See the possibilities

User Manual

AP-1600T-PMCL
AP-3200T-PMCL

Digital 3CMOS Progressive Scan
RGB Color Camera with Mini Camera Link Interface

Document Version: 2.0
Date: 2023-08-22

Thank you for purchasing this product.

⚠Be sure to read this documentation before use.

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

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

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About Technical Note

Some additional technical information is provided on the JAI website as Technical Notes. In this manual, if a technical note is available for a particular topic, the above icon is shown. Please refer to the following URL for Technical notes.

https://www.jai.com/support-software/technical-notes

Notice/Warranty

Notice

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

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

Warranty

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

Certifications

CE Compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that AP-1600T-PMCL and AP-3200T-PMCL comply with the following provisions applying to their 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 참조하십시오.

China RoHS

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『电器电子产品有害物质限制使用管理办法』， 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)
AP-1600T-PMCL AP-3200T-PMCL	×	○	○	○	○	○

○: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 或对其人身、财产造成严重损害的期限。

数字「15」为期限15年。

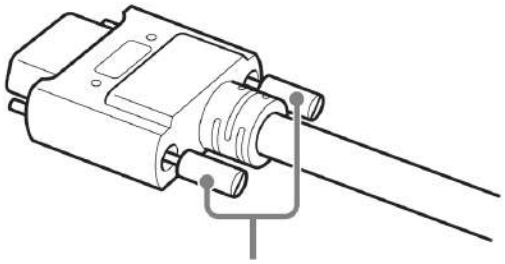
Usage Precautions

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: 0.15 N·m or less)



Caution: Secure manually. Do not secure too tightly.

Notes on Attaching the Lens

Technical Notes How to Clean a Sensor

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

This camera is an industrial progressive scan camera that uses three global shutter CMOS image sensors.

Enhanced color reproduction is achieved via the compact-designed 3CMOS C-mount prism optical system in addition to the internal color matrix circuit. Even higher definition imaging is made possible by the shading correction and gamma correction circuits.

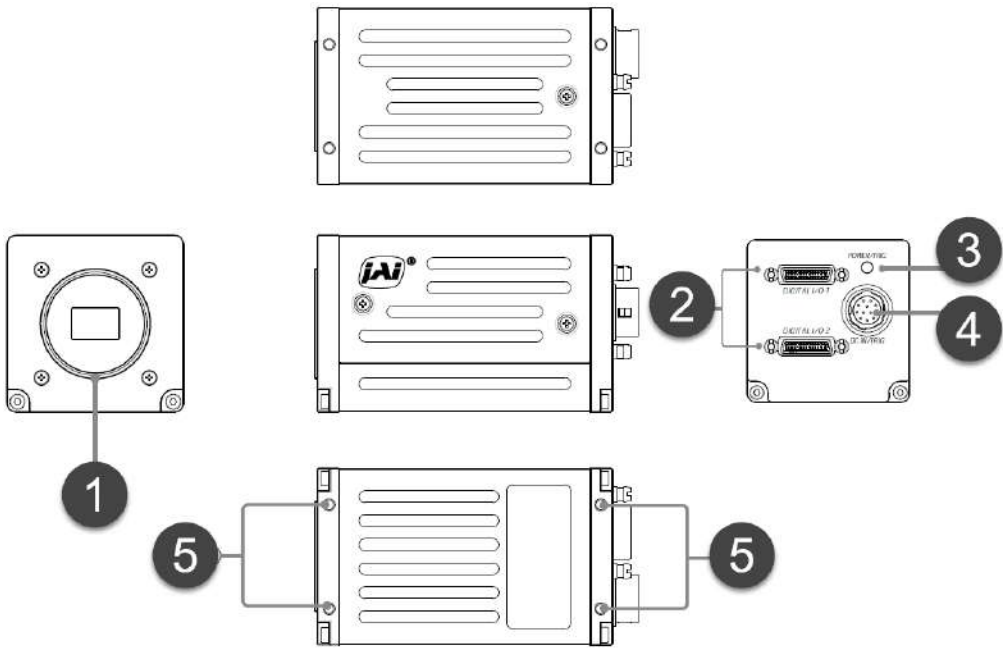
The ROI and binning functions allow for even faster readout speeds. The gain and exposure time can be configured individually for each CMOS sensor. A color space conversion function is also supported.

	AP-1600T-PMCL	AP-3200T-PMCL
Image Sensor	Type 1/2.9 (F1.8 prism optical system)	Type 1/1.8 (F4 prism optical system)
Effective Pixels	1456 × 1088	2064 × 1544
Pixel Size	3.45 um×3.45 um	
Max Frame Rate (Full)	126.1 fps	55.6 fps

Features Overview

- Compliance with CameraLink and GenICam standards
- Lens mount: C-mount (flange back: 17.526 mm)
- 24-bit or 30-bit RGB output (36-bit RGB output possible in video process bypass mode)
- Gamma correction circuit that uses lookup tables
- Color matrix that allows faithful color reproduction
- Color space conversion function (sRGB, Adobe RGB, HSI, XYZ) support
- Internal test signal for settings configuration

Parts Identification



① Lens Mount (C-Mount)

② Mini Camera Link Connectors

③ POWER/TRIG LED

④ DC IN / Trigger IN Connector (12-pin Round)

⑤ Mounting Holes (M3, 3mm depth)

① Lens Mount (C-Mount)

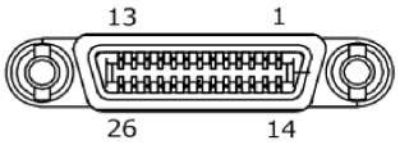
Mount a C-mount lens, microscope adapter, etc. here.

> **Note:** Before mounting a lens, be sure to refer to ① Lens and confirm the precautions for attaching a lens and the supported lens types.

② Mini Camera Link Connectors

Connect a cable that is compatible with Mini Camera Link (SDR) connectors here.

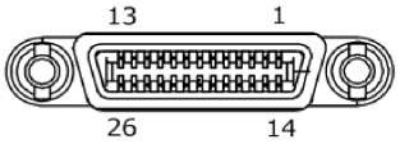
> **Note:** The cable length at which communication will be possible will be limited when using a cable that is not compatible with Camera Link, a small diameter type cable, or a high flex type cable.



Connector 1

Camera Link Connector 1

Pin	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 output
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

Camera Link Connector 2

Pin	Input Output	Signal	Description
1, 26		Shield	GND
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
7, 20		N.C	
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

Connectors

Camera Side: HONDA HDR-EC26FYTG2-SL+

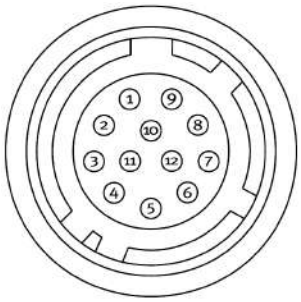
③ POWER/TRIG LED

Indicates the power or trigger input status.

LED		Status
	Lit amber	Camera initializing.
	Lit green	Operational and no triggers being input.
	Blinking green	Operational and triggers being input. **Note:** The blinking interval is not related to the actual input interval of the external trigger.

④ DC IN / Trigger IN Connector (12-pin Round)

Connect the cable for DC IN / Trigger IN here.

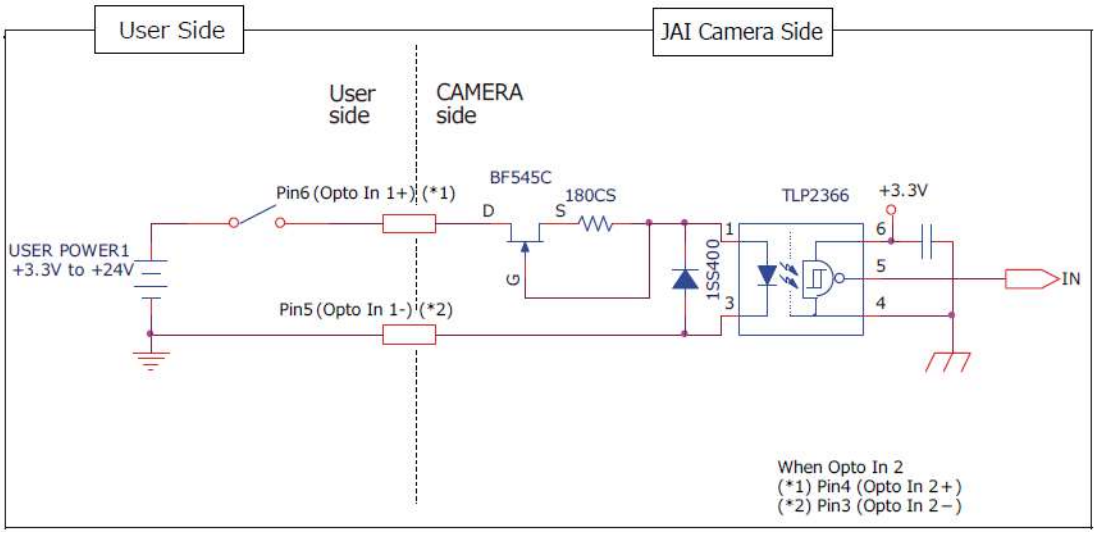


HR-10A-10R-12PB (71) (Hirose Electric or equivalent)

Pin No.	Input/Output	Signal	Description
1		GND	
2	Power In	DC In	DC 12 V ~ 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	

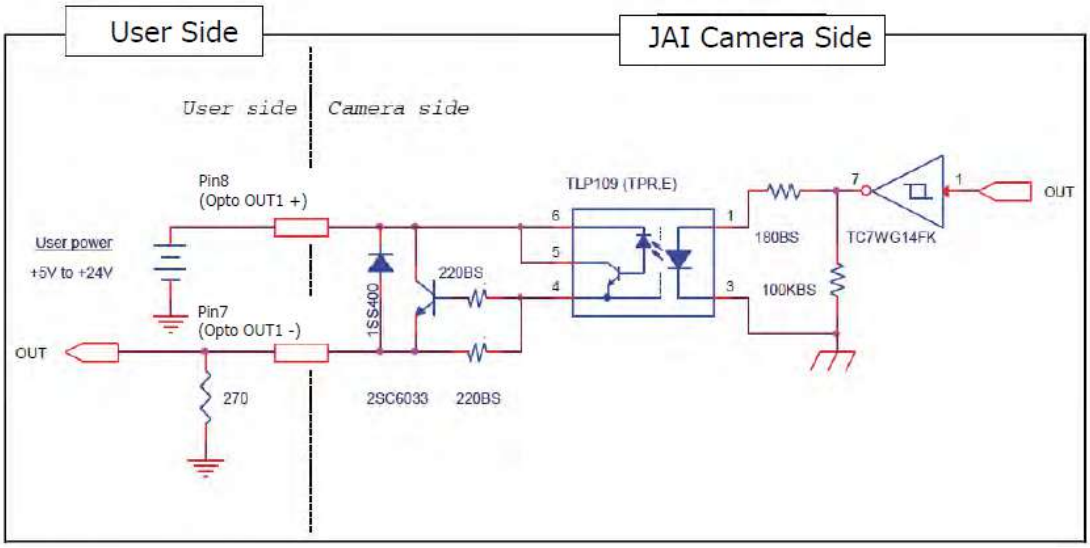
Note: When DC power is supplied to either Pin 1/Pin 2 or Pin 11/Pin 12, the camera operates.

Recommended External Input Circuit Diagram (Reference Example)



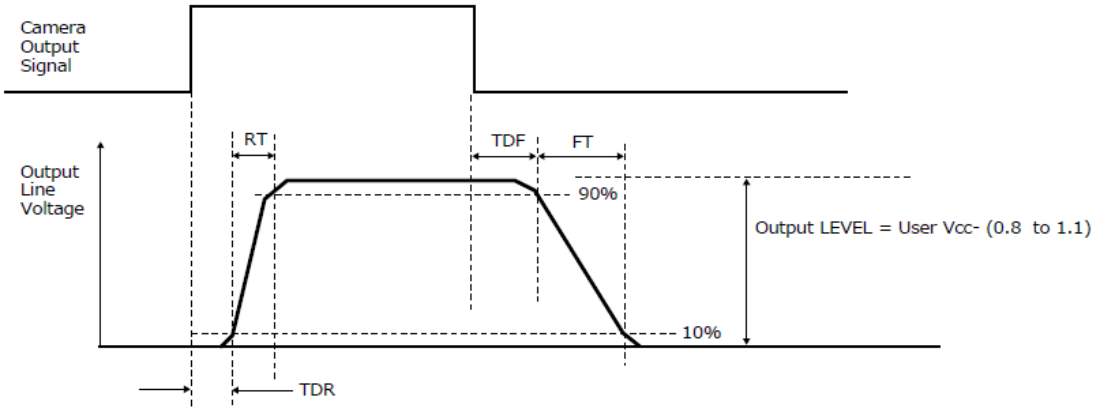
Recommended External Output Circuit Diagram (Reference Example)

Standard circuit diagram example



Characteristics of the Recommended Circuits for Opto OUT

OUTPUT LINE RESPONSE TIME



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

⑤ Mounting Holes (M3, 3mm depth)

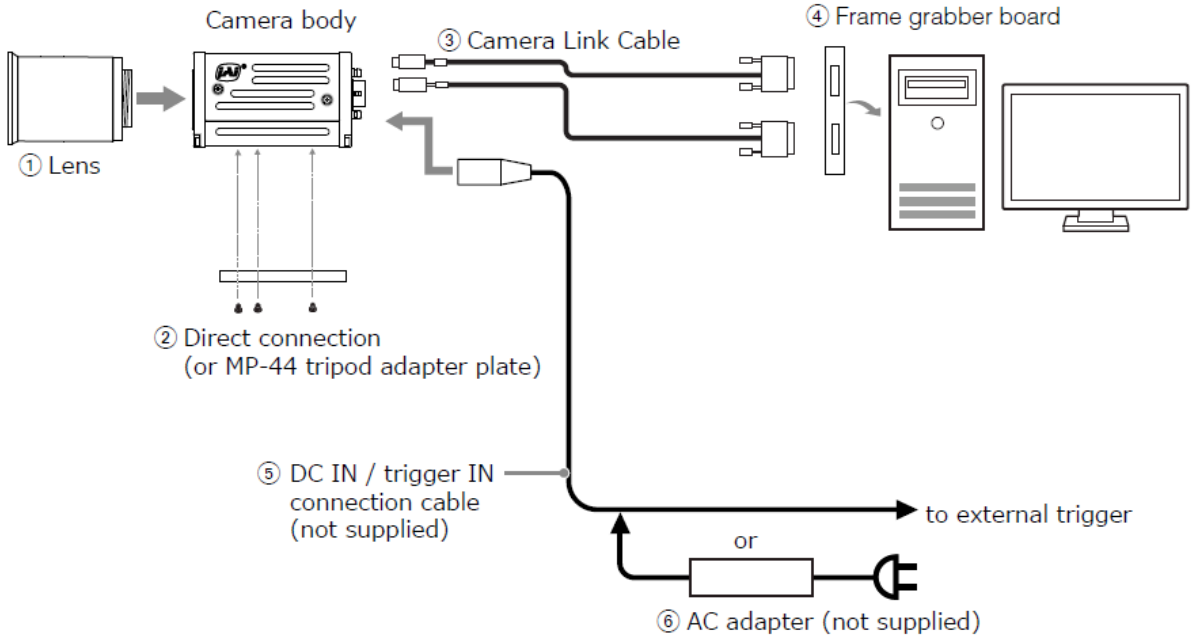
Use these holes when attaching an MP-44 tripod adapter plate (optional) or mounting the camera directly to a wall or other structural system.

