See the possibilities

User Manual

SP-12400M-PMCL
SP-12400C-PMCL

12M CMOS Digital Progressive Scan Monochrome and color Camera Document Version: 1.1
SP-12400MC-PMCL_Ver.1.1_Oct.2018

Thank you for purchasing this product.

⚠ Be sure to read this manual before use.

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

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

Contents

Notice

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-12400-PMCL complies with the following provisions applying to its standards.
EN 61000-6-3 (Generic emission standard part 1)
EN 61000-6-2 (Generic immunity standard part 1)

FCC

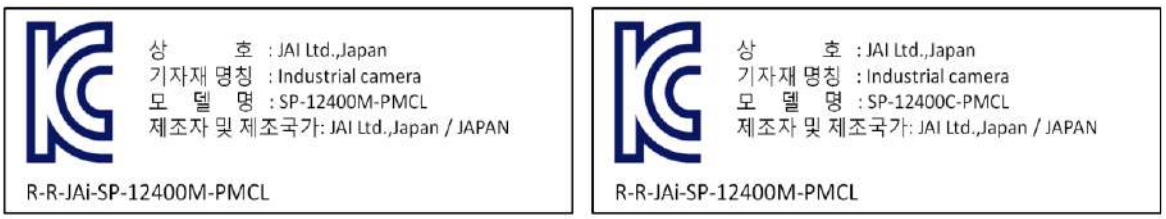
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate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

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

Warning

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

KC



제조년월은 제품상자의 라벨을 참조하십시요

Supplement

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

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

重要注意事项

有毒，有害物质或元素名称及含量表

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

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

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

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

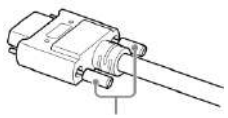
Usage Precautions

Notes on cable configurations

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

Notes on Camera Link cable connections

Secure the locking screws on the connector manually, and do not use a driver. Do not secure the screws too tightly. Doing so may wear down the screw threads on the camera.
(Tightening torque: 0.291±0.049 N·m or less)



Secure manually.
Do not secure too tightly.

Notes on attaching the lens

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

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

Phenomena specific to CMOS image sensors

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

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

Notes on exportation

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

Features

The SP-12400M-PMCL/SP-12400C-PMCL is an industrial progressive scan camera equipped with a 1.1-inch global shutter CMOS image sensor with 12.37 effective megapixels. The SP-12400M-PMCL/SP-12400C-PMCL is part of JAI's Spark Series, which provides an attractive combination of high resolution, high speed, and high image quality for machine vision applications.

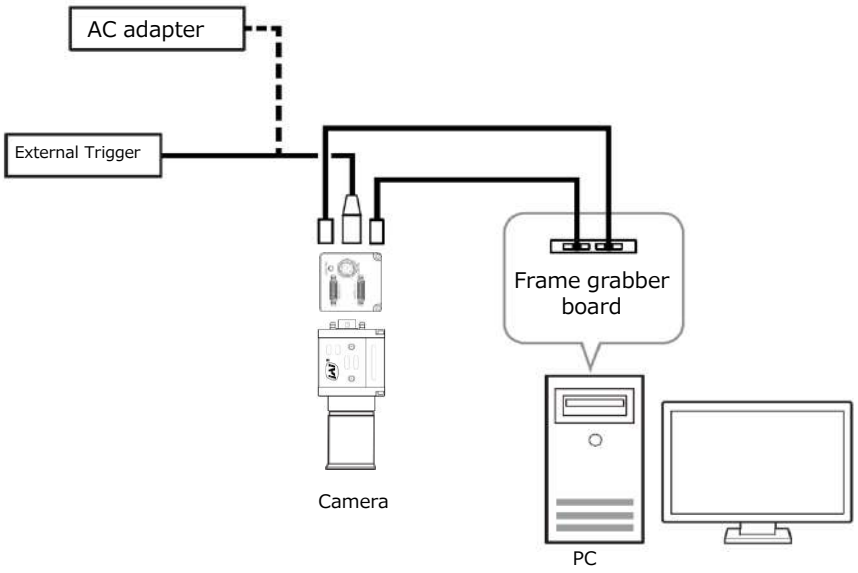
This camera is equipped with various functions required for machine vision including external trigger, exposure setting, image level control, look-up table, shading correction, blemish compensation, ROI, binning, etc.

*) The SP-12400M-PMCL produces monochrome output while the SP-12400C-PMCL produces Bayer output.

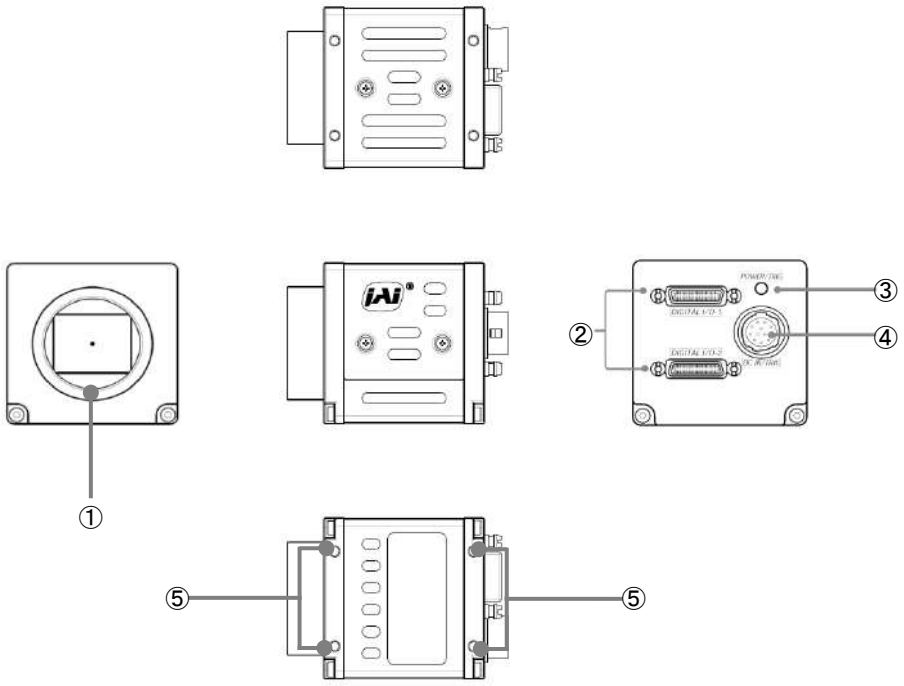
Feature overview

- Compliance with Camera Link and GenICam standards
- 1.1-inch 12.37 megapixel Global Shutter high resolution CMOS sensor
- Lens mount: C-mount (flange back: 17.526 mm)
- Pixel size : 3.45 um × 3.45 um
- Effective pixels 4112(H) x 3008(V)
  (The number of effective pixels varies depending on the setting of ClConfiguration and TapGeometry)
- Up to 64.6 fps at full resolution
- Gamma correction circuit that uses lookup tables
- Color matrix that allows faithful color reproduction
- Internal test signal for settings configuration

Connection example:

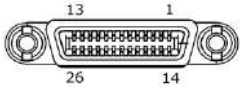


Parts Identification



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

② Mini Camera Link connector (DIGITAL I/O-1, DIGITAL I/O-2)
Connect a cable that is compatible with Mini Camera Link (SDR) connectors here.



Pin No.	Input/Output	Signal	Description
1, 26		Power	Power
2(−), 15(+)	Out	X_OUT0	Data out
3(−), 16(+)	Out	X_OUT1	Data out
4(−), 17(+)	Out	X_OUT2	Data out
5(−), 18(+)	Out	X_Clk	CL Clock
6(−), 19(+)	Out	X_OUT3	Data out
7(+), 20(−)	In	SerTC (RxD)	LVDS Serial Control
8(−), 21(+)	Out	SerTFG (TxD)	
9(−), 22(+)	In	CC1 (Trigger)	JAI standard trigger
10(+), 23(−)	In	CC2 (Reserved)	
11,24		N.C.	
12,25		N.C.	
13,14		Shield	GND

Connector 2

Pin No.	Input/Output	Signal	Description
1, 26		Power	Power
2(−), 15(+)	Out	Y_OUT0	Data out
3(−), 16(+)	Out	Y_OUT1	Data out
4(−), 17(+)	Out	Y_OUT2	Data out
5(−), 18(+)	Out	Y_Clk	CL Clock
6(−), 19(+)	Out	Y_OUT3	Data out
8(−), 21(+)	Out	Z_OUT0	Data out
9(−), 22(+)	Out	Z_OUT1	Data out
10(+), 23(−)	Out	Z_OUT2	Data out
11(−), 24(+)	Out	Z_CLK	CL Clock
12(+), 25(−)	Out	Z_OUT3	Data out
13,14		Shield	GND

Camera side: HONDA HDR-EC26FYTG2-SL+
Cable : SDR connector cable for PoCL

◇ When using cables not compatible with the Camera Link standard, fine type, high bending type, the cable length that can be transmitted is limited.

③ POWER/TRIG LED

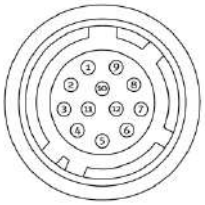
Indicates the power and trigger input status.

LED status and camera status

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

④ DC IN/TRIG connector（12-pin round）

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



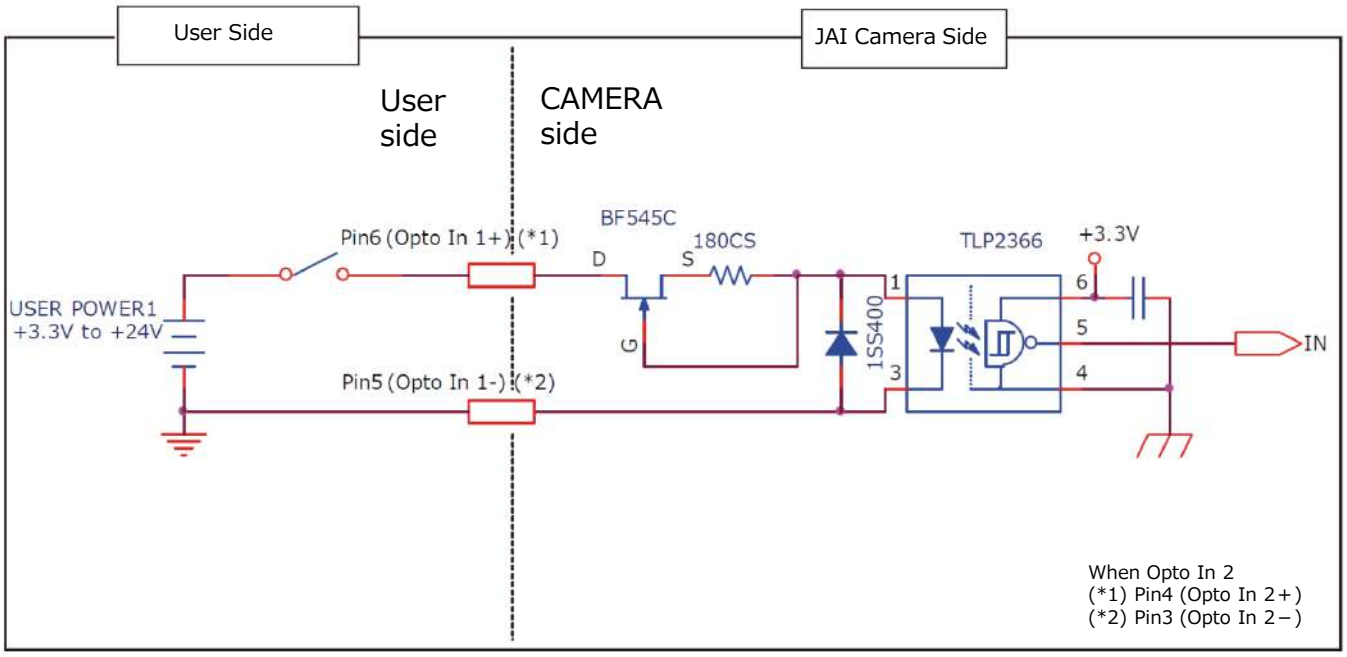
HR10A-10R-12PB（71） (Hirose Electric or equivalent)

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

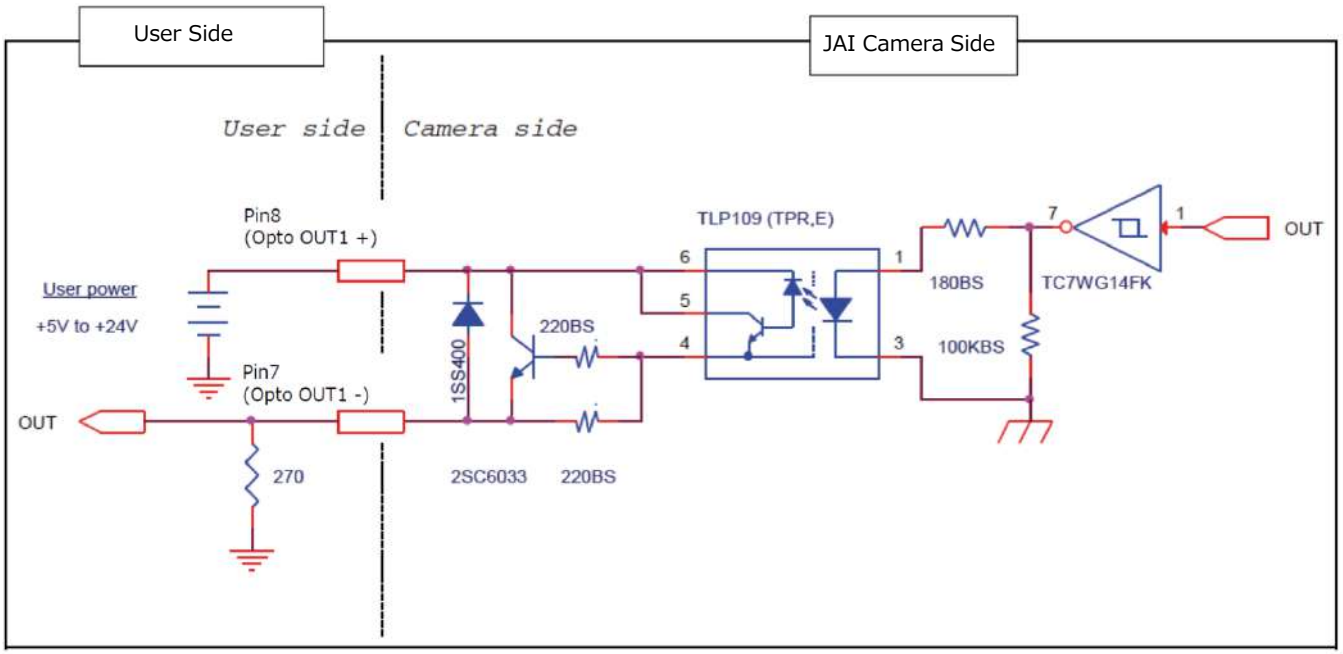
Note

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

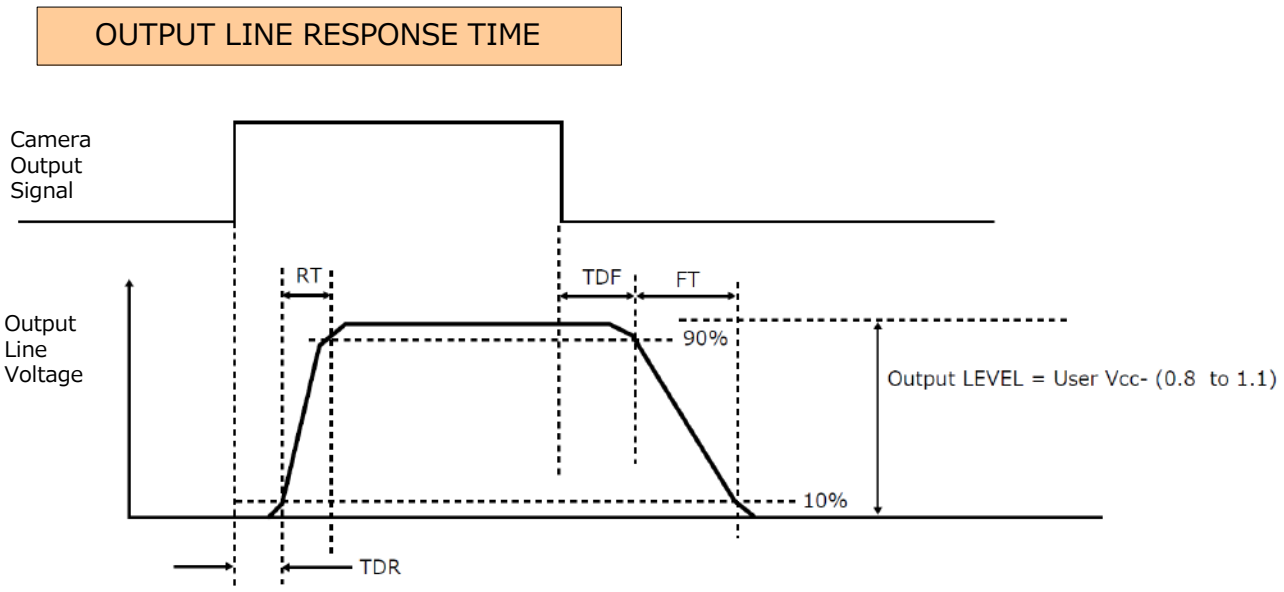
Recommended external input circuit diagram (reference example)



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



Characteristics of the recommended circuits for Opto OUT



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

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

Use these holes when attaching an MP-45 tripod adapter plate (optional) or mounting the camera directly to a wall or other structural system.

Preparation

Preparation Process

Step 1	**Connecting Devices** Connect the lens, CameraLink cable, AC adapter, computer, and other devices.
⬇	
Step 2	**Verifying Camera Operation** Verify whether the camera is turned on and ready for use.
⬇	
Step 3	**Verifying the Connection between the Camera and PC** Verify whether the camera is properly recognized via Control Tool.
⬇	
Step 4	**Changing the Camera Settings** Refer to the procedure for changing the output format setting as an example, and change various settings as necessary.
⬇	
Step 5	**Adjusting the Image Quality** Refer to the procedures for adjusting the gain, white balance, and black level as examples, and adjust the image quality.
⬇	
Step 6	**Saving the Settings** Save the current setting configurations in user memory.

