See the possibilities

User Manual

SW-4000TL-PMCL

High Speed CMOS Trilinear Camera

Document Version: 1.4
SW-4000TL-PMCL_Ver.1.4_July 2022

Thank you for purchasing this product.

⚠ Be sure to read this manual before use.

This manual includes important safety precautions and instructions on how to operate the unit. Be sure to read this manual to ensure proper operation. The contents of this manual are subject to change without notice for the purpose of improvement.

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Notice

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

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

Warranty

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

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that SW-4000TL-PMCL comply with the following provisions applying to its standards.
EN 61000-6-3 (Generic emission standard part 1)
EN 61000-6-2 (Generic immunity standard part 1)

FCC

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

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

Warning

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

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 (PBB)	多溴二苯醚 (PBDE)
连接插头	×	○	○	○	○	○
电路板	×	○	○	○	○	○
光学滤镜	×	○	×	○	○	○
棱镜	×	○	○	○	○	○
螺丝固定座	×	○	○	○	○	○
机体外壳	×	○	○	○	○	○

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

环保使用期限

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

数字「15」为期限15年。

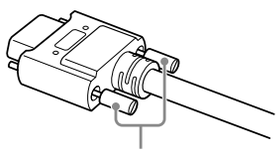
Usage Precautions

Notes on cable configurations

The presence of lighting equipment and television receivers nearby may result in video and audio 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: 0.15 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 SW-4000TL-PMCL is a 3 × 4096 pixel trilinear (RGB) CMOS line scan camera.
The camera has a Camera Link clock of 85 MHz and is capable of high-speed scanning at up to 66 kHz (Line Rate). 8-bit and 10-bit video output is possible via Camera Link.
Camera and external trigger settings are configured via the Camera Link interface or the 12-pin connector.

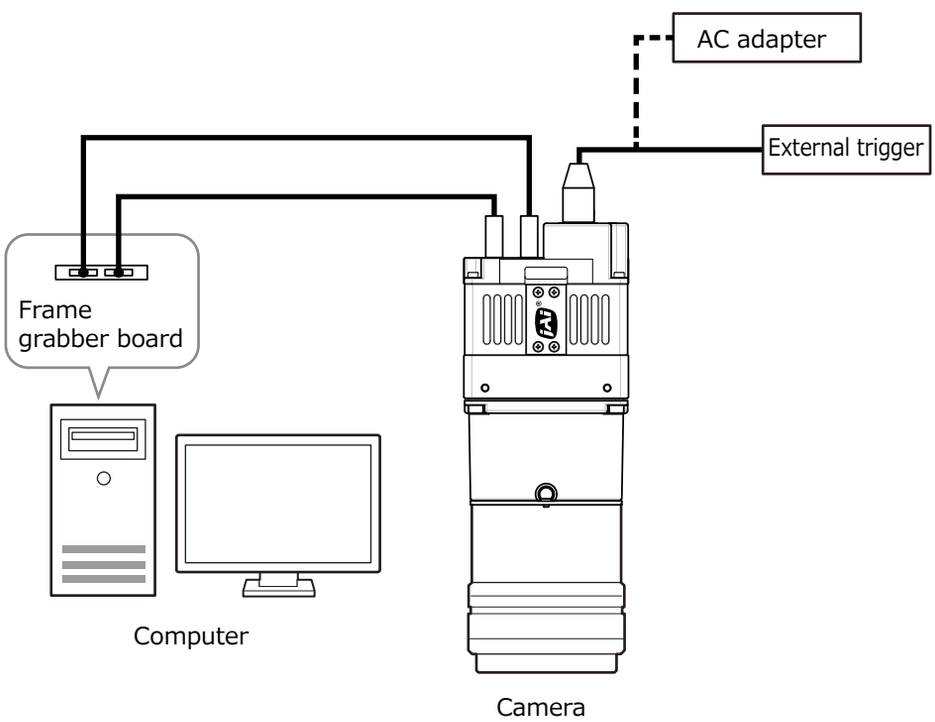
Camera Link compatible interface
• The Camera Link interface can be used for video output and trigger input.

Trilinear line-scan camera
• Tilted view correction
• Spatial compensation
• Automatic detection of scan direction (when using rotary encoders)
• Support for connection of rotary encoders

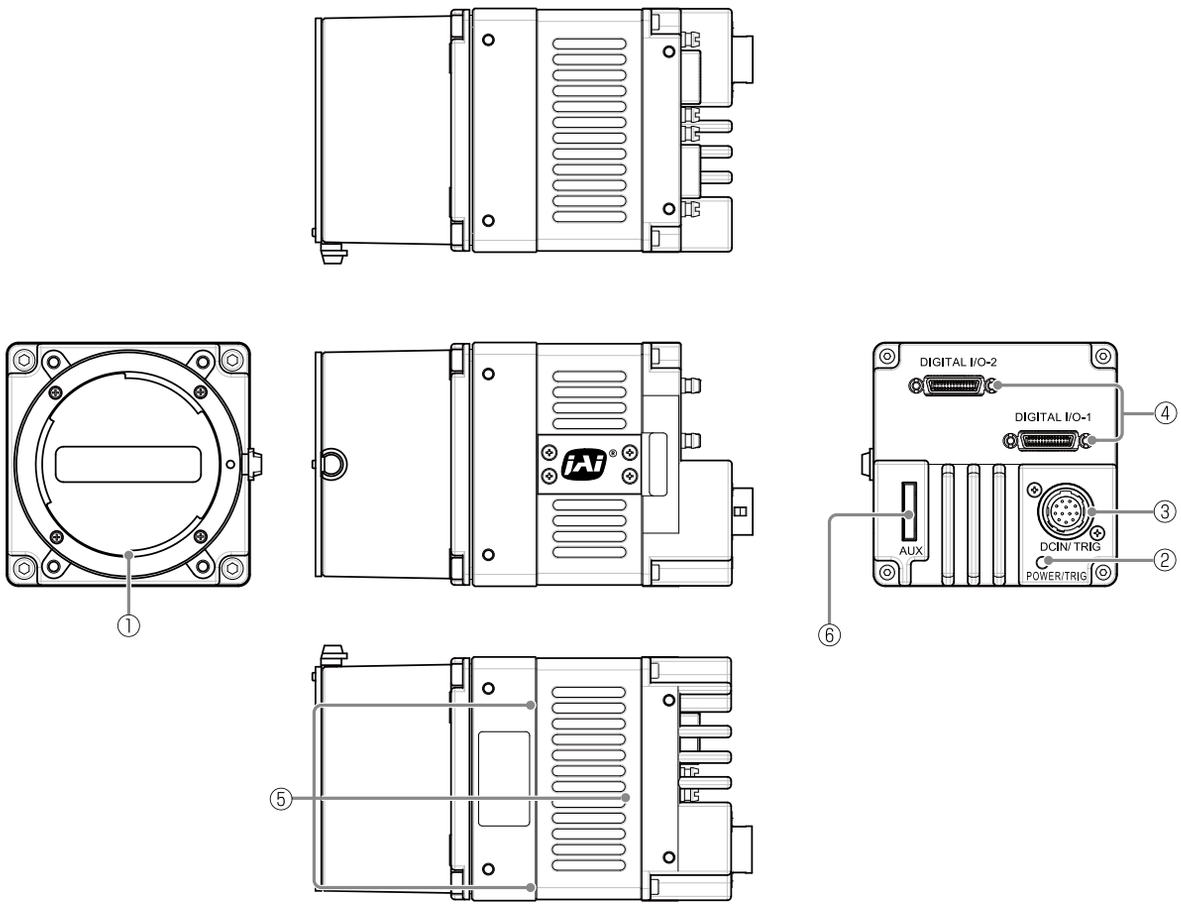
Variety of pre-process functions
• **LUT (Lookup Table)**
Programmable control over gamma and contrast is possible.
• **Gamma correction**
Gamma can be set to 1.0, 0.9, 0.8, 0.75, 0.65, 0.6, 0.55, 0.5, or 0.45 (off).
• **Shading correction (flat field)**
Non-uniformity (i.e., shading) in the amount of light generated by the lens and lighting equipment can be corrected.
• **Variable line rate**
By varying the line rate, the scanning speed of the camera can be matched to the feeding speed of the object, and the accumulation time can be lengthened to increase sensitivity.

Miscellaneous
• Timestamp function
• Color space conversion function (HSI, XYZ, sRGB, Adobe RGB) support

Connection example:



Parts Identification



① **Lens mount (M42 mount or F mount)**
Mount an M42-mount lens or F-mount lens here.

❖ Before mounting a lens, be sure to refer to “Step 2: Connecting Devices” and confirm the precautions for attaching a lens and the supported lens types.

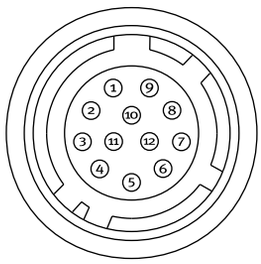
② **POWER/TRIG LED**
Indicates the power and trigger input status.

LED status and camera status

LED	Light	Status
POWER/TRIG LED	● Lit amber	Camera initializing.
	● Lit green	Operational and no triggers being input.
	✱ Blinking green	Operational and triggers being input. ❖ The blinking interval is not related to the actual input interval of the external trigger.

③ DC IN / TRIG IN connector (12-pin round)

Connect the cable for a power supply (sold separately) or for DC IN /TRIG IN here.



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

Pin No.	Input/ output	Signal	Description
1		GND	
2	Power In	DC IN	DC 12 V to 24 V ±10%
3		GND	
4		Reserved	External connection not possible
5	In	OPT IN1−	Line5
6	In	OPT IN1+	
7	Out	TTL OUT 4	Line12
8		NC	
9	Out	TTL Out 1	Line1
10	In	TTL In 1	Line4
11	Power In	DC In	+12 V to 24 V ±10%
12		GND	

Caution

The DC IN / TRIG IN connector, AUX connector or the CC1 of the DIGITAL I/O-1 video output connector will be used for external trigger inputs. You can switch which of these is used via a command.

Compatible connectors

Camera side: HR10A-10R-12PB (71) (Hirose Electric or equivalent)
Cable side: HR-10A-10P-12S (plug) (Hirose Electric or equivalent)

TTL Signal specification

TTL out signal specification (Typ.)

Output voltage : Low 0.0V
High 5.0V

Input/Output current : +/-32mA

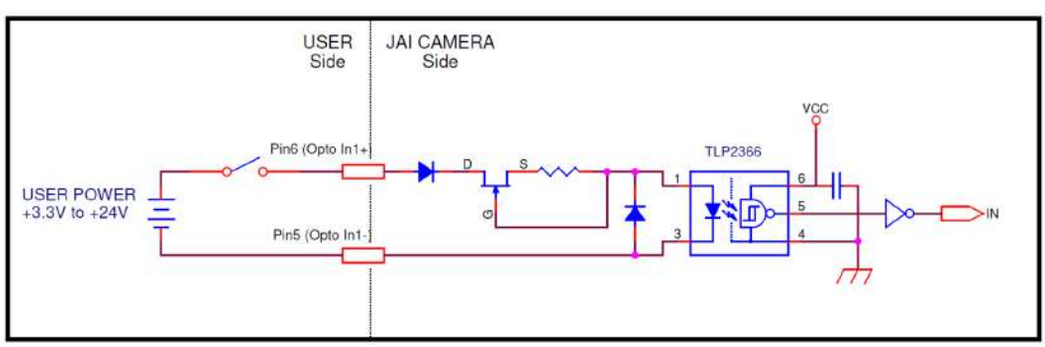
TTL in signal specification (Typ.)

Input voltage : Low 0.0～0.8V
High 2.0～5.5V

Caution

About Opto In.
Check the recommended external input circuit diagram (reference example) and connect correctly.
If you connect Opto In 1 and Opto In 2 in reverse, camera may be damaged.

Recommended external input circuit diagram (reference example)



④ **DIGITAL I/O-1 and DIGITAL I/O-2 video output connectors**
Connect a Cable Link compatible cable here.

Connector 1 (used during Base (RGB8), Medium (RGB8, RGB10), Full (RGB8), 80bit [Deca] (RGB8) output)

Pin No.	Input/ output	Signal	Description
1, 26		Power	Power
2 (-), 15 (+)	Out	TxOUT0	Data output
3 (-), 16 (+)	Out	TxOUT1	Data output
4 (-), 17 (+)	Out	TxOUT2	Data output
5 (-), 18 (+)	Out	TxClk	CL Clock
6 (-), 19 (+)	Out	TxOUT3	Data output
7 (+), 20 (-)	In	SerTC (RxD)	LVDS serial control
8 (-), 21 (+)	Out	SerTFG (TxD)	LVDS serial control
9 (-), 22 (+)	In	CC1	Trigger
10 (+), 23 (-)		CC2	Reserved
11, 24		N.C	
12, 25		N.C	
13, 14		Shield	GND

Connector 2 (used during Medium (RGB8, RGB10), Full (RGB8), 80bit [Deca] (RGB8) output)

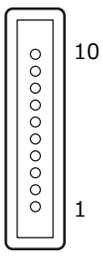
Pin No.	Input/ output	Signal	Description
1, 26		Power	Power
2 (-), 15 (+)	Out	TxOUT0	Data output
3 (-), 16 (+)	Out	TxOUT1	Data output
4 (-), 17 (+)	Out	TxOUT2	Data output
5 (-), 18 (+)	Out	TxClk	CL Clock
6 (-), 19 (+)	Out	TxOUT3	Data output
7 (+), 20 (-)		Reserved	
8 (-), 21 (+)	Out	TxOut0	Data output
9 (-), 22 (+)	Out	TxOut1	Data output
10 (-), 23 (+)	Out	TxOut2	Data output
11 (-), 24 (+)	Out	TxCLK	CL Clock
12 (-), 25 (+)	Out	TxOut3	Data output
13, 14		Shield	GND

Compatible connectors / cable assembly
Camera side: HDR-EC26FYTG2-SL+ (HONDA)
Cable: SDR connector cable for PoCL

❖ The cable length at which communication will be possible will be limited when using a cable that is not compatible with Camera Link, a small diameter type cable or a high flex type cable.

⑤ **Camera locking screw holes (M3, 5 mm depth)**
Use this to connect the camera to the system.

⑥ **AUX connector (10-pin)**



Camera side: Equivalent to Hirose Electronic 3260-10S3(55)
Cable side: Equivalent to Hirose Electronic 3240-10P-C(50)

Pin No.	Attribute	Name	Description
1	Out	TTL OUT2	Line 8
2	Out	TTL OUT3	Line 9
3	IN	TTL_IN2	Line 10
4		NC	
5	GND	GND	
6	IN	TTL_IN3	Line 13
7		NC	
8		NC	
9	GND	GND	
10	GND	GND	

Preparation

Preparation Flow

Step 1	**Installing the Software (first time only)** Install the software for configuring and controlling the camera (JAI SDK) on the computer.
⬇	
Step 2	**Connecting Devices** Connect the lens, Camera Link cable, AC adapter, computer, and other devices.
⬇	
Step 3	**Verifying the Camera's Connection Status** Verify whether the camera is ready for use via the LEDs at the rear of the camera.
⬇	
Step 4	**Configuring Initial Settings for the Camera** • Configure the Camera Link output port. • Configure external trigger settings.
⬇	
Step 5	**Configuring Basic Functions** Configure exposure time, shutter, gain, DSNU, PRNU, and shading correction settings.
⬇	
Step 6	**Configuring Various Other Settings** Configure various other settings as necessary.
⬇	
Step 7	**Saving the Settings** Save the current setting configurations as user memory.

