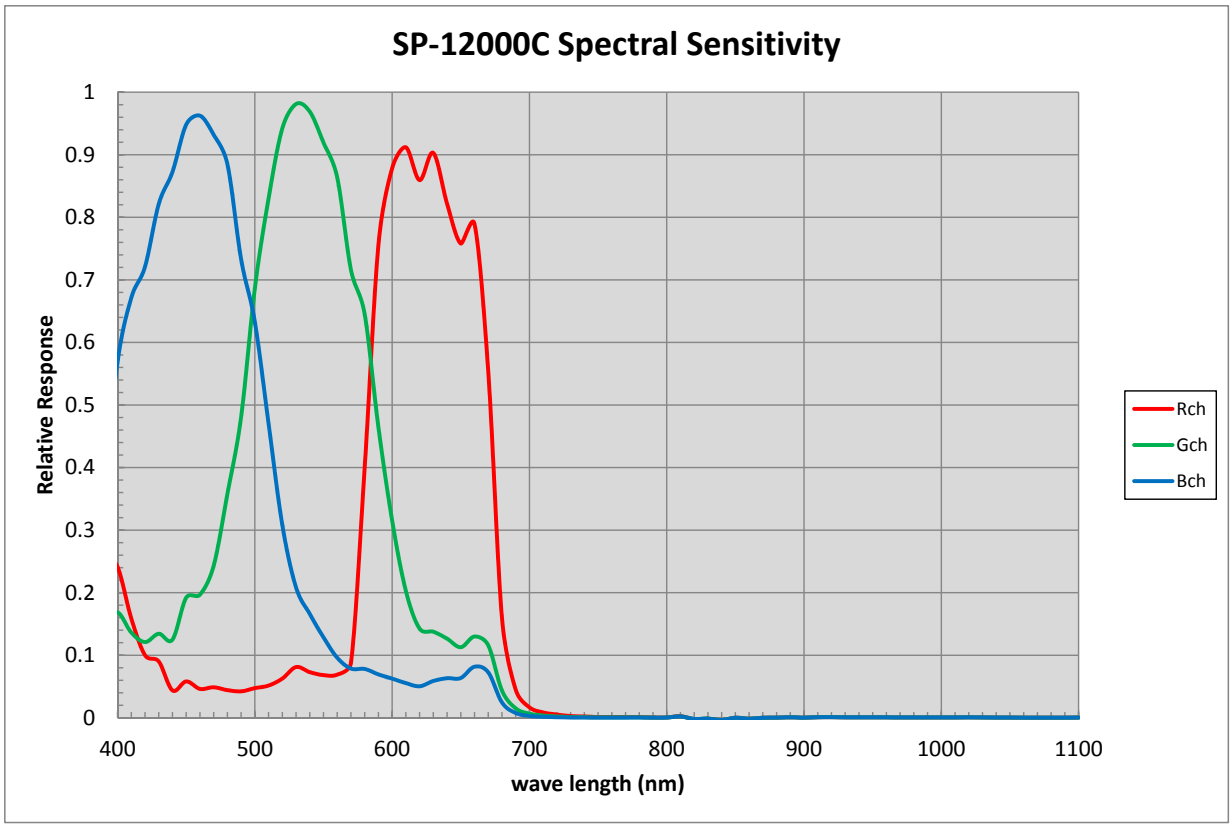
Pixel count	Resolution	Sensor scanning resolution	ROI/Binning	Pixel size (µm)	Image size	Frame rate
12 MP	4096 × 3072	4096×3072	Full pixel	5.5 × 5.5	APS size (2") (28.16 mm diagonal)	189 fps (@8-bit) 132 fps (@10-bit)
3 MP	2048 × 1536	2048×1536	ROI	5.5 × 5.5	1/1.1" (14.08 mm diagonal)	396 fps (@8-bit) 262 fps (@10-bit)
2 MP	1920 × 1080	1920×1080	ROI	5.5 × 5.5	1/1.3" (12.12 mm diagonal)	559 fps (@8-bit) 371 fps (@10-bit)
1.4 MP	1392 × 1052	1392×1052	ROI	5.5 × 5.5	1/1.7" (9.59 mm diagonal)	574 fps (@8-bit) 381 fps (@10-bit)
1.3 MP	1280 × 1024	1280×1024	ROI	5.5 × 5.5	1/1.8" (9.02 mm diagonal)	589 fps (@8-bit) 391 fps (@10-bit)
0.5 MP	800 × 600	800×600	ROI	5.5 × 5.5	1/2.9" (5.50 mm diagonal)	987 fps (@8-bit) 660 fps (@10-bit)
0.5 MP	800 × 600 (Mono only)	1600×1200 (Mono only)	ROI + 2×2 Binning	11.0 × 11.0	1/1.4" (11.00 mm diagonal)	505 fps (@8-bit) 335 fps (@10-bit)
0.3 MP	640 × 480	640×480	ROI	5.5 × 5.5	1/3.6" (4.40 mm diagonal)	1220 fps (@8-bit) 819 fps (@10-bit)
0.3 MP	640 × 480 (Mono only)	1280×960 (Mono only)	ROI + 2×2 Binning	11.0 × 11.0	1/1.8" (8.80 mm diagonal)	627 fps (@8-bit) 417 fps (@10-bit)