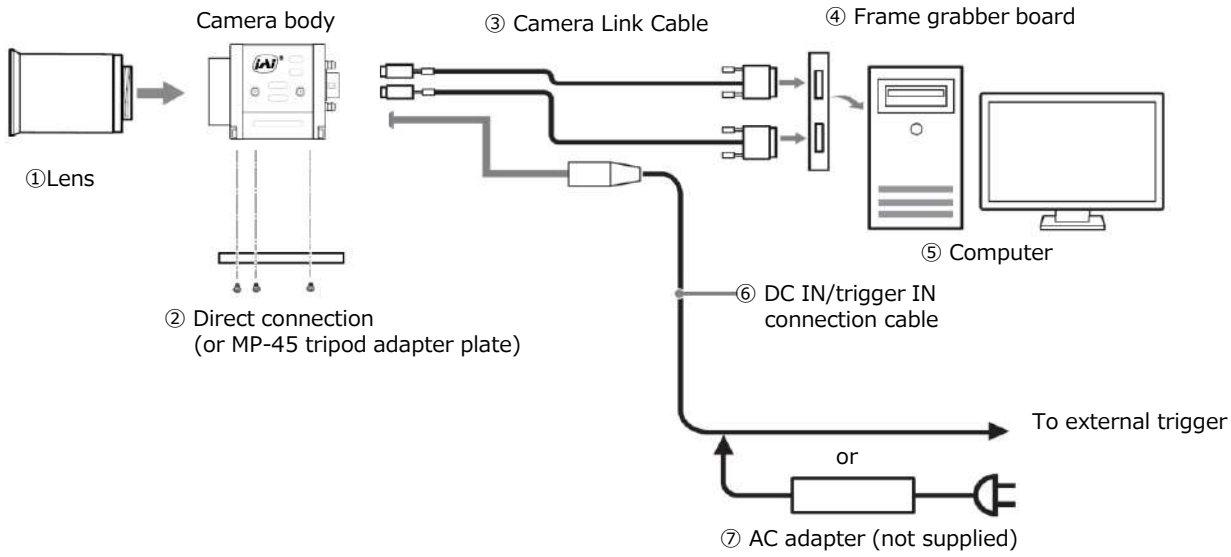
Short ASCII commands

The most universal method for controlling a Camera Link camera such as the SP-12400-PMCL is by the use of short ASCII commands sent via serial communications. All Camera Link frame grabber boards support the use of these short ASCII commands. SDKs that utilize these ASCII commands for developing machine vision applications are typically available from the grabber manufacturer, as well as from third-party vendors.

This section describes how to configure various camera settings using serial communication and specific short ASCII commands. A complete list of all available ASCII commands for this camera can be downloaded from the JAI website.

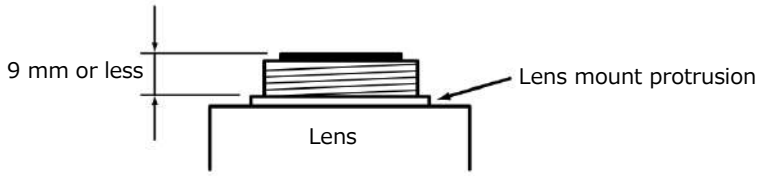
Later sections of the manual refer to GenICam nomenclature for various features/functions, and includes a complete list of all camera settings starting on Page 54. The SP-12400-PMCL fully supports applications written using GenICam-based SDKs. The advantage of this is that programs written using GenICam names can be applied with little or no modification to control cameras with other GenICam-compliant interfaces and even GenICam-compliant cameras from different vendors.

Step 1: Connecting Devices



① Lens

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



・The diagonal of the camera's CMOS image sensor is 17.6 mm, the size of standard 1.1-inch lenses. To prevent vignetting and to obtain the optimal resolution, use a lens that will cover the 17.6 mm diagonal. Some lens manufacturers offer lenses with a 17.6 mm format. If not, a 1.1-inch lens is recommended.

Caution

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

Note

The following formula can be used to estimate the focal length.
Focal length = WD / (1 + W/w)
WD : Working distance (distance between lens and object)
W : Width of object
w : Width of sensor (14.2 mm on this camera)

② Direct connection (or MP-45 tripod adapter plate)

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

Caution

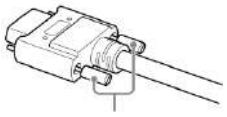
For heavy lenses, be sure to support the lens itself. Do not use configurations in which its weight is supported by the camera.

③ Camera Link cable

Connect the Camera Link cable to the Mini Camera Link connector.
- Use a cable that supports the Camera Link standard and is compatible with Mini Camera Link (SDR) connectors.
- Refer to the specifications of the cable for details on its bend radius.
- For details on the cable, see "② Mini Camera Link connector"

Caution

Secure the locking screws on the connector manually, and do not use a driver. Do not secure the screws too tightly. Doing so may wear down the screw threads on the camera. (Tightening torque: 0.291±0.049 N·m or less)



Secure manually.
Do not secure too tightly.

④ Frame grabber board

Refer to the operating instructions of the 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 7/8/10 32-bit/64-bit edition
CPU: Intel Core i3 or higher
Memory:
Windows 7/8/10 32-bit edition: DDR3, 4 GB or higher
Windows 7/8/10 64-bit edition: DDR3, 8 GB or higher
Graphics card: PCI-Express 3.0 or higher
Network card: We recommend using a network card that uses an Intel chip.

⑥ DC IN / trigger IN connection cable

⑦ AC adapter (power supply) (if necessary)

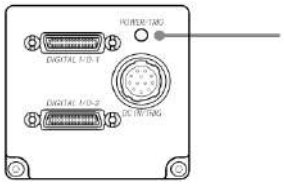
Connect the AC adapter and the round connector of the connection cable to the DC IN / trigger IN connector on the camera.

Step 2: Verifying Camera Operation

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

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

When properly turned on



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

Step 3: Verifying the Connection between the Camera and PC

Use a short ASCII command to verify whether the SP-12400-PMCL is properly recognized in your setup.

Please install terminal emulator software capable of serial communication to the PC connected to the camera via the frame grabber board.

Then set the following serial communication.

Baud Rate	9600
Data Length	8bit
Start Bit	1bit
Stop Bit	1bit
Parity	Non
Xon/Xoff Control	Non

Please enter the command **DVN? <CR><LF>** from the terminal emulator software.
If correctly connected, response **DVN = JAI Corporation** will be displayed.

Item	**Short ASCII command**	**Description**
DeviceVendorName	**DVN**	Display the device vendor name. "JAI Corporation"

Step 4: Changing the Camera Settings

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

Configuring the Output Format

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

Factory default values (SP-12400C-PMCL)

Item		Default Value
ImageFormatControl	Width	4112
	Height	3008
	OffsetX (horizontal position)	0
	OffsetY (vertical position)	0
	PixelFormat	BayerRG8

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

1 **Example of changing the [Width] setting of [ImageFormatControl].**

Use the Short ASCII command WTC.

You can check the current [Width] setting with **WTC? <CR> <LF>.**

To change the setting of [Width] to 3800, execute the following command.
WTC=3800<CR><LF>

To change the settings of other items, please use the Short ASCII command below.

Item	Short ASCII Command	Description
Width	**WTC**	96～4112 16 pixels/step
Height	**HTL**	8～3008 4 lines/step
OffsetX	**OFC**	0～4016 16 pixels/step
OffsetY	**OFL**	0～3000 4 lines/step
PixelFormat	**BA**	SP-12400M-PMCL 0. Mono8 1. Mono10 2. Mono12 SP-12400C-PMCL 0. BayerRG8 1. BayerRG10 2. BayerRG12

2 **Example of changing the [PixelFormat] setting of [ImageFormatControl] .**

Use the Short ASCII command BA.

You can check the current [PixelFormat] setting with **BA? <CR> <LF>.**

To change the setting of [PixelFormat] to BayerRG10, execute the following command.
BA=1<CR><LF>

Step 5: Adjusting the Image Quality

Display the camera image and adjust the image quality.

Displaying the Image

Display the image captured by the camera.
Please display the image with the viewer on the frame grabber board application.

Adjusting the Gain

Adjust the image quality using the gain and white balance* functions.
*) SP-12400C-PMCL only

To adjust the image quality

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

■ **Manual adjustment**

1 **Set [GainAuto] of [AnalogControl] to [Off].**

([Off] is default setting.)

2 **Configure the gain.**

Configure the gain value in [Gain].

- [AnalogAll] (master gain) can be set to a value from x1 to x16 the analog gain value. The resolution is set in 0.1 dB steps. Values are configured by multipliers.
- The [DigitalRed]* (digital R gain) and [DigitalBlue]* (digital B gain) can be set to a value from x0.447 to the [AnalogAll] (master gain) value.

To change the settings of any items, please use the Short ASCII command below.

Item	Short ASCII Command	Description
GainAuto	**AGC**	0. Off 1. Continuous 2. Once
Gain[AnalogAll]	**FGA**	It can be set in the range from 1 time to 16 times. Please specify with a value between 100 and 1600.
Gain[DigitalRed]	**PGR**	It can be set in the range from 0.447 times to 5.624 times. Please specify with a value between 44 and 562.
Gain[DigitalBlue]	**PGB**	It can be set in the range from 0.447 times to 5.624 times. Please specify with a value between 44 and 562.

Adjusting the White Balance*

Adjust the white balance using the automatic adjustment function.
*) SP-12400C-PMCL only

■ **Automatic white balance adjustment**

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

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

2 **In [BalanceWhiteAuto] setting, select from [Continuous], [Once], [PresetXXXX].**

The white balance is automatically adjusted.

Note

[Continuous], [Once] adjust the white balance by adjusting the gain.

To change the settings of any items, please use the Short ASCII command below.

Item	Short ASCII Command	Description
BalanceWhiteAuto	**AWB**	0. Off 1. Continuous 2. Once 3. Preset3200K 4. Preset5000K 5. Preset6500K 6. Preset7500K

Adjusting the Black Level

1 **Select the black level you want to configure in [BlackLevelSelector] of [AnalogControl].**

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

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

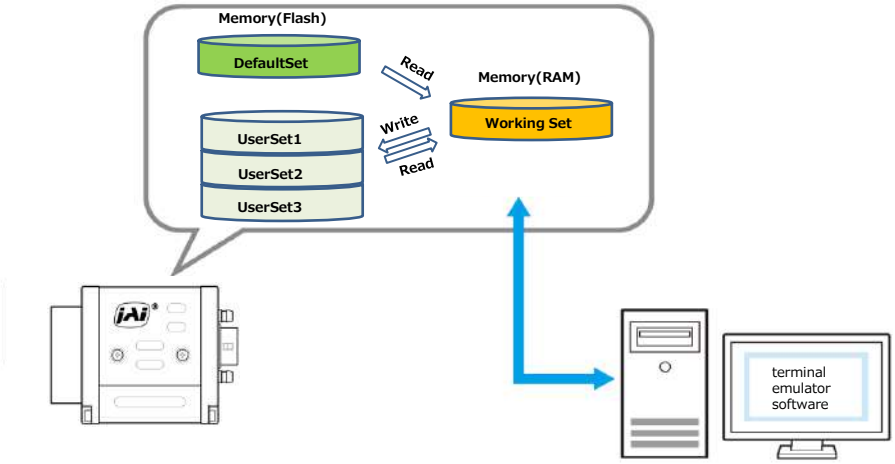
*) SP-12400C-PMCL only

To change the settings of any items, please use the Short ASCII command below.

Item	Short ASCII command	Description
BlackLevel[DigitalAll]	**BL**	It can be set in the range from -133 to 255.
BlackLevel[DigitalRed]	**BLR1**	It can be set in the range from -64 to 64.
BlackLevel[DigitalBlue]	**BLB1**	It can be set in the range from -64 to 64.

Step 6: Saving the Settings

The setting values configured will be deleted when the camera is turned off. By saving current setting values to user memory, you can load and recall them whenever necessary. You can save up to three sets of user settings in the camera. (UserSet1 to UserSet3)



Note

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

■ **To save user settings**

1 **Stop image acquisition.**

2 **Specify the storage location (UserSet1 - UserSet3) using the UserSetSave command and save the current camera settings.**

To save to UserSet1, execute the command **SA=1<CR><LF>**.

Note

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

Caution

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

Item	Short ASCII command	Description
UserSetLoad	**LD**	Set the specified user setting to the camera. 0: Default 1: UserSet1 2: UserSet2 3: UserSet3
UserSetSave	**SA**	Save the current camera settings in the specified user setting area. 1: UserSet1 2: UserSet2 3: UserSet3

■ **To load user settings**

1 **Stop image acquisition.**

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

2 **Specify the storage location (UserSet1 - UserSet3) using the UserSetLoad command and read the settings of the camera.**

To read the settings saved in UserSet 1, execute the command **LD=1<CR><LF>**.

Main Functions

Basic Function Matrix

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

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

GPIO (Digital Input/Output Settings)

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

Valid Input/Output Combinations

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

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

Selector (Cross point switch output) / Source Signal (Cross point switch input)		Output destination										
		TriggerSelector	LineSelector						PulseGeneratorSelector			
		FrameStart	Line1-TTLOut1	Line2-OptOut1	NANDGate0In1	NANDGate0In2	NANDGate1In1	NANDGate1In2	PulseGenerator0	PulseGenerator1	PulseGenerator2	PulseGenerator3
Signals to use as output	Low	○	○	○	○	○	○	○	○	○	○	○
	High	○	○	○	○	○	○	○	○	○	○	○
	Line5-OptIn1	○	○	○	○	○	○	○	○	○	○	○
	Line6-OptIn2	○	○	○	○	○	○	○	○	○	○	○
	UserOutput0	○	○	○	○	○	○	○	○	○	○	○
	UserOutput1	○	○	○	○	○	○	○	○	○	○	○
	UserOutput2	○	○	○	○	○	○	○	○	○	○	○
	UserOutput3	○	○	○	○	○	○	○	○	○	○	○
	PulseGenerator0	○	○	○	○	○	○	○	×	○	○	○
	PulseGenerator1	○	○	○	○	○	○	○	○	×	○	○
	PulseGenerator2	○	○	○	○	○	○	○	○	○	×	○
	PulseGenerator3	○	○	○	○	○	○	○	○	○	○	×
	NAND0Out	○	○	○	×	×	○	○	○	○	○	○
	NAND1Out	○	○	○	○	○	×	×	○	○	○	○
	ExposureActive	—	○	○	○	○	○	○	○	○	○	○
	AcquisitionActive	—	○	○	○	○	○	○	○	○	○	○
	AcquisitionTriggerWait	—	○	○	○	○	○	○	○	○	○	○
	FrameTriggerWait	—	○	○	○	○	○	○	○	○	○	○
	FrameActive	—	○	○	○	○	○	○	○	○	○	○
	FVAL	—	○	○	○	○	○	○	○	○	○	○
	LVAL	—	×	×	×	×	×	×	○	○	○	○
			LineSelector						PulseGeneratorSelector			
		Use										

: Indicates default values for each selector.

Camera Output Formats

The SP-12400M-PMCL supports the following output formats.

PixelFormat	Available only VideoProcessBypassMode
Mono8, Mono10, Mono12	Mono12

The SP-12400C-PMCL supports the following output formats.

PixelFormat	Available only VideoProcessBypassMode
BayerRG8, BayerRG10, BayerRG12	BayerRG12

In accordance with the setting of ClConfiguration, PixelFormat on the camera side, the frame grabber board must also be set to the same setting.

For details on how to set the frame grabber board, please refer to the owner's manual of each board.

The following tables show the PixelFormat which can be set for each TapGeometry.

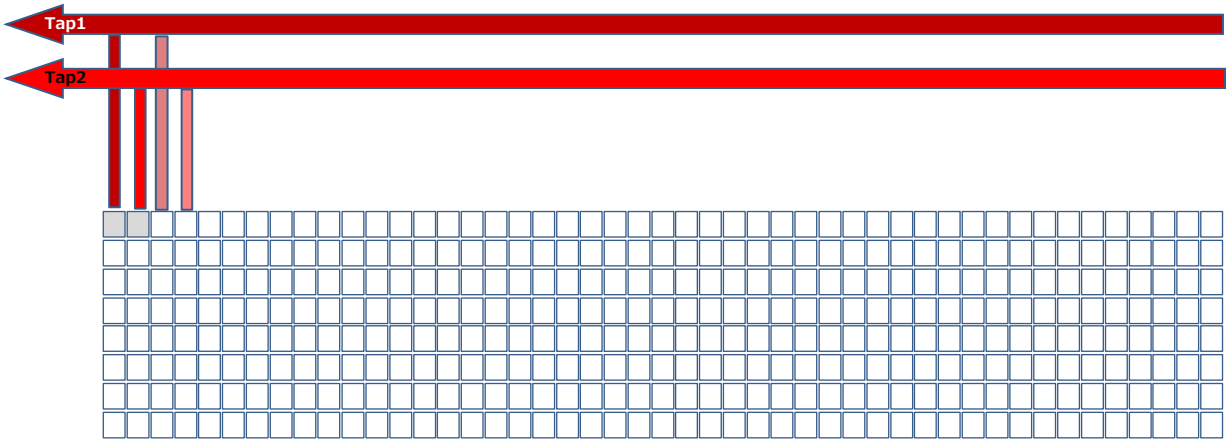
■ 1X2-1Y

SP-12400M-PMCL

PixelFormat	ClConfiguration	TapGeometry
Mono8	Base	1X2_1Y
Mono10	Base	1X2_1Y
Mono12	Base	1X2_1Y

SP-12400C-PMCL

PixelFormat	ClConfiguration	TapGeometry
BayerRG8	Base	1X2_1Y
BayerRG10	Base	1X2_1Y
BayerRG12	Base	1X2_1Y



In one cycle, the data of two pixels is output via Camera Link.

When the output of first line is completed, the pixel data of the second line is also outputted two pixels at a time.