Preparation

Read this section to learn how the camera connects to devices and accessories. The preparation process is described below.

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

Step 1: Connect Devices



① Lens

② Direct Mounting (or Use MP-44 Tripod Adapter Plate)

③ Camera Link Cable

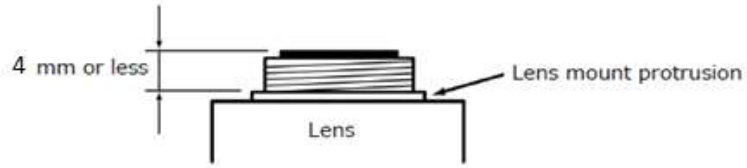
④ Frame Grabber Board

⑤ DC IN / Trigger IN Connection Cable

⑥ AC adapter (Power Supply, If Necessary)

① Lens

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



- Use a lens designed for three-sensor cameras. Using a lens for single-sensor cameras may hinder full performance of the camera.
- See the table below for the diagonal of the camera's CMOS image sensor. To prevent vignetting and to obtain the optimal resolution, use a lens that will cover the image sensor size.

	Image Sensor
AP-1600T-PMCL	Type 1/2.9, 6.27 mm diagonal Some lens manufacturers offer lenses with an 6.27 mm format. If not, a 1/2.9-inch lens is recommended.
AP-3200T-PMCL	Type 1/1.8, 8.89 mm diagonal Some lens manufacturers offer lenses with an 8.89 mm format. If not, a 1/1.8-inch lens is recommended.

Cautions:

- The maximum performance of the camera may not be realized depending on the lens.
- Attaching a lens with a mount protrusion of 4 mm or longer may damage the lens or camera.

Notes:
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

② Direct Mounting (or Use MP-44 Tripod Adapter Plate)

When mounting the camera directly to a wall or other device, use screws that match the mounting 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 Connectors.

> **Cautions:**
> - Refer to Notes on Camera Link Cable Connections when connecting the cables to the connectors.
> - When power is supplied by PoCL, be sure to connect the camera link cable to both DIGITAL I / O - 1 and DIGITAL I / O - 2 regardless of the setting.

④ Frame Grabber Board

Refer to the operating instructions of the frame grabber board and configure settings on the computer as necessary. (Use a computer that meets the requirements of your frame grabber board).

⑤ DC IN / Trigger IN Connection Cable

Performs external I/O such as power supply and trigger input.

⑥ AC adapter (Power Supply, If Necessary)

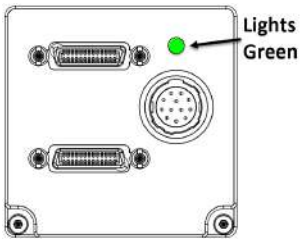
Connect the AC adapter and the round connector of the connection cable to the DC IN / trigger IN connector on the camera.

> **Note:** The AC adapter is not required when using PoCL.

Step 2: Verify 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, the power LED is lit green.



> **Note:** For details on how to read the LEDs, see the ③ POWER/TRIG LED section.

Step 3: Verify the Connection Between the Camera and PC

Use a short ASCII command to verify whether the camera is properly recognized in your setup.

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

   Set the following serial communication.

   - Baud Rate: 9600
   - Data Length: 8bit
   - Start Bit: 1bit
   - Stop Bit: 1 bit
   - Parity: None
   - Xon/Xoff Control: None

2. 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	DVN? <CR><LF> Display the device vendor name: "JAI Corporation"

Step 4: Change the Camera Settings

> **Related Setting Items:** ImageFormatControl

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

Configure the Output Format

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

Factory Default Values

Item		AP-1600T-PMCL	AP-3200T-PMCL
ImageFormatControl	Width	1456	2064
	Height	1088	1544
	OffsetX (horizontal position)	0	0
	OffsetY (vertical position)	0	0
	PixelFormat	RGB8	RGB8
TransportLayerControl	ClConfigurtion	Medium	Medium
	CameraLinkClockFrequency	74.3MHz	74.3MHz

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

Example: Change the Width setting (ImageFormatControl)

1. To check the current Width setting, enter the command **WTC?<CR><LF>** from the terminal emulator software.
2. To change the Width setting to 1200, enter **WTC=1400<CR><LF>**.

Example: Change the PixelFormat setting (ImageFormatControl)

1. To check the current PixelFormat setting, enter the command **BA?<CR><LF>** from the terminal emulator software. (Default: 3 = RGB8)
2. To change the PixelFormat setting to RGB10, enter **BA=4<CR><LF>**.

> **Note:** For more information on other ImageFormatSetting items' short ASCII commands, arguments, and setting ranges, see ImageFormatControl.

Step 5: Adjust the Image Quality

> **Related Setting Items:** AnalogControl

Display the camera image and adjust the image quality.

Display the Image

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

Adjust the Gain

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

> **Notes:**
> - For details on gain control, see "Gain Control" in the Main Functions section.
> - To see the short ASCII commands used to configure the Gain settings, see Analog Control (Command List) in the Short ASCII Command List Chapter.

Manual Adjustment

1. Set **GainAuto** and **IndividualGainMode** to **Off**. (Default = Off)
2. Configure the Gain.
    - Select the gain you want to configure in GainSelector. AnalogAll (master gain), AnalogRed (R gain), AnalogBlue (B gain), DigitalRed (digital R gain), and DigitalBlue (digital B gain) can be configured.
    - Configure the gain value in Gain.
        - AnalogAll (master gain) can be set to a value from x1 to x8 (0 dB to about +18 dB) the analog gain value. The resolution is set in x0.1 steps. Values are configured by multipliers.
        - The AnalogRed (R gain) and AnalogBlue (B gain) can be set to a value from x0.47 to x4.0 (–6.5 dB to +12 dB) the AnalogAll (master gain) value.
        - The DigitalRed (digital R gain) and DigitalBlue (digital B gain) can be set to a value from x0.9 to x1.1 (–0.915 dB to +0.828 dB) the AnalogAll (master gain) value.

> **Note**: The following two methods are available for adjusting the gain manually.

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

For details, see "Gain Control".

Adjust the White Balance

Related Setting Items: AnalogControl

Adjust the white balance using the automatic adjustment function.

Note: To see the short ASCII commands used to configure the WhiteBalance settings, see Analog Control (Command List) in the Short ASCII Command List Chapter.

Automatic White Balance Adjustment

1. Place a white sheet of paper or similar object under the same lighting conditions as the intended subject, and zoom in to capture the white. White objects near the subject, such as a white cloth or wall, can also be used. Be sure to prevent the high-intensity spot lights from entering the screen.
2. Select **Continuous**, **Once**, **ExposureContinuous**, or **ExposureOnce** from BalanceWhiteAuto for the adjustment method.

   The white balance is automatically adjusted.

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

Adjust the Black Level

Related Setting Items: AnalogControl

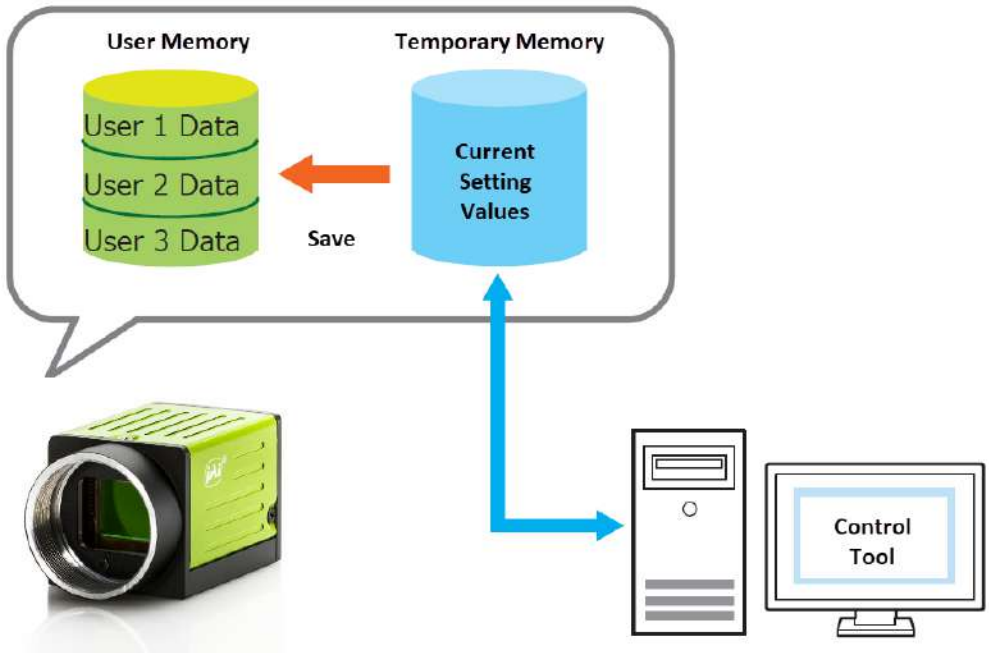
Note: To see the short ASCII commands used to configure the Black Level settings, see Analog Control (Command List) in the Short ASCII Command List Chapter.

1. Select the black level you want to configure in BlackLevelSelector. DigitalAll (master black), DigitalRed (digital R), and DigitalBlue (digital B) can be configured.
2. Specify the adjustment value in BlackLevel.

Step 6: Save the Settings

Related Setting Items: UserSetControl

The configured setting values will be deleted when the camera is turned off. By saving current setting values to user memory, you can load and recall them whenever necessary. You can save up to three sets of user settings in the camera. (User Set1 to 3)



Notes:
- Changes to settings are not saved to the computer (Control Tool).
- To see the short ASCII commands used to save and load the settings, see User Set Control (Command List) in the Short ASCII Command List Chapter.

Save the User Settings

1. Stop image acquisition. Settings can only be saved when image acquisition on the camera is stopped.
2. Specify the storage location (UserSet1 - UserSet3) using the **UserSetSave** command and save the current camera settings.

Load the 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.

Note: When selecting **Default**, the factory settings are loaded.

Main Functions

This chapter describes the camera's main functions.

Basic Function Matrix

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

Exposure Mode	Frame Start Trigger	Binning Horizontal	Binning Vertical	Exposure Time	ROI	Balance White Exposure Auto	Balance White Gain Auto	Gain Auto	Exposure Auto	Trigger Sequencer Mode	Command Sequencer Mode
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		✓	✓	✓	✓	✓	✓	✓	✓
TriggerWidth	On	1 x 1 (Off)			✓		✓	✓			
		1 x 2			✓		✓	✓			
		2 x 1			✓		✓	✓			
		2 x 2			✓		✓	✓			
RCT	On	1 x 1 (Off)		✓	✓	✓	✓	✓	✓		
		1 x 2		✓	✓	✓	✓	✓	✓		
		2 x 1		✓	✓	✓	✓	✓	✓		
		2 x 2		✓	✓	✓	✓	✓	✓		

✓ : Can be used together
Empty: Cannot be used together

GPIO (Digital Input/Output Settings)

Related Setting Items: DigitalIOControl

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) - Output Destination										
Source signal (Cross point switch input)	Trigger Selector	LineSelector						PulseGeneratorSelector			
	Frame Start	Line1 TTL Out1	Line2 Opt Out1	NAND Gate0 In1	NAND Gate0 In2	NAND Gate1 In1	NAND Gate1 In2	Pulse Generator 0	Pulse Generator 1	Pulse Generator 2	Pulse Generator 3
Low	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
High	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Line5-OptIn1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Line6-OptIn2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Line7-CC1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
User Output0	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
User Output1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
User Output2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
User Output3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pulse Generator0	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Pulse Generator1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Pulse Generator2	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Pulse Generator3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Nand0Out	✓	✓	✓			✓	✓	✓	✓	✓	✓

Source signal (Cross point switch input)	Selector (Cross point switch output) - Output Destination										
	Trigger Selector	LineSelector						PulseGeneratorSelector			
	Frame Start	Line1 TTL Out1	Line2 Opt Out1	NAND Gate0 In1	NAND Gate0 In2	NAND Gate1 In1	NAND Gate1 In2	Pulse Generator 0	Pulse Generator 1	Pulse Generator 2	Pulse Generator 3
Nand1Out	✓	✓	✓	✓	✓			✓	✓	✓	✓
Exposure Active	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Frame Trigger Wait	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
FrameActive	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
FVAL	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LVAL	–		✓	✓	✓	✓	✓	✓	✓	✓	✓
Software	✓	–	–	–	–	–	–	–	–	–	–
	Trigger Selector	LineSelector						PulseGeneratorSelector			
	用途										

	Indicates default values for each selector.
✓	Supported
	(Empty) Not Supported

Camera Output Formats

This camera supports three output formats (RGB 8, RGB 10, RGB 12). In accordance with the setting of CIConfiguration, 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.