Step 1: Installing the Software (first time only)

When using the camera for the first time, install the software for configuring and controlling the camera (JAI SDK) on the computer.

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

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

URL http://www.jai.com/en/support/jai_sdk_and_control_tool

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

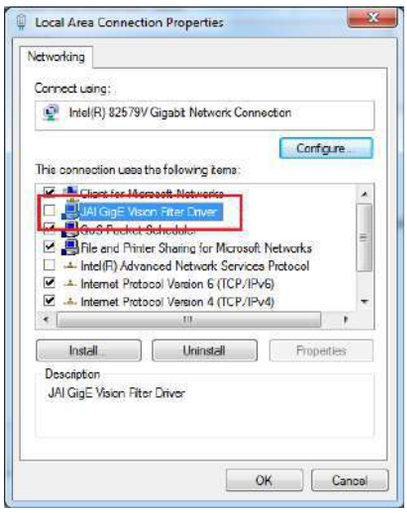
The computer will restart when installation is complete.

Note

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

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

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



3 Verify the settings for using Camera Link.

The SW-4000TL-PMCL supports GenIcam and Gen-CP. Check the following settings when controlling the camera via JAI SDK.

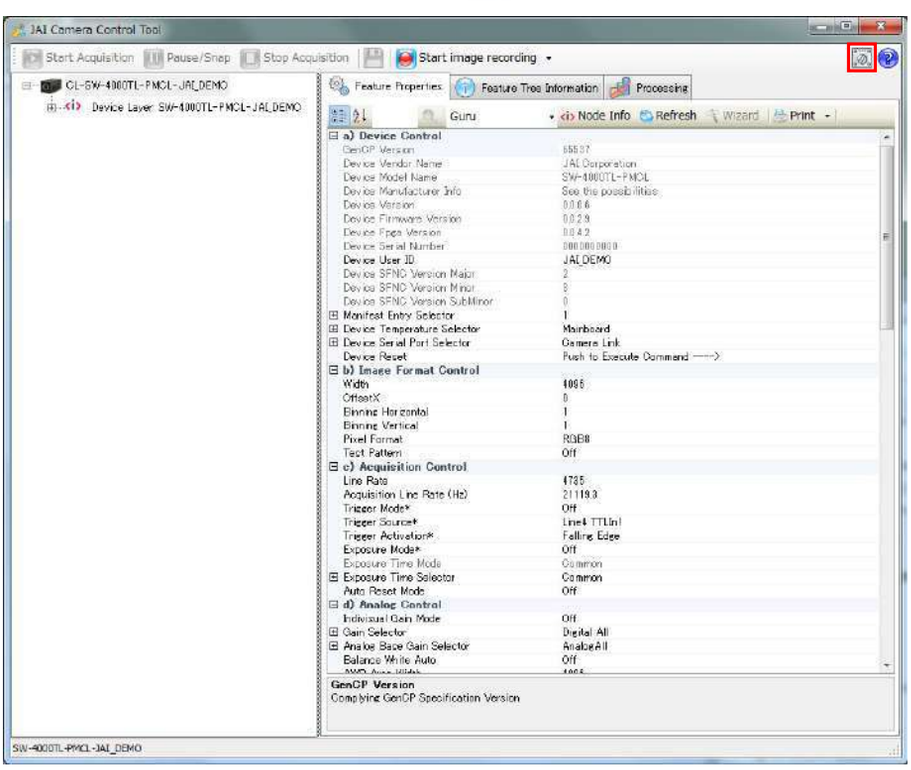
Checking the frame grabber board's settings

Settings must be configured on the frame grabber board to enable Gen-CP support.

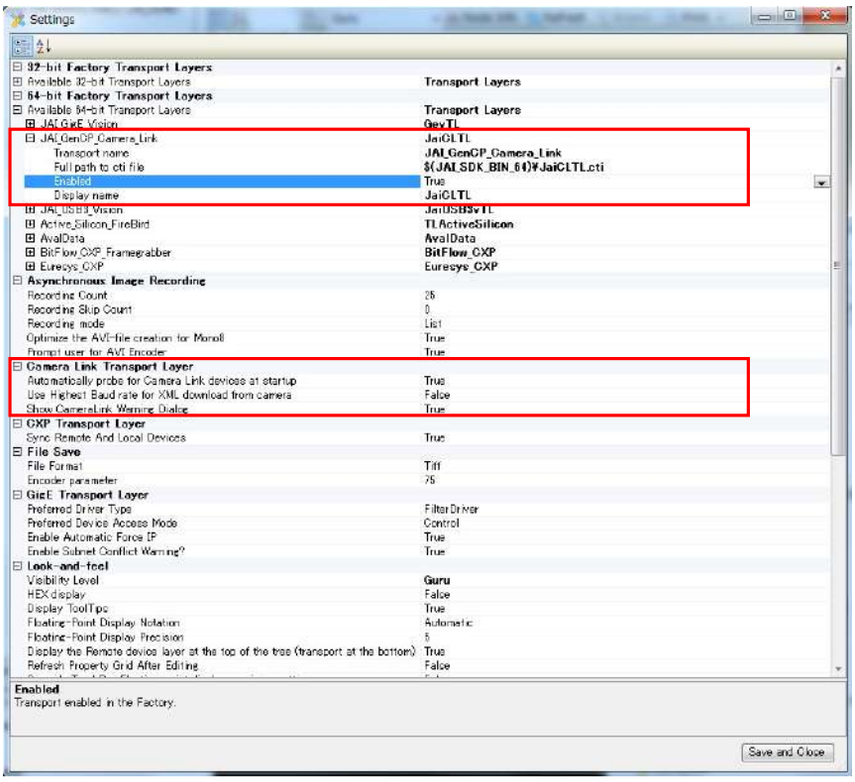
For details, refer to the operating instructions for each board.

Checking JAI SDK's settings

❶ Start JAI Control Tool, and click the  (Settings) icon at the top right.

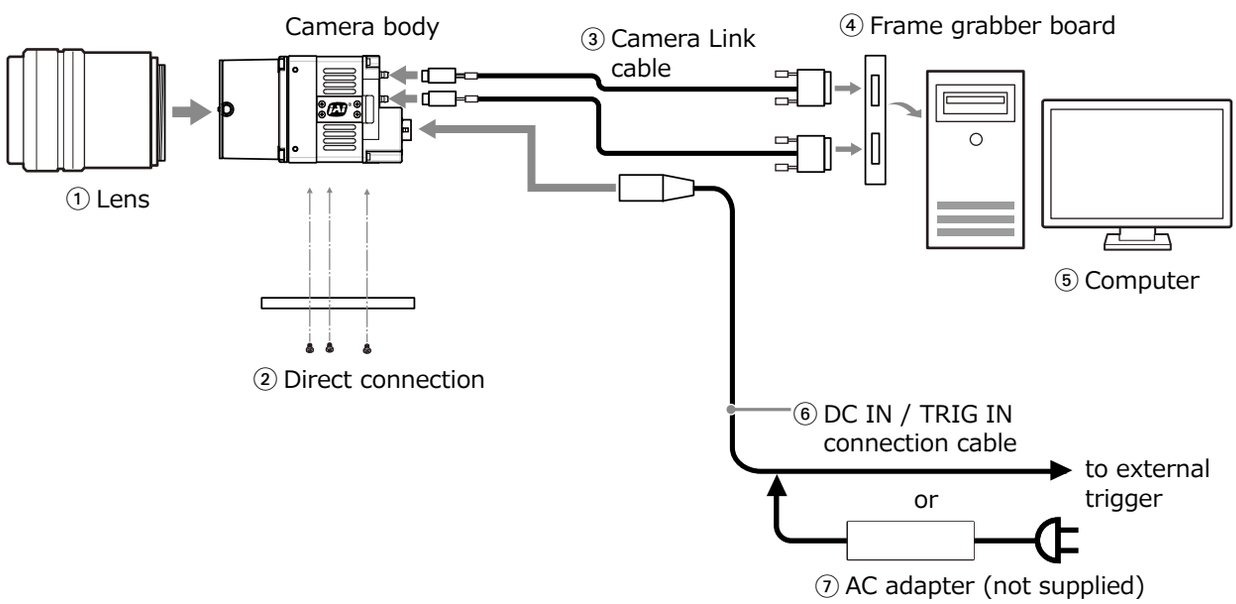


❷ Check that the [JAI_GenCP_Camera_Link] and [Camera Link Transport Layer] settings are configured as follows.



Step 2: Connecting Devices

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



① **Lens**
Attach an M42-mount lens or F-mount lens.

Caution

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

Note

The following formula can be used to estimate the focal length.
focal length = WD/(1 + W/w)
WD: Working distance (distance between lens and object)
W: Width of object
w: Width of sensor 30.72 mm on this camera.

② **Direct connection**
When mounting the camera directly to another device, for example, use screws that match the camera locking screw holes on the camera. (M3, 5 mm depth)
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 cables to the DIGITAL I/O-1 and DIGITAL I/O-2 video output connectors.
• Use Cable Link compatible cables.
• Refer to the specifications of the cable for details on its bend radius.
❖ For details on the cable, see “4 DIGITAL I/O-1 and DIGITAL I/O-2 video output connectors”.

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)

Caution

When supplying power from the camera link cable,
If only DIGITAL I/O 1 is connected, it may not operate correctly when the operating load is high.
Supply power from both DIGITAL I/O 1 and DIGITAL I/O 2.

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 requirements of your frame grabber board.

⑥ **DC IN / TRIG IN connection cable**

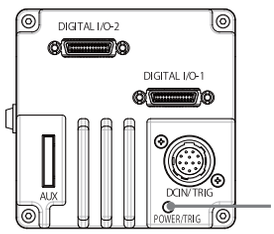
⑦ **AC adapter (if necessary)**
Connect the AC adapter and the round connector of the connection cable to the DC IN / TRIG IN connector on the camera.

Step 3: Verifying the Camera Connection Status

When the necessary devices are connected and power is supplied to the camera, 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 and whether the camera is operational by checking the rear LED.

During normal status



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

Note

If the POWER/TRIG LED does not switch to green within minutes of supplying power, check the DC IN/TRIG cable, the Camera Link cable and other connections.

Step 4: Configuring Basic Settings for the Camera

Start Control Tool, connect the camera to the frame grabber board, and configure initial settings for the output format.

Connecting to the Camera to Control Tool

1 Start JAI Control Tool.

Cameras connected to the frame grabber board are detected, and a window appears. If they do not appear, right-click inside the window and select [Search for Cameras].

2 Select the camera you want to configure.

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

Configuring the Output Format

Configure the pixel format for images.

Item		Default value
ImageFormatControl	PixelFormat	RGB8

Control via External Triggers

When Controlling the Exposure Time Using Specified Exposure Times

Configure the settings as follows.

Item	Setting value / selectable range
TriggerMode	On
TriggerSource (trigger signal source)	Any
TriggerActivation (trigger polarity)	RisingEdge (rising edge of input signal), FallingEdge (falling edge of input signal)
ExposureMode	Timed (control via exposure time)
ExposureTime	Varies depending on the ClConfiguration and CameraLinkClockFrequency settings.

1 **Set [ExposureMode] to [Timed].**
([Timed] is the default setting.)

2 **Specify the exposure time in [ExposureTime].**

3 **Set [TriggerMode] to [On].**

4 **If necessary, change the [TriggerSource], and [TriggerActivation] settings.**

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

Configure the settings as follows.

Item	Setting value / selectable range
TriggerMode	On
TriggerSource (trigger signal source)	Any
TriggerActivation (trigger polarity)	LevelHigh (high-level duration), LevelLow (low-level duration)
ExposureMode	TriggerWidth (control via trigger width)

1 **Set [TriggerMode] to [On] .**

2 **Set [ExposureMode] to [TriggerWidth] .**
When you select [On], [ExposureMode] will be set to [TriggerWidth] automatically.

3 **If necessary, change the [TriggerSource] and [TriggerActivation] settings.**

Control Without External Triggers

When Controlling the Exposure Time Using Specified Exposure Times

Configure the settings as follows.

Item	Setting value / selectable range
TriggerMode	Off
ExposureMode	Timed (control via exposure time)
ExposureTime	Varies depending on the ClConfiguration and CameraLinkClockFrequency settings.
AcquisitionLineRate	Varies depending on the PixelFormat and ClConfiguration settings.

1 **Set [ExposureMode] to [Timed].**
([Timed] is the default setting.)

2 **Set [TriggerMode] to [Off].**

3 **Specify a line period slower than the exposure time in [AcquisitionLineRate].**

4 **Specify the exposure time in [ExposureTime].**

When Not Controlling the Exposure Time

Configure the settings as follows.

Item	Setting value / selectable range
ExposureMode	Off

The exposure will be performed with an exposure time equal to 1 / line rate.

* The exposure time specified in [ExposureTime] will be disabled.

Step 5: Adjusting the Image Quality

To maximize the performance of the camera, configure its basic function in the following order.

1 **Configure the line rate.**

❖ For details on this setting, “Variable Line Rate”.

2 **Configure the exposure time.**

❖ For details on this setting, “Electronic Shutter”.

*The line rates and exposure times that can be set will vary depending on the CameraLinkClockFrequency and ClConfiguration settings for Camera Link.

3 Perform DSNU correction.

❖ For details on this setting, “Pixel Sensitivity Correction” .

4 Perform PRNU correction.

❖ For details on this setting, “Pixel Sensitivity Correction” .

5 Adjust the black level.

❖ For details on this setting, “Black Level Correction” .

6 Adjust the white balance.

Adjust the white balance using the automatic adjustment function.

❶ 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.
The white balance is automatically adjusted.

❷ Select the [BalanceWhiteAuto] tab, and select [Once].
The white balance is automatically adjusted.