Spectral Response

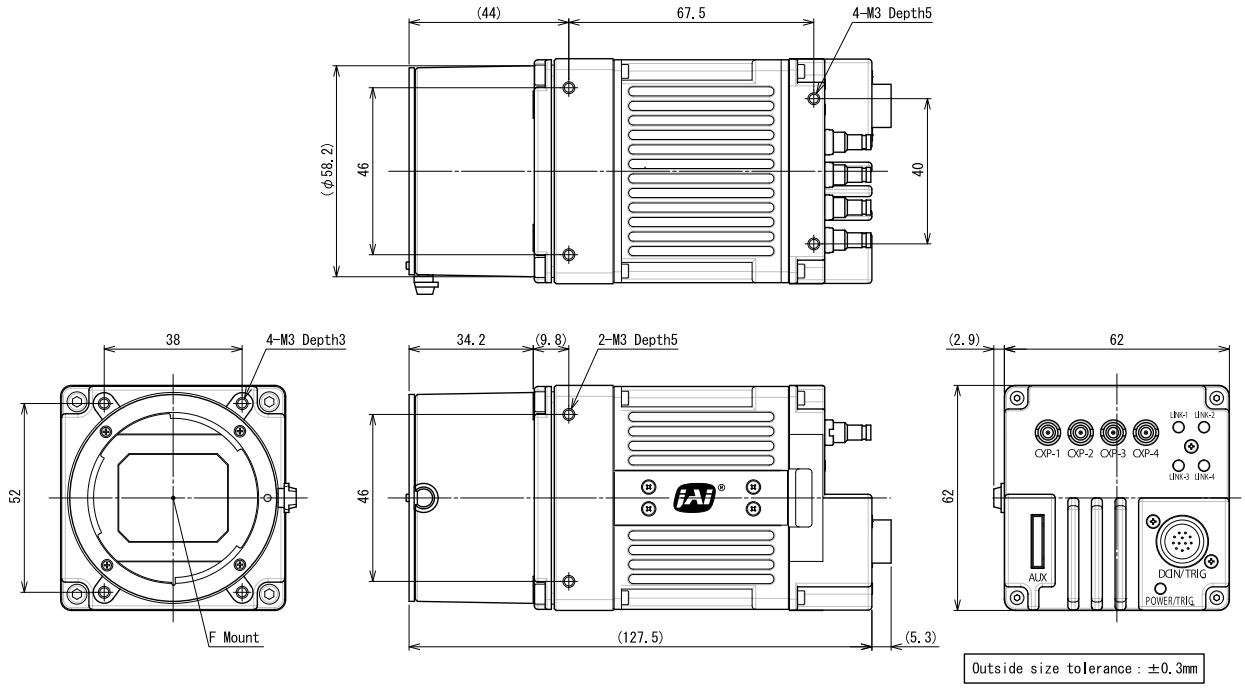
SP-12000M-CXP4



SP-12000C-CXP4



Dimensions



User's Record

Camera type: SP-12000M-CXP4 / SP-12000C-CXP4

Revision: ……..

Serial No. ……..

Firmware version. ……..

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

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Revision History

Revision	Date	Changes
1.0	May 2016	First edition
1.1	Sept. 2016	Revised frame rate frequency calculation formulas and frame rate values (p. 28, 32 to 34, 38, 66)
1.2	Jan. 2021	China RoHS