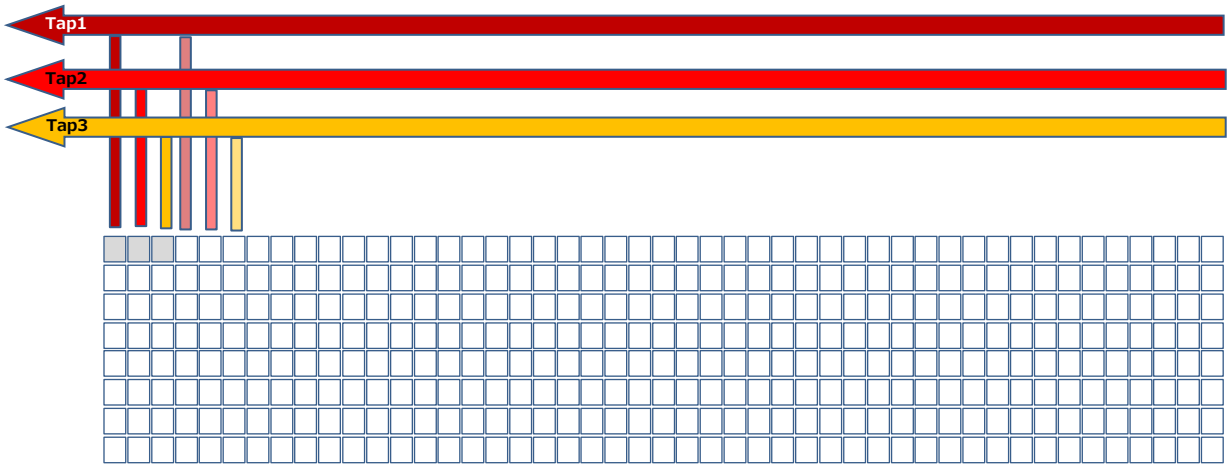
■ 1X3-1Y

SP-12400M-PMCL

PixelFormat	ClConfiguration	TapGeometry
Mono8	Base	1X3_1Y

SP-12400C-PMCL

PixelFormat	ClConfiguration	TapGeometry
BayerRG8	Base	1X3_1Y



In one cycle, the data of three pixels is output via Camera Link.

When the output of first line is completed, the pixel data of the second line is also outputted three pixels at a time.

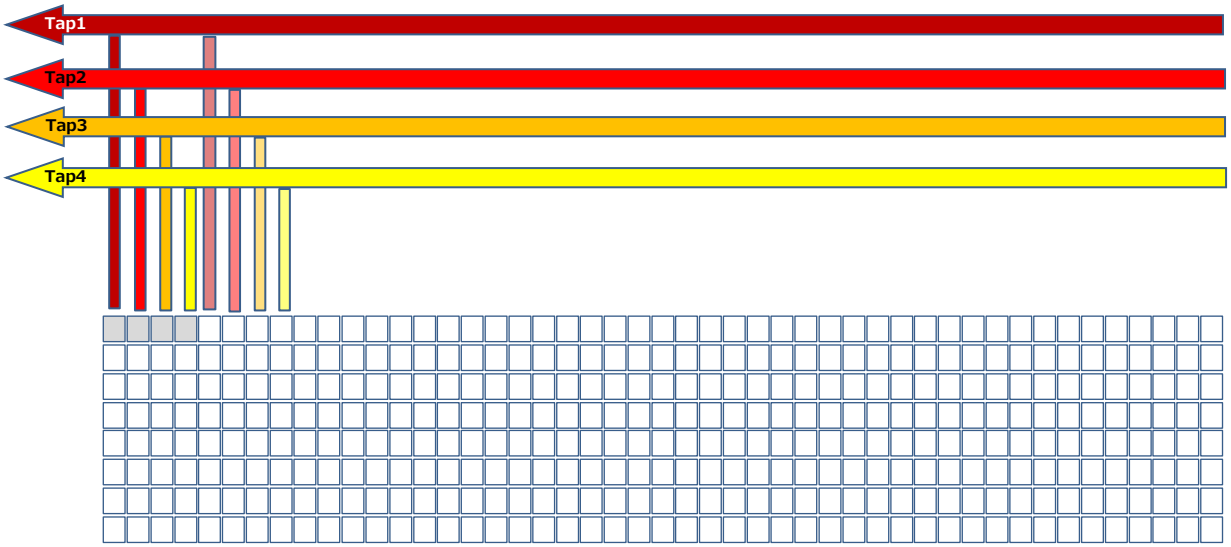
■ 1X4-1Y

SP-12400M-PMCL

PixelFormat	ClConfiguration	TapGeometry
Mono8	Medium	1X4_1Y
Mono10	Medium	1X4_1Y
Mono12	Medium	1X4_1Y

SP-12400C-PMCL

PixelFormat	ClConfiguration	TapGeometry
BayerRG8	Medium	1X4_1Y
BayerRG10	Medium	1X4_1Y
BayerRG12	Medium	1X4_1Y



In one cycle, the data of four pixels is output via Camera Link.

When the output of first line is completed, the pixel data of the second line is also outputted four pixels at a time.

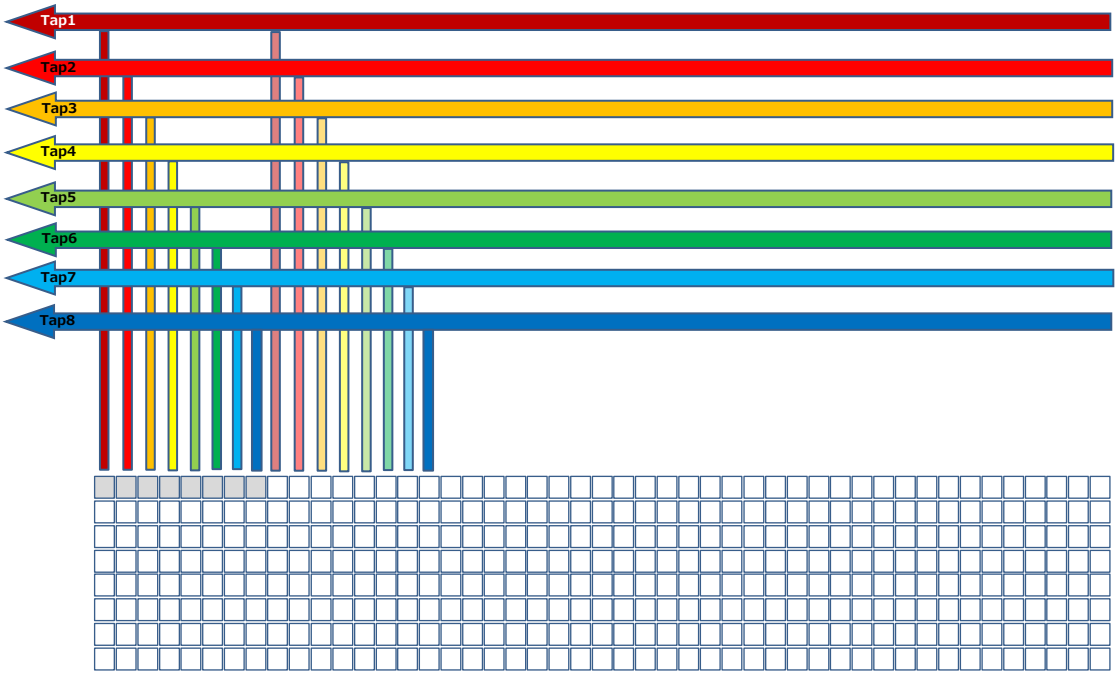
■ 1X8-1Y

SP-12400M-PMCL

PixelFormat	ClConfiguration	TapGeometry
Mono8	Full	1X8_1Y
Mono10	EightyBit	1X8_1Y

SP-12400C-PMCL

PixelFormat	ClConfiguration	TapGeometry
BayerRG8	Full	1X8_1Y
BayerRG10	EightyBit	1X8_1Y



In one cycle, the data of eight pixels is output via Camera Link.

When the output of first line is completed, the pixel data of the second line is also outputted eight pixels at a time.

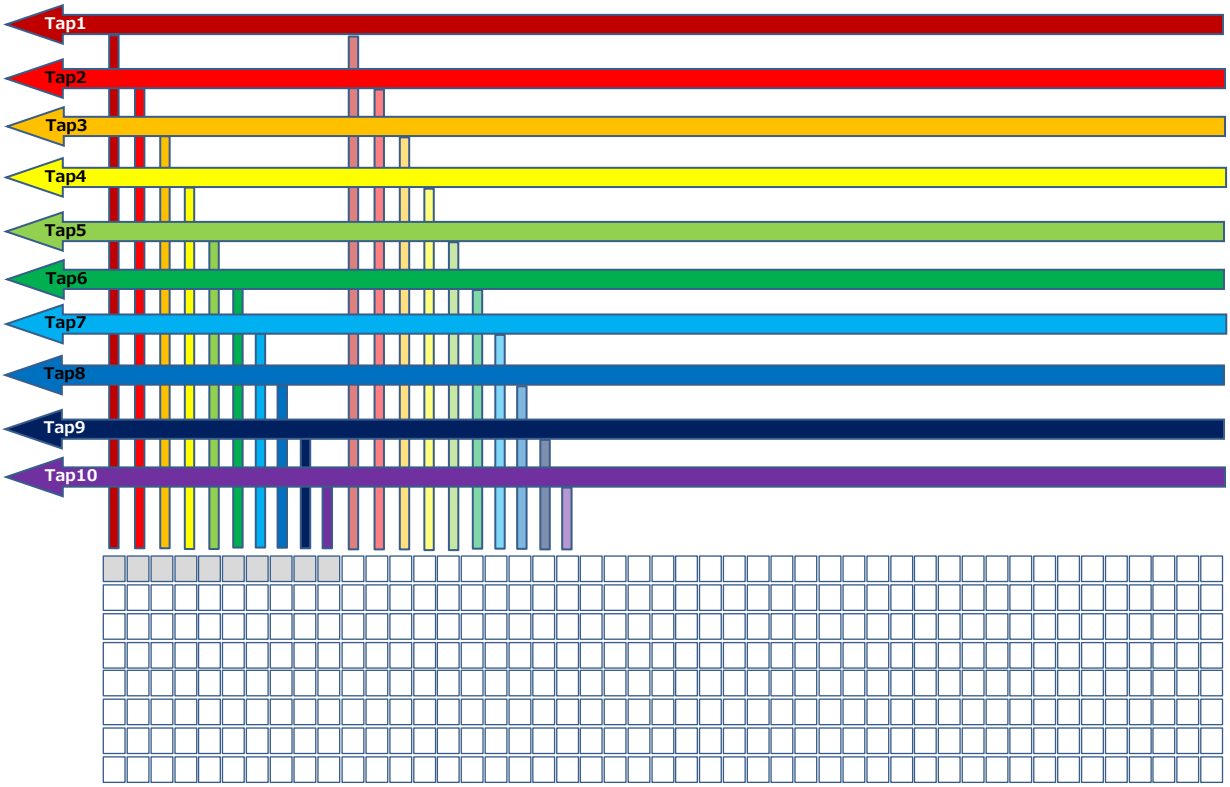
■ 1X10-1Y

SP-12400M-PMCL

PixelFormat	ClConfiguration	TapGeometry
Mono8	EightyBit	1X10_1Y

SP-12400C-PMCL

PixelFormat	ClConfiguration	TapGeometry
BayerRG8	EightyBit	1X10_1Y



In one cycle, the data of ten pixels is output via Camera Link.

When the output of first line is completed, the pixel data of the second line is also outputted ten pixels at a time.

■ **Maximum cable length reference**

The maximum Camera Link cable length is 10 m. However, if the ClPixelClock is 85 MHz, the maximum Camera Link cable length is 7 m. *1

Caution

*1 The maximum length of cable you can use will also vary depending on type and maker.

Image Acquisition Controls

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

On the SP-12400M-PMCL/SP-12401C-PMCL, acquisition control always operates in [Continuous] mode.

Changing the Frame Rate

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

Note

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

Maximum Frame Rate

■About the H_Period

Calculate the CL_valid_width using the following formulas.

CL_valid_width = Width / Taps

*) Taps values are as follows for each TapGeometry.
1X2-1Y : 2
1X3-1Y : 3
1X4-1Y : 4
1X8-1Y : 8
1X10-1Y : 10

Calculate the H_Period_1 using the following formulas.

H_Period_1 = Max((CL_valid_width + 4) / CL_Pixel_Clock, Sensor_min_H_cnt / 74.25)

*) CL_Pixel_Clock is one of 37.125, 74.25 and 84.86 (MHz).

*) Sensor_min_H_cnt values are as follows for each TapGeometry.
1X2-1Y : 522
1X3-1Y : 522
1X4-1Y : 522
1X8-1Y(10bit) : 522
1X8-1Y(8bit) : 375
1X10-1Y : 375

Calculate H_Period using the following formulas.

H_Period = RoundUp(H_Period_1 x 74.25, 0) / 74.25

*) Please round up to the decimal point.

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

・Maximum frame rate
[FR_Cont] = 1 / { H_Period × (Height + 56) }

■ **During continuous operation**
([Frame Start] trigger is [Off] and [ExposureMode] is [Timed])

・The longest exposure time at maximum frame rate.
Maximum frame rate FR_Cont = 1 / { H_Period × (Height + 56) }
The longest exposure time
Longest_Exposure_Time_fast_FR = (1 / FR_Cont) – (25 × H_Period)

・ Maximum frame rate when setting long exposure time.
Exposure time
NonOverlapExposureTime = ExposureTime – Longest_Exposure_Time_fast_FR
(However, NonOverlapExposureTime calculation results that are 0 or below will be considered as 0.)
Maximum frame rate
FR_Cont_LongexposureTime = 1/ { (1/FR_Cont) + NonOverlapExposureTime }

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

・ Maximum frame rate of sensor output
FR_Cont = 1 / { H_Period × (Height + 56) }

・ Maximum frame rate
FR_TrOloff = 1 / { (1 / FR_Cont) + ExposureTime }

■ **When [Frame Start] trigger is [On] and [TriggerOverLap] is [Readout]**
・ Maximum frame rate of sensor output
FR_Cont = 1 / { H_Period × (Height + 56) }

・ Exposure time possible within frames
MaxOverlapTime_TrOlrd= (1 / FR_Cont) - (25 * H_period)

・ Exposure time outside of frame interval
NonOverlapExposureTime_TrOlrd = ExposureTime - MaxOverlapTime_TrOlrd
(However, NonOverlapExposureTime_TrOlrd calculation results that are 0 or below will be considered as 0.)
(For TriggerWidth, the trigger pulse is equivalent to ExposureTime.)

・ Maximum frame rate
FR_TrOlrd = 1 / { (1 / FR_Cont) + NonOverlapExposureTime_TrOlrd }

ExposureMode

The following exposure modes are available on the camera.

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

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

Actual Exposure Times

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

ExposureMode	Shortest exposure time
Timed	15.26us
TriggerWidth	15.26us

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

・When [ExposureMode] is set to [Timed] and the exposure time is set to 1 μs, the actual exposure time will be as follows.
1 μs + 14.26 μs (offset duration of image sensor) = 15.26 μs

・When [ExposureMode] is set to [TriggerWidth], the exposure is slightly longer than the width of the trigger signal. To achieve an exposure time of 15.26 μs and the exposure time offset is 14.26 μs, use 15.26 μs - 14.26 μs = 1 μs as the high or low time for the trigger signal.

Trigger Control

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

TriggerSelector	Description
FrameStart	Start exposure in response to the external trigger signal input. Select this to perform exposure control using external triggers.

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

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

Shortest Repetition Period for Triggers

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

■ **SP-12400M-PMCL**

SP-12400M-PMCL			Width	Height	Shortest period of tigger (ms)		
					CL clock frequency(MHz)		
					37.1	74.3	84.9
Mono8	Base	1X2_1Y	4112	3008	170.0	85.0	74.4
Mono10	Base	1X2_1Y	4112	3008	170.0	85.0	74.4
Mono12	Base	1X2_1Y	4112	3008	170.0	85.0	74.4
Mono8	Base	1X3_1Y	4080	3008	112.6	56.3	49.3
Mono8	Medium	1X4_1Y	4112	3008	85.2	42.6	37.3
Mono10	Medium	1X4_1Y	4112	3008	85.2	42.6	37.3
Mono12	Medium	1X4_1Y	4112	3008	85.2	42.6	37.3
Mono8	Full	1X8_1Y	4112	3008	42.8	21.4	18.7
Mono10	EightyBit	1X8_1Y	4112	3008	42.8	21.5	21.5
Mono8	EightyBit	1X10_1Y	4080	3008	34.0	17.0	15.5

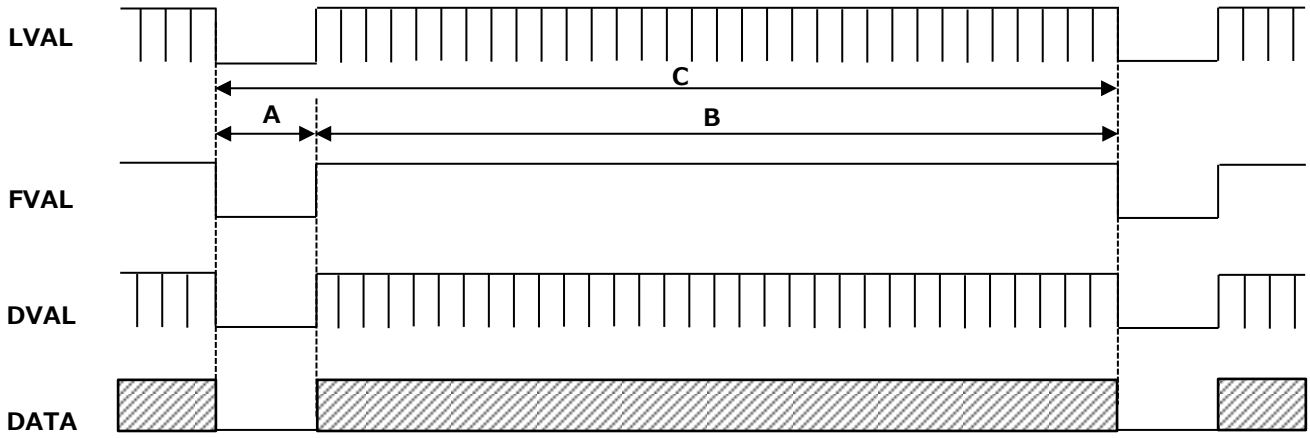
■ **SP-12400C-PMCL**

SP-12400C-PMCL			Width	Height	Shortest period of tigger (ms)		
					CL clock frequency(MHz)		
					37.1	74.3	84.9
BayerRG8	Base	1X2_1Y	4112	3008	170.0	85.0	74.4
BayerRG10	Base	1X2_1Y	4112	3008	170.0	85.0	74.4
BayerRG12	Base	1X2_1Y	4112	3008	170.0	85.0	74.4
BayerRG8	Base	1X3_1Y	4080	3008	112.6	56.3	49.3
BayerRG8	Medium	1X4_1Y	4112	3008	85.2	42.6	37.3
BayerRG10	Medium	1X4_1Y	4112	3008	85.2	42.6	37.3
BayerRG12	Medium	1X4_1Y	4112	3008	85.2	42.6	37.3
BayerRG8	Full	1X8_1Y	4112	3008	42.8	21.4	18.7
BayerRG10	EightyBit	1X8_1Y	4112	3008	42.8	21.5	21.5
BayerRG8	EightyBit	1X10_1Y	4080	3008	34.0	17.0	15.5