7 Perform spatial correction.

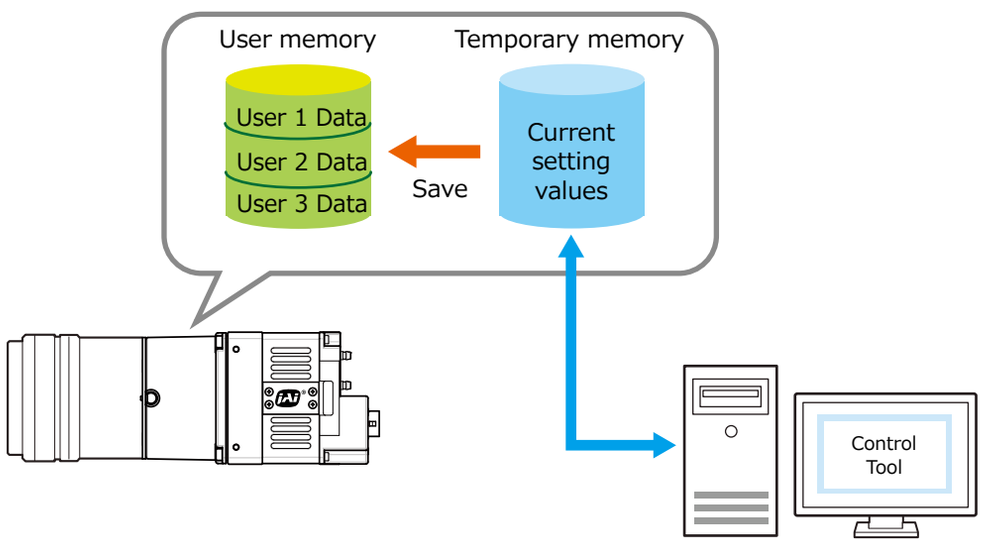
❖ For details on this setting, “Spatial Compensation Function” .

Step 6: Configuring Various Other Settings

See “Settings List” and configure settings as necessary.
*We recommend performing DSNU and PRNU calibration again whenever the line rate setting is changed significantly.

Step 7: Saving the Settings

The setting values configured in Control Tool will be deleted when the camera is turned off. By storing current setting values to user memory, you can load and recall them whenever necessary. You can save up to three sets of user memory settings (User 1 Data to User 3 Data).



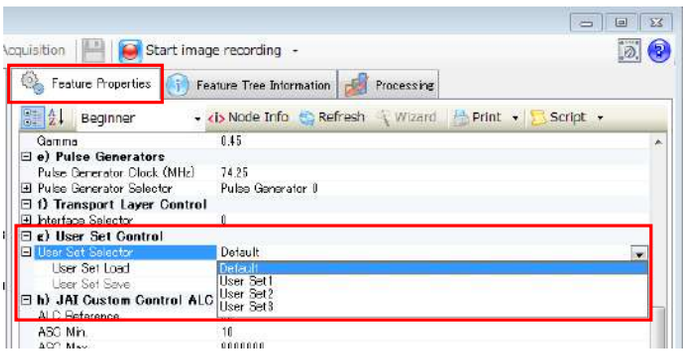
Note

The setting values are not saved to the computer (Control Tool).

■ To save user settings

1 Use a frame grabber board application to stop image capture.

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



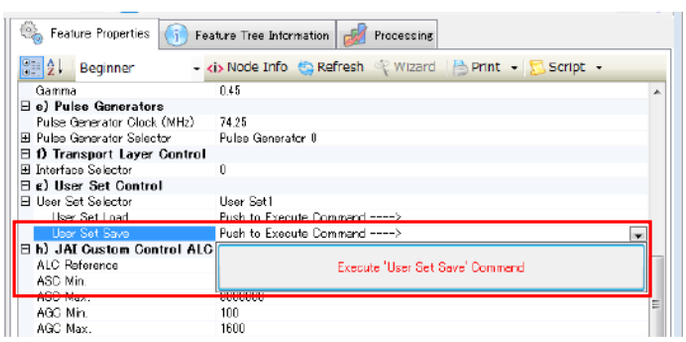
Note

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

Caution

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

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



The current setting values are saved as user settings.

■ To load user settings

1 Use a frame grabber board application to stop image capture.

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

2 Select the settings to load (Default, and UserSet1 to UserSet3) in [UserSetSelector].

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

The selected user settings are loaded.

❖ The next time the unit is started up, the settings selected in [UserSetSelector] will be loaded automatically.

Basic Function Matrix

Valid Input/Output Combinations

The following signals can be used as sources for each output destination (TriggerSelector, LineSelector, PulseGeneratorSelector).

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

Selector (Cross point switch output) / Source signal (Cross point switch input)		Output destination										
		Trigger	LineSelector						PulseGeneratorSelector			
		Line Start	Line1-TTLOut1	Line8-TTLOut2	Line9-TTLOut3	Line12-TTLOut4	NAND0	NAND1	Pulse Generator0	Pulse Generator1	Pulse Generator2	Pulse Generator3
Signals to use as output	Low	○	○	○	○	○	○	○	○	○	○	○
	High	○	○	○	○	○	○	○	○	○	○	○
	Line 4(TTL Input1)	○	○	○	○	○	○	○	○	○	○	○
	Line 5(Opto In1)	○	○	○	○	○	○	○	○	○	○	○
	Line 7(CL CC1)	○	○	○	○	○	○	○	○	○	○	○
	Line 10(TTL Input2)	○	○	○	○	○	○	○	○	○	○	○
	Line 13(TTL Input3)	○	○	○	○	○	○	○	○	○	○	○
	Encoder trigger	○	○	○	○	○	○	○	○	○	○	○
	UserOutput0	○	○	○	○	○	○	○	○	○	○	○
	UserOutput1	○	○	○	○	○	○	○	○	○	○	○
	UserOutput2	○	○	○	○	○	○	○	○	○	○	○
	UserOutput3	○	○	○	○	○	○	○	○	○	○	○
	Pulse Generator0	○	○	○	○	○	○	○	×	×	×	×
	Pulse Generator1	○	○	○	○	○	○	○	×	×	×	×
	Pulse Generator2	○	○	○	○	○	○	○	×	×	×	×
	Pulse Generator3	○	○	○	○	○	○	○	×	×	×	×
	Nand0 out	○	○	○	○	○	×	○	○	○	○	○
	Nand1 out	○	○	○	○	○	○	×	○	○	○	○
	Exposure Active	–	○	○	○	○	○	○	○	○	○	○
	LVAL	–	○	○	○	○	○	○	○	○	○	○
	EncoderDirection	–	○	○	○	○	○	○	○	○	○	○
		Trigger	LineSelector						PulseGeneratorSelector			
		Use										

: Indicates default values for each selector.

Main Functions

GPIO (Digital Input/Output Settings)

The unit can input/output the following signals to and from external input/output connectors.

External output	TTL Out1 (Line1)	12-pin
	TTL Out4 (Line12)	12-pin
	TTL Out2 (Line8)	10-pin
	TTL Out3 (Line9)	10-pin
External input	TTL IN1 (Line4)	12-pin
	Opt IN- (Line5)	12-pin
	Opt IN+ (Line5)	12-pin
	TTL IN2 (Line10)	10-pin
	TTL IN3 (Line13)	10-pin
	CC1 (Line7)	Camera Link cable

These signals can be used as triggers and other necessary signals within the camera or as signals output from the camera to the system, such as those used for lighting equipment control.

Signals are selected as follows.
- When using external signals or the signals of each GPIO module as trigger signals:
  Select in [TriggerSelector] > [TriggerSource].
- When selecting the signals to use for external outputs:
  Select in [LineSelector] > [LineSource].

Camera Output Formats

The SW-4000TL-PMCL supports two output formats (RGB8 and RGB10).

The ClConfiguration and PixelFormat settings on the camera side and the frame grabber board side must match. For details on frame grabber board settings, refer to the instruction manual of the board.

ClConfiguration	PixelFormat
Base	RGB8
Medium	RGB8, RGB10
Full	RGB8
80 bit (Deca)	RGB8

■ 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

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

Exposure Mode

The following operation modes are available on the camera.

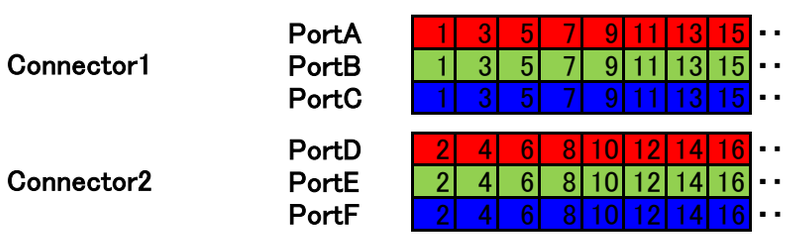
Operation mode	
Exposure Mode	**Trigger Mode**
OFF	OFF
	ON

■ ClConfiguration Base / PixelFormat　RGB8

Connector1

Port / bit	24-bit RGB
Port A0	R0
Port A1	R1
Port A2	R2
Port A3	R3
Port A4	R4
Port A5	R5
Port A6	R6
Port A7	R7
Port B0	G0
Port B1	G1
Port B2	G2
Port B3	G3
Port B4	G4
Port B5	G5
Port B6	G6
Port B7	G7
Port C0	B0
Port C1	B1
Port C2	B2
Port C3	B3
Port C4	B4
Port C5	B5
Port C6	B6
Port C7	B7

■ ClConfiguration Medium / PixelFormat　RGB8



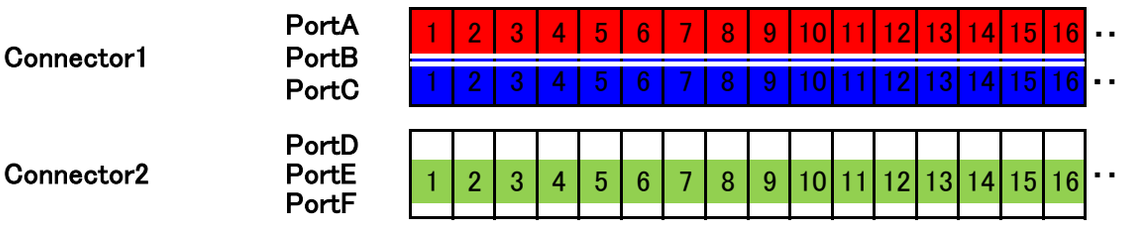
Connector1

Port / bit	Custom
Port A0	R0
Port A1	R1
Port A2	R2
Port A3	R3
Port A4	R4
Port A5	R5
Port A6	R6
Port A7	R7
Port B0	G0
Port B1	G1
Port B2	G2
Port B3	G3
Port B4	G4
Port B5	G5
Port B6	G6
Port B7	G7
Port C0	B0
Port C1	B1
Port C2	B2
Port C3	B3
Port C4	B4
Port C5	B5
Port C6	B6
Port C7	B7

Connector2

Port / bit	Custom
Port D0	R0
Port D1	R1
Port D2	R2
Port D3	R3
Port D4	R4
Port D5	R5
Port D6	R6
Port D7	R7
Port E0	G0
Port E1	G1
Port E2	G2
Port E3	G3
Port E4	G4
Port E5	G5
Port E6	G6
Port E7	G7
Port F0	B0
Port F1	B1
Port F2	B2
Port F3	B3
Port F4	B4
Port F5	B5
Port F6	B6
Port F7	B7

■ ClConfiguration Medium / PixelFormat RGB10



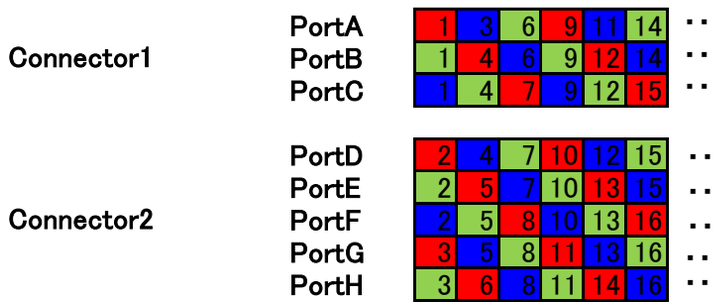
Connector1

Port / bit	30-bit RGB
Port A0	R0
Port A1	R1
Port A2	R2
Port A3	R3
Port A4	R4
Port A5	R5
Port A6	R6
Port A7	R7
Port B0	R8
Port B1	R9
Port B2	-
Port B3	-
Port B4	B8
Port B5	B9
Port B6	-
Port B7	-
Port C0	B0
Port C1	B1
Port C2	B2
Port C3	B3
Port C4	B4
Port C5	B5
Port C6	B6
Port C7	B7

Connector2

Port / bit	30-bit RGB
Port D0	-
Port D1	-
Port D2	-
Port D3	-
Port D4	-
Port D5	-
Port D6	-
Port D7	-
Port E0	G0
Port E1	G1
Port E2	G2
Port E3	G3
Port E4	G4
Port E5	G5
Port E6	G6
Port E7	G7
Port F0	G8
Port F1	G9
Port F2	-
Port F3	-
Port F4	-
Port F5	-
Port F6	-
Port F7	-

■ ClConfiguration Full / PixelFormat RGB8



Connector1

Port / bit	24-bit RGB
Port A0	R0
Port A1	R1
Port A2	R2
Port A3	R3
Port A4	R4
Port A5	R5
Port A6	R6
Port A7	R7
Port B0	G0
Port B1	G1
Port B2	G2
Port B3	G3
Port B4	G4
Port B5	G5
Port B6	G6
Port B7	G7
Port C0	B0
Port C1	B1
Port C2	B2
Port C3	B3
Port C4	B4
Port C5	B5
Port C6	B6
Port C7	B7

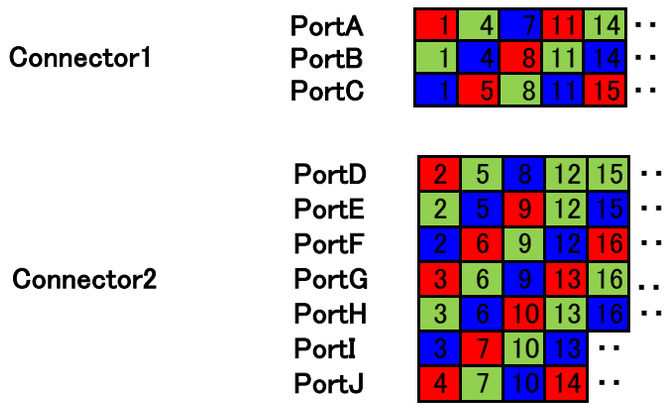
Connector2

Port / bit	24-bit RGB
Port D0	R0
Port D1	R1
Port D2	R2
Port D3	R3
Port D4	R4
Port D5	R5
Port D6	R6
Port D7	R7
Port E0	G0
Port E1	G1
Port E2	G2
Port E3	G3
Port E4	G4
Port E5	G5
Port E6	G6
Port E7	G7
Port F0	B0
Port F1	B1
Port F2	B2
Port F3	B3
Port F4	B4
Port F5	B5
Port F6	B6
Port F7	B7

Connector2

Port / bit	24-bit RGB
Port G0	R0
Port G1	R1
Port G2	R2
Port G3	R3
Port G4	R4
Port G5	R5
Port G6	R6
Port G7	R7
Port H0	G0
Port H1	G1
Port H2	G2
Port H3	G3
Port H4	G4
Port H5	G5
Port H6	G6
Port H7	G7

■ ClConfiguration EightyBit / PixelFormat RGB8



Connector1

Port / bit	24-bit RGB
Port A0	R0
Port A1	R1
Port A2	R2
Port A3	R3
Port A4	R4
Port A5	R5
Port A6	R6
Port A7	R7
Port B0	G0
Port B1	G1
Port B2	G2
Port B3	G3
Port B4	G4
Port B5	G5
Port B6	G6
Port B7	G7
Port C0	B0
Port C1	B1
Port C2	B2
Port C3	B3
Port C4	B4
Port C5	B5
Port C6	B6
Port C7	B7

Connector2

Port / bit	24-bit RGB
Port D0	R0
Port D1	R1
Port D2	R2
Port D3	R3
Port D4	R4
Port D5	R5
Port D6	R6
Port D7	R7
Port E0	G0
Port E1	G1
Port E2	G2
Port E3	G3
Port E4	G4
Port E5	G5
Port E6	G6
Port E7	G7
Port F0	B0
Port F1	B1
Port F2	B2
Port F3	B3
Port F4	B4
Port F5	B5
Port F6	B6
Port F7	B7

Connector2

Port / bit	24-bit RGB
Port G0	R0
Port G1	R1
Port G2	R2
Port G3	R3
Port G4	R4
Port G5	R5
Port G6	R6
Port G7	R7
Port H0	G0
Port H1	G1
Port H2	G2
Port H3	G3
Port H4	G4
Port H5	G5
Port H6	G6
Port H7	G7
Port I0	B0
Port I1	B1
Port I2	B2
Port I3	B3
Port I4	B4
Port I5	B5
Port I6	B6
Port I7	B7
Port J0	R0
Port J1	R1
Port J2	R2
Port J3	R3
Port J4	R4
Port J5	R5
Port J6	R6
Port J7	R7

Image Output Timing

Trigger Control

The camera allows Line Start trigger controls to be performed via external trigger signals.
The Line Start trigger allows exposure control via the trigger signal inputs.