CIConfiguration	PixelFormat
Base	RGB8
Medium	RGB8, RGB10, RGB12
Full	RGB8
EightyBit	RGB8

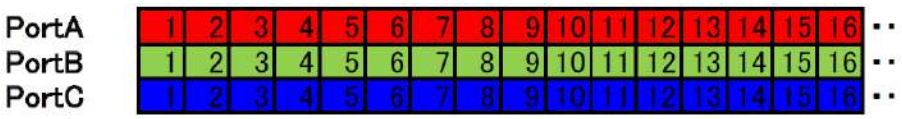
Estimated camera link cable length that can be used with this camera

The Camera Link cable length is less than 10 m.However, if CameraLinkClockFrequency is 84.9 MHz, the Camera Link cable length is 7 m or less.

> **Note:** Cable length that can be used will vary depending on cable type and manufacturer.

CIConfiguration Base - PixelFormat RGB8

Connector 1

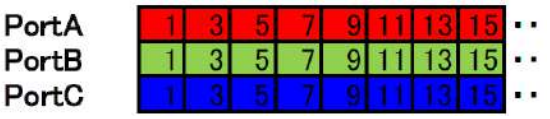


Connector 1

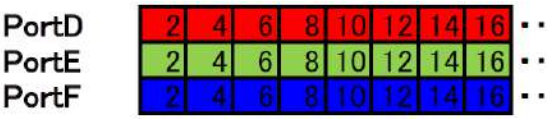
Port / Bit	24-bit RGB
Port A0	R0
Port A1	R1
Port A2	R2
Port A3	R3
Port A4	R4
Port A5	R5
Port A6	R6
Port A7	R7
Port B0	G0
Port B1	G1
Port B2	G2
Port B3	G3
Port B4	G4
Port B5	G5
Port B6	G6
Port B7	G7
Port C0	B0
Port C1	B1
Port C2	B2
Port C3	B3
Port C4	B4
Port C5	B5
Port C6	B6
Port C7	B7

CIConfiguration Medium - PixelFormat RGB8

Connector 1



Connector 2



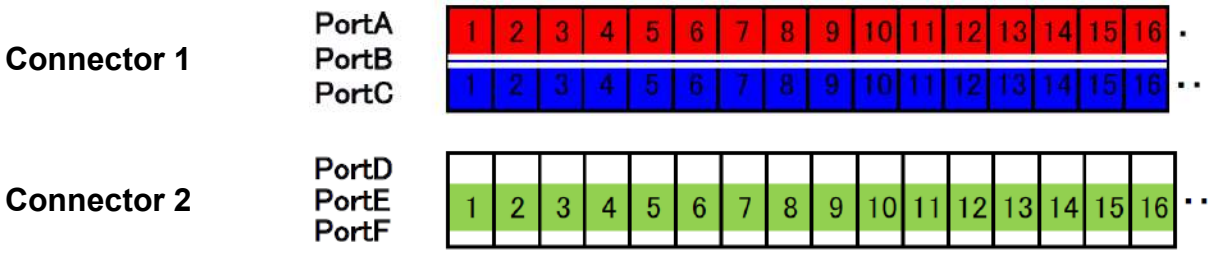
Connector 1

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

Connector 2

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

CIConfiguration Medium - PixelFormat RGB10



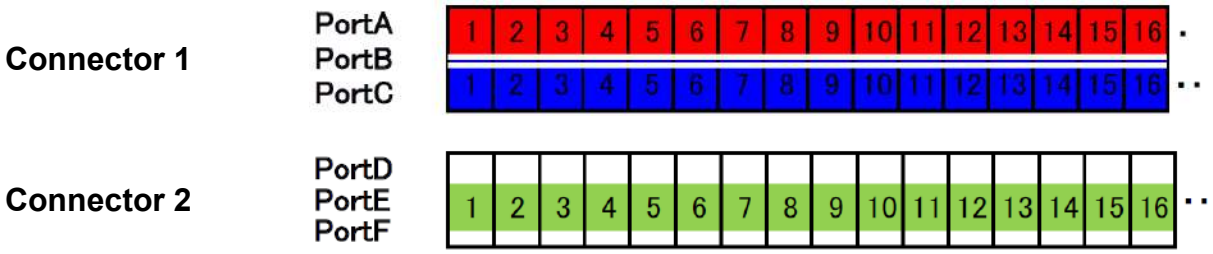
Connector 1

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

Connector 2

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	-

CIConfiguration Medium - PixelFormat RGB12



Connector 1

Port / bit	36-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	R10
Port B3	R11
Port B4	B8
Port B5	B9
Port B6	B10
Port B7	B11
Port C0	B0
Port C1	B1
Port C2	B2
Port C3	B3
Port C4	B4
Port C5	B5
Port C6	B6
Port C7	B7

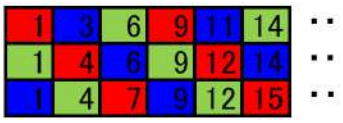
Connector 2

Port / bit	36-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	G10
Port F3	G11
Port F4	-
Port F5	-
Port F6	-
Port F7	-

CIConfiguration Full - PixelFormat RGB8

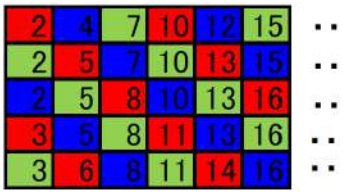
Connector 1

PortA
PortB
PortC



Connector 2

PortD
PortE
PortF
PortG
PortH



Connector 1

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

Connector 2

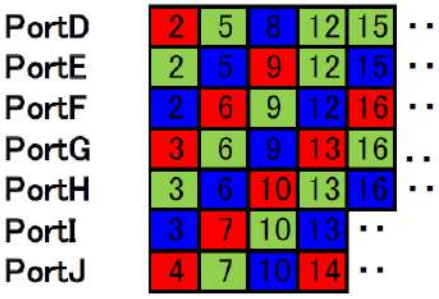
Port / bit	24bit-RGB
Port D0	R0
Port D1	R1
Port D2	R2
Port D3	R3
Port D4	R4
Port D5	R5
Port D6	R6
Port D7	R7
Port E0	G0
Port E1	G1
Port E2	G2
Port E3	G3
Port E4	G4
Port E5	G5
Port E6	G6
Port E7	G7
Port F0	B0
Port F1	B1
Port F2	B2
Port F3	B3
Port F4	B4
Port F5	B5
Port F6	B6
Port F7	B7

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

CIConfiguration EightyBit - PixelFormat RGB8

Connector 1

Connector 2



Connector 1

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

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

Connector 2

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 / bit	24-bit RGB
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 Acquisition Controls (Acquisition Control)

Related Setting Items: AcquisitionControl

Perform operations and configure settings related to image capture in Acquisition Control. On this camera, acquisition control always operates in Continuous mode.

Changing the Frame Rate

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

Notes:

- The shortest frame period varies depending on the ROI, pixel format, CIConfiguration, CameraLinkClockFrequency and binning mode selected. The longest frame period is 0.125 Hz (8 sec.).
- When Trigger Mode is enabled, the Acquisition Frame Rate setting is disabled.

Maximum Frame Rate Period Formula

Note: The Frame Rate Calculator, which calculates the maximum frame rate or trigger rate, is available for download from the product page on the JAI website (www.jai.com).

About the H_Period

For a full image, the H_period values are as follows for each CIConfiguration, PixelFormat and CameraLink Clock Frequency.

CIConfiguration / PixelFormat	CameraLink Clock Frequency	H period (µs)	
		AP-1600T-PMCL	AP-3200T-PMCL
Base/RGB8	37.125MHz	39.33	55.70
	74.25 MHz	19.66	27.85
	84.86 MHz	17.21	24.38
Medium/RGB8	37.125MHz	19.72	27.91
	74.25 MHz	9.86	13.95
	84.86 MHz	8.63	12.22
Medium/RGB10	37.125MHz	39.33	55.70
	74.25 MHz	19.66	27.85
	84.86 MHz	17.21	24.38

CIConfiguration / PixelFormat	CameraLink Clock Frequency	H period (µs)	
		AP-1600T-PMCL	AP-3200T-PMCL
Medium/RGB12	37.125MHz	39.33	55.70
	74.25 MHz	19.66	27.85
	84.86 MHz	17.21	24.38
Full/RGB8	37.125MHz	14.81	20.96
	74.25 MHz	7.41	11.39
	84.86 MHz	7.00	11.39
EightyBit/RGB8	37.125MHz	11.88	16.79
	74.25 MHz	7.00	11.39
	84.86 MHz	7.00	11.39

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

```
H_Count  =  Max(Sensor_H_Max, CL_H_Count_Max)

AP-1600T-PMCL: H_Period  =  H_Count x Binning_vert* / 74.25MHz
```

***Binning=vert**

AP-1600T-PMCL	AP-3200T-PMCL
1	Vertical Binning Off: 1
	Vertical Binning On: 2

The Sensor_H_Max values and Pack Value are as follows for each CIConfiguration, PixelFormat and CameraLink Clock Frequency.

CIConfiguration / PixelFormat	CameraLink Clock Frequency	Sensor_H_Max		Pack Value
		AP-1600T-PMCL	AP-3200T-PMCL	
Base/RGB8	37.125MHz	612	846	1
	74.25 MHz	612	846	1
	84.86 MHz	612	846	1
Medium/RGB8	37.125MHz	612	846	2
	74.25 MHz	612	846	2
	84.86 MHz	612	846	2
Medium/RGB10	37.125MHz	612	846	1
	74.25 MHz	612	846	1
	84.86 MHz	612	846	1
Medium/RGB12	37.125MHz	612	846	1
	74.25 MHz	612	846	1
	84.86 MHz	612	846	1
Full/RGB8	37.125MHz	612	846	8/3 (2.667)
	74.25 MHz	520	846	8/3 (2.667)
	84.86 MHz	520	846	8/3 (2.667)
EightyBit/RGB8	37.125MHz	612	846	10/3 (3.333)
	74.25 MHz	520	846	10/3 (3.333)
	84.86 MHz	520	846	10/3 (3.333)

Calculate the CL_H_Count_Max using the following formulas.

```
CL_H_Count_Max =
Roundup( (Width / Pack Value) + 4 ) × 74.25MHz / CameraLink Clock Frequency, 0 )
```

During Continuous Operation (Frame Start Trigger is Off or ExposureMode is Off)

> **Note:** See the below table for the A and B values.

- When the exposure time is longer than the frame interval

```
MaxOverlapTime_longExp  =  (1 / FR_Cont)  -  (A × H_Period)
```

- Exposure time outside of frame interval

```
NonOverlapExposureTime  =  ExposureTime  -  MaxOverlapTime_long
```

However, MaxOverlapTime_long calculation results that are 0 or below will be considered as 0. For TriggerWidth, the trigger pulse is equivalent to ExposureTime.

- Maximum frame rate

```
FR_longExp  =  1 / { (1 / FR_Cont)  +  NonOverlapExposureTime}
```

*) Calculate the FR_Cont using the following formulas.

```
FR_Cont  =  1 / ((Height  +  B)×H_Period)
```

When Frame Start Trigger is On and TriggerOverLap is Off

> **Note:** See the below table for the B value.

- Maximum frame rate

```
FR_TrOloff  =  1 / { (1 / FR_Cont)  +  NonOverlapExposureTime_TrOloff}
```

*) Calculate the FR_Cont using the following formulas.

```
FR_Cont  =  1 / ((Height  +  B)×H_Period)
```

When Frame Start trigger is On and TriggerOverLap is Readout

> **Note:** See the below table for the A and B values.

- Exposure time possible within frames

```
MaxOverlapTime_TrOlrd  =  (1 / FR_Cont)  -  (A × 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_TrOloff  =  1 / { (1 / FR_Cont)  +  NonOverlapExposureTime_TrOloff}
```

*) Calculate the FR_Cont using the following formulas.

```
FR_Cont  =  1 / ((Height  +  B)×H_Period)
```

	AP-1600T-PMCL	AP-3200T-PMCL
A	20	14
B	44	34

Exposure Mode

Related Setting Items: AcquisitionControl

The following exposure modes are available on the camera.

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

Notes:

- The settings for exposure control and triggers are related to each other. Be sure to configure the settings described in "Trigger Control".
- When **ExposureTimeMode** is set to **Individual**, you can set the exposure times for Red, Green, and Blue individually. To set the exposure time individually for Red, set **ExposureTimeSelector** to **Red**, and configure the exposure time for Red in **ExposureTime**. Similarly, configure the exposure times individually for Green and Blue.
- When **ExposureTimeMode** is set to **Individual**, SequenceExposureTimeCommon will be disabled. When **ExposureTimeMode** is set to **Common**, **SequencerExposureTimeRed**/**Green**/**Blue** will be disabled.

Actual Exposure Times

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

ExposureMode	Shortest Exposure Time	
	AP-1600T-PMCL	AP-3200T-PMCL
Timed	15.26 µs (8-bit)	14.73 µs
Trigger Width	15.26 µs(8-bit)	14.73 µs

The actual exposure time will consist of the image sensor's offset duration added to the setting configured on the camera.

Image Sensor's Offset Duration	
AP-1600T-PMCL	AP-3200T-PMCL
14.26 µs	13.73 µs

When **ExposureMode** is set to **Timed** and the exposure time is set to **1 µs**, the actual exposure time will be as follows.

- AP-1600T-PMCL: 1 µs + 14.26 µs (offset duration of image sensor) = 15.26 µs
- AP-3200T-PMCL: 1 µs + 13.73 µs (offset duration of image sensor) = 14.73 µs

When **ExposureMode** is set to **TriggerWidth**, the exposure is slightly longer than the width of the trigger signal.

- AP-1600T-PMCL: 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.
- AP-3200T-PMCL: To achieve an exposure time of 14.73 µs and the exposure time offset is 13.73 µs, use 14.73 µs - 13.73 µs = 1 µs as the high or low time for the trigger signal.

The Minimum Value for ExposureTime

On this camera, the Minimum ExposureTime value depends on the ExposureModeOption setting.

- **Off**: The minimum ExposureTime value is 1us. However, when HorizontalBinning and HorizontalVertical are enabled on AP-1600T-PMCL, the minimum value will be 3us.
- **RCT**: The minimum ExposureTime value depends on the Camera Output Formats and CameraClockFrequency. See below for the minimum value for each setting.