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

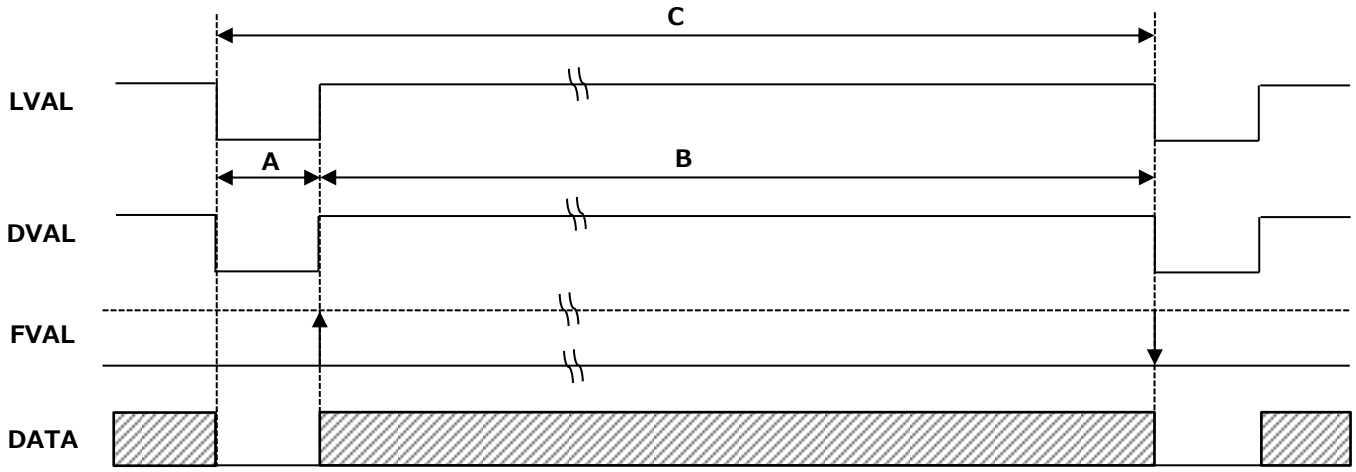
Image Output Timing

■ Vertical timing



PixelFormat	CL Configuration	TapGeometry	CameraLink Clock Frequency (MHz)	H Frequency (KHz)	FVAL Blanking Line[A]	FVAL Valid Line[B]	Total Frame Line[C]	Total Frame Period (msec)	Frame Rate(Hz)
Mono8/Mono10/ Mono12 BayerRG8/BayerRG10/ BayerRG12	Base	1x2-1Y	37.1	18.022	56	3,008	3,064	170.02	5.9
			74.3	36.044	56	3,008	3,064	85.01	11.8
			84.9	41.193	56	3,008	3,064	74.38	13.4
Mono8 BayerRG8	Base	1x3_1Y	37.1	27,218	56	3,008	3,064	112.57	8.9
			74.3	54,435	56	3,008	3,064	56.29	17.8
			84.9	62,212	56	3,008	3,064	49.25	20.3
Mono8/Mono10/ Mono12 BayerRG8/BayerRG10/ BayerRG12	Medium	1x4_1Y	37.1	35.974	56	3,008	3,064	85.17	11.7
			74.3	71.948	56	3,008	3,064	42.59	23.5
			84.9	82.226	56	3,008	3,064	37.26	26.8
Mono8 BayerRG8	Full	1x8_1Y	37.1	71.67	56	3,008	3,064	42.75	23.4
			74.3	143.34	56	3,008	3,064	21.38	46.8
			84.9	163.817	56	3,008	3,064	18.7	53.5
Mono10 BayerRG10	EightyBit	1x8_1Y	37.1	71.67	56	3,008	3,064	42.75	23.4
			74.3	142.241	56	3,008	3,064	21.54	46.4
			84.9	142.241	56	3,008	3,064	21.54	46.4
Mono8 BayerRG8	EightyBit	1x10_1Y	37.1	90,109	56	3,008	3,064	34	29.4
			74.3	180,218	56	3,008	3,064	17	58.8
			84.9	198,000	56	3,008	3,064	15.47	64.6

■ Horizontal timing

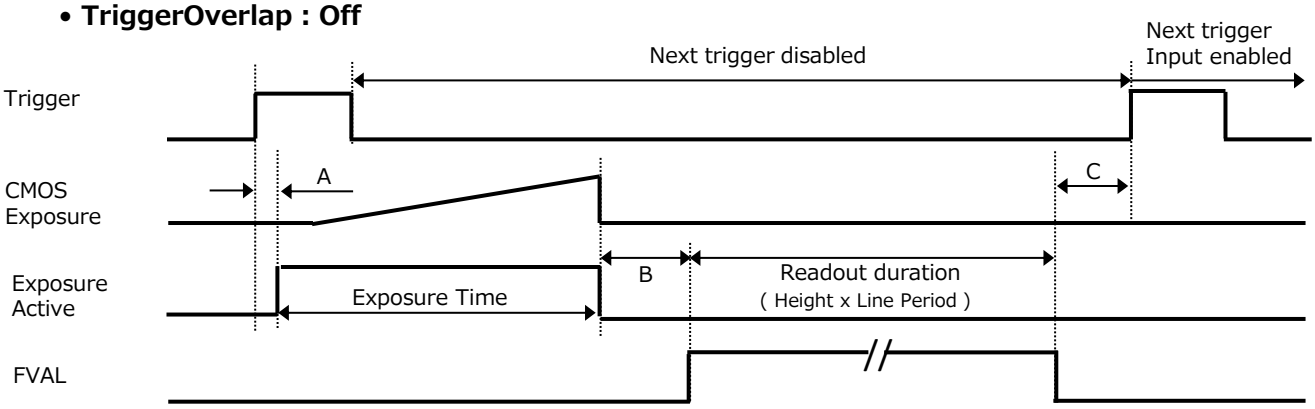


PixelFormat	CL Configuration	TapGeometry	CameraLink Clock Frequency (MHz)	Line Blanking Clock[A]	Line Valid clock[B]	Total Line clock[C]	Total Line Period(usec)	Line Rate(Hz)
Mono8/Mono10/ Mono12 BayerRG8/BayerRG10/ BayerRG12	Base	1x2-1Y	37.1	4	2,056	2,060	55.488	18,022
			74.3	4	2,056	2,060	27.744	36,044
			84.9	4	2,056	2,060	24.276	41,193
Mono8 BayerRG8	Base	1x3_1Y	37.1	4	1,360	1,364	36.741	27,218
			74.3	4	1,360	1,364	18.37	54,435
			84.9	4	1,360	1,364	16.074	62,212
Mono8/Mono10/ Mono12 BayerRG8/BayerRG10/ BayerRG12	Medium	1x4_1Y	37.1	4	1,028	1,032	27.798	35,974
			74.3	4	1,028	1,032	13.899	71,948
			84.9	4	1,028	1,032	12.162	82,226
Mono8 BayerRG8	Full	1x8_1Y	37.1	4	514	518	13.953	71,670
			74.3	4	514	518	6.976	143,340
			84.9	4	514	518	6.104	163,817
Mono10 BayerRG10	EightyBit	1x8_1Y	37.1	4	514	518	13.953	71,670
			74.3	8	514	522	7.03	142,241
			84.9	82	514	596	7.03	142,241
Mono8 BayerRG8	EightyBit	1x10_1Y	37.1	4	408	412	11.098	90,109
			74.3	4	408	412	5.549	180,218
			84.9	20	408	428	5.051	198,000

■ **When [ExposureMode] is [Timed]**

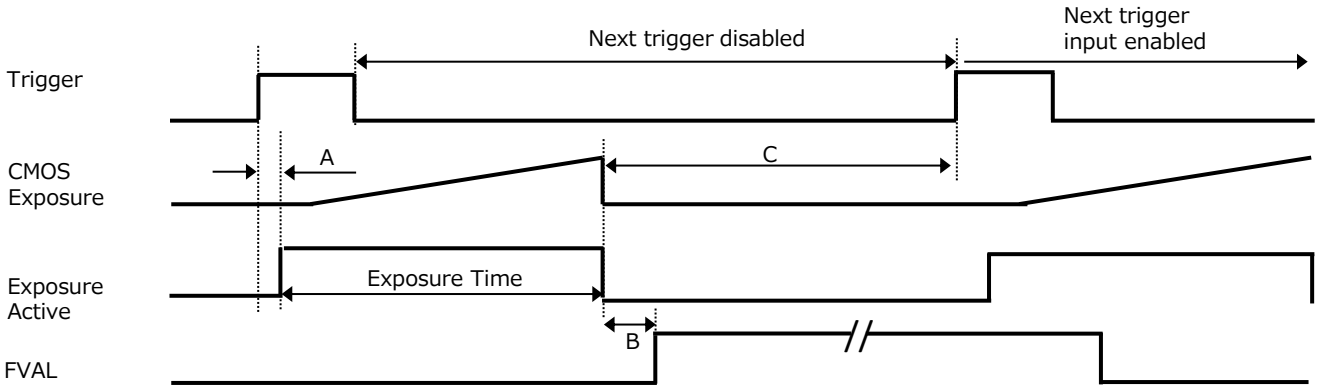
Example: When [TriggerSource] is set to [Line5-OptIn1] and [OptInFilterSelector] is set to [10 µs].

• **TriggerOverlap : Off**



PixelFormat	CL Configuration	TapGeometry	CameraLinkClock Frequency (MHz)	Period from Trigger start edge to Exposure start [A] (usec)	Period From Exposure end to FVAL Start [B] (usec)	Period From Exposure end to Next Trigger in [C] (usec)
Mono8/Mono10/ Mono12 BayerRG8/BayerRG10/ BayerRG12	Base	1x2-1Y	37.1	167	2,843	-124
			74.3	84	1,428	-68
			84.9	74	1,252	-61
Mono8 BayerRG8	Base	1x3_1Y	37.1	111	1,887	-86
			74.3	56	950	-49
			84.9	49	833	-44
Mono8/Mono10/ Mono12 BayerRG8/BayerRG10/ BayerRG12	Medium	1x4_1Y	37.1	84	1,431	-68
			74.3	43	722	-40
			84.9	37	633	-37
Mono8 BayerRG8	Full	1x8_1Y	37.1	43	724	-40
			74.3	22	368	-25
			84.9	19	324	-24
Mono10 BayerRG10	EightyBit	1x8_1Y	37.1	43	725	-40
			74.3	22	372	-26
			84.9	22	372	-26
Mono8 BayerRG8	EightyBit	1x10_1Y	37.1	34	578	-34
			74.3	17	295	-23
			84.9	16	270	-21

- **TriggerOverlap : readout**

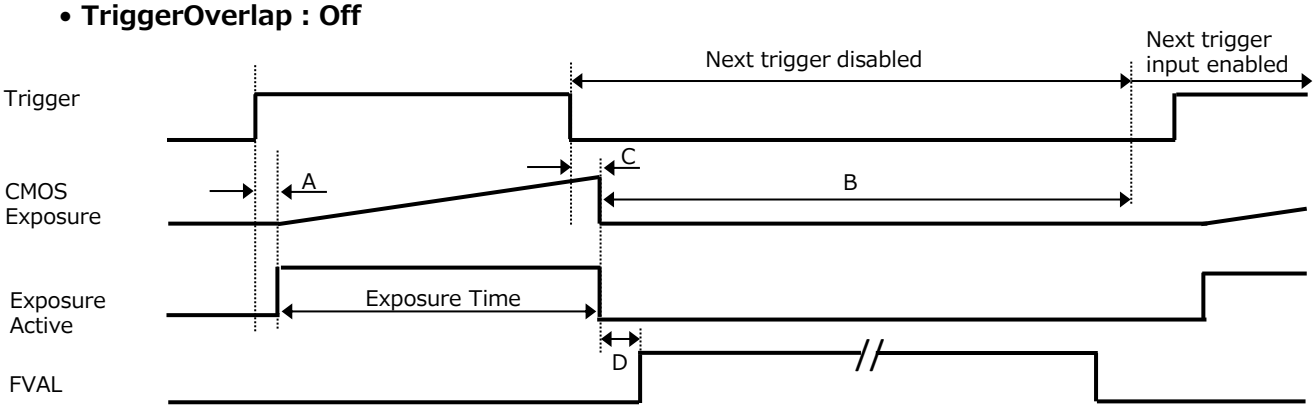


PixelFormat	CL Configuration	TapGeometry	CameraLinkClock Frequency (MHz)	Period from Trigger start edge to Exposure start [A] (usec)	Period From Exposure end to FVAL Start [B] (usec)	Exposure Invalid period [C] (usec) [Minimum exposure time]
Mono8/Mono10/ Mono12 BayerRG8/BayerRG10/ BayerRG12	Base	1x2-1Y	37.1	167	2,843	170,015
			74.3	84	1,428	85,007
			84.9	74	1,252	74,402
Mono8 BayerRG8	Base	1x3_1Y	37.1	111	1,887	112,573
			74.3	56	950	56,286
			84.9	49	833	49,271
Mono8/Mono10/ Mono12 BayerRG8/BayerRG10/ BayerRG12	Medium	1x4_1Y	37.1	84	1431	85,420
			74.3	43	722	42,586
			84.9	37	633	37,263
Mono8 BayerRG8	Full	1x8_1Y	37.1	43	724	42,751
			74.3	22	368	21,375
			84.9	19	324	18,734
Mono10 BayerRG10	EightyBit	1x8_1Y	37.1	43	725	42,751
			74.3	22	372	21,540
			84.9	22	372	21,540
Mono8 BayerRG8	EightyBit	1x10_1Y	37.1	34	578	34,003
			74.3	17	295	17,001
			84.9	16	270	15,474

■ When [ExposureMode] is [TriggerWidth]

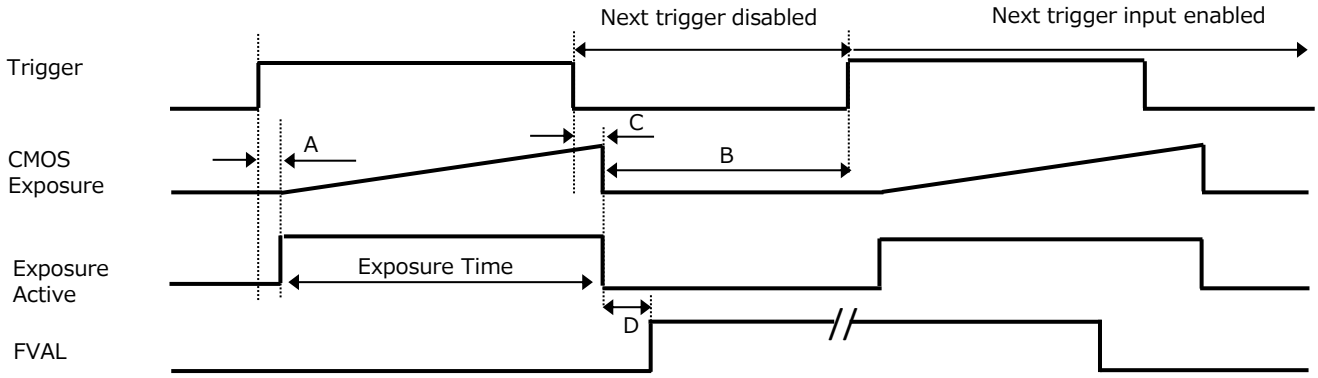
Example: When [TriggerSource] is set to [Line5-OptIn1] and [OptInFilterSelector] is set to [10 µs].