❖ The settings for exposure control and triggers are related to each other. Be sure to configure the settings described in “Connecting to the Camera to Control Tool”.

Shortest Repetition Period for Triggers

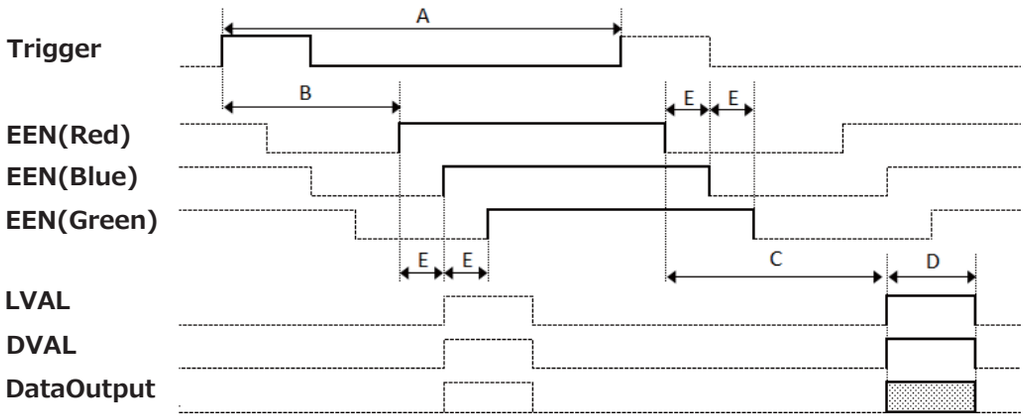
Trigger Mode ON, full resolution

		Shortest period (µs)
Exposure Mode : OFF	Camera Link	Varies depending on the Tap Geometry and CL Clock settings.
	12-pin/AUX	
Exposure Mode : Timed	Camera Link	
	12-pin/AUX	
Exposure Mode :TriggerWidth (PWC)	Camera Link	
	12-pin/AUX	

Shortest Trigger Pulse Width

Camera Link	TTL In
3 µs	50 ns

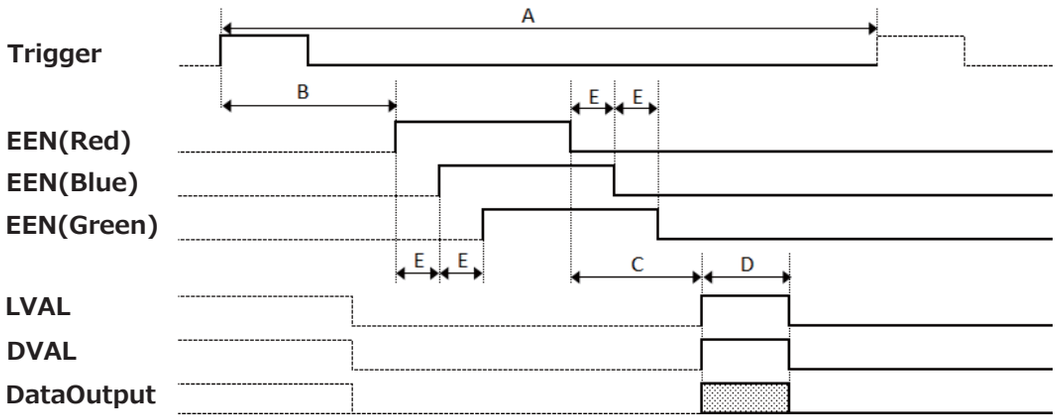
When [Exposure Mode] is [Off]



CL Configuration	Pixel Format	CL Clock (MHz)	Line Period[A] (μs)	Delay Time from Trigger to EEN(red)[B] (μs)	Period from EEN(red) Falling to LVAL rising[C] (μs)	Valid Data Time[D] (μs)	Exposure Delay between color lines[E] (μs)
Base	RGB8	31.875	130.09	3.6	43	128.5	5.0
		42.5	97.57	3.6	43	96.4	5.0
		63.75	6505	3.6	43	64.3	5.0
		85	48.79	3.6	43	48.2	5.0
Medium	RGB8	31.875	65.05	3.6	43	64.3	5.0
		42.5	48.79	3.6	43	48.2	5.0
		63.75	32.53	3.6	43	32.1	5.0
		85	24.4	3.6	43	24.1	5.0
	RGB10	31.875	130.09	3.6	43	128.5	5.0
		42.5	97.57	3.6	43	96.4	5.0
		63.75	6505	3.6	43	64.3	5.0
		85	48.79	3.6	43	48.2	5.0
Full	RGB8	31.875	48.83	3.6	43	48.2	5.0
		42.5	36.63	3.6	43	36.1	5.0
		63.75	24.42	3.6	43	24.1	5.0
		85	18.32	3.6	43	18.1	5.0
Eighty	RGB8	31.875	40.41	3.6	43	38.5	5.0
		42.5	30.31	3.6	43	28.9	5.0
		63.75	20.21	3.6	43	19.3	5.0
		85	17.82 (*1)	3.6	43	14.4	5.0

(*1) Value is 15.16 when setting "AcquisitionLineRateOption" in mode1.

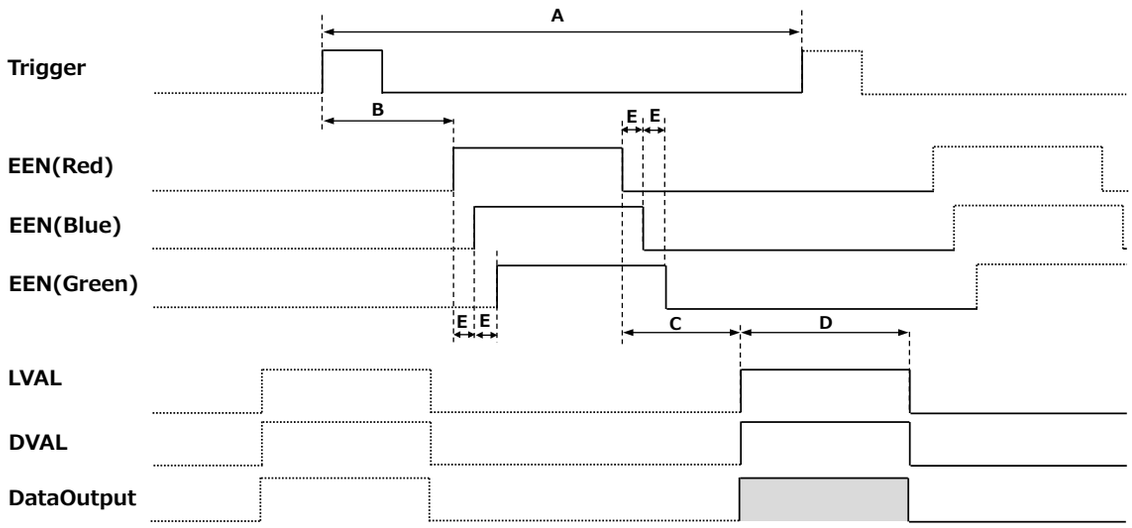
When [Exposure Mode] is [Timed]



CL Configuration	Pixel Format	CL Clock (MHz)	Line Period[A] (μs)	Delay Time from Trigger to EEN(red)[B] (μs)	Period from EEN(red) Falling to LVAL rising[C] (μs)	Valid Data Time[D] (μs)	Exposure Delay between color lines[E] (μs)
Base	RGB8	31.875	130.09	0.3	43	128.5	5.0
		42.5	97.57	0.3	43	96.4	5.0
		63.75	6505	0.3	43	64.3	5.0
		85	48.79	0.3	43	48.2	5.0
Medium	RGB8	31.875	65.05	0.3	43	64.3	5.0
		42.5	48.79	0.3	43	48.2	5.0
		63.75	32.53	0.3	43	32.1	5.0
		85	24.4	0.3	43	24.1	5.0
	RGB10	31.875	130.09	0.3	43	128.5	5.0
		42.5	97.57	0.3	43	96.4	5.0
		63.75	6505	0.3	43	64.3	5.0
		85	48.79	0.3	43	48.2	5.0
Full	RGB8	31.875	48.83	0.3	43	48.2	5.0
		42.5	36.63	0.3	43	36.1	5.0
		63.75	24.42	0.3	43	24.1	5.0
		85	18.32	0.3	43	18.1	5.0
Eighty	RGB8	31.875	40.41	0.3	43	38.5	5.0
		42.5	30.31	0.3	43	28.9	5.0
		63.75	20.21	0.3	43	19.3	5.0
		85	17.82 (*1)	0.3	43	14.4	5.0

(*1) Value is 15.16 when setting "AcquisitionLineRateOption" in mode1.

When [Exposure Mode] is [Trigger Width]



CL Configuration	Pixel Format	CL Clock (MHz)	Line Period[A] (μs)	Delay Time from Trigger to EEN(red)[B] (μs)	Period from EEN(red) Falling to LVAL rising[C] (μs)	Valid Data Time[D] (μs)	Exposure Delay between color lines[E] (μs)
Base	RGB8	31.875	130.09	0.3	43	128.5	5.0
		42.5	97.57	0.3	43	96.4	5.0
		63.75	6505	0.3	43	64.3	5.0
		85	48.79	0.3	43	48.2	5.0
Medium	RGB8	31.875	65.05	0.3	43	64.3	5.0
		42.5	48.79	0.3	43	48.2	5.0
		63.75	32.53	0.3	43	32.1	5.0
		85	24.4	0.3	43	24.1	5.0
	RGB10	31.875	130.09	0.3	43	128.5	5.0
		42.5	97.57	0.3	43	96.4	5.0
		63.75	6505	0.3	43	64.3	5.0
		85	48.79	0.3	43	48.2	5.0
Full	RGB8	31.875	48.83	0.3	43	48.2	5.0
		42.5	36.63	0.3	43	36.1	5.0
		63.75	24.42	0.3	43	24.1	5.0
		85	18.32	0.3	43	18.1	5.0
Eighty	RGB8	31.875	40.41	0.3	43	38.5	5.0
		42.5	30.31	0.3	43	28.9	5.0
		63.75	20.21	0.3	43	19.3	5.0
		85	17.82 (*1)	0.3	43	14.4	5.0

(*1) Value is 15.16 when setting "AcquisitionLineRateOption" in mode1.

Pixel Sensitivity Correction

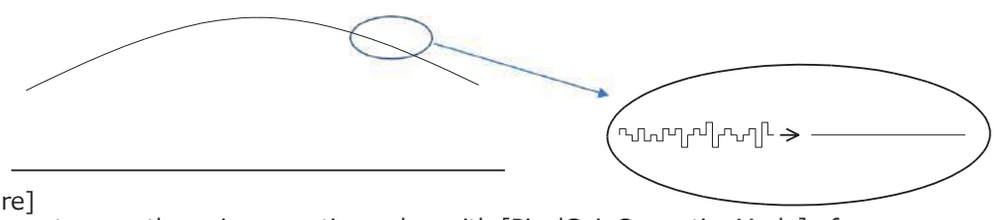
Correct variations between the sensor's pixels.
Calibration must be performed within the camera and correction data must be created beforehand.DSNU (PixelBlackCorrect) / PRNU (PixelGainCorrect) can be reduced using that correction data.
We recommend performing calibration and creating correction data whenever the line rate setting or Analog base gain setting or vertical binning setting are changed significantly.

❖ Correction data is saved for DSNU (PixelBlackCorrect) / PRNU (PixelGainCorrect) according to the conditions adjusted at the factory.

❖ A single correction data entry can be saved on the camera for a each user.
When calibration is performed, the correction data is saved to the non-volatile ROM at the same time.

PRNU Correction (PixedlGainCorrect)

PRNU (photo response non-uniformity) is a variation between pixels generated by the sensor under bright conditions. If the line rate is slowed or a long exposure time is set, the dark current in the sensor may change and the state of the PRNU may change.



[Correction procedure]
1. Specify the user area to save the gain correction value with [PixelGainCorrectionMode] of [JAICustomControlPixelCorrection].
2. Gain correction data is automatically generated by [PerformPixelGainCalibration] of [JAICustomControlPixelCorrection] and saved in the user area specified in 1.
3. You can check the execution result of gain correction by [PixelGainDetectResult] of [JAICustomControlPixelCorrection].

DSNU Correction (PixelBlackCorrect)

DSNU (dark signal non-uniformity) is a variation between pixels in the dark areas generated by the sensor. If the line rate is slowed or a long exposure time is set, the dark current in the sensor may change and the state of the DSNU may change.

Black Level 

[Correction procedure]
1. Specify the user area to save the black level correction value with [PixelBlackCorrectionMode] of [JAICustomControlPixelCorrection].
2. Black level correction data is automatically generated by [PerformPixelBlackCalibration] in [JAICustomControlPixelCorrection] and saved in the user area specified in 1.
3. You can check the execution result of black level correction by [PixelBlackDetectResult] of [JAICustomControlPixelCorrection].

Gain Control

The following gain functions are available on the camera.
• Analog base gain
• Digital gain

■ Analog base gain

Analog base gain (ABG) is gain that is performed to the analog video signal output from the sensor.
The gain steps can be configured to one of three levels (0 dB, 6 dB, 12 dB).

■ Two digital gain control modes

Two digital gain control modes are available; a mode where you adjust the master gain and then perform fine adjustment for R and B (MasterMode), and a mode where R, G, and B gain are adjusted individually (IndividualMode).