CIConfiguration / PixelFormat	CameraLink Clock Frequency	ExposureMode Option = RCT	
		AP-1600T-PMCL	AP-3200T-PMCL
Base/RGB8	37.125MHz	56	40
	74.25 MHz	29	20
	84.86 MHz	25	18
Medium/RGB8	37.125MHz	56	40
	74.25 MHz	29	20
	84.86 MHz	25	18
Medium/RGB10	37.125MHz	56	40
	74.25 MHz	29	20
	84.86 MHz	25	18
Medium/RGB12	37.125MHz	29	21
	74.25 MHz	15	11
	84.86 MHz	13	9

CIConfiguration / PixelFormat	CameraLink Clock Frequency	ExposureMode Option = RCT	
		AP-1600T-PMCL	AP-3200T-PMCL
Full/RGB8	37.125MHz	22	16
	74.25 MHz	12	9
	84.86 MHz	12	9
EightyBit/RGB8	37.125MHz	18	13
	74.25 MHz	12	9
	84.86 MHz	12	9

Trigger Control

Related Setting Items: AcquisitionControl

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

- FrameStart: Start exposure in response to the external trigger signal input. Select this to perform exposure control using external triggers.[1)]

Notes:

- The settings for exposure control and triggers are related to each other. Be sure to configure the settings described in "Exposure Mode".
- [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.

AP-1600T-PMCL

CameraLink ClockFrequency	Shortest Period of Trigger					
	Base	Medium	Medium	Medium	Ful	EightyBit
	RGB8	RGB8	RGB10	RGB12	RGB8	RGB8
37.125MHz	44.5ms	22.3ms	44.5ms	44.5ms	16.8ms	13.4ms
74.25 MHz	22.3ms	11.2ms	22.3ms	22.3ms	8.4ms	7.9ms
84.86 MHz	19.5ms	9.8ms	19.5ms	19.5ms	7.9ms	7.9ms

AP-3200T-PMCL

CameraLink ClockFrequency	Shortest Period of Trigger					
	Base	Medium	Medium	Medium	Ful	EightyBit
	RGB8	RGB8	RGB10	RGB12	RGB8	RGB8
37.125MHz	87.9ms	44.0ms	87.9ms	87.9ms	33.1ms	26.5ms
74.25 MHz	44.0ms	22.0ms	44.0ms	44.0ms	18.0ms	18.0ms
84.86 MHz	38.5ms	19.3ms	38.5ms	38.5ms	18.0ms	18.0ms

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

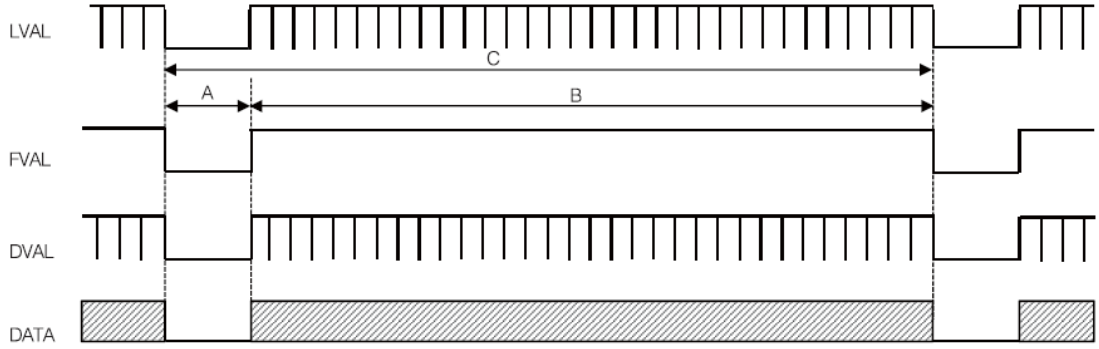
Minimum trigger pulse width

- Camera Link : 3 µs
- TTL In: 50 ns

Image Output Timing

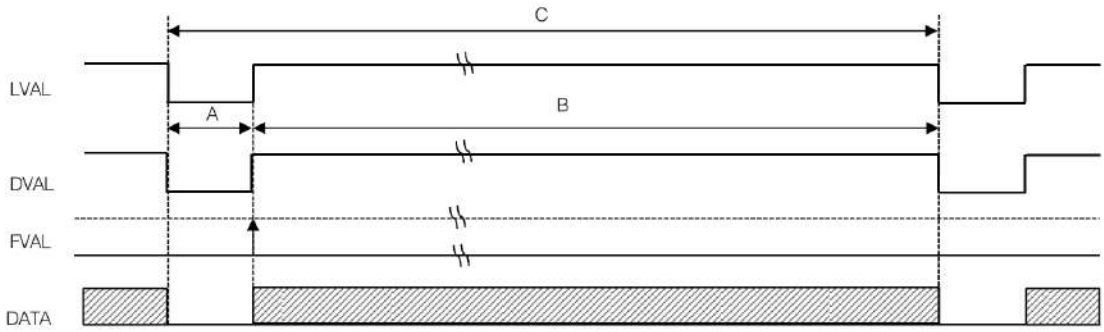
Vertical / Horizontal Timing (AP-1600T-PMCL)

Vertical Timing (AP-1600T-PMCL)



CIConfiguration/ PixelFormat	CL PixelClock [MHz]	H Frequency (KHz)	FVAL BlankingLine [A]	FVAL Valid Line [B]	Total FrameLine [C]	Total Frame Period (msec)	Frame Rate (Hz)
Base/RGB8	37.125	25.428	44	1088	1132	44.518	22.46
	74.25	50.856	44	1088	1132	22.259	44.93
	84.86	58.121	44	1088	1132	19.476	51.34
Medium/RGB8	37.125	50.717	44	1088	1132	22.32	44.8
	74.25	101.434	44	1088	1132	11.16	89.61
	84.86	115.925	44	1088	1132	9.765	102.33
Medium/RGB10	37.125	25.428	44	1088	1132	44.518	22.46
	74.25	50.856	44	1088	1132	22.259	44.93
	84.86	58.121	44	1088	1132	19.476	51.34
Medium/RGB12	37.125	25.428	44	1088	1132	44.518	22.46
	74.25	50.856	44	1088	1132	22.259	44.93
	84.86	58.121	44	1088	1132	19.476	51.34
Full/RGB8	37.125	67.5	44	1088	1132	16.77	59.63
	74.25	135	44	1088	1132	8.385	119.26
	84.86	142.788	44	1088	1132	7.927	126.14
EightyBit/RGB8	37.125	84.183	44	1088	1132	13.447	74.37
	74.25	142.788	44	1088	1132	7.928	126.14
	84.86	142.788	44	1088	1132	7.928	126.14

Horizontal Timing (AP-1600T-PMCL)

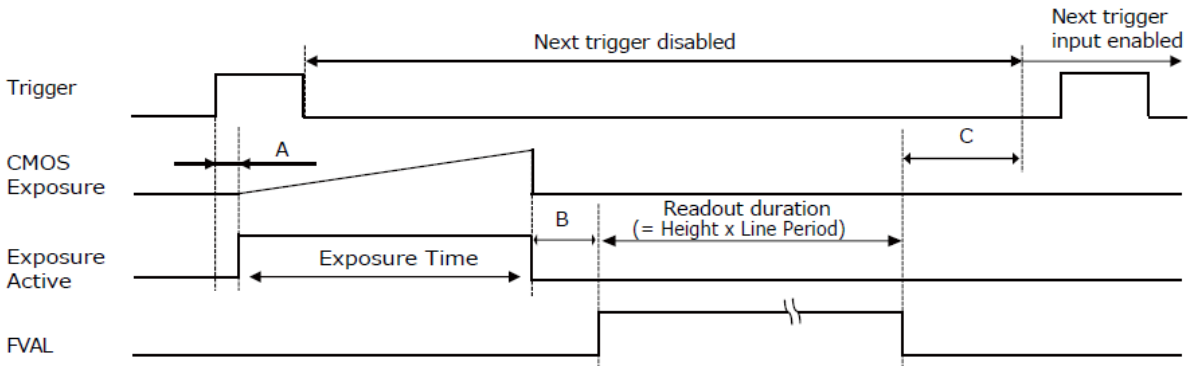


CIConfiguration/ PixelFormat	CL PixelClock [MHz]	LIne BlankingClock [A]	Line Valid Clock[B]	Total Line Clock [C]	Total Line Period (usec) [C]	Line Rate (KHz) [C]
Base/RGB8	37.125	4	1456	1460	39.33	25.428
	74.25	4	1456	1460	19.66	50.856
	84.86	4	1456	1460	17.21	58.121
Medium/RGB8	37.125	4	728	732	19.72	50.717
	74.25	4	728	732	9.86	101.434
	84.86	4	728	732	8.638	115.925
Medium/RGB10	37.125	4	1456	1460	39.33	25.428
	74.25	4	1456	1460	19.66	50.856
	84.86	4	1456	1460	17.21	58.121
Medium/RGB12	37.125	4	1456	1460	39.33	25.428
	74.25	4	1456	1460	19.66	50.856
	84.86	4	1456	1460	17.21	58.121
Full/RGB8	37.125	4	546	550	14.81	67.5
	74.25	4	546	550	7.41	135
	84.86	49	546	595	7	142.788
EightyBit/RGB8	37.125	4	437	441	11.8	84.184
	74.25	83	437	520	7	142.788
	84.86	158	437	595	7	142.788

When ExposureMode is Timed (AP-1600T-PMCL)

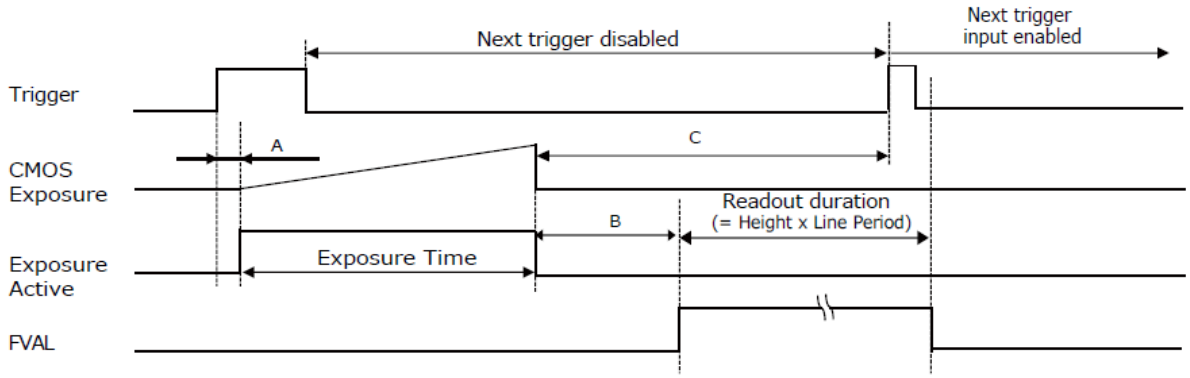
Example: When TriggerSource is set to Line 5 - OptIn1 and OptInFilterSelector is set to Off

- **TriggerOverlap = Off (AP-1600T-PMCL)**



CLConfiguration/ PixelFormat	CameraLink Clock Frequency	Line Period (usec)	Period from Trigger start edge to Exposure start [A](usec)	Period from Exposure end to FVAL start[B] (usec)	Period FVAL end to next trigger start[C](usec)
Base/RGB8	37.125MHz	39.33	119	1479	3426
	74.25 MHz	19.66	60	751	1702
	84.86 MHz	17.21	53	661	1493
Medium/RGB8	37.125MHz	19.72	60	753	1761
	74.25 MHz	9.86	31	388	868
	84.86 MHz	8.63	27	343	764
Medium/RGB10	37.125MHz	39.33	119	1479	3426
	74.25 MHz	19.66	60	751	1702
	84.86 MHz	17.21	53	661	1493
Medium/RGB12	37.125MHz	39.33	119	1479	3426
	74.25 MHz	19.66	60	751	1702
	84.86 MHz	17.21	53	661	1493
Full/RGB8	37.125MHz	14.81	46	572	1343
	74.25 MHz	7.41	23	297	660
	84.86 MHz	7	22	282	1142
EightyBit/RGB8	37.125MHz	11.88	37	463	1094
	74.25 MHz	7	22	282	1690
	84.86 MHz	7	22	282	2426

- **TriggerOverlap = Readout (AP-1600T-PMCL)**

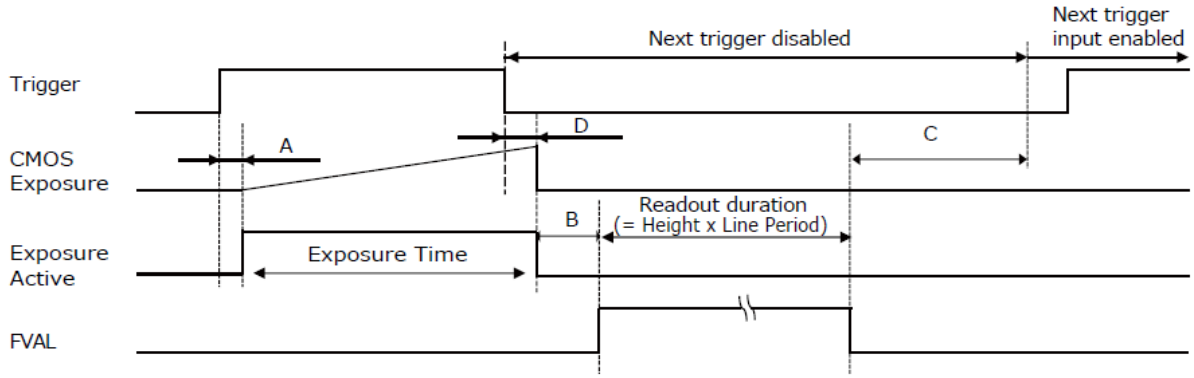


CLConfiguration/ PixelFormat	CameraLink Clock Frequency	Line Period (usec)	Period from Trigger start edge to Exposure start [A](usec)	Period from Exposure end to FVAL start[B] (usec)	Period from Exposure end to next trigger start [C](usec)
Base/RGB8	37.125MHz	39.33	119	1479	787 ~ 44517
	74.25 MHz	19.66	60	751	393 ~ 22258
	84.86 MHz	17.21	53	661	344 ~ 19483
Medium/RGB8	37.125MHz	19.72	60	753	394 ~ 22319
	74.25 MHz	9.86	31	388	197 ~ 11159
	84.86 MHz	8.63	27	343	173 ~ 9772
Medium/RGB10	37.125MHz	39.33	119	1479	787 ~ 44517
	74.25 MHz	19.66	60	751	393 ~ 22258
	84.86 MHz	17.21	53	661	344 ~ 19483
Medium/RGB12	37.125MHz	39.33	119	1470	787 ~ 44517
	74.25 MHz	19.66	60	751	393 ~ 22258
	84.86 MHz	17.21	53	661	344 ~ 19483
Full/RGB8	37.125MHz	14.81	46	572	296 ~ 16769
	74.25 MHz	7.41	23	297	148 ~ 8384
	84.86 MHz	7.00	22	282	140 ~ 7927
EightyBit/RGB8	37.125MHz	11.88	37	463	238 ~ 13446
	74.25 MHz	7.00	22	282	140 ~ 7927
	84.86 MHz	7.00	22	282	140 ~ 7927