• TriggerOverlap : Off



PixelFormat	CL Configuration	TapGeometry	CameraLinkClock Frequency (MHz)	Period from Trigger start edge to Exposure start [A] (usec)	Exposure Invalid period [B] (usec)	Period From Trigger end edge to Exposure end [C] (usec)	Period From Exposure end to FVAL Start [D] (usec)
Mono8/Mono10/ Mono12 BayerRG8/BayerRG10/ BayerRG12	Base	1x2-1Y	37.1	167	169,629	167	2,843
			74.3	84	84,815	84	1,428
			84.9	74	74,233	74	1,252
Mono8 BayerRG8	Base	1x3_1Y	37.1	111	112,317	111	1,887
			74.3	56	56,159	56	950
			84.9	49	49,160	49	833
Mono8/Mono10/ Mono12 BayerRG8/BayerRG10/ BayerRG12	Medium	1x4_1Y	37.1	84	84,979	84	1,431
			74.3	43	42,490	43	722
			84.9	37	37,179	37	633
Mono8 BayerRG8	Full	1x8_1Y	37.1	43	42,655	43	724
			74.3	22	21,328	22	368
			84.9	19	18,693	19	324
Mono10 BayerRG10	EightyBit	1x8_1Y	37.1	43	42,655	43	725
			74.3	22	21,492	22	372
			84.9	22	21,492	22	372
Mono8 BayerRG8	EightyBit	1x10_1Y	37.1	34	33,926	34	578
			74.3	17	16,963	17	295
			84.9	16	15,440	16	270

- **TriggerOverlap : readout**

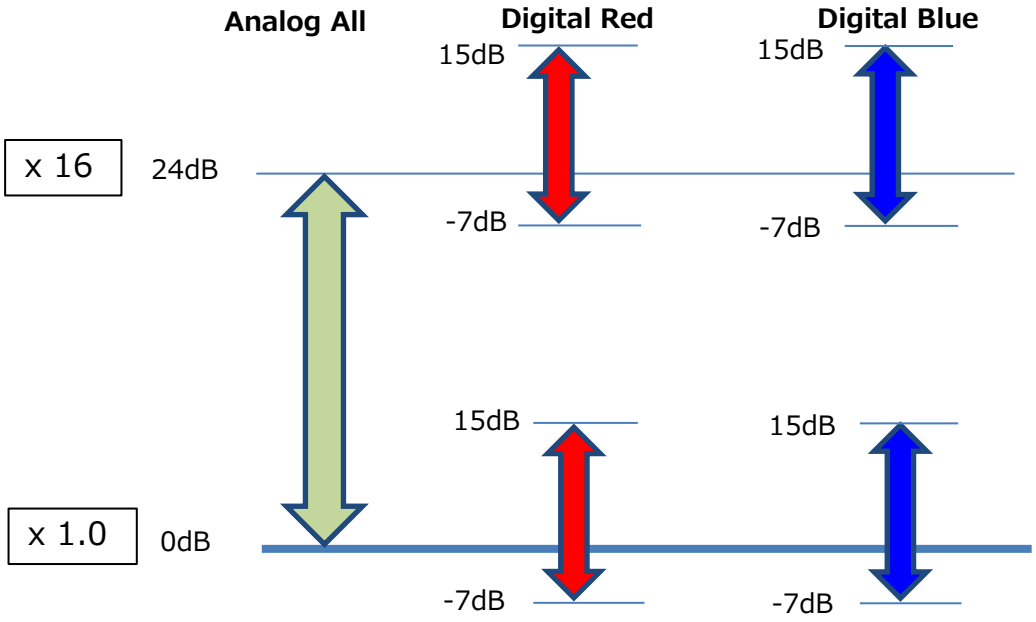


PixelFormat	CL Configuration	TapGeometry	CameraLinkClock Frequency (MHz)	Period from Trigger start edge to Exposure start [A] (usec)	Exposure Invalid period [B] (usec)	Period From Trigger end edge to Exposure end [C] (usec)	Period From Exposure end to FVAL Start [D] (usec)
Mono8/Mono10/ Mono12 BayerRG8/BayerRG10/ BayerRG12	Base	1x2-1Y	37.1	**167**	**1,387**	**167**	**2,843**
			74.3	84	693	84	1,428
			84.9	74	606	74	1,252
Mono8 BayerRG8	Base	1x3_1Y	37.1	111	918	111	1,887
			74.3	56	459	56	950
			84.9	49	401	49	833
Mono8/Mono10/ Mono12 BayerRG8/BayerRG10/ BayerRG12	Medium	1x4_1Y	37.1	84	694	84	1,431
			74.3	43	347	43	722
			84.9	37	304	37	633
Mono8 BayerRG8	Full	1x8_1Y	37.1	43	348	43	724
			74.3	22	174	22	368
			84.9	19	152	19	324
Mono10 BayerRG10	EightyBit	1x8_1Y	37.1	43	348	43	725
			74.3	22	175	22	372
			84.9	22	175	22	372
Mono8 BayerRG8	EightyBit	1x10_1Y	37.1	34	277	34	578
			74.3	17	138	17	295
			84.9	16	126	16	270

Gain Control

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

*) Adjustment of DigitalRed and DigitalBlue is possible only for SP-12400C-PMCL



Automatic Gain Level Control

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

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

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

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

Auto gain metering areas (16 areas)

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

Lookup Table (LUT)

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

■ To use the LUT function

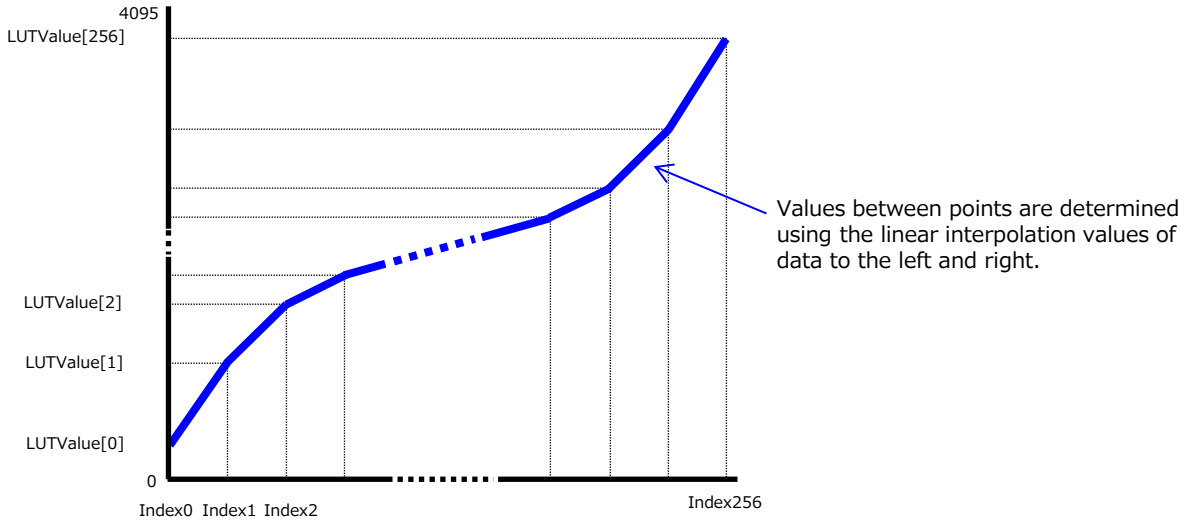
Configure the settings as follows.

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

*) SP-12400C-PMCL only

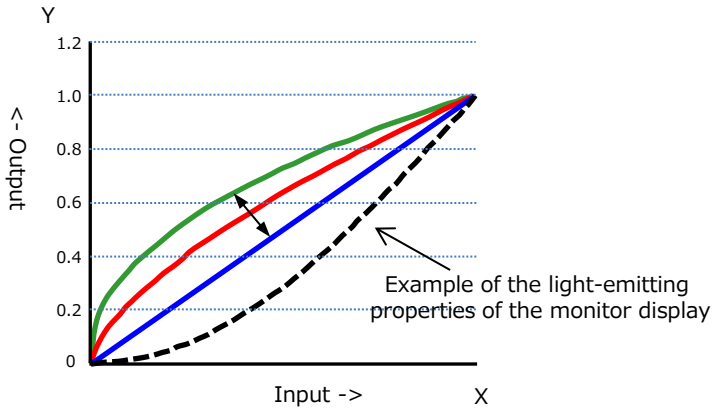
■ LUT values

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



Gamma Function

The gamma function corrects the output signals from the camera beforehand (reverse correction), taking into consideration the light-emitting properties of the monitor display. As the light-emitting properties of the monitor are not linear, the entire image may be darker or the gradation in the dark areas may be less noticeable when camera outputs are displayed without processing. The gamma function can be used to correct the camera signals with an opposite-direction curve and produce a display that is close to linear.



■ **To use the gamma function**

Configure the settings as follows.

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

Note

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

LineStatus

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

- Line5-OptIn1, Line6-OptIn2
- NANDGate0In1, NANDGate0In2
- NANDGate1In1, NANDGate1In2
- Line1-TTLOut1, Line2-OptOut1
- Line7-CC1

BlemishCompensation

Multiple defective pixels that are not adjacent to each other can occur on conventional CMOS sensor cameras.
This camera features a function that interpolates defective pixels using the surrounding pixels. Up to 800 pixels can be corrected for each of the three sensors. Pixel interpolation can be performed via automatic detection or point-by-point manual settings.

■ Automatic detection

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

1 **Shield the camera sensor.**

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

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

Up to 800 pixels can be corrected.
The threshold value is specified as a percentage.
The default setting is "10" with 10% of the full scale (100%) specified as the threshold value.

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

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

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

■ Manual configuration

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

You can select from 1 to 800. However, configure the indexes in order starting with the smallest index. If you skip indexes while configuring settings, interpolation may not be performed.

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

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

Note

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

3 **Execute [BlemishStore].**

Blemish compensation data will be stored.

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

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

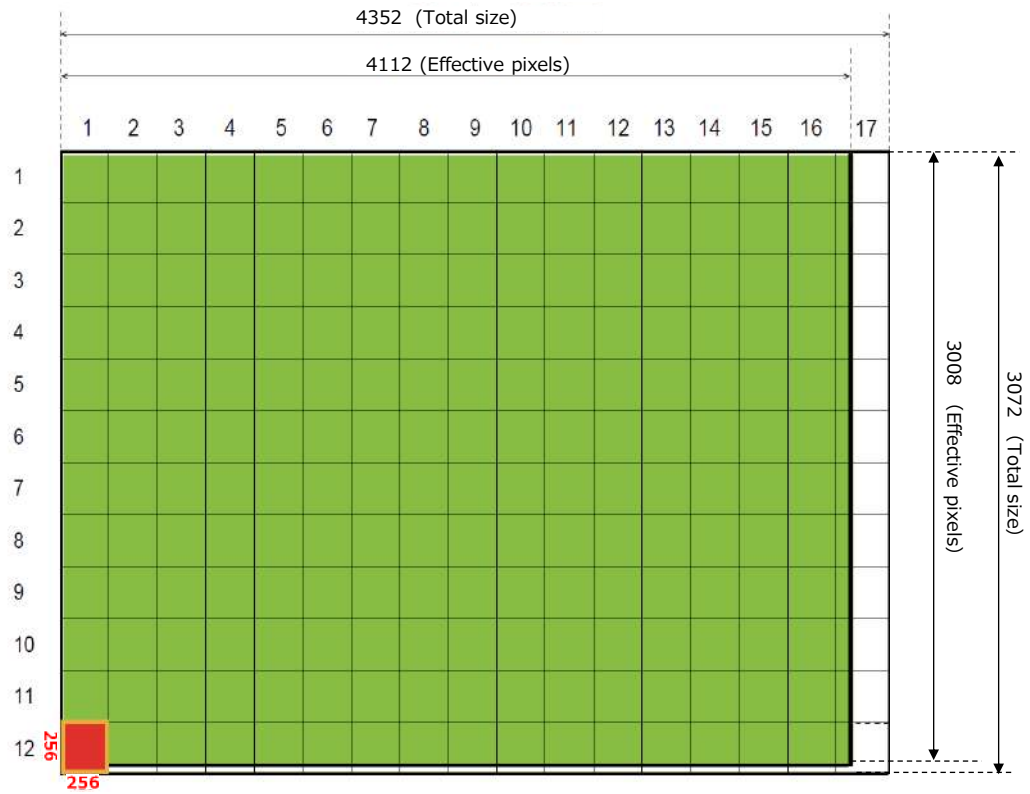
ShadingCorrection

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

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

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

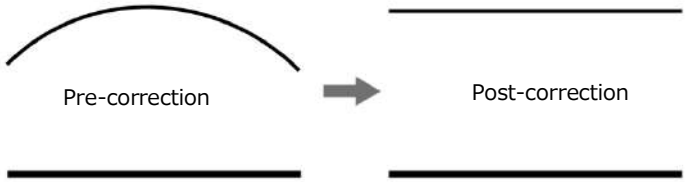
When using ROI, the number of blocks and the number of pixels that comprise each block differ from a full image.



The following shading correction modes are available on the camera.

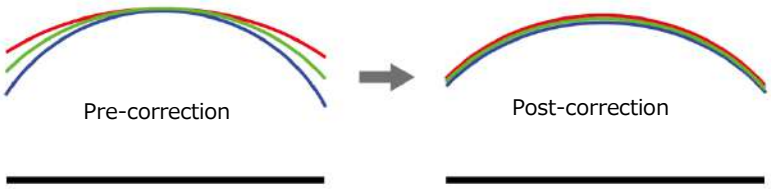
■ **FlatShading**

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



■ **ColorShading (SP-12400C-PMCL only)**

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



Caution

- For FlatShading and ColorShading, the maximum amount of correction gain for all pixels is limited to 8 times the amount of gain before correction. (The amount of gain cannot be increased to more than 8 times the amount of gain from before correction.)

■ **To use the shading correction function**

Configure the settings as follows.

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

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

Note

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

Binning Function

(SP-12400M-PMCL only)
The binning function allows you to combine the signal values of clusters of adjacent pixels to create improved virtual pixels. Using the function results in images with lower pixel resolution and higher sensitivity.

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

ROI (Regional Scanning Function)

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

ROI Settings

Specify the area to scan by specifying width, height, and horizontal/vertical offset values under [ImageFormatControl].
For details on how to configure the settings, see “Configuring the Output Format”.
You can increase the frame rate by specifying a lower height, as the number of lines scanned decreases.The setting ranges for the ROI function's readable area based on the Binning setting (BinningHorizontal, BinningVertical) are as follows.

SP-12400M-PMCL

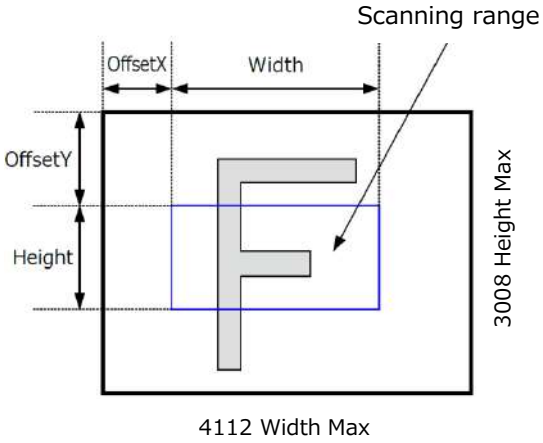
SP-12400M-PMCL (H/V Binning Off)			Width (Min, Max, Step)			Height (Min, Max, Step)			Offset X(Min, Max, Step)			Offset Y(Min, Max, Step)		
Mono8	Base	1X2_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
Mono10	Base	1X2_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
Mono12	Base	1X2_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
Mono8	Base	1X3_1Y	96	4080	48	8	3008	4	0	3984	48	0	3000	4
Mono8	Medium	1X4_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
Mono10	Medium	1X4_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
Mono12	Medium	1X4_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
Mono8	Full	1X8_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
Mono10	EightyBit	1X8_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
Mono8	EightyBit	1X10_1Y	160	4080	80	8	3008	4	0	3920	80	0	3000	4

SP-12400M-PMCL (H/V Binning On)			Width (Min, Max, Step)			Height (Min, Max, Step)			Offset X(Min, Max, Step)			Offset Y(Min, Max, Step)		
Mono8	Base	1X2_1Y	48	2056	8	8	1504	2	0	2008	8	0	1496	2
Mono10	Base	1X2_1Y	48	2056	8	8	1504	2	0	2008	8	0	1496	2
Mono12	Base	1X2_1Y	48	2056	8	8	1504	2	0	2008	8	0	1496	2
Mono8	Base	1X3_1Y	48	2040	24	8	1504	2	0	1992	24	0	1496	2
Mono8	Medium	1X4_1Y	48	2056	8	8	1504	2	0	2008	8	0	1496	2
Mono10	Medium	1X4_1Y	48	2056	8	8	1504	2	0	2008	8	0	1496	2
Mono12	Medium	1X4_1Y	48	2056	8	8	1504	2	0	2008	8	0	1496	2
Mono8	Full	1X8_1Y	48	2056	8	8	1504	2	0	2008	8	0	1496	2
Mono10	EightyBit	1X8_1Y	48	2056	8	8	1504	2	0	2008	8	0	1496	2
Mono8	EightyBit	1X10_1Y	80	2040	40	8	1504	2	0	1960	40	0	1496	2

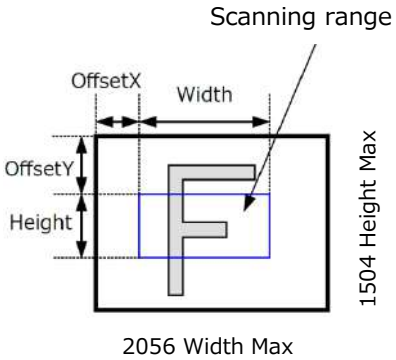
SP-12400C-PMCL

SP-12400C-PMCL			Width (Min, Max, Step)			Height (Min, Max, Step)			Offset X(Min, Max, Step)			Offset Y(Min, Max, Step)		
BayerRG8	Base	1X2_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
BayerRG10	Base	1X2_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
BayerRG12	Base	1X2_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
BayerRG8	Base	1X3_1Y	96	4080	48	8	3008	4	0	3984	48	0	3000	4
BayerRG8	Medium	1X4_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
BayerRG10	Medium	1X4_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
BayerRG12	Medium	1X4_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
BayerRG8	Full	1X8_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
BayerRG10	EightyBit	1X8_1Y	96	4112	16	8	3008	4	0	4016	16	0	3000	4
BayerRG8	EightyBit	1X10_1Y	160	4080	80	8	3008	4	0	3920	80	0	3000	4

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



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



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

SensorMultiROI

In this mode, the Multi ROI function built into the image sensor is used. Up to 64 areas can be specified. In this mode, areas can not be overlapped.

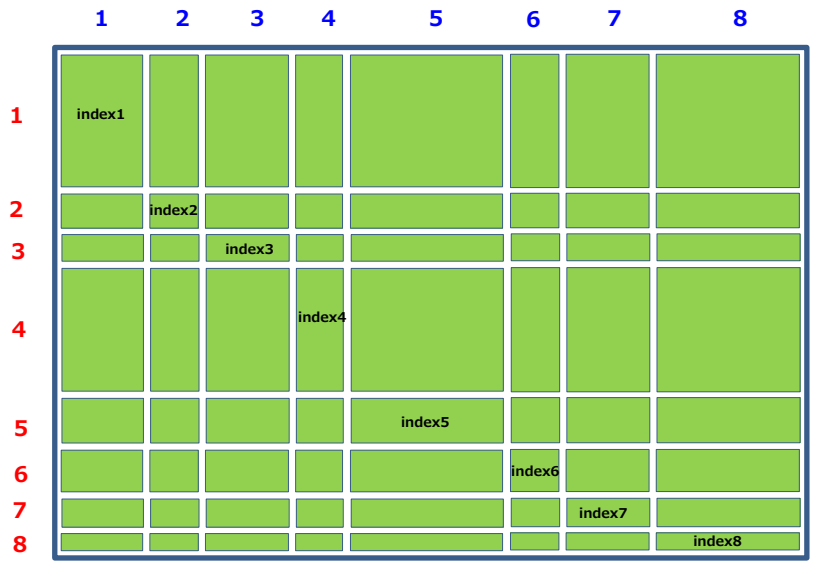
*) Sequencer mode and SensorMultiROI mode can not be used at the same time.

The setting is [JAICustomControlSensorMultiROI]. Specify width, height, horizontal / vertical offset value for each index.
In addition, set [SensorMultiRoiHorizontalEnable], [SensorMultiRoiVerticalEnable].

The area where [SensorMultiRoiHorizontalEnable] and [SensorMultiRoiVerticalEnable] are both valid is the read area.

*) For Index 1, both [SensorMultiRoiHorizontalEnable] and [SensorMultiRoiVerticalEnable] are fixed to True.