- **MasterMode**
  Set [IndividualGainMode] to [Off], and adjust the gain by configuring the following three items.

DigitalAll	×1 to ×8 (0 dB to 18 dB)
DigitalRed	×0.4 to ×4.0 (–7.96 dB to 12 dB)
DigitalBlue	×0.4 to ×4.0 (–7.96 dB to 12 dB)

- **IndividualMode**
  Set [IndividualGainMode] to [On], and adjust the gain by configuring the following three items.

DigitalGreen	×1 to ×16 (0 dB to 24 dB)
DigitalRed	×1 to ×16 (0 dB to 24 dB)
DigitalBlue	×1 to ×16 (0 dB to 24 dB)

The following two gain values are added together for the total gain value.
Total Gain = AnalogBaseGain (dB) + DigitalGain (dB)

*) In IndividualGainMode, white balance cannot be set automatically.

LUT (Lookup Table) / Gamma Function

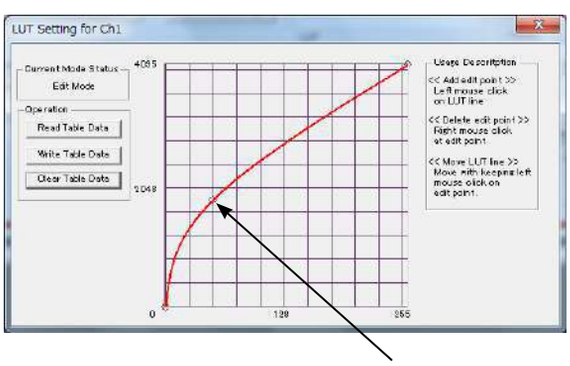
The LUT function is used to generate a non-linear mapping between signal values captured on the sensor and those that are output from the camera.
The gamma function corrects the output signals from the camera beforehand (reverse correction), taking into consideration the light-emitting properties of the monitor display.
The Gamma, LUT, and OFF settings can be selected on this camera. When OFF is selected, γ1 (linear) sensitivity is applied.
The factory default setting is OFF.

■ Gamma

When [Gamma] is set, you can switch the curve characteristics by 9 steps.
1.0, 0.9, 0.8, 0.75, 0.65, 0.6, 0.55, 0.5, 0.45

■ LUT

In this mode, the sensitivity curve can be configured.
Setting range: 0 to 4095LSB (100%)
Number of setting points: 257



Setting point

Shading Correction

The shading correction is a function that corrects non-uniformity (i.e., shading) in the amount of light generated by the lens and lighting equipment.

The following shading correction modes are available on the camera.

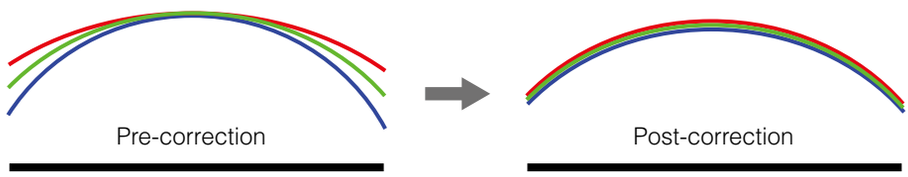
■ Flat shading correction

The range of brightness that can be corrected is within ±30% of the region with the highest signal level on one line.

❖ Complete correction may not be possible depending on the optical system and light source you are using.
❖ Data based on corrections performed under factory conditions is stored for this function.

■ Color shading correction

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



■ To perform the shading function

The function is turned ON/OFF via serial communication.
This function is not dependent on the operation mode, but is effective when used during actual use.

❖ You can also save the setting and have it applied whenever the power is subsequently turned on. For details on saving the setting, see “Step 7: Saving the Settings”.

Black Level Correction

Black level correction is a function for adjusting the setup level.
When this function is used, the following is performed for the gain mode setting.

DigitalAll	–133 to +255 LSB@12-bit
DigitalRed	–64 to +64 LSB@12-bit
DigitalBlue	–64 to +64 LSB@12-bit

Variable Line Rate

You can set the line rate to 1L or more.
This function can be used to match the scanning speed of the camera to the feeding speed of the object or to lengthen the accumulation time to increase sensitivity.

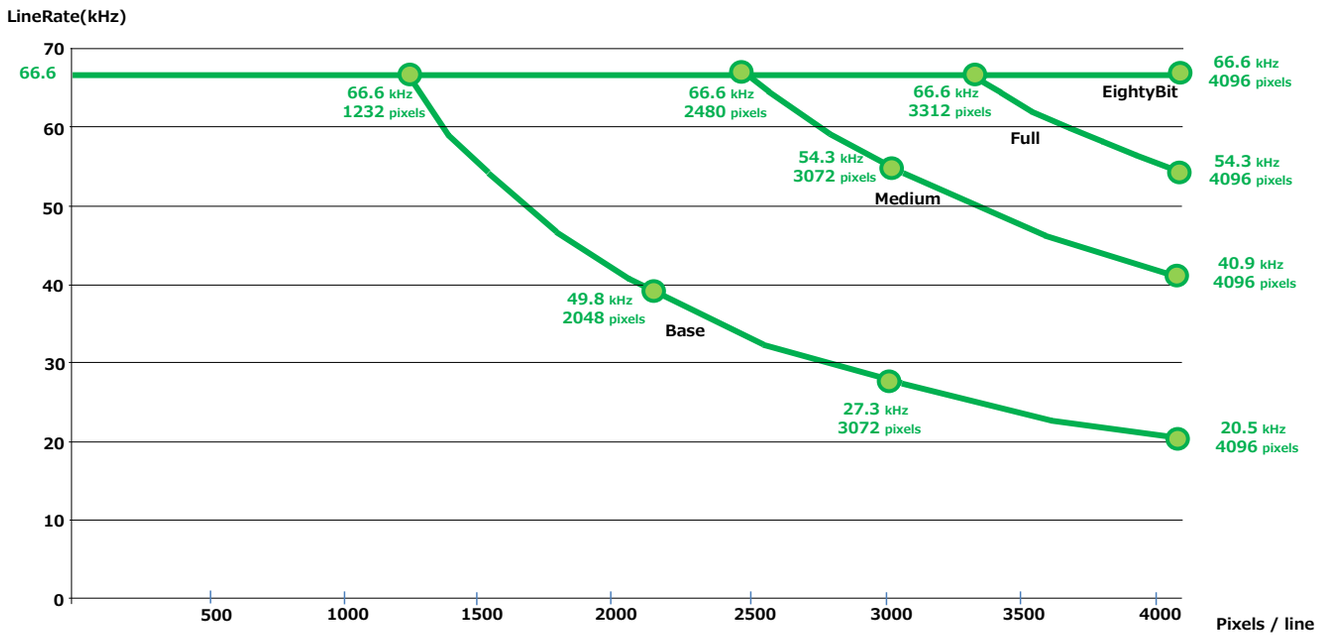
- Variable range: 66 Hz to 66 kHz* (15.16 µs to 15.15 ms*)
- Variable unit: 0.1 Hz
- Supported operation modes: Exposure Mode OFF / Trigger OFF
  Exposure Mode Timed / Trigger OFF

❖If AcquisitionLineRateOption is mode2(Default), Runs up to 56.117 kHz, in all modes of operation (triggered mode, exposure mode and exposure timed mode).
If AcquisitionLineRateOption is mode1(Optional), Runs up to 66 (65.963) kHz, in all modes of operation (trigger mode, exposure mode and exposure timed mode)
(SNR degradation or image distortion due to shutter nonlinearity may be observed at specific line rates >56.117 kHz. Users should verify that picture quality is acceptable when running in this mode.

❖You can also save the setting and have it applied whenever the power is subsequently turned on, but this requires additional operations.
❖Switching and settings storage for this function is performed via serial communication.
❖The black level will change depending on the line rate, so be sure to readjust the black level after changing the line rate or trigger period.

Number of pixels per line and line rate

When CL Configuration is Full, Medium, or Base, you can increase the line rate by decreasing the number of pixels per line. Use Width (ASCII = WTC) to set the line width. Line rate can be increased to a maximum of 66.6 kHz for each configuration.
The relationship between the number of pixels per line and the line rate for each CL configuration is shown below. Widths smaller than the minimums shown will also run at 66.6 kHz.



❖ It becomes the line rate in the case of CameralinkClockFrequency 85MHz, PixelFormat RGB8, ExposureMode Off.
The maximum line rate varies depending on operating conditions.

Electronic Shutter

When you use this function, you can set the exposure to a preconfigured accumulation time, regardless of the line rate.

- Variable range: 3 µs to 15.149 ms
- Variable unit: 0.01 µs (1clk)
- Supported operation modes: When Trigger Mode ON, Exposure Mode Timed

Caution

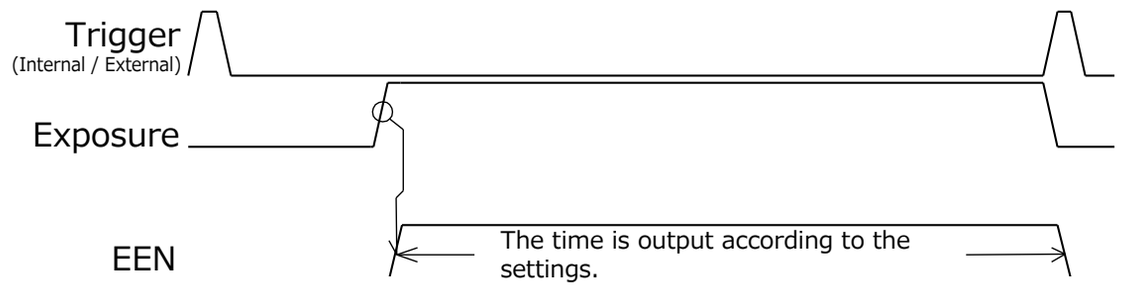
In “Trigger Mode OFF, Exposure Mode Timed” mode, the line rate configured will be the maximum value at which the shutter operates. However, in “Trigger Mode ON, Exposure Mode Timed” mode, the input trigger period will be the maximum value.

❖ You can also save the setting and have it applied whenever the power is subsequently turned on, but this requires additional operations.

EEN (Exposure Enable) Function

Perform external output for the timing at which video is accumulated to the sensor.
The signal is output to the DC IN / TRIG IN connector (12-pin round) and the DIGITAL I/O-1 video output connector (Camera Link).

Example: Output to the DIGITAL I/O-1 video output connector (Camera Link)



Test Pattern Function

You can display the following types of test patterns (Off, White, GrayPattern1, GrayPattern2, ColorBar). Video output is not possible while a test pattern is being executed.
This function is not dependent on gain and offset values that have already been configured, and output is performed in the following states.

❖ This function cannot be saved as the initial state of the camera.

Non-Volatile Flash Memory

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

Note

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

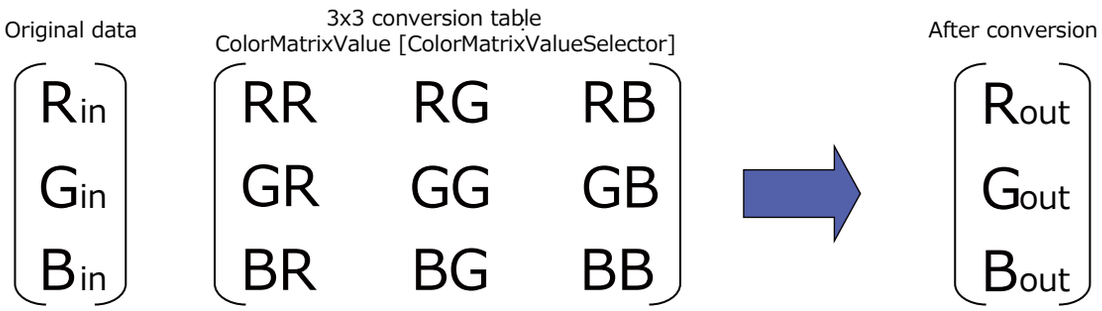
Color Space Conversion (Color Transformation Control)

This camera allows you to convert the standard color space (RGB) that is used to produce colors into other color spaces, including XYZ and HSI.
Five color spaces are available: RGB(sRGB), RGB(AdobeRGB), RGB(UserCustom), XYZ, and HSI.
Specify the desired color space by configuring ColorTransofrmationMode and ColorTransformationRGBMode as follows.

Color space	ColorTransformationMode	ColorTransformationRGBMode
RGB(sRGB)	RGB	sRGB
RGB(AdobeRGB)	RGB	AdobeRGB
RGB(UserCustom)	RGB	UserCustom
XYZ	XYZ	Off
HSI	HSI	Off
Default	RGB	Off

■ Note on RGB(UserCustom)

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



Caution

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

Configuring the 3x3 conversion table

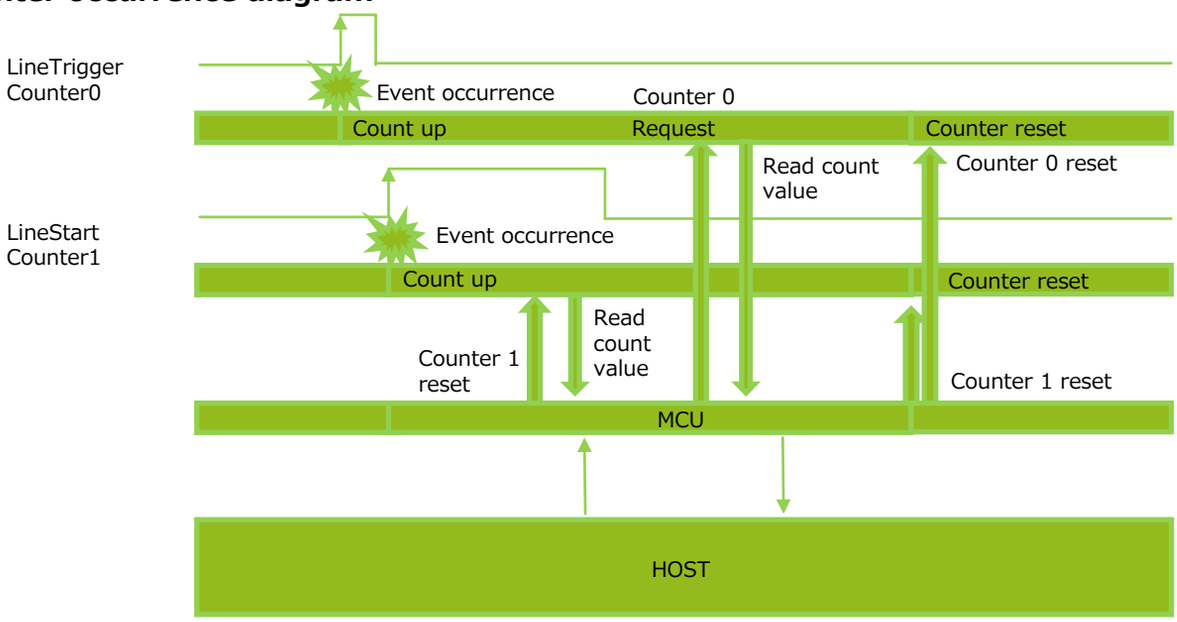
Specify one of the nine items that are the components to the 3×3 conversion table in [ColorMatrixValueSelector], and specify a value from –2 to +2 in [ColorMatrixValue].