When ExposureMode is TriggerWidth (AP-1600T-PMCL)

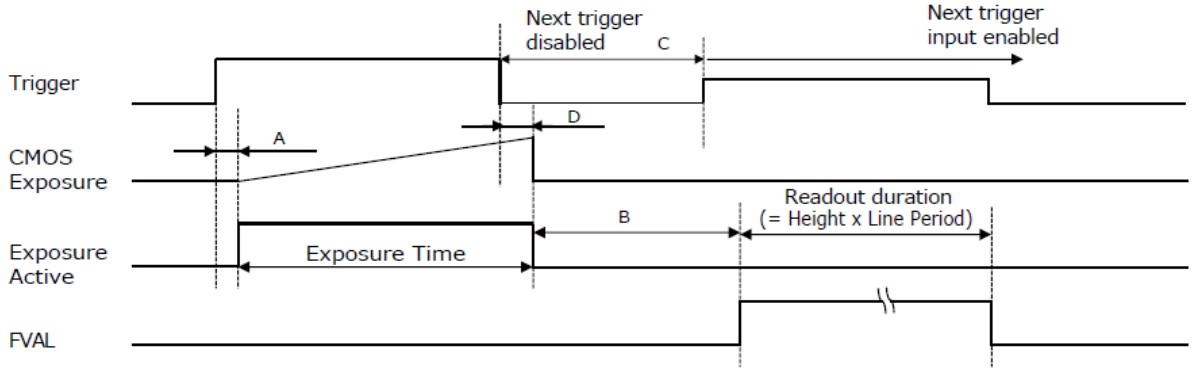
Example: When TriggerSource is set to Line 5 - Optical In 1 and OptInFilterSelector is set to Off

- **TriggerOverlap = Off (AP-1600T-PMCL)**



CLConfiguration/ PixelFormat	CameraLink Clock Frequency	Line Period (usec)	Period from Trigger start edge to Exposure start [A](usec)	Period from Exposure end to FVAL start [B](usec)	Period FVAL end to next trigger start[C] (usec)	Period from Trigger end edge to Exposure end [D](usec)
Base/RGB8	37.125MHz	39.33	119	1479	3426	119
	74.25 MHz	19.66	60	751	1702	60
	84.86 MHz	17.21	53	661	1493	53
Medium/RGB8	37.125MHz	19.72	60	753	1761	60
	74.25 MHz	9.86	31	388	868	31
	84.86 MHz	8.63	27	343	764	27
Medium/RGB10	37.125MHz	39.33	119	1479	3426	119
	74.25 MHz	19.66	60	751	1702	60
	84.86 MHz	17.21	53	661	1493	53
Medium/RGB12	37.125MHz	39.33	119	1479	3426	119
	74.25 MHz	19.66	60	751	1702	60
	84.86 MHz	17.21	53	661	1493	53
Full/RGB8	37.125MHz	14.81	46	572	1343	46
	74.25 MHz	7.41	23	297	660	23
	84.86 MHz	7.00	22	282	1142	22
EightyBit/RGB8	37.125MHz	11.88	37	463	1094	37
	74.25 MHz	7.00	22	282	1690	22
	84.86 MHz	7.00	22	282	2426	22

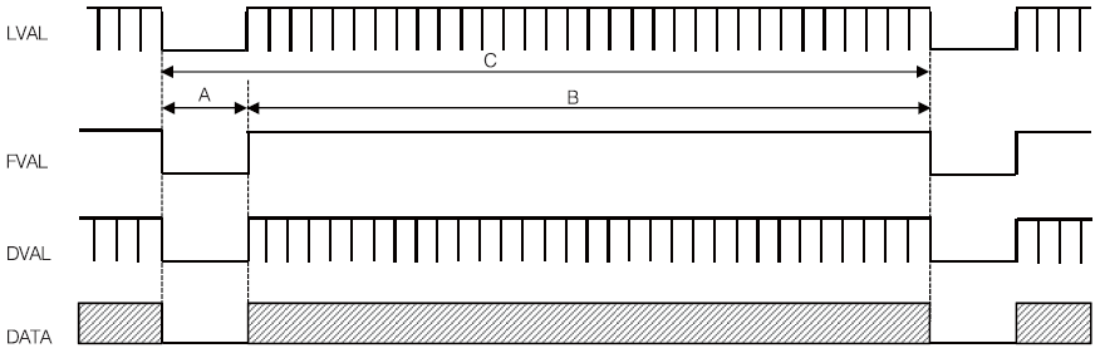
- **TriggerOverlap = Readout (AP-1600T-PMCL)**



CLConfiguration/ PixelFormat	CameraLink Clock Frequency	Line Period (usec)	Period from Trigger start edge to Exposure start [A](usec)	Period from Exposure end to FVAL start [B](usec)	Next trigger start prohibited period[C] (usec)	Period from Trigger end edge to Exposure end [D](usec)
Base/RGB8	37.125MHz	39.33	119	1479	906	119
	74.25 MHz	19.66	60	751	453	60
	84.86 MHz	17.21	53	661	397	53
Medium/RGB8	37.125MHz	19.72	60	753	454	60
	74.25 MHz	9.86	31	388	228	31
	84.86 MHz	8.63	27	343	200	27
Medium/RGB10	37.125MHz	39.33	119	1479	906	119
	74.25 MHz	19.66	60	751	453	60
	84.86 MHz	17.21	53	661	397	53
Medium/RGB12	37.125MHz	39.33	119	1479	906	119
	74.25 MHz	19.66	60	751	453	60
	84.86 MHz	17.21	53	661	397	53
Full/RGB8	37.125MHz	14.81	46	572	342	46
	74.25 MHz	7.41	23	297	171	23
	84.86 MHz	7.00	22	282	162	22
EightyBit/RGB8	37.125MHz	11.88	37	463	275	37
	74.25 MHz	7.00	22	282	162	22
	84.86 MHz	7.00	22	282	162	22

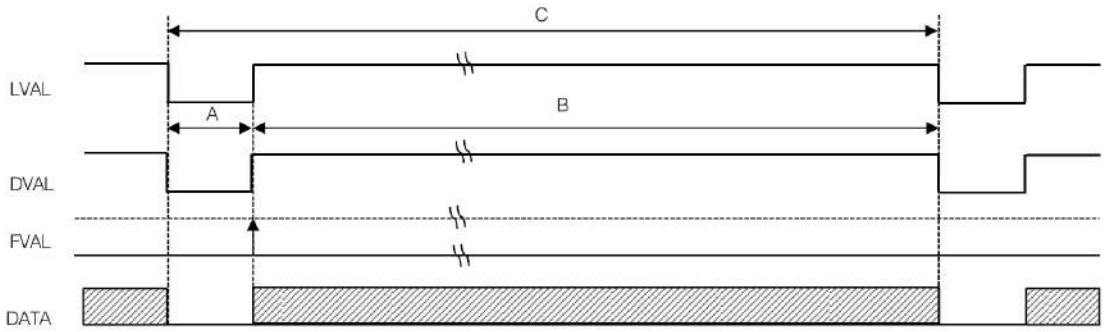
Vertical / Horizontal Timing (AP-3200T-PMCL)

Vertical Timing (AP-3200T-PMCL)



CIConfiguration/ PixelFormat	CL PixelClock [MHz]	H Frequency (KHz)	FVAL BlankingLine [A]	FVAL Valid Line [B]	Total FrameLine [C]	Total Frame Period (msec)	Frame Rate (Hz)
Base/RGB8	37.125	17.952	34	1544	1578	87.9	11.38
	74.25	35.904	34	1544	1578	43.95	22.75
	84.86	41.033	34	1544	1578	38.456	26
Medium/RGB8	37.125	35.835	34	1544	1578	44.035	22.71
	74.25	71.67	34	1544	1578	22.018	45.42
	84.86	81.908	34	1544	1578	19.265	51.91
Medium/RGB10	37.125	17.952	34	1544	1578	87.9	11.38
	74.25	35.904	34	1544	1578	43.95	22.75
	84.86	41.033	34	1544	1578	38.456	26
Medium/RGB12	37.125	17.952	34	1544	1578	87.9	11.38
	74.25	35.904	34	1544	1578	43.95	22.75
	84.86	41.033	34	1544	1578	38.456	26
Full/RGB8	37.125	47.719	34	1544	1578	33.069	30.24
	74.25	87.766	34	1544	1578	17.98	55.62
	84.86	87.765	34	1544	1578	17.98	55.62
EightyBit/RGB8	37.125	59.495	34	1544	1578	26.523	37.7
	74.25	87.766	34	1544	1578	17.98	55.62
	84.86	87.766	34	1544	1578	17.98	55.62

Horizontal Timing (AP-3200T-PMCL)

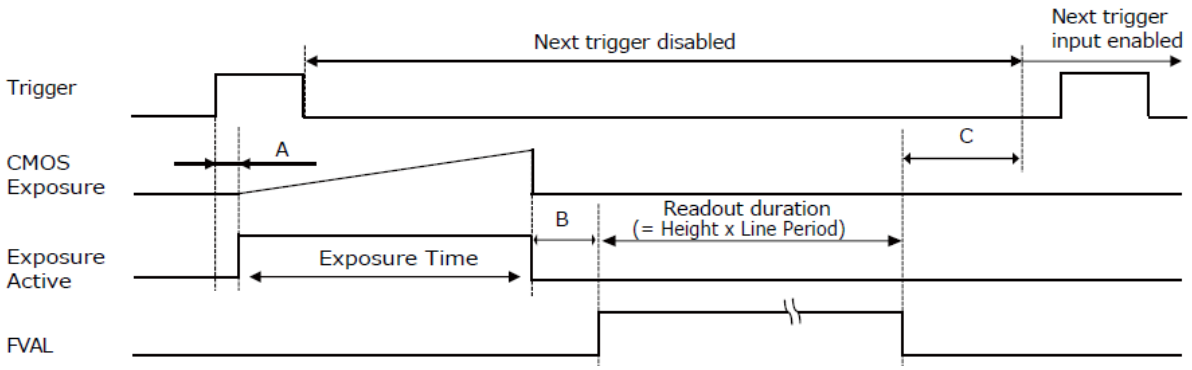


CIConfiguration/ PixelFormat	CL PixelClock [MHz]	LIne BlankingClock [A]	Line Valid Clock[B]	Total Line Clock [C]	Total Line Period (usec) [C]	Line Rate (KHz) [C]
Base/RGB8	37.125	4	2064	2068	55.7	17.952
	74.25	4	2064	2068	27.85	35.904
	84.86	4	2064	2068	24.37	41.033
Medium/RGB8	37.125	4	1032	1036	27.91	35.835
	74.25	4	1032	1036	13.95	71.67
	84.86	4	1032	1036	12.21	81.908
Medium/RGB10	37.125	4	2064	2068	55.7	17.952
	74.25	4	2064	2068	27.85	35.904
	84.86	4	2064	2068	24.37	41.033
Medium/RGB12	37.125	4	2064	2068	55.7	17.952
	74.25	4	2064	2068	27.85	35.904
	84.86	4	2064	2068	24.37	41.033
Full/RGB8	37.125	4	774	778	20.96	47.719
	74.25	72	774	846	11.39	87.766
	84.86	193	774	967	11.39	87.766
EightyBit/RGB8	37.125	4	620	624	16.81	59.495
	74.25	226	620	846	11.39	87.766
	84.86	347	620	967	11.39	87.766

When ExposureMode is Timed (AP-3200T-PMCL)

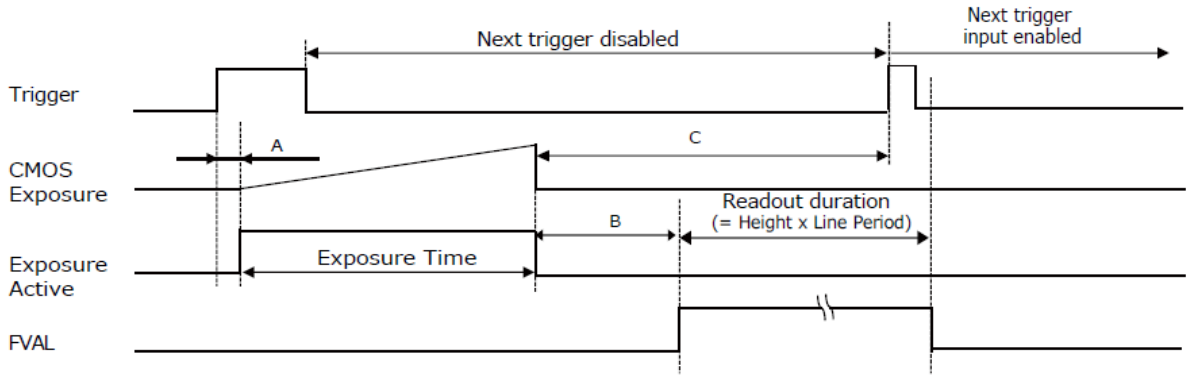
Example: When TriggerSource is set to Line 5 - OptIn1 and OptInFilterSelector is set to Off