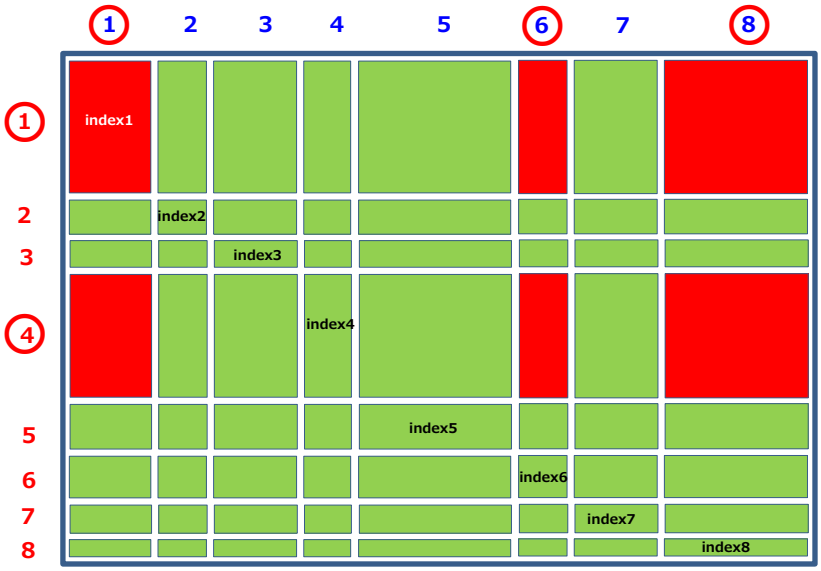
By setting the width, height, horizontal / vertical offset value of index 1 to 8, set the area of 64 as shown below.



You can set the readout area by setting [SensorMultiRoiHorizontalEnable] and [SensorMultiRoiVerticalEnable] of index 1 to 8 to True.

The figure below shows an example
[SensorMultiRoiHorizontalEnable] index1, index6, index8 is set to True
[SensorMultiRoiVerticalEnable] index1, index4 is set to True.

In this case, the red area becomes the read out area.



Sequencer Function

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

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

Note

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

About indexes (imaging conditions)

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

Trigger Sequencer mode

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

[SequencerSetActive]

This allows you to confirm the currently configured index number.

[SequencerSetStart]

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

[SequencerLUTMode]

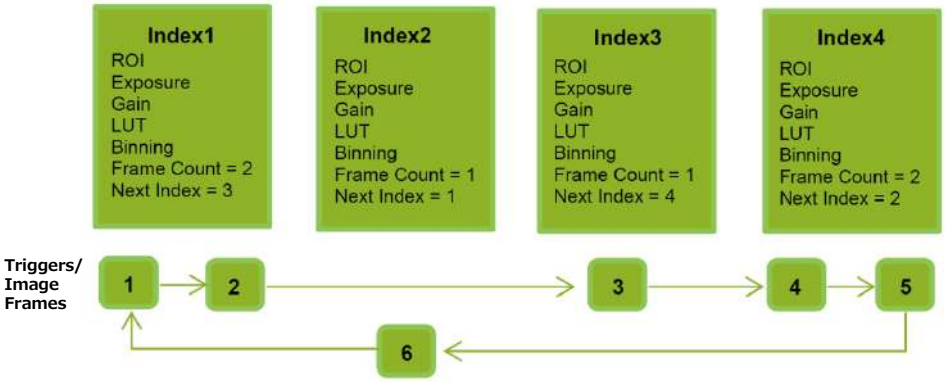
This defines whether to apply gamma or LUT to the sequence.When gamma is selected, the gamma setting defined in [AnalogControl] is applied to all exposures in the sequence. When LUT is selected, the LUT characteristics defined in [AnalogControl] are applied to indexes for which [SequencerLUT enable]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

[SequencerReset]

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

Sample TriggerSequencer mode operation

User-defined Indexes (up to 128)



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

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

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

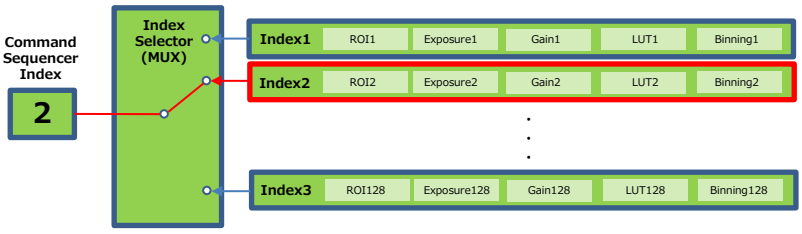
Proceed to sequence from index 4 to index 2 to index 1.

Command Sequencer mode

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

Note

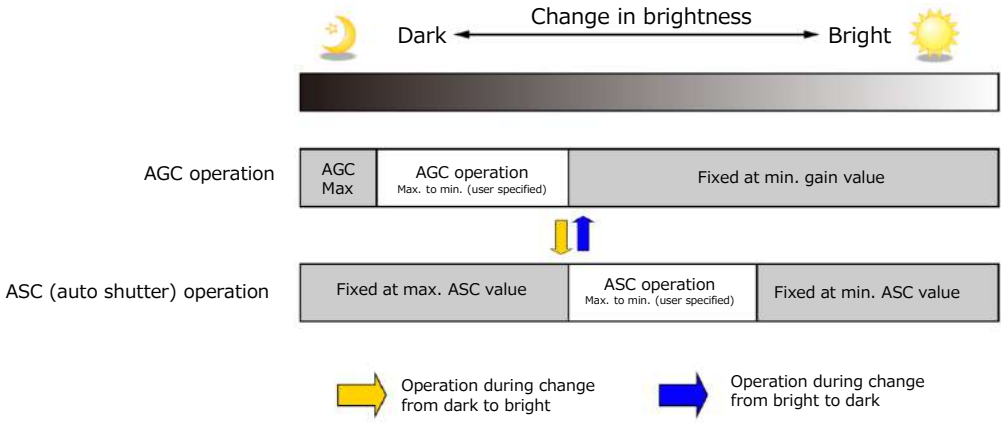
- The same index table will be executed for subsequent triggers unless the [CommandSequencerIndex] value is changed.
- [SequencerFrameNumber] and [SequencerSetNext] cannot be used in CommandSequencer mode.



ALC (Automatic Level Control) Function

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

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



■ **To use the ALC function**

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

Edge Enhancer

This camera (SP-12400M-PMCL only) is equipped with an edge enhancer function for enhancing the contrast of lines or edges within.

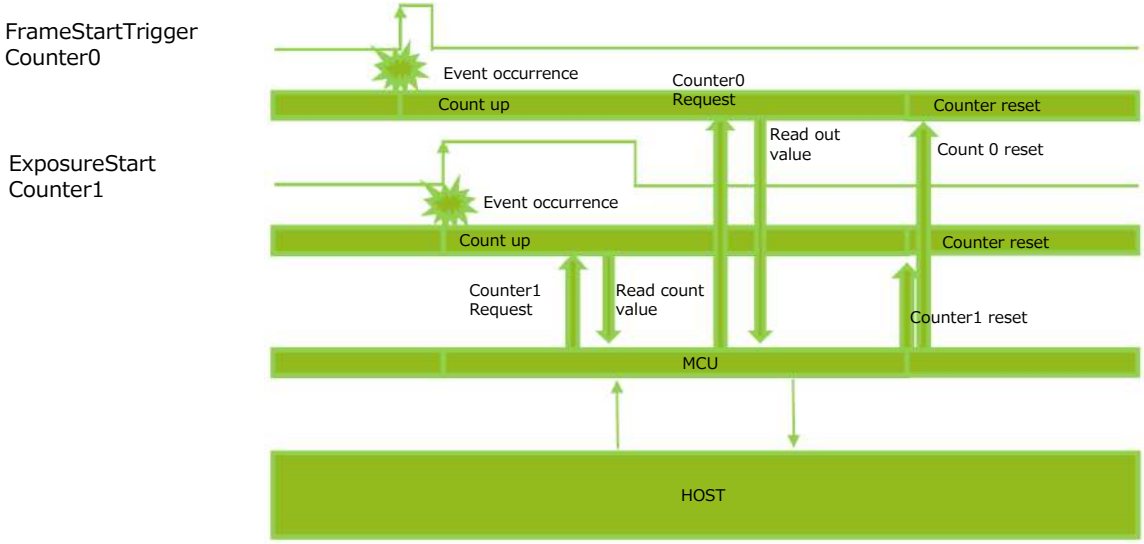
Edge enhancer function
The edge enhancer function is enabled when EnhancerEnable[Edge] is set to True. Four enhancement levels are available: Low, Middle, High, and Strong.

CounterAndTimerControl Function

This camera supports only the counter function.
The counter function counts up change points in the camera's internal signals using the camera's internal counter, and reads that information from the host side. This function is useful for verifying error conditions via the count value using internal camera operations.
Three counters are available on the camera; Counter0, Counter1 and Counter2.
The functions that can be counted are fixed for each counter.
Counter0: Counts the number of FrameStartTrigger instances.
Counter1: Counts the number of ExposureStart instances.
Counter2: Counts the number of SensorReadOut instances.

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

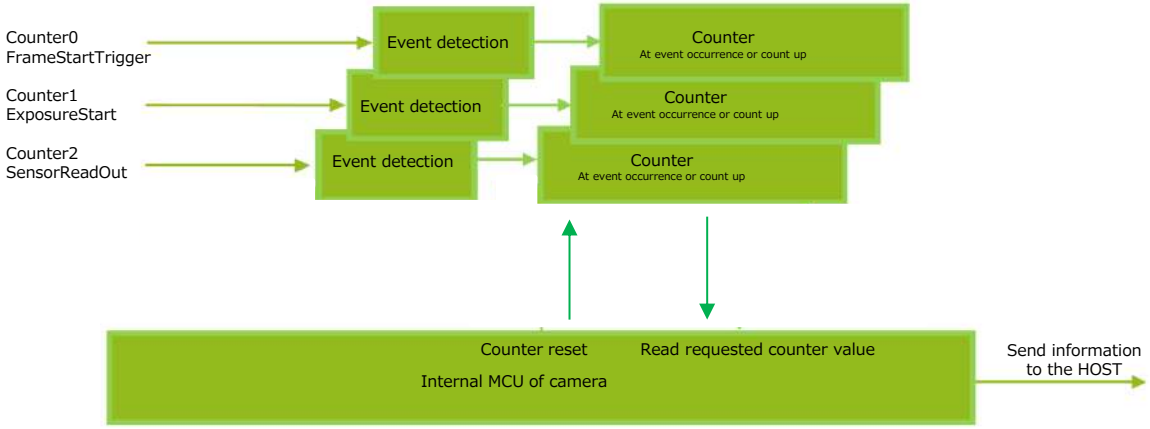
■ Counter occurrence diagram



Note

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

■ Internal camera blocks



■ To use the counter function

Configure the settings as follows.
Three counters are available. Specify a counter (Counter0 to Counter2), and configure the settings.

Item	Setting value / selectable range	Description
Counter 0 ～ 2	Counter 0 ～ 2	Select the counter.
CounterEventSource	Counter0 Off, Frame Trigger Counter1 Off, ExposureStart Counter2 Off, SensorReadOut	Select the counter event signal for which to read the count value. When set to Off, the counter operation will stop (but will not be reset).
CounterEventActivation	When the counter function is enabled, Counter0, Counter1, and Counter2 are fixed at RisingEdge.	Specify the timing at which to count.

VideoProcessBypassMode

The video process bypass mode is a function that bypasses internal video processing on the camera. When bypass is enabled, the sensor output and camera output data can be set to the same bit depth.
12-bit outputs can only be performed in bypass mode.
*) At 12-bit outputs, output is not performed with full range.

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

■ **Functions available in VideoProcessBypassMode**

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

Setting List

Feature Properties

Item	Setting range	Default value	Description
a) DeviceControl			Display/configure information related to the device.
DeviceVendorName	—	"JAI Corporation"	Display the manufacturer name.
DeviceModelName	—	SP-12400M-PMCL/ SP-12400C-PMCL	Display the model name.
DeviceManufacturerInfo	—	See the possibilities	Display the manufacturer information.
DeviceVersion	—	—	Display the hardware version.
DeviceFirmwareVersion	—	—	Display the firmware version.
DeviceSerialNumber	—	—	Display the device ID.
DeviceUserID	Any	—	Set the user ID (16bytes) for the camera.
DeviceTemperatureSelector	Mainboard	Mainboard	Select the area of the camera's interior for which to display the temperature sensor's reading. (fixed Mainboard)
DeviceTemperature(C)	—	—	Display the internal temperature (°C) of the camera.
DeviceSerialPortSelector	CameraLink	CameraLink	Specify the serial port to set the communication speed. (CameraLink fixed)
DeviceSerialPortBaudRate	Baud9600, Baud19200, Baud38400, Baud57600, Baud115200, Baud230400, Baud460800, Baud921600	Baud9600	Display communication speed of serial port.
DeviceReset	—	—	Reset the device. (After the camera receives this command, it returns an ACK response. Then, execute reset.)

Item	Setting range	Default value	Description
b) ImageFormatControl			Configure image format settings.
SensorWidth	4112	4112	Display the maximum image width.
SensorHeight	3008	3008	Display the maximum image height.
SensorDigitizationBits	12 Bits, 10 Bits	12 Bits	Display the number of bits at which the sensor is operating.
WidthMax	4112	4112	Display the maximum image width. Values range varies depending on the setting of PixelFormat, Binning, TapGeometry. For details, refer to [ROI(Regional Scanning Function)].
HeightMax	3008	3008	Display the maximum image height. Values range varies depending on the setting of Binning. For details, refer to [ROI(Regional Scanning Function)].
Width	96～4112 16 pixels/step	4112	Set the image width. Values range varies depending on the setting of PixelFormat, Binning, TapGeometry. For details, refer to [ROI(Regional Scanning Function)].
Height	8～3008 4 lines/step	3008	Set the image height. Values range varies depending on the setting of Binning. For details, refer to [ROI(Regional Scanning Function)].
OffsetX	0～4016 16 pixels/step	0	Set the horizontal offset. Values range varies depending on the setting of PixelFormat, Binning, TapGeometry. For details, refer to [ROI(Regional Scanning Function)].
OffsetY	0～3000 4 lines/step	0	Set the vertical offset. Values range varies depending on the setting of Binning. For details, refer to [ROI(Regional Scanning Function)].
BinningHorizontalMode	Average, Sum	Sum	Set the addition process to be used during horizontal binning. (SP-12400M-PMCL only)
BinningHorizontal	1,2	1	Set the number of pixels in the horizontal direction for which to perform binning. (SP-12400M-PMCL only)
BinningVerticalMode	Sum	Sum	Display the addition process to be used during vertical binning. [Sum] fixed. (SP-12400M-PMCL only)
BinningVertical	1,2	1	Set the number of pixels in the vertical direction for which to perform binning. (SP-12400M-PMCL only)
PixelFormat	SP-12400M-PMCL Mono8, Mono10, Mono12 SP-12400C-PMCL BayerRG8, BayerRG10, BayerRG12	SP-12400M-PMCL Mono8 SP-12400C-PMCL BayerRG8	Set the pixel format. The following mode are enabled when [VideoProcessBypassMode] is set to [On]. SP-12400M-PMCL Mono12 SP-12400M-PMCL BayerRG12
TestPattern	Off, GreyHorizontalRamp, GreyVerticalRamp, GreyHorizontalRampMoving SP-12041C-PGE only HorizontalColorBar, VerticalColorBar, HorizontalColorBarMoving	Off	Select the test image.

Item	Setting range	Default value	Description
c) AcquisitionControl			Configure image capture settings.
AcquisitionFrameRate(Hz)	0.125～		Set the frame rate as a frequency. (unit: Hz) The maximum value varies depending on the PixelFormat and ROI settings.
TriggerSelector	FrameStart	FrameStart	Select the trigger operation. [FrameStart] fixed.
TriggerMode	Off, On	Off	Select the trigger mode.
TriggerSoftware			Execute a software trigger.
TriggerSource	Low High Software PulseGenerator0 PulseGenerator1 PulseGenerator2 PulseGenerator3 UserOutput0 UserOutput1 UserOutput2 UserOutput3 Line5 - OptIn1 Line6 - OptIn2 Line7 - CC1 NAND0Out NAND1Out	TriggerSource [AcquisitionStart]=Low TriggerSource [AcquisitionEnd]=Low TriggerSource [FrameStart]=FrameStart TriggerSource [AcquisitionTransferStart] =Low	Select the trigger signal source.
TriggerActivation	RisingEdge FallingEdge LevelHigh LevelLow	RisingEdge	Select the polarity of the trigger signal (i.e., location of signal at which trigger is applied).
TriggerOverlap	Off, ReadOut	TriggerOverlap [FrameStart]=ReadOut	Select the trigger overlap operation.
TriggerDelay (us)	0～500000	0	Set the time of exposure start from trigger input. (unit: μs)
ExposureModeOption	Off, RCT	Off	Set whether to enable RCT mode.
ExposureMode	Off, Timed, TriggerWidth	Timed	Select the exposure mode.
ExposureTime (us)	1μs ～	—	Set the exposure time. The specifiable range varies depending on the [AcquisitoinFramerate] setting.
ExposureAuto	Off, Continuous, Once	Off	Set whether to enable auto exposure.

Item	Setting range	Default value	Description
d) AnalogControl			Configure analog control settings.
GainSelector	SP-12400M-PMCL AnalogAll SP-12400C-PMCL AnalogAll, DigitalRed, DigitalBlue	AnalogAll	Select the gain to configure.
Gain	SP-12400M-PMCL AnalogAll, x1.0 ～ x16.0 SP-12400C-PMCL AnalogAll, x1.0 ～ x16.0 DigitalRed, x0.447～x5.624 DigitalBlue, x0.447～x5.624	SP-12400M-PMCL AnalogAll x1.0 SP-12400C-PMCL AnalogAll, x1.0 DigitalRed, x1.0 DigitalBlue, x1.0	Set the gain value for the gain setting selected in [GainSelector].
GainAuto	Off, Continuous, Once	Off	Enable/disable gain auto adjustment. [Once] automatically changes to [Off] when the signal level converges once.
BalanceWhiteAuto	Off, Continuous, Once, Preset3200K, Preset5000K, Preset6500K, Preset7500K	Off	Enable/disable auto white balance.
BlackLevelSelector	DigitalAll, DigitalRed, DigitalBlue	DigitalAll	Select the black level to configure. DigitalRed, DigitalBlue are SP-12400C-PMCL only.
BlackLevel	DigitalAll, -133～255 DigitalRed, -64～ 64 DigitalBlue -64～ 64	DigitalAll, 0 DigitalRed, 0 DigitalBlue 0	Set the black level value.
Gamma	0.45, 0.5, 0.55, 0.6, 0.65, 0.75, 0.8, 0.9, 1.0	0.45	Set the gamma value.
LUTMode	Off, Gamma, LUT	Off	Select the LUT mode.
e) LUTControl			Configure LUT settings. SP-12400C-PMCL only
LUTSelector	Red, Green, Blue	Red	Select the LUT channel to control.
LUTIndex	0～256	0	Set the LUT index table number.
LUTValue	0～4095	Gamma=1.0	Set the LUT value.