Item		Setting value / selectable range	Description
ColorMatrixValueSelector		ColorMatrixR-R, ColorMatrixR-G, ColorMatrixR-B, ColorMatrixG-R, ColorMatrixG-G, ColorMatrixG-B, ColorMatrixB-R, ColorMatrixB-G, ColorMatrixB-B	Select the ColorMatrix setting component for UserCustom.
	ColorMatrixValue	-2 to 2	Specify the ColorMatrix value.

Counter And Timer Control Function

This camera supports only the counter function.
The counter function counts up change points in the camera's internal signals using the camera's internal counter, and reads that information from the host side. This function is useful for verifying error conditions via the count value using internal camera operations.
Four counters are available on the camera; Counter0, Counter1, Counter2, and Counter3. The functions that can be counted are fixed for each counter.
Counter0: Counts the number of LineTrigger instances.
Counter1: Counts the number of LineStart instances.
Counter2: Counts the number of ExposureStart instances.
Counter3: Counts the number of LineTransferEnd instances.

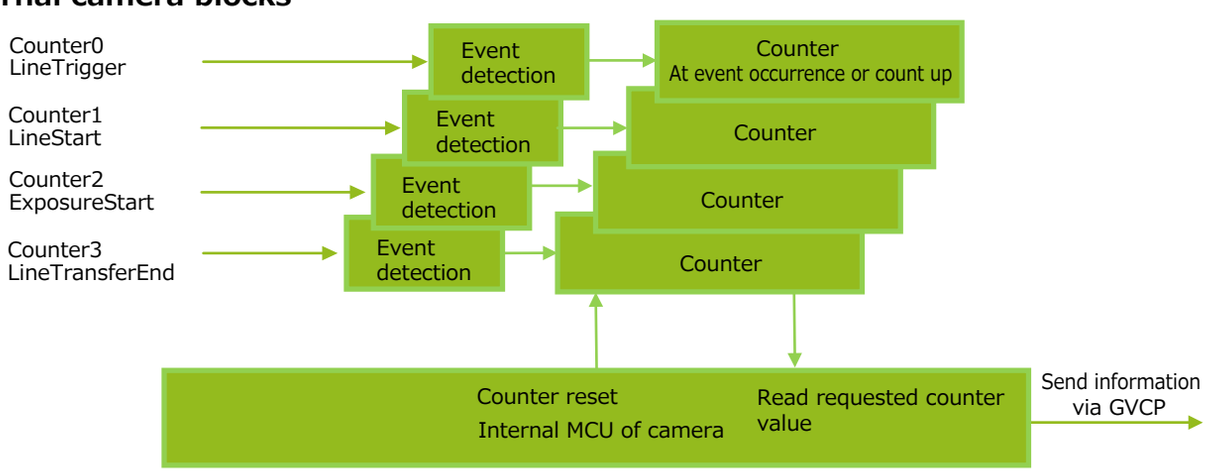
■ Counter occurrence diagram



Note

You can reset a specific counter's count value by executing CounterReset [Counter0, Counter1, Counter2, Counter3].

■ Internal camera blocks



■ To use the counter function

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

Item		Setting value / selectable range	Description
Counter 0 to 3		Counter 0 to 3	Select the counter.
	CounterEventSource	Counter0 Off, LineTrigger Counter1 Off, LineStart Counter2 Off, ExposureStart Counter3 Off, LineTransferEnd	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	RisingEdge (fixed)	Specify the timing at which to count.

Tilted View Correction and Chromatic Aberration Correction

This camera features a tilted view correction function.
The G channel, B channel, and R channel are positioned in that order on the sensor used on this camera.
The G channel and R channel are corrected using the B channel in the middle as a reference.
The user can adjust the amount of correction to capture the best possible image based on the angle of the camera in relation to the subject, the distance between the camera and the subject, the lens used, and other factors.

The tilted view correction function also corrects for the chromatic aberration of magnification caused by the lens (i.e., when the size of the image differs at the focal point for each color (RGB)). You can save correction data for three types of lenses.
This function assumes that the amount of deviation between the left and right is identical.
If the amount of deviation between the left and right is not identical, correction will not be performed properly. Specify the number of pixels to delay or advance the R channel and B channel using the G channel as a reference. The correction range is –4.0 to +4.0 in steps of 0.1.

Adjustment procedure

1 Correct the R channel.
Set [ChromaticAberrationCorrectionSelecter] to [RChannel].
Specify the amount of correction in [ChromaticAberrationCorrectionLens1,2,3] (–4.0 to +4.0 in steps of 0.1).

2 Similarly, correct the B channel.
Set [ChromaticAberrationCorrectionSelecter] to [BChannel].
Specify the amount of correction in [ChromaticAberrationCorrectionLens1,2,3] (–4.0 to +4.0 in steps of 0.1).

3 Enable the chromatic aberration of magnification correction function.
Set [ChromaticAberrationCorrectionMode] to [On].
Alternatively, select preset Lens1, Lens2, or Lens3.

Spatial Compensation Function

This function corrects the spatial pixel differences individually for the R, G, and B lines captured by the trilinear line sensor.
Two modes are available; Manual and Auto.

Configuring settings for SpatialCompensationMode: Manual
You can configure the number of pixels to correct individually for the R, G, and B lines.
To do so, configure the SpatialCompensationR, SpatialCompensationG, and SpatialCompensationB values.

Configuring settings for SpatialCompensationMode: Auto
In this mode, the number of pixels to correct individually for the R, G, and B lines is calculated automatically using the trigger interval at which the camera operates, the amount of movement in pixels of the imaging subject within the sensor during a single trigger (SpatialCompensationDistance), and the movement direction (Object Direction) signal of the subject.

The object direction signal is used to obtain the direction of the imaging subject. The direction signal from the rotary encoder, the I/O signal input of the camera, or the high/low control signal from the software can be used as the object direction signal.

Connecting Rotary Encoders

This camera can generate trigger signals or detect the scanning direction of the subject in response to signals output from the rotary encoder.

Adjustment procedure

1 Input the two signals (phase A and phase B) from the rotary encoder.

Select which I/O on the camera (Line5:OptIn1, Line4:TTLIn1, Line10:TTLIn2, Line13:TTLIn3) you want to input each of the two outputs from the rotary encoder [phase A (EncoderSourceA), phase B (EncoderSourceB)].

2 Specify the number of triggers (number of vertical lines) to generate during each rotation of the rotary encoder.

When [EncoderDivider] is set to [N], the rotary encoder generates 65536/N triggers.

3 If necessary, enable the low-pass filter for the signal to prevent unintended operations due to signal noise from the rotary encoder.

Specify the number of cycles from a range of 0 to 15 (0 to 150 ns).

4 If necessary, specify the strobe length of the generated signal.

When [EncoderStrobe] is set to [M], the strobe length will be [M]×10 ns.

Binning function

The binning function allows you to combine the signal values of clusters of adjacent pixels to create improved virtual pixels. Using the function results in images with lower pixel resolution and higher sensitivity.
This camera performs vertical binning via addition in the sensor.
This camera performs horizontal binning via digital addition or averaging processing.

Noise reduction digital filter function

This function reduces noise by applying a 1x3 median filter or FIR(Finite Impulse Response) filter.

SNR can be improved, but it affects the sense of resolution and sensitivity. An imaging test should be performed before deciding to use this feature.

Select the target to apply the filter from [Median Filter Selector] or [FIR Filter Selector] of [JAI Custom Control Pixel Correction] from Red, Green, Blue, and set the [Median Filter Mode] or [FIR Filter Mode]. When set to On, this function is enabled.
(Both functions are disabled (Off) by default.)

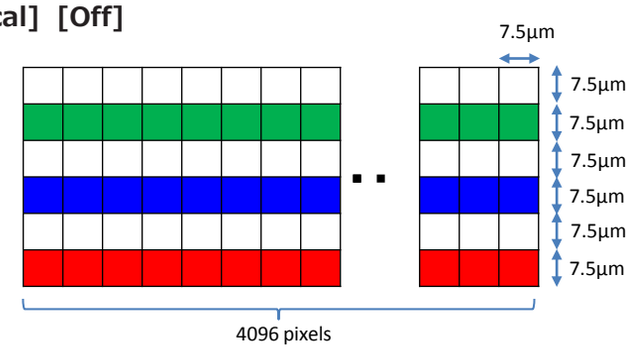
In FIR Filter, the coefficients of the three signals (left, center, right) can be set in the range of -2 to 2. The correction value through the FIR Filter is:

Left pixel read value x Left pixel coefficient +
Center pixel read value x Center pixel coefficient +
Right pixel read value x Right pixel coefficient.

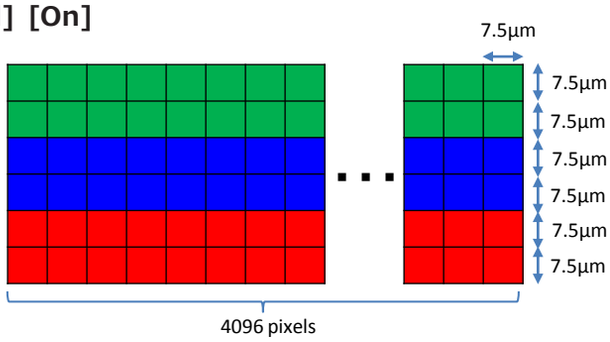
Layout of pixels

The arrangement of Green, Blue, Red pixels in the sensor is shown in the figure below.
In the case of Binning Off, there is a gap between individual lines of Green, Blue, Red.

[BinningVertical] [Off]



[BinningVertical] [On]



Settings List

For details on the ASCII Command List, visit the product page (SW-4000TL-PMCL) on our website.

Control Tool

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

Item	Setting range	Default value	Description
a) DeviceControl			
DeviceVendorName	–	"JAI Ltd., Japan"	Display the manufacturer name.
DeviceModelName	–	SW-4000TL-PMCL	Display the model name.
DeviceManufacturerInfo	–	"See the possibilities"	Display the manufacturer information.
DeviceVersion	–	–	Display the device version.
DeviceFirmwareVersion	–	–	Display the firmware version.
DeviceFpgaVersion	–	–	Display the FPGA version.
DeviceSerialNumber	–	–	Display the camera's unique serial number.
DeviceUserID	Any	–	Display the user ID for the camera.
DeviceSFNCVersionMajor	2	2	Display the SFNC Major version.
DeviceSFNCVersionMinor	3	3	Display the SFNC Minor version.
DeviceSFNCVersionSubMinor	0	0	Display the SFNC Sub Minor version
DeviceManifestEntrySelector	XML1	XML1	Display the valid XML file information.
DeviceTemperatureSelector	Mainboard	Mainboard	Display the location of the temperature sensor inside the camera.
DeviceTemperature	–	–	Display the internal temperature (℃) of the camera.
DeviceSerialPortSelector	CameraLink	CameraLink	Fixed at CameraLink.
DeviceSerialPortBaudRate	Baud9600, Baud19200, Baud38400, Baud57600, Baud115200	–	Display the baud rate for the serial board.
DeviceReset	–	–	Reset the device.
b) ImageFormatControl			Configure image format settings.
Width	BinningHorizontal 1: 16 to 4096 (steps of 16) BinningHorizontal 2: 8 to 2048 (steps of 8)	4096	Set the image width.
OffsetX	BinningHorizontal 1: 0 to 4080 (steps of 16) BinningHorizontal 2: 0 to 2040 (steps of 8)	0	Set the horizontal offset.
BinningHorizontal	1, 2	1	Set the number of pixels in the horizontal direction for which to perform binning.

Item	Setting range	Default value	Description
BinningVertical	1, 2	1	Set the number of pixels in the vertical direction for which to perform binning.
PixelFormat	RGB8, RGB10	RGB8	The selectable options for [PixelFormat] differs depending on the [ClConfiguration] setting. Base, Full, EightyBit: RGB8 onlyMedium: RGB8, RGB10
TestPattern	Off, White, GrayPattern1(Ramp), GrayPattern2(Stripe), ColorBar	Off	Select the test image.
c) AcquisitionControl			Configure image capture settings.
AcquisitionLineRate	66 to 56338 or 65963 depending on Mode (steps of 0.1)	66	Set the AcquisitionLineRate(Hz).
AcquisitionLineRateOption	mode1, mode2	mode2	mode 1 (Optional): Runs up to 66 (65.963) kHz, in all modes of operation (trigger mode, exposure mode and exposure timed mode) (SNR degradation or image distortion due to shutter nonlinearity may be observed at specific line rates >56.117 kHz. Users should verify that picture quality is acceptable when running in this mode.) mode 2 (Default): Runs up to 56.117 kHz, in all modes of operation (triggered mode, exposure mode and exposure timed mode)
TriggerMode	Off, On	Off	Select the trigger mode. When [ExposureMode] is set to [TriggerWidth], [TriggerMode] is automatically set to [On].
TriggerSource	Low, High, PulseGenerator 0, PulseGenerator 1, PulseGenerator 2, PulseGenerator 3, UserOutput 0, UserOutput 1, UserOutput 2, UserOutput 3, Line4-TTLIn1, Line5-OptIn1, Line7-CC1, Line10-TTL In2, NAND0Out, NAND1Out, Line13-TTL In3, EncoderTriger	–	Select the trigger signal source.

Item	Setting range	Default value	Description
TriggerActivation	Rising Edge, FallingEdge, LevelHigh, LevelLow	Falling Edge (falling edge of input signal)	Select the polarity of the trigger signal (i.e., location of signal at which trigger is applied).
ExposureMode	Off, Timed, TriggerWidth	Timed	Select the exposure mode.
ExposureTimeMode	Common, Individual	Common	Select the Common Exposure configuration method.
ExposureTimeSelector	Common, Red, Green, Blue	Common	Select the sensor for which the configure the ExposureTime. To share the same setting value for the three sensors, select Common.
ExposureTime	300 to 1514908	–	Set the exposure time.
AutoReset	Off, On	Off	After trigger input is interrupted for a prolonged period (52 msec or more) when [ExposureMode] is set to [Off] and [TriggerMode] is set to [On], the over-exposed image exposed during the interruption is output after the first trigger input after resumption. When AutoReset mode is enabled, LVAL and DVAL images are not output during interruption, and LVAL and DVAL image output is resumed after the second trigger input.
d) AnalogControl			Configure analog control settings.
IndividualGainMode	Off, On	Off	In IndividualGainMode, RGB can be configured individually for the entire gain adjustment range of the sensor.
GainSelector	When [IndividualGainMode] is [On]: DigitalGreen, DigitalRed, DigitalBlue When [IndividualGainMode] is [Off]: DigitalAll, DigitalRed, DigitalBlue	–	Select the gain to configure.