- **TriggerOverlap = Off (AP-3200T-PMCL)**



CLConfiguration/ PixelFormat	CameraLink Clock Frequency	Line Period (usec)	Period from Trigger start edge to Exposure start [A](usec)	Period from Exposure end to FVAL start[B] (usec)	Period FVAL end to next trigger start[C](usec)
Base/RGB8	37.125MHz	55.70	168	1424	469
	74.25 MHz	27.85	85	729	218
	84.86 MHz	24.38	74	642	187
Medium/RGB8	37.125MHz	27.91	85	729	220
	74.25 MHz	13.95	43	381	94
	84.86 MHz	12.22	38	338	77
Medium/RGB10	37.125MHz	55.70	168	1424	469
	74.25 MHz	27.85	85	729	218
	84.86 MHz	24.38	74	642	187
Medium/RGB12	37.125MHz	55.70	168	1424	469
	74.25 MHz	27.85	85	729	218
	84.86 MHz	24.38	74	642	187
Full/RGB8	37.125MHz	20.96	64	556	157
	74.25 MHz	11.39	35	318	70
	84.86 MHz	11.39	35	318	70
EightyBit/RGB8	37.125MHz	16.79	51	452	119
	74.25 MHz	11.39	35	318	70
	84.86 MHz	11.39	35	318	70

- **TriggerOverlap = Readout (AP-3200T-PMCL)**

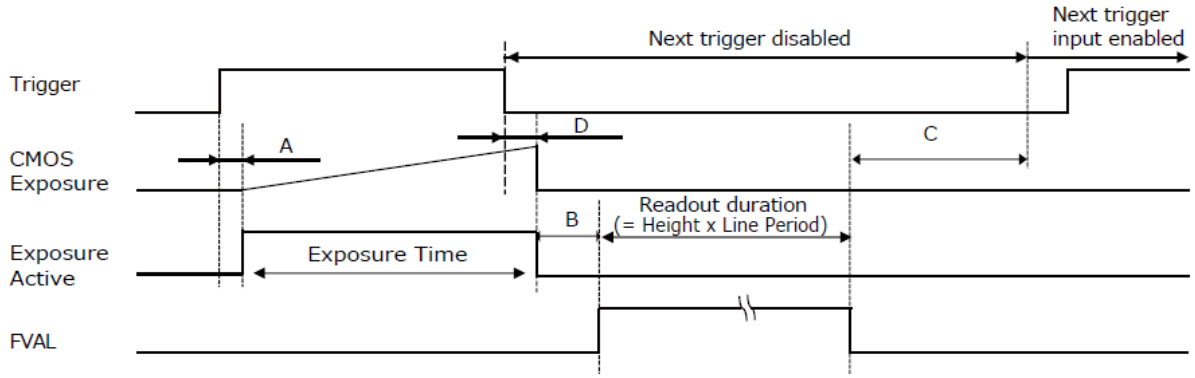


CLConfiguration/ PixelFormat	CameraLink Clock Frequency	Line Period (usec)	Period from Trigger start edge to Exposure start [A](usec)	Period from Exposure end to FVAL start[B] (usec)	Period from Exposure end to next trigger start [C](usec)
Base/RGB8	37.125MHz	55.70	168	1424	780 ~ 87889
	74.25 MHz	27.85	85	729	390 ~ 43949
	84.86 MHz	24.38	74	642	341 ~ 38466
Medium/RGB8	37.125MHz	27.91	85	729	391 ~ 44034
	74.25 MHz	13.95	43	381	195 ~ 22017
	84.86 MHz	12.22	38	338	171 ~ 19275
Medium/RGB10	37.125MHz	55.70	168	1424	780 ~ 87889
	74.25 MHz	27.85	85	729	390 ~ 43949
	84.86 MHz	24.38	74	642	341 ~ 38466
Medium/RGB12	37.125MHz	55.70	168	1424	780 ~ 87889
	74.25 MHz	27.85	85	729	390 ~ 43949
	84.86 MHz	24.38	74	642	341 ~ 38466
Full/RGB8	37.125MHz	20.96	64	556	293 ~ 33068
	74.25 MHz	11.39	35	318	160 ~ 17979
	84.86 MHz	11.39	35	318	160 ~ 17979
EightyBit/RGB8	37.125MHz	16.79	51	452	235 ~ 26501
	74.25 MHz	11.39	35	318	160 ~ 17979
	84.86 MHz	11.39	35	318	160 ~ 17979

When ExposureMode is TriggerWidth (AP-3200T-PMCL)

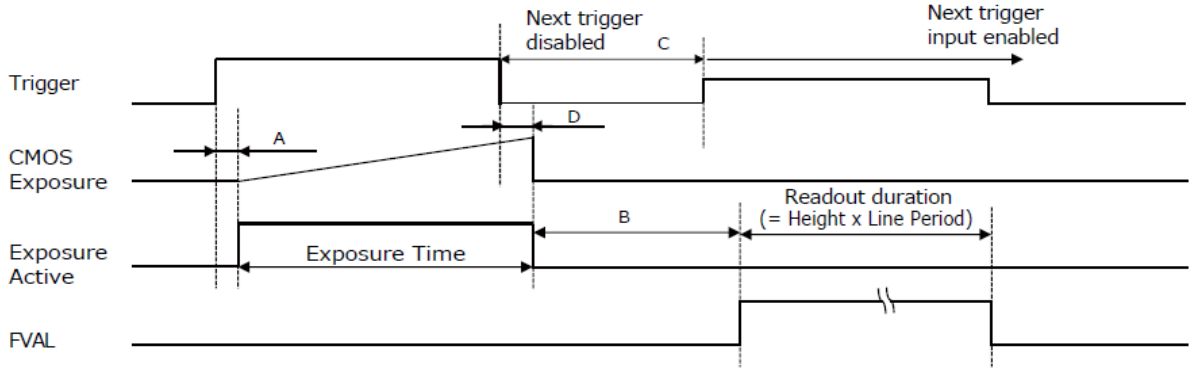
Example: When TriggerSource is set to Line 5 - Optical In 1 and OptInFilterSelector is set to Off

- **TriggerOverlap = Off (AP-3200T-PMCL)**



CLConfiguration/ PixelFormat	CameraLink Clock Frequency	Line Period (usec)	Period from Trigger start edge to Exposure start [A](usec)	Period from Exposure end to FVAL start [B](usec)	Period FVAL end to next trigger start[C] (usec)	Period from Trigger end edge to Exposure end [D](usec)
Base/RGB8	37.125MHz	55.70	168	1424	469	168
	74.25 MHz	27.85	85	729	218	85
	84.86 MHz	24.38	74	642	187	74
Medium/RGB8	37.125MHz	27.91	85	729	220	85
	74.25 MHz	13.95	43	381	94	43
	84.86 MHz	12.22	38	338	77	38
Medium/RGB10	37.125MHz	55.70	168	1424	469	168
	74.25 MHz	27.85	85	729	218	85
	84.86 MHz	24.38	74	642	187	74
Medium/RGB12	37.125MHz	55.70	168	1424	469	168
	74.25 MHz	27.85	85	729	218	85
	84.86 MHz	24.38	74	642	187	74
Full/RGB8	37.125MHz	20.96	64	556	157	64
	74.25 MHz	11.39	35	318	70	35
	84.86 MHz	11.39	35	318	70	35
EightyBit/RGB8	37.125MHz	16.79	51	452	119	51
	74.25 MHz	11.39	35	318	70	35
	84.86 MHz	11.39	35	318	70	35

- **TriggerOverlap = Readout (AP-3200T-PMCL)**



CLConfiguration/ PixelFormat	CameraLink Clock Frequency	Line Period (usec)	Period from Trigger start edge to Exposure start [A](usec)	Period from Exposure end to FVAL start [B](usec)	Next trigger start prohibited period[C] (usec)	Period from Trigger end edge to Exposure end [D](usec)
Base/RGB8	37.125MHz	55.70	168	1424	948	168
	74.25 MHz	27.85	85	729	475	85
	84.86 MHz	24.38	74	642	415	74
Medium/RGB8	37.125MHz	27.91	85	729	476	85
	74.25 MHz	13.95	43	381	238	43
	84.86 MHz	12.22	38	338	209	38
Medium/RGB10	37.125MHz	55.70	168	1424	948	168
	74.25 MHz	27.85	85	729	475	85
	84.86 MHz	24.38	74	642	415	74
Medium/RGB12	37.125MHz	55.70	168	1424	948	168
	74.25 MHz	27.85	85	729	475	85
	84.86 MHz	24.38	74	642	415	74
Full/RGB8	37.125MHz	20.96	64	556	357	64
	74.25 MHz	11.39	35	318	195	35
	84.86 MHz	11.39	35	318	195	35
EightyBit/RGB8	37.125MHz	16.79	51	452	286	51
	74.25 MHz	11.39	35	318	195	35
	84.86 MHz	11.39	35	318	195	35

Gain Control

Related Setting Items: AnalogControl

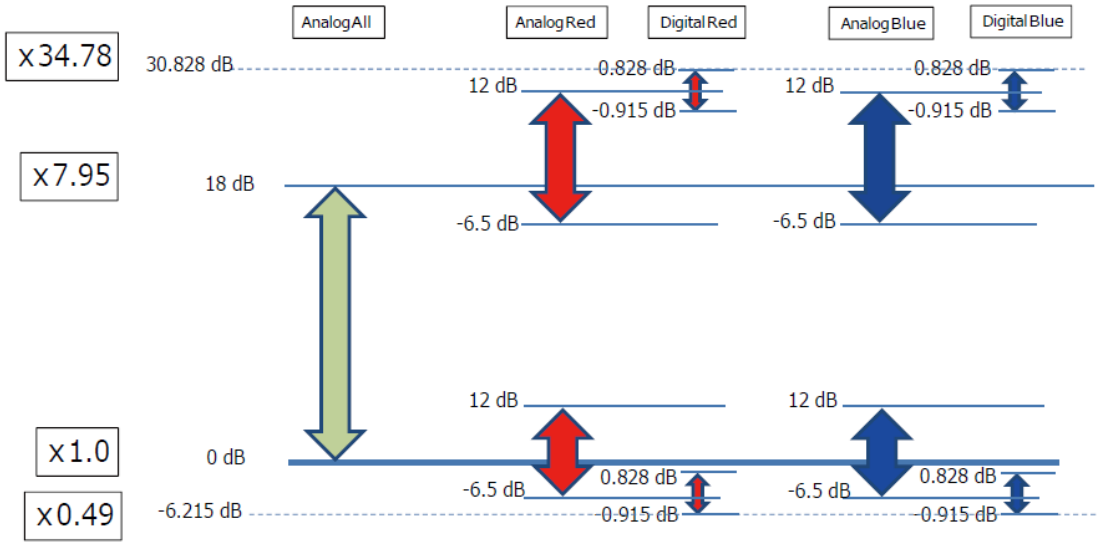
Gain control can be performed in the following two modes on this camera.

Note: For details on how to configure the settings, see "Adjust the Gain".

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

When using this mode, set **IndividualGainMode** to **Off**.

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



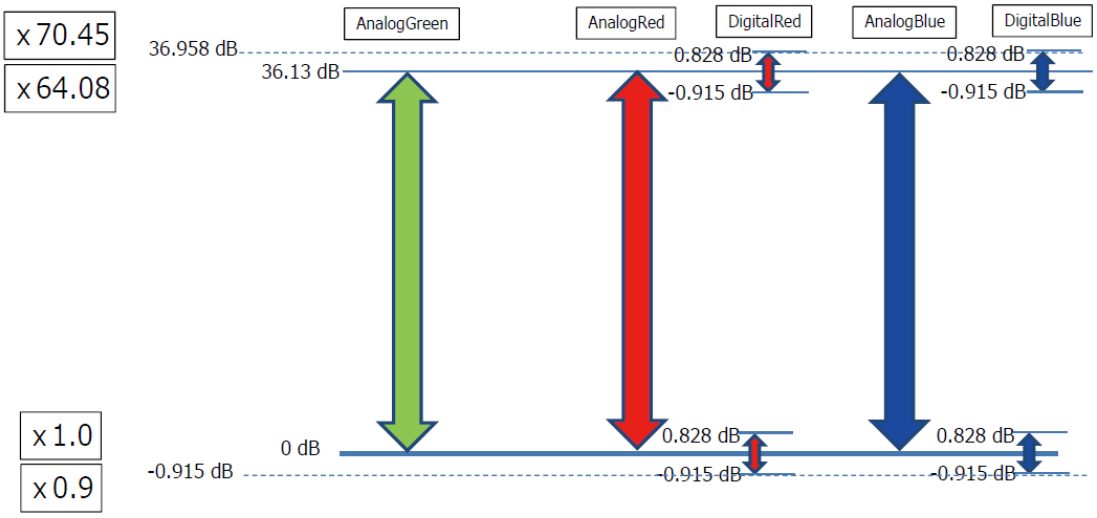
Adjusting the Gain Individually for RGB (Individual Mode)

When using this mode, set **IndividualGainMode** to **On**.

Adjust the **AnalogGreen**, **AnalogRed**, **DigitalRed**, **AnalogBlue**, **DigitalBlue** setting values to adjust the gain.

This mode allows a wider range of adjustment by the user when compared to Master Mode.

- **When IndividualGainMode is set to On**



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

Automatic Gain Level Control

Set **GainAuto** to **Continuous** to control the gain level automatically.

Notes:

- When **IndividualGainMode** is set to **On**, GainAuto will be fixed at Off.
- When **GainAuto** is set to **Continuous**, you can configure the conditions for automatic adjustment in detail.
- For more information on Automatic Control, see ALC (Automatic Level Control) . For more information on the setting items, see JAI CustomControlALC.

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

LUT (Lookup Table)

Related Setting Items: LUT Control

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).

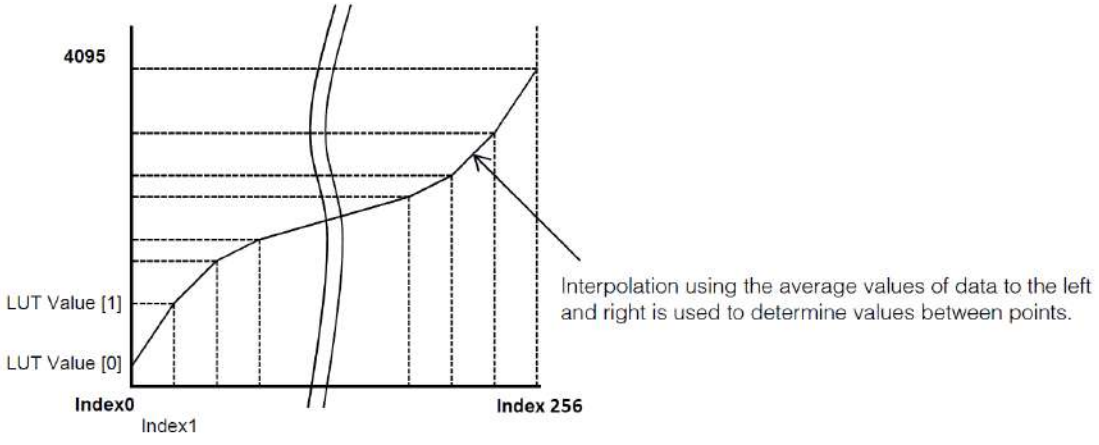
To use the LUT function

Configure the settings as follows.