Item	Setting range	Default value	Description
f) DigitalI/Ocontrol			Configure settings for digital input/output.
LineSelector	Line1-TTLOut1 Line2-OptOut1 Line5-OptIn1 Line6-OptIn2 Line7-CC1 NANDGate0In1 NANDGate0In2 NANDGate1In1 NANDGate1In2	Line2-OptOut1	Select the input/output to configure.
LineMode	Input, Output	—	Display the input/output status (whether it is input or output).
LineInverter	True, False	False	Enable/disable polarity inversion for the selected input signal or output signal.
LineStatus	True, False	—	Display the status of the input signal or output signal (True: High, False: Low).
LineSource	Low High FrameTriggerWait FrameActive ExposureActive FVAL LVAL PulseGenerator0 PulseGenerator1 PulseGenerator2 PulseGenerator3 UserOutput0 UserOutput1 UserOutput2 UserOutput3 Line5 - OptIn1 Line6 - OptIn2 Line7 - CC1 NAND0Out NAND1Out	LineSource [Line1-TTLOut1] = ExposureActive Other default value is of.	Select the line source signal for the item selected in [LineSelector].
LineFormat	NoConnect, TTL, OptoCoupled InternalSignal	—	Display the signal format.
LineStatusAll	—	—	Display the input/output signal status. The state is shown with 16 bits. Bit assignments are as follows. [0] Line1 - TTL Out 1 [1] Line2 - OptOut1 [2], [3] (unused) [4] Line5 - Opt In 1 [5] Line6 - Opt In 2 [6] Line7 - CC1 [7], [8], [9], [10], [11] (unused) [12] NAND Gate 0 In 1 [13] NAND Gate 0 In 2 [14] NAND Gate 1 In 1 [15] NAND Gate 1 In 2
OptInFilterSelector	Off, 10us, 100us, 500us, 1ms, 5ms, 10ms	Off	Remove noise from the OptIn input signal of Digital I/O.
UserOutputSelector	UserOutput0 UserOutput1 UserOutput2 UserOutput3	UserOutput0	Set the UserOutput signal.
UserOutputValue	True, False	False	Set the value for the UserOutput selected in [UserOutputSelector].

Item	Setting range	Default value	Description
g) CounterAndTimerControl			Configure counter settings. (This camera only supports counter functions.)
CounterSelector	Counter0 Counter1 Counter2	—	Select the counter.
CounterEventSource	Counter0 Off, FrameTrigger Counter1 Off, ExposureStart Counter2 Off, SensorReadOut	Off	Assign the counter event signal for which you want to read the count value to a dedicated counter, and read the value.
CounterEventActivation	—	—	Set the count timing. The setting value is fixed with the following data. Counter0 RisingEdge Counter1 RisingEdge Counter2 RisingEdge
CounterReset	—	—	Reset the counter.
CounterRefresh	0～65535	0	Update the count value.
CounterValue	0～65535	0	Display the count value.
CounterStatus	—	—	Display the counter status. CounterIdle: Idle CounterActive: Counting CounterOverflow: Count value exceeded the mazimum value
h) UserSetControl			Configure user settings.
UserSetSelector	Default, UserSet1, UserSet2, UserSet3	Default	Select the user settings.
UserSetLoad	0(default), 1, 2, 3	—	Load user settings. (If 0 is specified, the factory default setting is read.)
UserSetSave	1,2,3	—	Save the current setting values as user settings.

Item	Setting range	Default value	Description
i) SequencerControl			Configure sequencer settings.
SequencerMode	Off, On	Off	Enable/disable [SequencerMode].
SequencerModeSelect	TriggerSequencerMode, CommandSequencerMode	TriggerSequencerMode	Select the sequencer mode.
SequencerConfigurationMode	Off, On	On	Select [On] to change the settings within the index.
SequencerSetSelector	1～128	1	Select the index number to configure.
SequencerFrameNumber	1～255	1	Set the number of frames to display for the selected SequencerIndex. (Enabled only for TriggerSequencer.)
SequencerSetNext	0～128	—	Set the next index to be displayed for the selected SequencerIndex. (Enabled only for TriggerSequencer.) If 0 is specified, the operation of Sequencer is stopped.
SequencerWidth	96～4112 16 pixels/step	4112	Set the width of the selected SequencerIndex. Values range varies depending on the setting of PixelFormat, Binning, TapGeometry. For details, refer to [ROI(Regional Scanning Function)].
SequencerHeight	8～3008 4 lines/step	3008	Set the height of the selected SequencerIndex. Values range varies depending on the setting of Binning. For details, refer to [ROI(Regional Scanning Function)].
SequencerOffsetX	0～4016 16 pixels/step	0	Set the horizontal offset value for the selected SequencerIndex. Values range varies depending on the setting of PixelFormat, Binning, TapGeometry. For details, refer to [ROI(Regional Scanning Function)].
SequencerOffsetY	0～3000 4 lines/step	0	Set the vertical offset value for the selected SequencerIndex. Values range varies depending on the setting of Binning. For details, refer to [ROI(Regional Scanning Function)].
SequencerGainAnalogAll	1.0 ～ 16.0	1.0	Set the GainAnalogAll value.
SequencerGainDigitalRed	0.447～5.624	1.0	SP-12400C-PMCL only Set the DigitalRed Gain value for the selected SequencerIndex.
SequencerGainDigitalBlue	0.447～5.624	1.0	SP-12400C-PMCL only Set the DigitalBlue Gain value for the selected SequencerIndex.
SequencerExposureTime	1μs ～	—	Set the exposure time for the selected SequencerIndex.
SequencerBinningHorizontal	1,2	1	SP-12400M-PMCL only For the selected SequencerIndex, set the number of pixels in the vertical direction for which to perform binning. In binning mode, the setting value of BinningHorizontalMode is applied.
SequencerBinningVertical	1,2	1	SP-12400M-PMCL only For the selected SequencerIndex, set the number of pixels in the vertical direction for which to perform binning. In binning mode, the setting of BinningVerticalMode is applied.
SequencerLUTEnable	True, False	False	Set the LUTEnable for the selected SequencerIndex.
SequencerBlackLevelDigitalAll	-133～255	0	Set the BlackLevelDigitalAll for the selected SequencerIndex.
SequencerLUTMode	Gamma, LUT	Gamma	Set the sequence LUT mode.
SequencerSetActive	1～128	1	Displays the sequencer set number.
SequencerCommandIndex	1～128	1	Set this to change the SequencerIndex. (Enabled only for CommandSequencer.)
SequencerSetStart	1～128	1	Specify the first index number to switch to when starting [TriggerSequencerMode].
SequencerReset	—	—	In [TriggerSequencerMode], reset the current index number to the number configured in [SequencerSetStart].

Item	Setting range	Default value	Description
j) TransportLayerControl			Configure Camera Link Transport Layer settings.
DeviceTapGeometry	Geometry_1X2_1Y, Geometry_1X3_1Y, Geometry_1X4_1Y, Geometry_1X8_1Y, Geometry_1X10_1Y	Geometry_1X4_1Y	Set the transmission method for each time images are transmitted from the device (TAP structure).
ClConfiguration	Base, Medium, Full, EightyBit	Medium	Display the setting of Camera Link Configuration.
CameraLinkClockFrequency	37.1MHz, 74.3MHz, 84.9MHz	74.3MHz	Set the Camera Link clock.

Item	Setting range	Default value	Description
k) PulseGenerator			Configure pulse generator settings.
ClockPreScaler	1～4096	165	Set the division value for the prescaler (12 bit) using PixelClock as the base clock.
PulseGeneratorClock (MHz)	0.0181274～74.25	0.45	Set the clock used for the pulse generator. This value is calculated using the [ClockPreScaler] value as a base.
PulseGeneratorSelector	PulseGenerator0, PulseGenerator1, PulseGenerator2, PulseGenerator3	PulseGenerator0	Select the pulse generator.
PulseGeneratorLength	1～1048575	30000	Set the maximum count-up value as a clock count.
PulseGeneratorLengthMs (ms)	1 / PulseGeneratorClock (MHz) ～1048575 / PulseGeneratorClock (MHz)	66.6667	Set the maximum count-up value in milliseconds. This value is calculated using the [PulseGeneratorLength] value as a base. The setting range varies depending on the [ClockPreScaler] value.
PulseGeneratorFrequency (Hz)	PulseGeneratorClock (MHz) ÷ 1048575 x 1000000 ～ PulseGeneratorClock (MHz) x 1000000	15	Set the maximum count-up value as a frequency. This value is calculated using the [PulseGeneratorLength] value as a base.
PulseGeneratorStartPoint	0 ～ 1048574	0	Set the start point of the High interval as a clock count. When the counter reaches this value, the output will be 1.
PulseGeneratorStartPointMs (ms)	0 ～ 1048575 / PulseGeneratorClock (MHz)	0	Set the start point of the High interval in milliseconds. When the counter reaches this value, the output will be 1. The setting range varies depending on the [ClockPreScaler] value.
PulseGeneratorEndPoint	1 ～ 1048575	15000	Set the start point of the Low interval as a clock count. When the counter reaches this value, the output will be 0.
PulseGeneratorEndPointMs (ms)	1/ PulseGeneratorClock (MHz) ～ 1048575 / PulseGeneratorClock (MHz)	33.3333	Set the start point of the Low interval in milliseconds. When the counter reaches this value, the output will be 0. The setting range varies depending on the [ClockPreScaler] value.
PulseGeneratorPulseWidth (ms)	—	33.3333	Display the High interval width of the pulse in milliseconds. The duration between the Start Point and End Point is calculated. The setting range varies depending on the [ClockPreScaler] value.
PulseGeneratorRepeatCount	0 ～ 255	0	Set the repeat count for the counter. When this is set to [0], a free counter is enabled with no repeat limit.
PulseGeneratorClear Activation	Off, LevelHigh, LevelLow, RisingEdge, FallingEdge	Off	Set the clear signal condition for the count clear input of the pulse generator.
PulseGeneratorClearSource	Low, High AcquisitiionTriggerWait, AcquisitionActive, FrameTriggerWait, FrameActive, ExposureActive, FVAL, LVAL PulseGenerator0, PulseGenerator1, PulseGenerator2, PulseGenerator3, UserOutput0, UserOutput1, UserOutput2, UserOutput3, Line5 - OptIn1, Line6 - OptIn2, NAND0Out, NAND1Out,	Low	Select the count clear input signal source.
PulseGeneratorClearInverter	True, False	False	Select whether to invert the polarity of the count clear input signal.
PulseGeneratorClearSync Mode	AsyncMode, SyncMode	AsyncMode	Select the sync mode for the count clear input signal.

Item	Setting range	Default value	Description
l) JAICustomControlALC			Configure JAI ALC settings. These settings are also used for AGC (auto gain control).
ALCReference	30～95	50	Set the target level for ALC. (unit: %)
ALCAreaSelector	Low Right, Low Mid-Right, Low Mid-Left, Low Left, Mid-Low Right, Mid-Low Mid-Right, Mid-Low Mid-Left, Mid-Low Left, Mid-High Right, Mid-High Mid-Right, Mid-High Mid-Left, Mid-High Left, High Right, High Mid-Right, High Mid-Left, High Left	Low Right	Select the area for which to configure [ALCAreaEnable].
ALCAreaEnable	True, False	True	Enable/disable the photometry area selected in [ALCAreaSelector].
ALCAreaEnableAll	True, False	True	True: Operate ALC with all areas designated as photometry areas, regardless of the individual enabled/disabled photometry area states configured in [ALCAreaSelector]. False: Operate ALC according to the individual enabled/disabled photometry area states configured in [ALCAreaSelector].
AutoShutterControlExposureMin	100 ～	100	Set the minimum value for the ExposureAuto(ASC) control range.
AutoShutterControlExposureMax	—	—	Set the maximum value for the ExposureAuto(ASC) control range.
AutoGainControlGainRawMin	100 ～	100	Set the minimum value for the GainAuto(ASC) control range.
AutoGainControlGainRawMax	～ 1600	1600	Set the maximum value for the GainAuto(ASC) control range.
ALCControlSpeed	1 ～ 8	4	Set the response speed for AGC/ASC. (8 is the fastest.)
ALCStatus	Off, ASC, AGC	Off	Allows confirmation of the current operation area during ALC operation.
AutoControlStatus	ExecutingASC, ExecutingAGC, ExecutingASCandAGC, ExecutingAWB, ExecutingASCandAWBExecutingAGCandAWB, ExecutingASCandAGCandAWB, Convergent, ConditionError, Idle	Idle	Allows confirmation of the AGC, ASC, and AWB convergence status.

Item	Setting range	Default value	Description
m) JAICustomControlAWB			Configure AWB settings.
AWBAreaSelector	Low Right, Low Mid-Right, Low Mid-Left, Low Left, Mid-Low Right, Mid-Low Mid-Right, Mid-Low Mid-Left, Mid-Low Left, Mid-High Right, Mid-High Mid-Right, Mid-High Mid-Left, Mid-High Left, High Right, High Mid-Right, High Mid-Left, High Left	Low Right	Select the area for which to configure [AWBAreaEnable].
AWBAreaEnable	True, False	True	Enable/disable the photometry area selected in [AWBAreaSelector].
AWBAreaEnableAll	True, False	True	True: Operate AWB with all areas designated as photometry areas, regardless of the individual enabled/disabled photometry area states configured in [AWBAreaSelector]. False: Operate AWB according to the individual enabled/disabled photometry area states configured in [AWBAreaSelector].
AWBControlSpeed	1 ～ 8	4	Set the AWB control speed. (8 is the fastest.)
AWBControlStatus	Complete, TooBright, TooDark, Timeout, Executing, TriggerError, Convergent, ConditionError, Idle	Idle	Displays the operation status of the AWB.
n) JAICUstomControlBlemish			Configure settings for JAI white blemish correction.
BlemishEnable	True, False	True	Enable/disable blemish correction.
BlemishDetect	—	—	Execute blemish detection. This command can not be executed under the following conditions. ・When no image is output ・Outputting TestPattern ・In Sequencer mode ・In Overlap MultiRoi mode ・In single ROI mode
BlemishStore	—	—	Save the location information of detected blemishes.
BlemishDetectThreshold	1 ～ 100	10	Set the blemish detection threshold.
BlemishCompensationIndex	1 ～ 800	1	Select the index for the target blemish coordinates (BlemishDataPosition X/Y).
BlemishCompensation PositionX	-1～4111	-1	Display the X coordinate (horizontal pixel position) of the target blemish selected in [BlemishCompensationIndex]. You can also manually enter the X coordinate of the blemish you want to correct.
BlemishCompensation PositionY	-1～3007	-1	Display the Y coordinate (vertical pixel position) of the target blemish selected in [BlemishCompensationIndex]. You can also manually enter the Y coordinate of the blemish you want to correct.
BlemishCompensation DataClear	—	—	Delete detected or specified blemish information selected in [BlemishCompensationIndex].
BlemishCompensationNumber	0 ～ 800	0	Display the number of target blemishes.

Item	Setting range	Default value	Description
o) JAICustomControlShading			Configure shading correction settings.
ShadingCorrectionMode	FlatShading, ColorShading	FlatShading	Select the shading correction method.
ShadingMode	Off, User1, User2, User3	Off	Set the area to which to save shading correction data. When this is set to [Off], shading correction data is not saved.
PerformShadingCalibration	—	—	Execute shading correction. This command can not be executed under the following conditions. ・When no image is output ・Outputting TestPattern ・In Sequencer mode ・In Overlap MultiRoi mode ・When the ROI setting is under the following conditions (Width or Height is less than 128)
ShadingDetectResult	Condition Error, TooDark, TooBright, Correction Limit, Complete	—	Display the shading correction results.
p) JAICustomControlSensorMultiROI			Configure settings for sensor Multi Roi.
SensorMultiRoiMode	Off, On	Off	Enable/disable sensor Multi Roi.
SensorMultiRoiIndex	1 ～ 8	1	Select the index for the sensor Multi Roi mode.
SensorMultiRoiWidth	16～	512	Set the width for the selected sensor Multi Roi index.
SensorMultiRoiHeight	2～	376	Set the height for the selected sensor Multi Roi index.
SensorMultiRoiOffsetX		Index1 0 Index2 512 Index3 1024 Index4 1536 Index5 2048 Index6 2560 Index7 3072 Index8 3584	Set the horizontal offset for the selected sensor Multi Roi index.
SensorMultiRoiOffsetY		Index1 0 Index2 376 Index3 752 Index4 1128 Index5 1504 Index6 1880 Index7 2256 Index8 2632	Set the vertical offset for the selected sensor Multi Roi index.
SensorMultiRoiHorizontal Enable	True, False	Value of Index1 is True only.	For each SensorMultiRoiIndex, enable / disable is set. Area where both SensorMultiRoiHorizontalEnable and SensorMultiRoiVerticalEnable are valid is output.
SensorMultiRoiVertical Enable	True, False	Value of Index1 is True only.	For each SensorMultiRoiIndex, enable / disable is set. Area where both SensorMultiRoiHorizontalEnable and SensorMultiRoiVerticalEnable are valid is output.

Item	Setting range	Default value	Description
q) JAICustomControlMisc			Enable/disable VideoProcessBypass mode.
VideoProcessBypassMode	Off, On	Off	Enable/disable VideoProcessBypass mode.
EnhancerSelect	Edge		Specify the operation mode of Enhancer. [Edge] fixed.
EnhancerEnable	True, False	False	Enable/disable EdgeEnhancer.
EdgeEnhancerLevel	Low, Middle, High, Strong	Middle	Set the Level for EdgeEnhancer.
VideoSendMode	NormalMode, TriggerSequencerMode, CommandSequencerMode, SensorMultiRoiMode	NormalMode	Display the [VideoSendMode].