Item	Setting range	Default value	Description
Gain	When [IndividualGainMode] is [On]: DigitalGreen ×1.0 to ×16.0 (steps of 0.000122) DigitalRed ×1.0 to ×16.0 (steps of 0.000122) DigitalBlue ×1.0 to ×16.0 (steps of 0.000122) When [IndividualGainMode] is [Off]: DigitalAll ×1.0 to ×8.0 (steps of 0.000122) DigitalRed ×0.4 to ×4.0 (steps of 0.000122) DigitalBlue ×0.4 to ×4.0 (steps of 0.000122)	1	Set the gain value for the gain setting selected in [GainSelector].
AnalogBaseGainSelector	AnalogAll	AnalogAll	Select the analog base gain to configure.
AnalogBaseGain	0dB, 6dB, 12dB	0dB	Set the gain value for the analog base gain item selected in [AnalogBaseGainSelector].
BalanceWhiteAuto	Off, Once, Preset 5000K, Preset 6500K, Preset 7500K	Off	Enable/disable auto white balance. *)When IndividualGainMode is On, white balance cannot be set automatically.
AWBAreaWidth	For BinningHorizontal 1: 16 to 4096 (steps of 16) For BinningHorizontal 2: 8 to 2048 (steps of 8)	4096	When [BalanceWhiteAuto] is set to [Once], specify the area for referencing the level with Offset and Width.
AWBAreaOffsetX	For BinningHorizontal 1: 16 to 4080 (steps of 16) For BinningHorizontal 2: 8 to 2040 (steps of 8)	0	When [BalanceWhiteAuto] is set to [Once], specify the area for referencing the level with Offset and Width.
AWBOnceStatus	Succeeded. Error1-G image was too bright. Error2-G image was too dark. Error3-Timeout-error occurred. IDLE	–	When [BalanceWhiteAuto] is set to [Once], display the status.
BlackLevelSelector	DigitalAll, DigitalRed, DigitalBlue	DigitalAll	Select the black level to configure.

Item	Setting range	Default value	Description
BlackLevel	DigitalAll: -133 to 255 DigitalRed: -64 to 64 DigitalBlue: -64 to 64	0	Set the black level value.
Gamma	0.45, 0.5, 0.55, 0.6, 0.65, 0.75, 0.8, 0.9, 1.0	0.45	Set the gamma value.
LUTMode	Off, Gamma, LUT	Off	Select the LUT mode.
e) LUTControl			Configure LUT settings.
LUTSelector	Red, Green, Blue	Red	Select the LUT channel to control.
LUTIndex	0 to 256	0	Set the LUT index table number.
LUTValue	0 to 4095	0	Set the LUT value.
f) ColorTransformationControl			Configure color space conversion settings.
ColorTransformationMode	RGB, XYZ, HSI	RGB	Select the color space.
ColorTransformationRGBMode	Off, sRGB, AdobeRGB, UserCustom	Off	Set the detailed mode when RGB is selected for the color space.
ColorMatrixValueSelector	ColorMatrixR-R, ColorMatrixR-G, ColorMatrixR-B, ColorMatrixG-R, ColorMatrixG-G, ColorMatrixG-B, ColorMatrixB-R, ColorMatrixB-G, ColorMatrixB-B	–	Select the ColorMatrix setting component for UserCustom.
ColorMatrixValue	-2 to 2	–	Specify the ColorMatrix value.
g) DigitalIOControl			
LineSelector	Line1-TTLOut1, Line4-TTLIn1, Line5-OptIn1, Line8-TTLOut2(Option), Line9-TTLOut3(Option), Line10-TTLIn2(Option), Line12-TTLOut4, Line13-TTLIn3(Option), NANDGate0In1, NANDGate0In2, NANDGate1In1, NANDGate1In2	–	Select the input/output to configure.

Item		Setting range	Default value	Description
	LineMode	Input, Output	–	Display the input/output status.
	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).
	LineFormat	NoConnect, TTL, OptoCoupled, InternalSignal		Display the signal format.
	LineSource	Low, High, ExposureActive, LVAL, PulseGenerator0, PulseGenerator1, PulseGenerator2, PulseGenerator3, UserOutput0, UserOutput1, UserOutput2, UserOutput3 Line4-TTLIn1, Line5-OptIn1, Line7-CC1, Line10-TTL In2, NAND0Out, NAND1Out, Line13-TTL In3, EncoderTriger, EncoderDirection	–	Select the source signal.
LineStatusAll		–	–	Display the input/output signal status (16bits fields). Line1 TTLOut1, Line2 Unused, Line3 Unused, Line4 TTLInput1, Line5 OptIn1, Line6 Unused, Line7 CC1, Line8 TTLOut2, Line9 TTLOut3, Line10 TTLIn2, Line11 Unused, Line12 TTLOut4, Line13 TTLIn3, NAND0A, NAND0B, NAND1A, NAND1B
OptInFilterSlector		Off, 0.1 us, 1 us, 5 us, 10 us, 50 us, 100 us	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
h) CounterAndTimerControl			Configure counter settings. (This camera supports only the counter function.)
CounterSelector	Counter0, Counter1, Counter2, Counter3	Counter0	Select the counter.
CounterEventSource	Counter0: Off, LineTrigger Counter1: Off, LineStart Counter2: Off, ExposureStart Counter3: Off, LineTransferEnd	Off	Assign the counter event signal for which you want to read the count value to a dedicated counter, and read the value.
CounterEventActivation	RisingEdge	RisingEdge	The timing at which to count is fixed at [RisingEdge].
CounterReset	–	–	Reset the counter.
CounterRefresh	–	–	Update the count value.
CounterValue	–	–	Display the count value.
CounterStatus	CounterIdle, CounterActive, CounterOverflow	CounterIdle	Display the counter status. CounterIdle: Idle CounterActive: Counting CounterOverflow: Count value exceeded the maximum value
i) UserSetControl			Configure user settings.
UserSetSelector	Default, UserSet1, UserSet2, UserSet3	Default	Select the user settings.
UserSetLoad	–	–	Load user settings.
UserSetSave	–	–	Save the current setting values as user settings.
j) TransportLayerControl			Configure transport layer control settings.
ClConfiguration	Base, Medium, Full, EightyBit	Base	Set the CameraLink configuration.
CameraLinkClockFrequency	85MHz, 63.75MHz, 42.5MHz, 31.875MHz	85MHz	Set the CameraLink lock.
SwapBandR	Off, On	Off	Specify whether to swap Blue and Red to enable support for connecting a particular grabber board.
AdditionalInformation	Off, On	On	
ExposureActiveSource	R, G, B	R	
k) PulseGenerators			Configure pulse generator settings.
ClockPreScaler	1 to 4096	1	Set the division value for the prescaler (12 bit) using PixelClock as the base clock.

Item	Setting range	Default value	Description
PulseGeneratorClock(MHz)	0.0244 to 100	–	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 to 1048575	30000	Set the maximum count-up value as a clock count.
PulseGenratorLength(ms)	1/ PulseGeneratorClock (MHz) to 1048575/ PulseGeneratorClock (MHz)	66.6667	Set the maximum count-up value in milliseconds. This value is calculated using the [PulseGeneratorLength] value as a base. The setting range varies depending on the [ClockPreScaler] value.
PulseGeneratorFrequency(Hz)	0 to 1048574	15	Set the maximum count-up value as a frequency. This value is calculated using the [PulseGeneratorLength] value as a base.
PulseGeneratorStartPoint	0 to 1048574	0	Set the start point of the High interval as a clock count. When the counter reaches this value, the output will be 1.
PulseGeneratorStartPoint(ms)	0 to (1048575 / PulseGeneratorClock (MHz))	0	Set the start point of the High interval in milliseconds. When the counter reaches this value, the output will be 1. The setting range varies depending on the [ClockPreScaler] value.
PulseGeneratorEndPoint	1 to 1048575	15000	Set the start point of the Low interval as a clock count. When the counter reaches this value, the output will be 0.
PulseGeneratorEndPoint(ms)	(1 / PulseGeneratorClock (MHz)) to (1048575 / PulseGeneratorClock(MHz))	33.3333	Set the start point of the Low interval in milliseconds. When the counter reaches this value, the output will be 0. The setting range varies depending on the [ClockPreScaler] value.
PulseGeneratorPulseWdth(ms)	–	33.3333	Display the High interval width of the pulse in milliseconds. The duration between the StartPoint and EndPoint is calculated. The setting range varies depending on the [ClockPreScaler] value.
PulseGeneratorRepeatCount	0 to 255	0	Set the repeat count for the counter. When this is set to [0], a free counter is enabled with no repeat limit.
PulseGeneratorClearActivation	Off, LevelHigh, LevelLow, RisingEdge, FallingEdge	Off	Set the clear signal condition for the count clear input of the pulse generator.

Item		Setting range	Default value	Description
	PulseGeneratorClearSource	Low, High, ExposureActive, LVAL, PulseGenerator0, PulseGenerator1, PulseGenerator2, PulseGenerator3, UserOutput0, UserOutput1, UserOutput2, UserOutput3, Line4-TTLIn1, Line5-OptIn1, Line10-TTLIn2, NAND0Out, NAND1Out, Line13-TTLIn3, EncoderTriger, EncoderDirection	Low	Select the count clear input signal source.
	PulseGeneratorClearInverter	True, False	False	Select whether to invert the polarity of the count clear input signal.
	PulseGeneratorClearSyncMode	AsyncMode, SyncMode	AsyncMode	Select the sync mode for the count clear input signal.
l) 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.
ShadingDetectResult		Condition Error, Too Dark, Too Bright, Correction Limit, Complete	–	Display the shading correction results.
ShadingDataSelector		Green, Red, Blue	Green	Read the shading correction data, and set the target sensor for modification.
ShadingDataIndex		1 to 1024	1	Set the number of shading correction index tables.
ShadingData		0 to 32767	–	Display the shading correction results.
ShadingDataUpdate		–	–	
ShadingDataSave		–	–	
m) JAICustomControlPixelCorrection				Configure settings related to the correction function for non-uniformity in black levels and gain between pixels.
PixelBlackCorrectionMode		Off, Default, User1, User2, User3	Default	(DSNU) Select the user area to which to save the black level correction value.

Item	Setting range	Default value	Description
PerformPixelBlackCalibration	–	–	(DSNU) Generate black level correction data automatically from the captured image. **Caution** When [PixelBlackCorrectionMode] is set to [Off] or [Default] and a test pattern is being output instead of an image, this command cannot be executed.
PixelBlackDetectResult	–	–	(DSNU) Display the results of [PerformPixelGainBlackCalibration] execution. The results will be one of the following. Succeeded, Image too bright, Image too dark, Timeout error
PixelGainCorrectionMode	Off, Default, User1, User2, User3	Default	(PRNU) Select the user area to which to save the gain correction value.
PerformPixelGainCalibration	–	–	(PRNU) Generate gain correction data automatically from the captured image. **Caution** When [PixelBlackCorrectionMode] is set to [Off] or [Default] and a test pattern is being output instead of an image, this command cannot be executed.
PixelGainDetectResult	–	–	(PRNU) Display the results of [PerformPixelGainCorrectionCalibration] execution. The results will be one of the following. Success, Image too bright, Image too dark, Timeout error
FIR Filter Selector	Red, Green, Blue	–	Select the target to apply FIR Filter from Red, Green, Blue.
FIR Filter Mode	Off, On	–	Enable / Disable FIR Filter.
FIR Filter Left Ratio	-2 ～ 2	–	Set the coefficient of the left pixel when FIR Filter is applied.
FIR Filter Center Ratio	-2 ～ 2	–	Set the coefficient of the center pixel when FIR Filter is applied.
FIR Filter Right Ratio	-2 ～ 2	–	Set the coefficient of the right pixel when FIR Filter is applied.
Median Filter Selector	Red, Green, Blue	–	Select the target to apply Median Filter from Red, Green, Blue.
Median Filter Mode	Off, On	–	Enable / Disable Median Filter.

Item	Setting range	Default value	Description
n) JAICustomControlImagingSetup			
HorizontalImageMirroring	Off, On	Off	Specify whether to mirror the image horizontally.
ObjectDirectionMode	forward direction, reverse direction	forward direction	Set the direction moving objects.
ObjectDirectionSource	Low, High, Line5-OptIn1, Line4-TTLIn1, Line10-TTLIn2, Line13-TTLIn3, EncoderDirection	Low	Select the input to use for obtaining the movement direction information for the object.
SpartialCompenstationMode	Auto, Manual	Manual	
SpartialCompenstationR	0 to 80	0	Set the compensation value for R-Channel.
SpartialCompenstationG	0 to 80	0	Set the compensation value for G-Channel.
SpartialCompenstationB	0 to 80	0	Set the compensation value for B-Channel.
SpartialCompenstationDistance	0.5 to 2.0	1.0	
o) JAICustomControlVideoProcess			
ChromaticAberrationCorrectionMode	Off, Lens1, Lens2, Lens3	Off	Correct the color aberration that occurs at the left and right edges due to lens characteristics.
ChromaticAberrationCorrectionSelector	RChannel, BChannel	RChannel	Specify the channel for which to perform[ChromaticAberration CorrectionLens1,2,3].
ChromaticAberrationCorrection Lens1,2,3	-4.0 to +4.0 (steps of 0.1)	0	Set the amount of correction for [ChromaticAberrationCorrectionLens1,2,3].
p) EncoderControl			
EncoderSourceA	Line5-OptIn1, Line4-TTLIn1, Line10-TTLIn2, Line13-TTLIn3	Line5-OptIn1	Select where to input the signal from the rotary encoder.
EncoderSourceB	Line5-OptIn1, Line4-TTLIn1, Line10-TTLIn2, Line13-TTLIn3	Line5-OptIn1	Select where to input the signal from the rotary encoder.
EncoderDivider	1 to 4294967295	65536	Set the number of triggers to be generated during one pitch of the rotary encoder. The number of triggers is 65536 / (set value).
EncoderFilter	0 to 15	0	Apply a low-pass filter to prevent noise on the signal from the rotary encoder and stabilize the signal for the specified number of cycles.
EncoderStrobe	1 to 256	1	Set the strobe length of the Trigger signal generated from the rotary encoder by the number of cycles

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.	• A drop in voltage may have occurred due to the length of the power cable. Check whether input voltage specification for the camera is being met. • Check that the sufficient power is being provided at the power supply in regards to the camera's power usage. • Check the 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 "LUT (Lookup Table) / Gamma Function" .

■ Settings and operations

Problem	Cause and solution
I want to restore the factory default settings.	To restore the factory default settings, select [Loadsettings] in the [Settings] menu of the [SW-4000TL-PMCL Control Tool] window, select [Factory] in the dialog box that appears, and click [OK].