Item	Setting Value / Selectable Range	Description
JAI LUT Mode	LUT	Use LUT.
LUT Selector	Red, Green, Blue	Select the LUT channel to control.
LUT Index	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.
LUT Value	0 ~ 4095	Set the LUT output value for the selected index.

LUT values

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

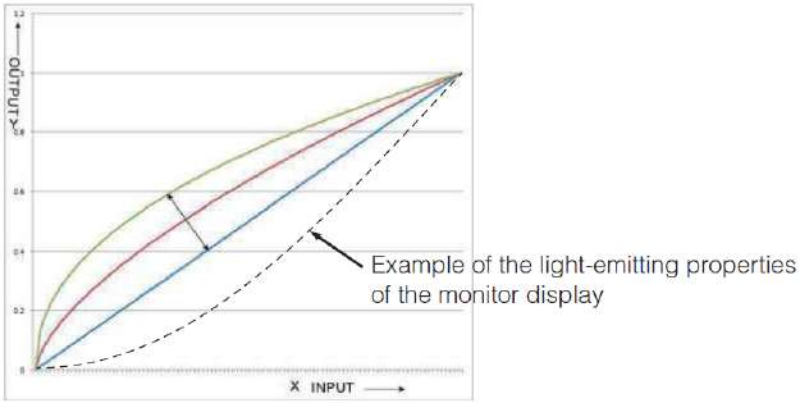


Gamma Function

> **Note:** AnalogControl

The Gamma function corrects the output signals from the camera beforehand (reverse correction), taking into consideration the light-emitting properties of the monitor display. As the light-emitting properties of the monitor are not linear, the entire image may be darker or the gradation in the dark areas may be less noticeable when camera outputs are displayed without processing.

The gamma function can be used to correct the camera signals with an opposite-direction curve and produce a display that is close to linear.



To use the gamma function

Configure the settings as follows.

Item	Setting Value / Selectable Range	Description
Gamma	0.45, 0.5, 0.55, 0.6, 0.65, 0.75, 0.8, 0.9, 1.0	Select the gamma correction value.
JAI LUT Mode	Gamma	Use gamma.

> **Note:** You can use the LUT function to configure a curve with more detailed points. For details, see "LUT (Lookup Table)".

Line Status

> **Related Setting Items:** DigitalIOControl

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

You can verify the status of the following signals.

- Line1-TTLOut1, Line2-OptOut1
- Line5-OptIn1, Line6-OptIn2
- Line7-CC1
- NAND0In1, NAND0In2, NAND1In1, NAND1In2

BlemishCompensation

> **Related Setting Items:** JAI CustomControlBlemish

Multiple defective pixels that are not adjacent to each other can occur on conventional CMOS sensor cameras.

This camera features a function that interpolates defective pixels using the surrounding pixels. Up to 200 pixels can be corrected for each of the three sensors. Pixel interpolation can be performed via automatic detection or point-by-point manual settings.

Automatic Detection

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

1. Shield the camera sensor. If a lens is attached, use the lens cap as a shield, for example.
2. Configure the threshold level for defective pixel detection.

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

   The threshold value is specified as a percentage. The default setting is "10" with 10% of the full scale (100%) specified as the threshold value.
3. Execute **Blemish Detect** to start automatic detection. After detection, the interpolation data is saved to the camera's internal memory.

To check the number of interpolated pixels after automatic detection

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

Manual Configuration

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

   You can select from 1 to 200. However, configure the indexes in order starting with the smallest index. If you skip indexes while configuring settings, interpolation may not be performed.

2. Specify the pixel points for interpolation using the **BlemishCompensationPositionX** and **BlemishCompensationPositionY** settings. Each point is saved to the camera's internal memory as you configure them.

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

   > **Note:** By executing **BlemishCompensationDataClear** (specify sensor) **BlemishCompensationIndex**, you can return a specific pixel correction setting to the default value (storage not required).

3. Execute **BlemishStore**. Blemish compensation data will be stored.

4. Set **BlemishEnable** to **True** , and execute interpolation. If **False** is specified, defective pixel interpolation is disabled.

Shading Correction

Related Setting Items: JAI CustomControlShading

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

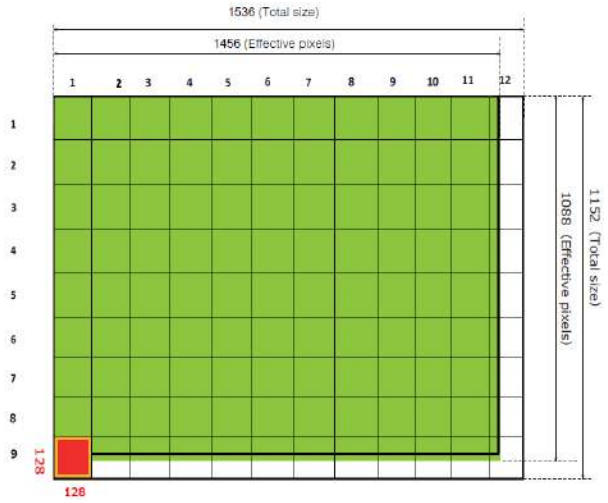
This function can be used even when the effective image area is limited (an area with both Width and Height set to more than 128 must must be configured) by the ROI function. In such cases, the correction area is included in the image area configured by the ROI.

See the table below for the block size information for a full image. The ineffective peripheral areas will be deleted internally on the camera automatically.

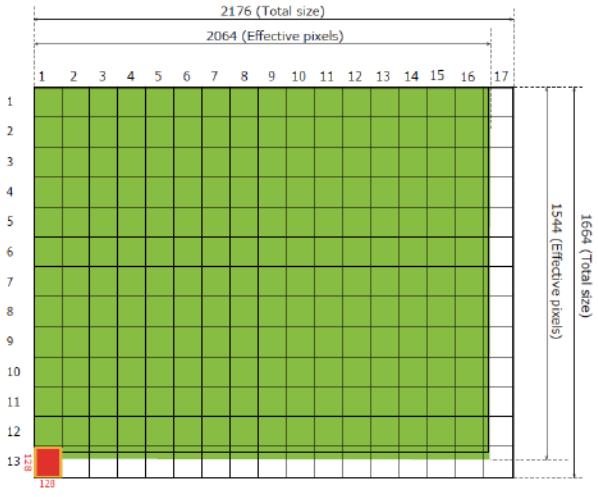
	AP-1600T-PMCL	AP-3200T-PMCL
Number of Correction Blocks	12 (H) × 9 (V) block	17 (H) × 13 (V) block
Block Size	128 × 128 pixels	
Total Size of Blocks	1536 (H) × 1152 (V)	2176 (H) × 1664 (V)
Effectrive Pixels	1456 (H) × 1088 (V)	2064 (H) × 1544 (V)

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

AP-1600T-PMCL



AP-3200T-PMCL



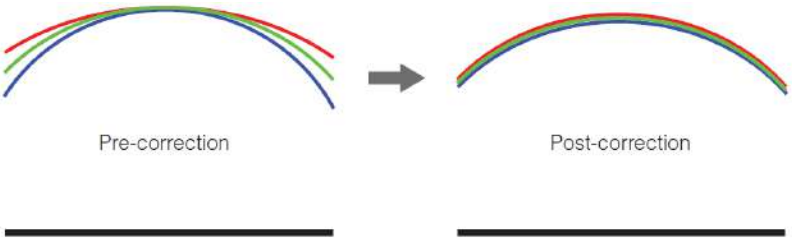
The following shading correction modes are available on the camera

Flat Shading

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.

Color Shading

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



Cautions:

- For FlatShading and ColorShading, the maximum amount of correction gain for all pixels is limited to twice the amount of gain before correction. (The amount of gain cannot be increased to more than twice the amount of gain from before correction.)
- If the area in the screen with the highest brightness level is 175 LSB or less (during 10-bit video output), proper correction is not possible.

To Use the Shading Correction Function

Configure the settings as follows.

Item	Setting Value	Description
Shading Correction Mode	FlatShading, ColorShading	Select the shading correction mode.
Shading Mode	User 1, User 2, User 3	Select the user area to which to save the shading correction value.

Display a white chart under a uniform light, and execute **Perform Shading Calibration**.

Note: After shading correction is executed, the shading correction value is automatically saved to the user area selected in Shading Mode.

Binning Function

> **Related Setting Items:** ImageFormatControl

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 a lower pixel resolution and higher sensitivity in summing mode (Sum) or reduced noise in averaging mode (Average).

	AP-1600T-PMCL	AP-3200T-PMCL
Binning Horizontal Mode (Sum / Average)	Fixed to "**Sum**" when BinningVertical and BinningHorizontal are both set to **2**".	Always operates in conjunction with BinningVerticalMode (subject to whichever you set later).
Binning Horizontal	When BinningVertical = 1 (Off): Digital Binning (on FPGA) When BinningVertical = 2 (On): Analog Binning (on Sensor) **Note:** Disabled when **SensorMultiRoiMode** is set to **On**, and **BinningVertical** is set to **2**.	Digital Binning (on FPGA)
Binning Vertical Mode (Sum / Average)	Fixed to "**Sum**"	Always operates in conjunction with BinningHorizontalMode (subject to whichever you set later).
Binning Vertical	Analog Binning (on Sensor) **Note:** Disabled when **SensorMultiRoiMode** is set to **On**, and **BinningHorizontal** is set to **2**.	Digital Binning (on FPGA)

When VideoProcessBypassMode is On

When Video Process Bypass Mode is set to **On**, the Binning function will be disabled for Digital Binning.

Binning Horizontal	Binning Vertical	AP-1600T-PMCL	AP-3200T-PMCL
1	2	Enabled	Disabled
2	1	Disabled	Disabled
2	2	Enabled	Disabled

ROI (Regional Scanning Function)

Related Setting Items: ImageFormatControl

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 "Configure 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.

Width/OffsetX (Pixels)

	Horizontal Binning = 1	Horizontal Binning = 2	A, B = WidthMax
Width(pixels)	96 ~ (A - OffsetX), step 16	48 ~ (B - Offset X), step 8	
OffsetX (pixels)	0 ~ (A - Width), step 16	0 ~ (B - Width), step 8	

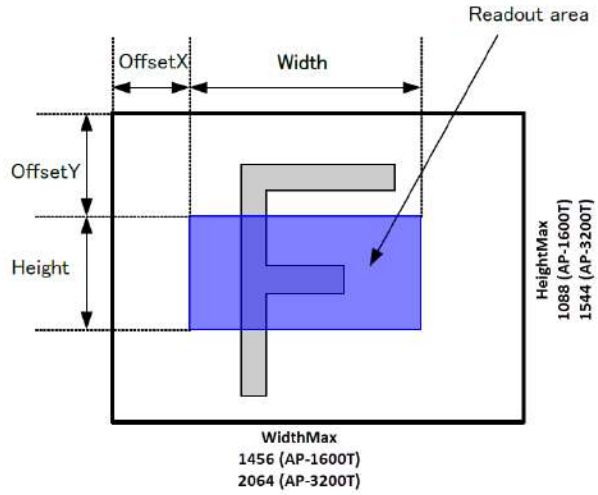
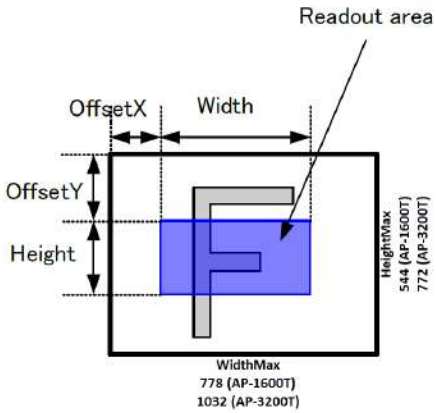
	A	B
AP-1600T	1456	728
AP-3200T	2064	1032

Height/OffsetY (Lines)

	Vertical Binning = 1	Vertical Binning = 2	C, D = HeightMax
Height (lines)	2 ~ (C - OffsetY), step 2	2 ~ (D - Offset Y), step 2	
OffsetY (lines)	0 ~ (C - Height), step 16	0 ~ (D - Height), step 2	

	C	D
AP-1600T	1088	544
AP-3200T	1544	772

Examples

Setting Example: 1	**Setting Example: 2**
Binning Horizontal = 1 Binning Vertical = 1	Binning Horizontal = 2 Binning Vertical = 2
	

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

Sensor Multi ROI Function

Related Setting Items: JAI CustomControlSensorMultiROI

In this mode, the Multi ROI function built into the image sensor is used. Up to 4 areas can be specified. In this mode, areas can not be overlapped.

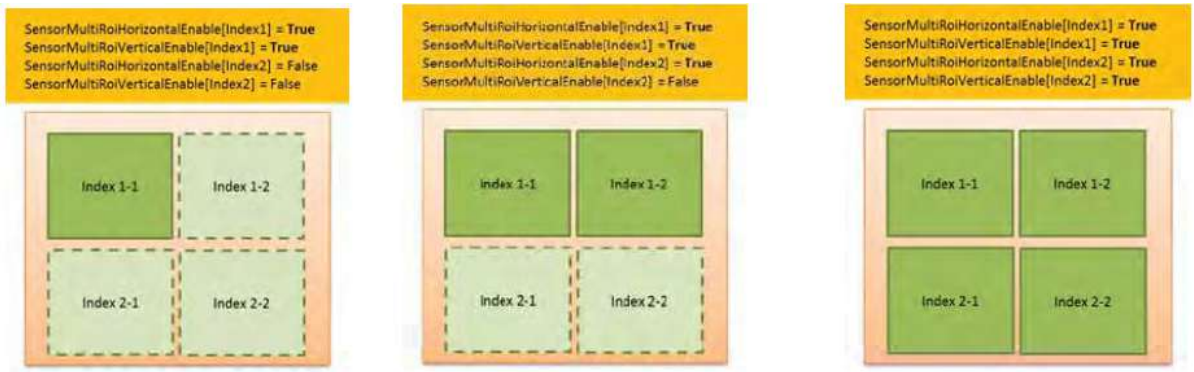
Notes:

- This function is only supported on AP-1600T-PMCL.
- Binning mode (BinningVertical = 2 and BinningHorizontal = 2) and SensorMultiROI mode can not be used at the same time.