Miscellaneous

Troubleshooting

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

■ Power supply and connections

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

■ Image display

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

■ Settings and operations

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

Specifications

項目				SP-12400M-PMCL			SP-12400C-PMCL		
Scanning system				Progressive scan, 1 tap					
Synchronization				Internal					
Interface				CameraLink (Version 2.0)					
Image sensor				Monochrome CMOS			Bayer color CMOS		
Image size (effective image)				1.1-inch 14.2mm(H) x 10.4mm(V) : 17.6mm(diagonal)					
Pixel size				3.45 μm (H) x 3.45μm(V)					
Effective image pixel (Image sensor)				4112(H) x 3008(V)					
Acquisition Frame Rate (fps) (max)	PixelFormat	ClConfiguration	TapGeometry	37.1MHz	74.3MHz	84.9MHz	37.1MHz	74.3MHz	84.9MHz
	Mono8	Base	1X2_1Y	5.8	11.7	13.4			
	Mono10	Base	1X2_1Y	5.8	11.7	13.4			
	Mono12	Base	1X2_1Y	5.8	11.7	13.4			
	Mono8	Base	1X3_1Y	8.8	17.6	20.1			
	Mono8	Medium	1X4_1Y	11.7	23.4	26.8			
	Mono10	Medium	1X4_1Y	11.7	23.4	26.8			
	Mono12	Medium	1X4_1Y	11.7	23.4	26.8			
	Mono8	Full	1X8_1Y	23.3	46.7	53.4			
	Mono10	EightyBit	1X8_1Y	23.3	46.4	46.4			
	Mono8	EightyBit	1X10_1Y	29.1	58.2	64.6			
	BayerRG8	Base	1X2_1Y				5.8	11.7	13.4
	BayerRG10	Base	1X2_1Y				5.8	11.7	13.4
	BayerRG12	Base	1X2_1Y				5.8	11.7	13.4
	BayerRG8	Base	1X3_1Y				8.8	17.6	20.1
	BayerRG8	Medium	1X4_1Y				11.7	23.4	26.8
	BayerRG10	Medium	1X4_1Y				11.7	23.4	26.8
	BayerRG12	Medium	1X4_1Y				11.7	23.4	26.8
	BayerRG8	Full	1X8_1Y				23.3	46.7	53.4
	BayerRG10	EightyBit	1X8_1Y				23.3	46.4	46.4
	BayerRG8	EightyBit	1X10_1Y				29.1	58.2	64.6
EMVA1288 parameters Absolute sensitivity Maximum SN ratio				At 10-bit output 3.50p (λ=525nm) 40.03dB			At 10-bit output 4.00p (λ=525nm) 40.10dB		
Digital image output format *1	Full			4112(H) x 3008(V)					
	ROI		Width	96 ～ 4112 pixels 16 pixels/step					
			Offset X	0 ～ 4016 pixels 16 pixels/step					
			Height	8 ～ 3008 lines 4 lines/step					
			Offset Y	0 ～ 3000 lines 4 lines/step					
	Binning (H)		1	4112(H)					
			2	2056(H)					
	(V)		1	3008(V)					
			2	1504(V)					
	Pixel Format			Mono8, Mono10, Mono12			BayerRG8, BayerRG10, BayerRG12		
Acquisition Mode				Continuous					
Trigger Selector	Exposure			FrameStart					
Opto filter				Off(Default), 10 μs, 100 μs, 500 μs, 1 ms, 5 ms, 10 ms					
Trigger overlap				Off / Read out					
Trigger input signals				Low, High, Software, PulseGenerator0-3, UserOutput0-3, Line5-Opt In 1, Line6-Opt In 2, Line7-CC1, NAND 0 Out, NAND 1 Out					

*1) Values range varies depending on the setting of PixelFormat, Binning, TapGeometry.
For details, refer to [ROI(Regional Scanning Function)].

項目			SP-12400M-PMCL	SP-12400C-PMCL
ExposureMode	Timed		15.26 μs* (min) ～ 8 s (max) ❖ erformance verified for up to 1 second.	
	Trigger Witdh		15.26 μs* (min) ～ ∞ s (max) ❖ erformance verified for up to 1 second.	
Exposure Auto			Off / Continuous / Once	
Auto exposure response speed (AGC/ASC Control Speed)			1 ～ 8	
Video send mode			NormalMode, TriggerSequencerMode, CommandSequencerMode, SensorMultiRoiMode	
Digital I/O			LineSelector (12P) : GPIO IN / GPIO OUT	
Black Level adjustment	Default level		8LSB@8bit	
	Video level adjustment range		DigitalAll : -133 ~ +255 LSB @12bit DigitalRed : -64 ~ +64 LSB @12bit DigitalBlue : -64 ~ +64 LSB @12bit	
	Resolution adjustment		1LSB@12bit	
Gain adjustment	Manual adjustment range		AnalogAll : 0dB ～ 24dB DigitalRed : -7dB ～ 15dB DigitalBlue : -7dB ～ 15dB	
	Auto gain		Off, Continuous, Once	
White balance	WBA		DigitalRed, DigitalBlue : -7dB ～ 15dB	
	BalanceWhiteAuto		Off, Continuous, Once, Preset3200K, Preset5000K, Preset6500K, Preset7500K	
	Area		16 (4 x 4) Area	
	Adjustment range		3000K ～ 9000K	
Blemish correction	Detection		Detect white blemishes using threshhold values (100 steps available) (black blemish correction performed only at factory)	
	Correction		Interpolation using adjacent pixels (continuous blemishes not corrected)	
	Correctable pixels		800 pixels	
ALC			Can be adjusted automatically together with AGC and auto exposure control	
Gamma			0.45, 0.5, 0.55, 0.6, 0.65, 0.75, 0.8, 0.9, 1.0 (9 steps available)	
LUT			OFF : γ= 1.0, ON = 257 points can be set	
Vibration resistance			10G (20 Hz ～ 200 Hz X-Y-Z direction)	
Impact resistance			80G	
Power supply	12-pin Connector	Input range	DC + 12 V ～+ 24 V ± 10% (Via input terminal)	
		Consumption	5.1 W (typ.) (at 12 V input, default setting, 25 ℃ environment) 6.7 W (max.)	
	PoCL	Input range	DC + 10 V ～+ 13 V	
		Consumption	5.2 W (typ.) (at 12 V input, default setting, 25 ℃ environment) 6.6 W (max.)	
Lens mount			C-mount Lens mount protrusion length of 9 mm or less is supported	
Flange back			17.526, tolerance: 0 mm to -0.05 m	
Optical filter			IR cut filter (SP-12400C-PMCL only)	
Verified performance temperature / humidity			− 5℃～+ 45℃ / 20%～ 80% (non-condensing)	
Storage temperature / humidity			− 25℃～+ 60℃ / 20%～ 80% (non-condensing)	
Regulations			CE (EN61000-6-2 and EN61000-6-3) , FCC part 15 class B, RoHS, WEEE	
Dimensions (housing)			44 × 44 × 44 mm (WHD) (excluding mount protrusions)	
Weight			135 g	

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

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

Optional accessories (not supplied)
MP-45 tripod mount

Design and specifications are subject to change without notice.

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

Caution

About the verified performance temperature: Make sure the following temperature conditions are met when operating the unit.
1) The camera's internal temperature sensor detects temperatures of 72°C or less during operation.
2) The top surface of the camera's casing is 57°C or less.
If the above temperature conditions are exceeded, take measures to dissipate heat according to your installation environment and conditions.

Frame Rate Reference

[Theoretical value]

■ **SP-12400M-PMCL (PixelFormat : Mono8, TapGeometry : 1x10_1Y, CL clock frequency : 84.9MHz)**

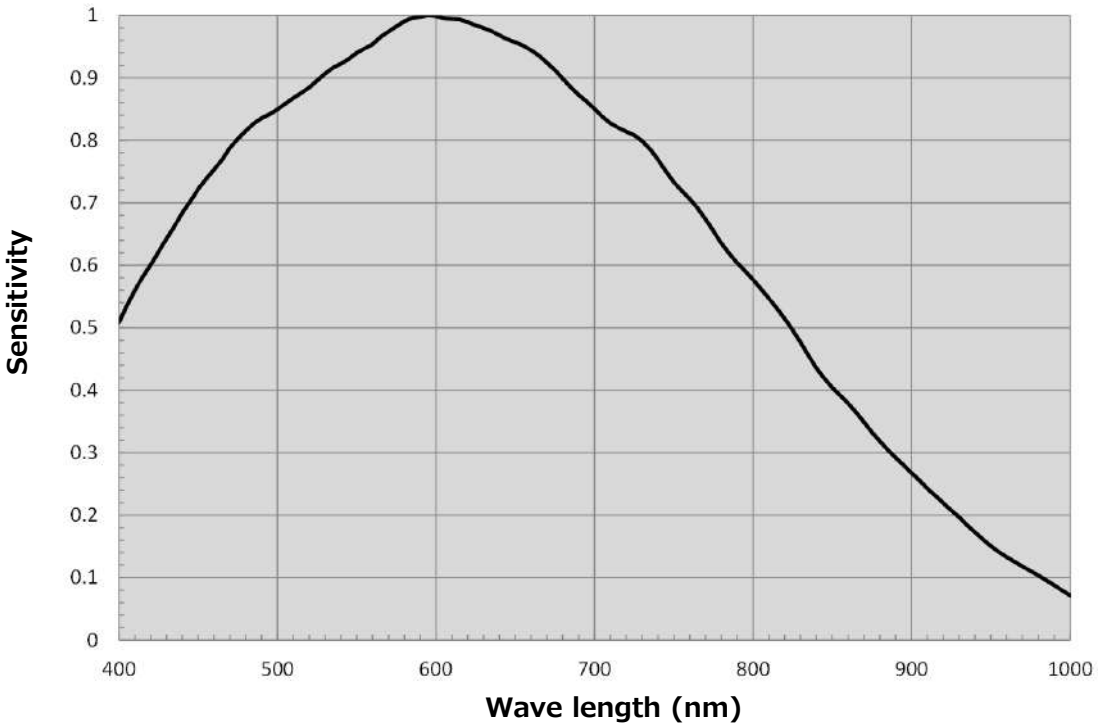
Pixel count (MP)	Resolution (screen size)	ROI/Binning	Pixel size (um)	Image size (mm)	Frame rate (fps)
12.27	4080 x 3008	Full pixel	3.45 x 3.45	14.08 x 10.38 (17.58)	64.6 fps
3.13	2080 x 1504	ROI	3.45 x 3.45	7.18 x 5.19 (8.77)	126.9 fps
1.97	1920 x 1024	ROI	3.45 x 3.45	6.62 x 3.53 (7.51)	183.3 fps
1.97	1920 x 1024	ROI + 2x2 Binning	6.9 x 6.9	13.25 x 7.07 (15.01)	183.3 fps

■ **SP-12400C-PMCL (PixelFormat : BayerRG8, TapGeometry : 1x10_1Y, CL clock frequency : 84.9MHz)**

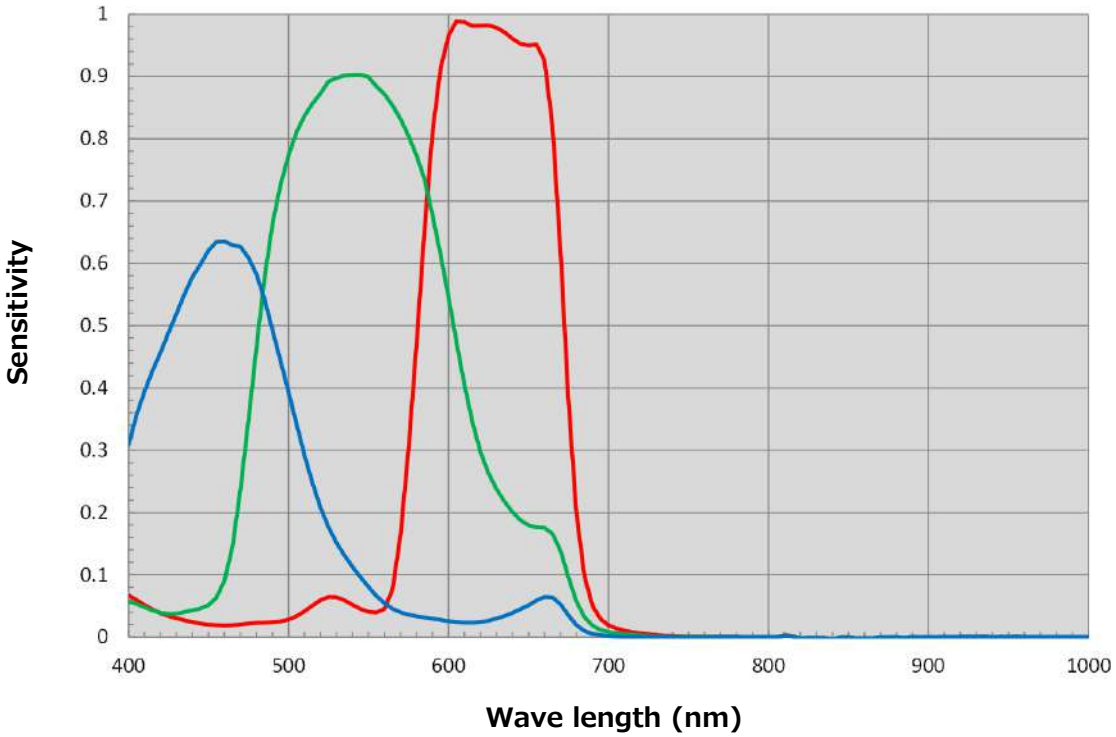
Pixel count (MP)	Resolution (screen size)	ROI/Binning	Pixel size (um)	Image size (mm)	Frame rate (fps)
12.27	4080 x 3008	Full pixel	3.45 x 3.45	14.08 x 10.38 (17.58)	64.6 fps
3.13	2080 x 1504	ROI	3.45 x 3.45	7.18 x 5.19 (8.77)	126.9 fps
1.97	1920 x 1024	ROI	3.45 x 3.45	6.62 x 3.53 (7.51)	183.3 fps

Spectral Response

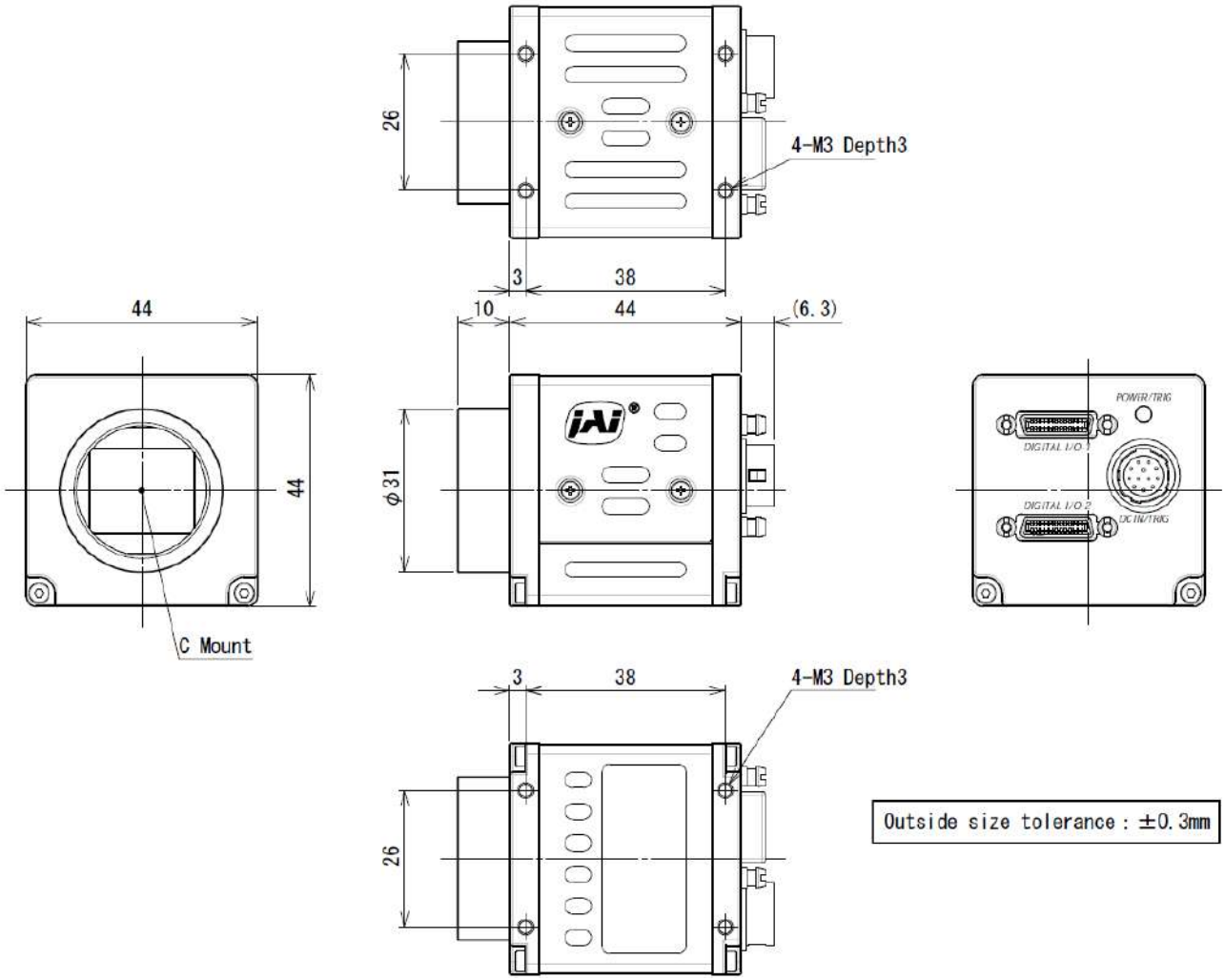
SP-12400M-PMCL Sensitivity



SP-12400C-PMCL Sensitivity



Dimensions


26
4-M3 Depth3
3
38
44
10
44
(6.3)
44
φ31
C Mount
POWER/TRIG
DIGITAL I/O 1
DIGITAL I/O 2
DC IN/TRIG
3
38
4-M3 Depth3
26
Outside size tolerance : ±0.3mm

Comparison of the Decibel Display and Multiplier Display

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

User's Record

Camera type: SP-12400M-PMCL / SP-12400C-PMCL

Revision: ……

Serial No: ……

Firmware version: ……

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

Trademarks

- Microsoft and Windows are trademarks or registered trademarks of Microsoft Corporation in the United States and other countries.
- Intel and Intel Core are trademarks of Intel Corporation in the United States and other countries.

Other system and product names described in this document are trademarks or registered trademarks of their respective owners. The ™ and ® symbols are not used in this document.

Index

Revision history

Revision	Date	Changes
1.1	Oct. 2018	Add value of EMVA