Specifications

Image sensor	4K high speed trilinear CMOS image sensor	
	Effective pixels	3×4096 pixel (R, G, B)
	Pixel size	7.5 µm × 7.5 µm
Camera Link pixel clock	31.875/42.5/63.75/85 MHz	
Line rate	66 Hz - 66 kHz	
Video S/N ratio	55 dB or more (when Gain = 0 dB)	
PRNU	Post-correction: Within ±1% (during 100% output)	
DSNU	Post-correction: Within ±5% (during 0% output)	
Gain	Analog Base Gain: 0 dB, 6 dB, 12 dB Digtal: IndividualGainMode Off: DigitalAll 0 dB to 18 dB DigitalRed −7.96 dB to 12 dB DigitalBlue −7.96 dB to 12 dB IndividualGainMode On: DigitalGreen 0 dB to 24 dB DigitalRed 0 dB to 24 dB DigitalBlue 0 dB to 24 dB	
Black level (user settings)	Manual DigitalAll: −133 to +255 LSB (during 12-bit) DigitalRed: −64 to +64 LSB (during 12-bit) DigitalBlue: −64 to +64 LSB (during 12-bit) Default setting: Output black level at 0 (33LSB during 10-bit)	
Image output	Digital video output (Camera Link) Base : RGB8 Medium : RGB8, RGB10 Full : RGB8 80bit(Deca) : RGB8 ❖ Default: Base: RGB8	
Variable line rate	Supported (for Exposure mode : OFF / internal trigger mode or Exposure mode : Timed / internal trigger mode) Variable range: 66 Hz to 66 kHz Variable unit: 0.1Hz ❖ The black level may vary with longer line rates, due to the increase in dark currents.	
Electronic shutter	Supported (Exposure mode : Timed) Variable range: 3 µs to 15.148 ms Variable unit: 0.01 µs	
Test pattern	Available Off, White, GrayPattern1(Ramp), GrayPattern2(Stripe), ColorBar	
Synchronization	Internal	
Image processing	① Pixel sensitivity correction: Pixel correction (DSNU, PRNU) ② Shading correction: ColorShading, FlatShading ③ LUT: OFF: γ＝1.0, ON: 257 points can be set ④ Gamma: 0.45, 0.5, 0.55, 0.6, 0.65, 0.75, 0.8, 0.9, 1.0 (9 steps available)	
Operation mode	• Exposure Mode：OFF（Internal/External trigger） • Exposure Mode：Timed（Internal/External trigger） • Exposure Mode：TriggerWidth	
Trigger inputs	12-pin: TTL input, 10-pin: TTL input Camera Link: LVDS (CC1) Positive / negative logic switchable. Minimum trigger width: CameraLink 3µs / TTL In 50ns	

Synchronous output (when the terminal is open)	Camera Link	• LVAL (Camera Link Tx24), DVAL (Camera LinkTx25), EEN (Camera Link Tx26)
	12-pin	• Exposure Active or LVAL
	10-pin	• Exposure Active or LVAL
Communication interface	EIA-644: Camera Link Communication rate: 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps	
Field update	Supported	
Power supply voltage	12 pin	DC Input range: +12 V to +24 V ±10% Power consumption: 7.8 W (typical)
	PoCL	DC +10 V to +13 V Power consumption: 7.8 W (typical) during DC +12 V input
Lens mount	M42 mount, F mount	
Flange back	M42 mount: 16 mm (in air), tolerance: 0 mm to –0.05 mm F mount: 46.5 mm, tolerance: 0 mm to –0.05 mm	
Operating temperature / humidity	-5°C to +45°C* / 20% to 80% (non-condensing)	
Storage temperature / humidity	-25°C to +60°C / 20% to 80% (non-condensing)	
Vibration resistance	10G (20 Hz to 200 Hz XYZ directions)	
Impact resistance	80G	
Standard compliance	CE (EN61000-6-2, EN61000-6-3) RoHS/WEEE FCC Part15 Class B	
Dimensions	F mount: 62 × 62 × 71.8 mm (WHD; excluding mount and protrusions) M42 mount: 62 × 62 × 71.6 mm (WHD; excluding mount and protrusions)	
Weight	F mount: 410 g M42 mount: 340 g	
Connectors / LEDs	Mini Camera Link	Model: HDR-EC26FYTG2-SLt × 2 Function: video output / communication / external trigger / EEN ❖ Positive polarity for EEN (polarity switching not possible)
	12-pin	Model: HR10A-10R-12PB (71) (or equivalent) Function: power supply input / external trigger / external IO
	10-pin	Model: Camera side: Equivalent to Hirose Electronic 3260-10S3(55) Cable side: Equivalent to Hirose Electronic 3240-10P-C(50) Function: external trigger / external IO
	LED	Function: Power on, trigger input indicator

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

Design and specifications are subject to change without notice.
Approximately 30 minutes of warm-up are required to achieve these specifications.

Caution

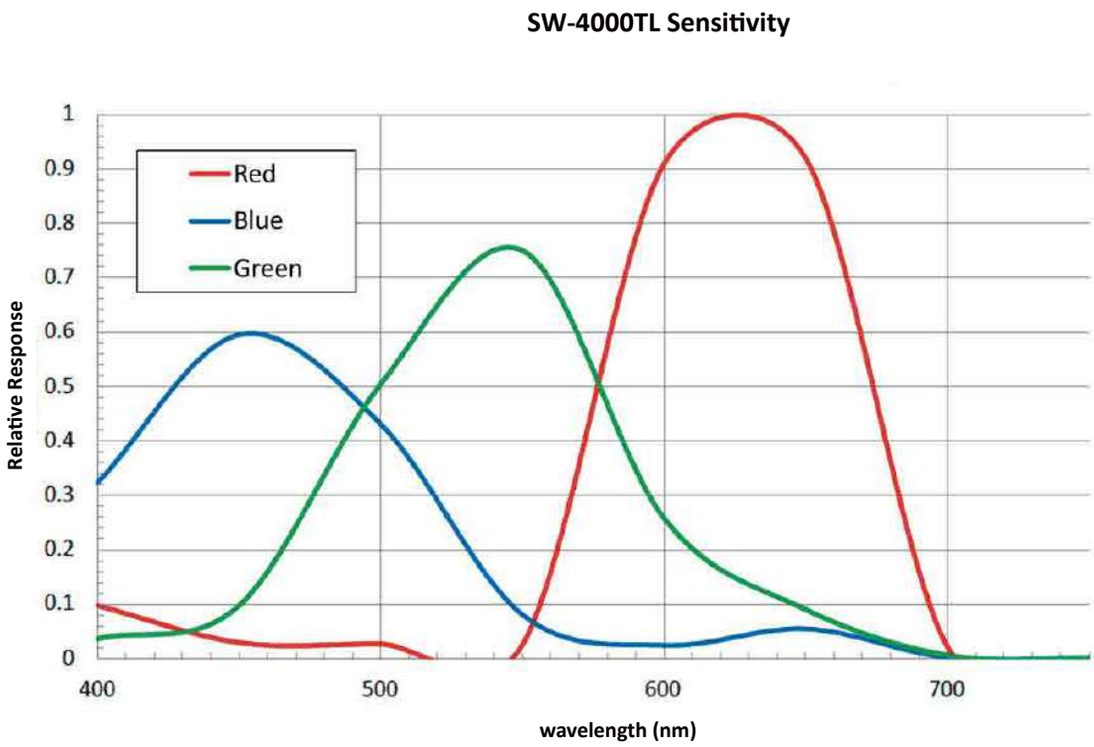
About the Operating temperature

Make sure the following temperature conditions are met when operating the unit.

1) The camera's internal temperature sensor detects temperatures of 79℃ or less during operation.
2) The top surface of the camera's casing is 68℃ or less.

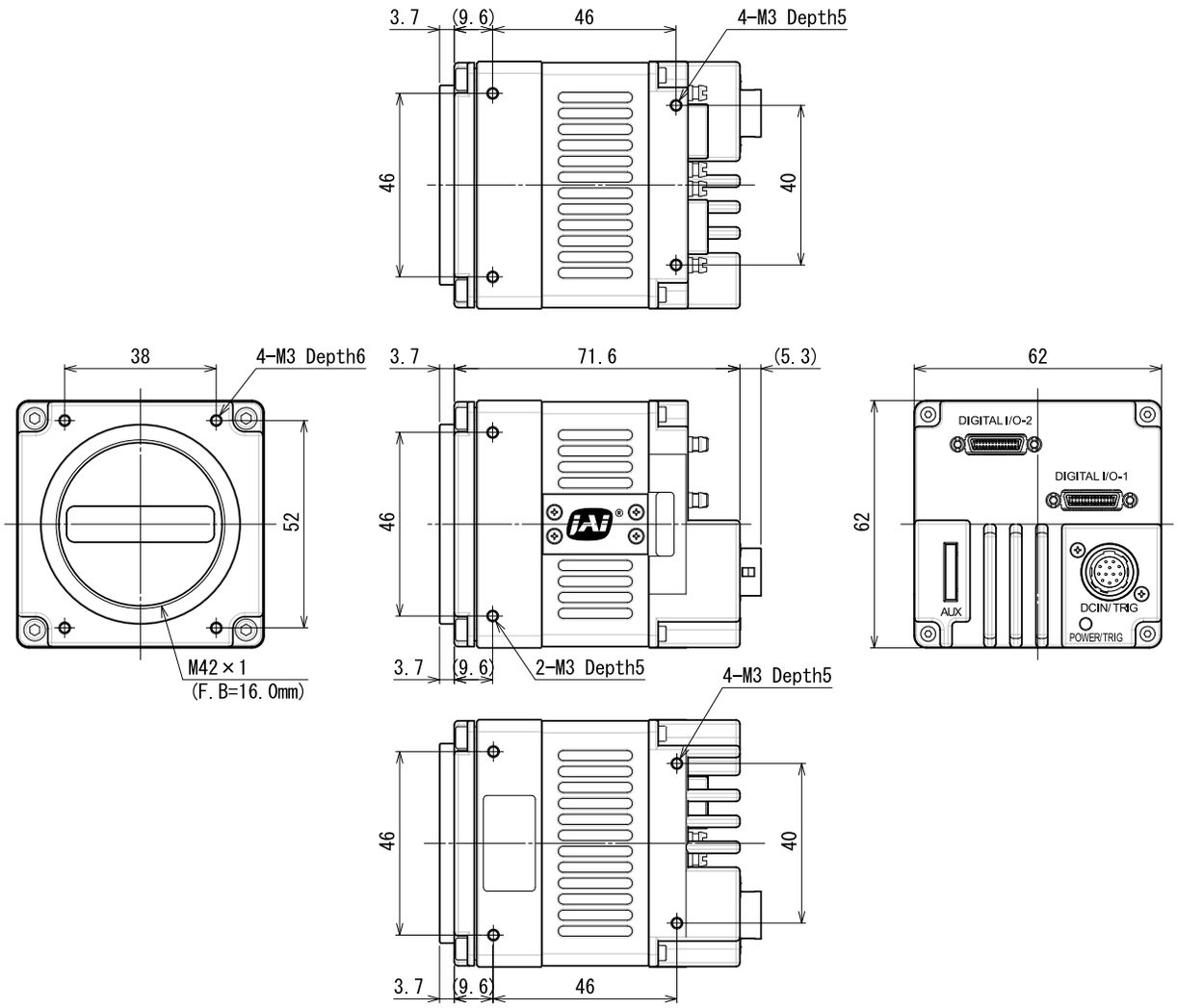
If the above temperature conditions are exceeded, take measures to dissipate heat according to your installation environment and conditions.

Spectral Response



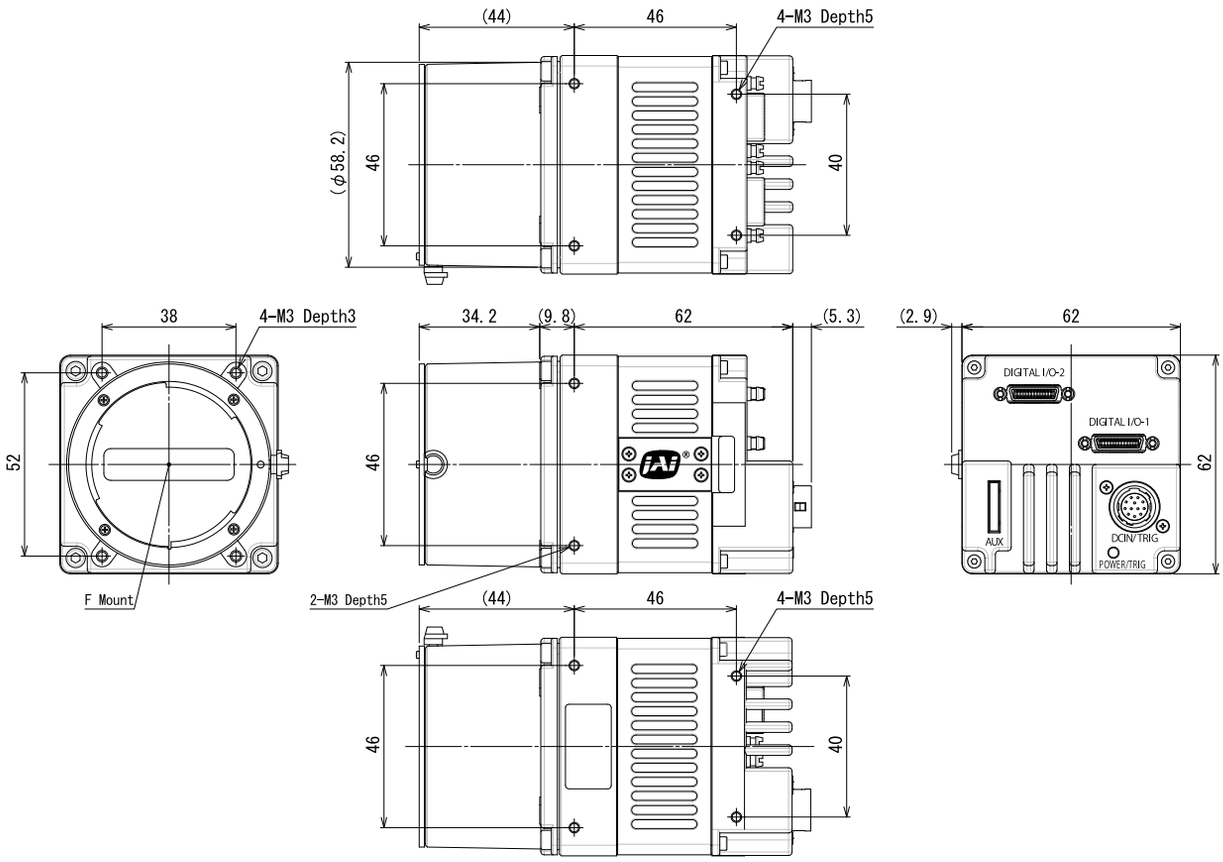
Dimensions

M42 Mount



Dimensional tolerance: ±0.3 mm
Unit: mm

F Mount



Dimensional tolerance: ±0.3 mm
Unit: mm

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Revision history

Revision	Date	Changes
1.0	Jan. 2018	First version
1.1	Aug. 2019	Add HV Binning, Pixel Format, etc
1.2	Dec. 2019	Add Noise reduction digital filter function, etc.
1.3	Dec. 2020	China RoHS
1.4	July 2022	Corrected China RoHS, added the Non-Volatile Flash Memory topic.