  Binning mode and SensorMultiROI mode can be used at the same time, if BinningVertical = 1 or BinningHorizontal =1.
- Sequencer mode and SensorMultiROI mode can not be used at the same time.

The setting is JAI CustomControlSensorMultiROI. Specify width, height, horizontal / vertical offset value for each index.

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



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

Sequencer Function

> **Related Setting Items:** Sequencer Control

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:** The Sequencer function cannot be used together 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.

> **Note:** For more information on each setting item, see Sequencer Control.

Item	Trigger Sequenceer Mode	Command Sequenceer Mode
SequencerFrameNumber	✓	
SequencerSetNext	✓	
SequencerWidth	✓	✓
SequencerHeight	✓	✓
SequencerOffsetX	✓	✓
SequencerOffsetY	✓	✓
SequencerGainAnalogAll	✓	✓
SequencerGainAnalogRed	✓	✓
SequencerGainAnalogGreen	✓	✓
SequencerGainAnalogBlue	✓	✓
SequencerExposureTimeCommon	✓	✓
SequencerExposureTimeRed	✓	✓
SequencerExposureTimeGreen	✓	✓
SequencerExposureTimeBlue	✓	✓
SequencerBinningHorizontal	✓	✓
SequencerBinningVertical	✓	✓
SequencerLUTEnable	✓	✓
SequencerBlackLevelDigitalAll	✓	✓

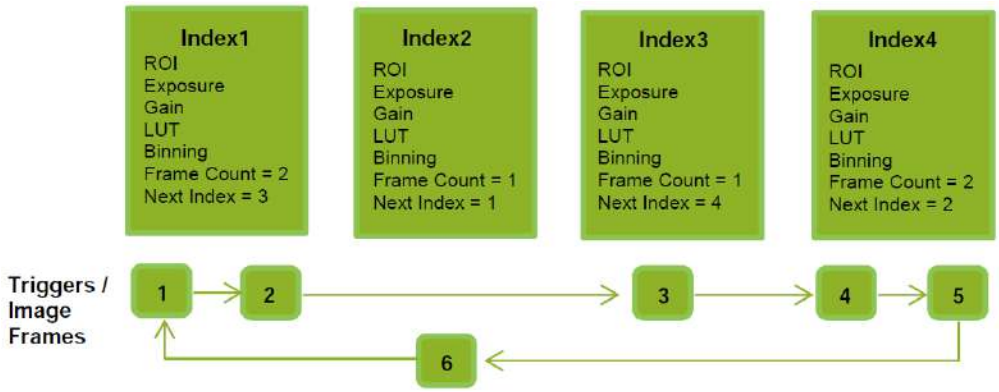
Trigger Sequencer mode

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

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

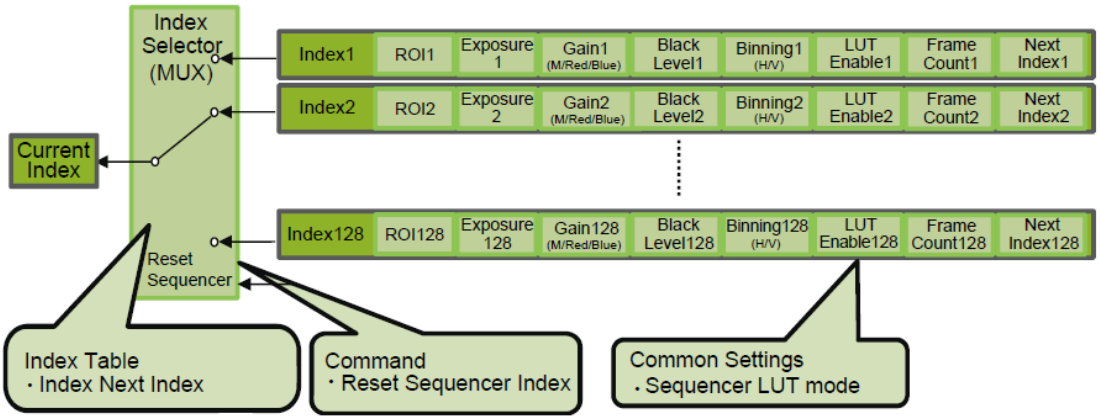
As with TriggerSequencer mode, you can define up to 128 indexes beforehand in this mode. Set SequencerCommandIndex to point to one of your pre-configured indexes. This index will be executed on each trigger, until it is changed to point to a different index, typically by your vision application. In this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

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.

Notes:

- 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.

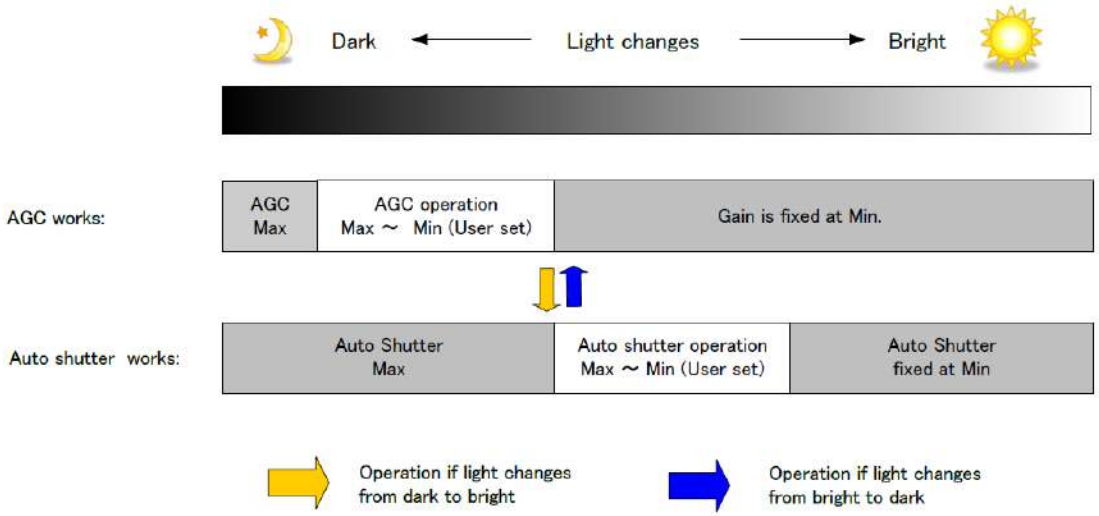


ALC (Automatic Level Control)

Related Setting Items: JAI CustomControlALC

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 **Gain Auto** or **Exposure Auto** or both to **Continuous** mode. Configure the minimum value, maximum value, etc. for AGC and ASC under JAI CustomControlALC. The target video levels for AGC and ASC are configured in **ALC Reference**. For example, when ALC Reference is set to 95%, video levels will be maintained at 95% for AGC and ASC.

ALCControlReference: Specify the channel to use as a reference for the ALC control.

- **SelectedChannel**: Specify the channel (Red, Green, or Blue) to use as a reference in ALCControlChannel.
- **PeakChannel**: Use the channel with the highest average image level as a reference.

ALCControlMode: Specify the ALC control speed.

- **Standard**: Control the speed in **ALCControlSpeed**. Set from 1 ~ 8 (fastest).
- **Ratio**: Control the speed in **ALCControlRatio**. Set from 1 ~ 100 %(fastest).

Note: If the ALCControlRatio setting is large, the ALC operation may cause hunting depending on the AcquisitionFrameRate setting. In this case, lower the value of AcquisitionFrameRate or ALCControlRatio.

Color Space Conversion (ColorTransformationControl)

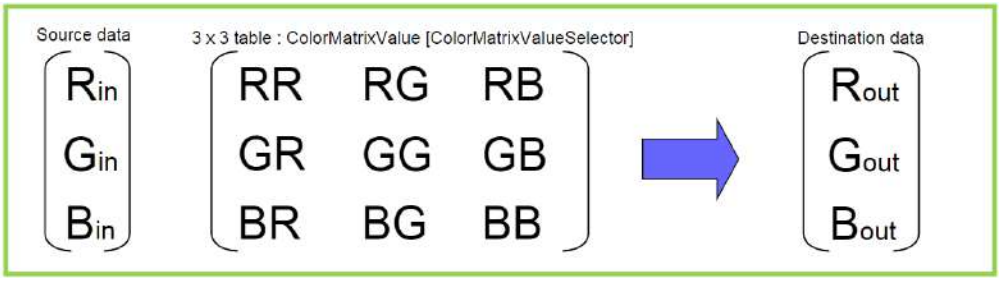
Related Setting Items: Color Transformation Control

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

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

Note on RGB (UserCustom)

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



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

Configuration 3x3 table

1. Select the item you want to configure in ColorMatrixValueSelector.
2. Configure the value in ColorMatrixValue.
3. ColorMatrixValue can be set to a value from -2 to +2.

See Color Transformation Control for detailed information on the setting items.

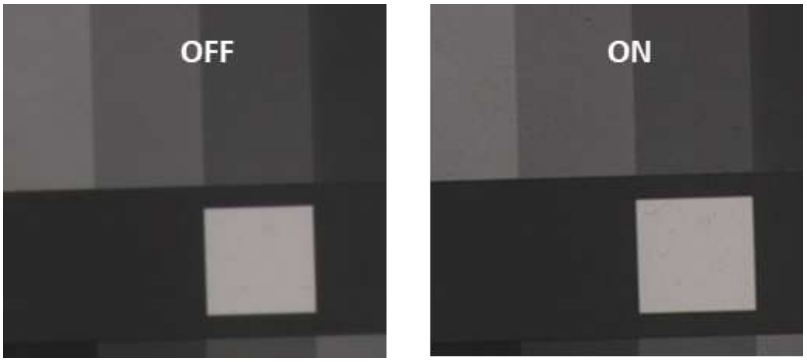
Edge Enhancer, Color Enhancer

> **Related Setting Items:** JAI CustomControlFeatureMisc

This camera is equipped with an Edge Enhancer function for enhancing the contrast of lines or edges within images and a Color Enhancer function for enhancing specified colors.

Edge Enhancer Function

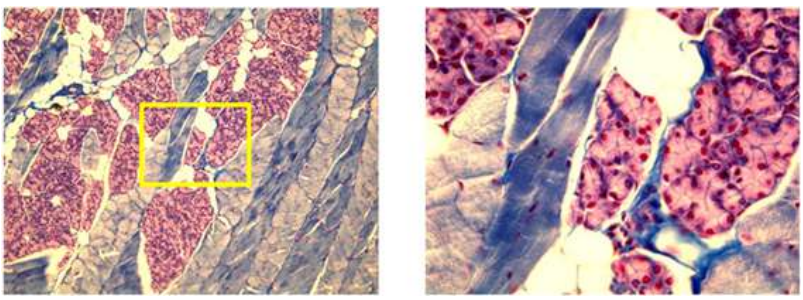
The Edge Enhancer function is enabled when EnhancerEnable[Edge] is set to **True**. Four enhancement levels are available: Low, Middle, High, and Strong.



Color Enhancer Function

The Color Enhancer function is enabled when EnhancerEnable[Color] is set to **True**. Set a value from 0 to 1.0 (0.1 steps) for ColorEnhancerValue to configure the enhancement level: 0 = no enhancement, 1.0 = approx. x2 the color level of the original data.

Six colors can be specified in ColorEnhancerSelector: Red, Cyan, Green, Magenta, Blue, and Yellow.



Counter and Timer Control

Related Setting Items: Counter and Timer Control

Note: This camera supports the Counter function only.

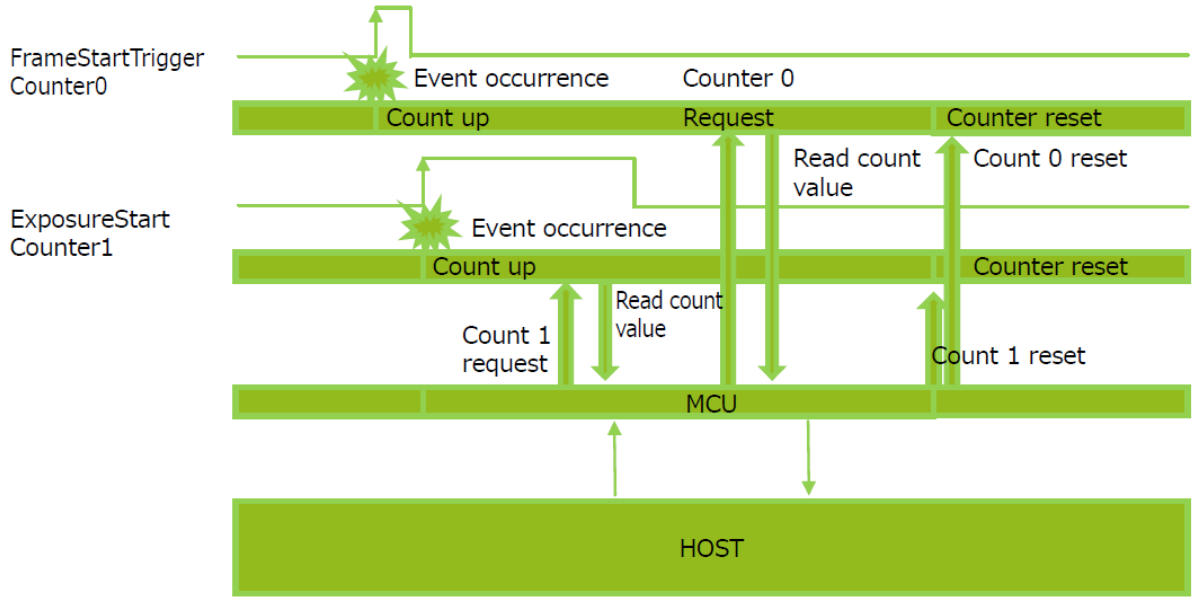
The counter function counts up change points in the camera's internal signals using the camera's internal counter, and reads that information from the host side. This function is useful for verifying error conditions via the count value using internal camera operations.

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.

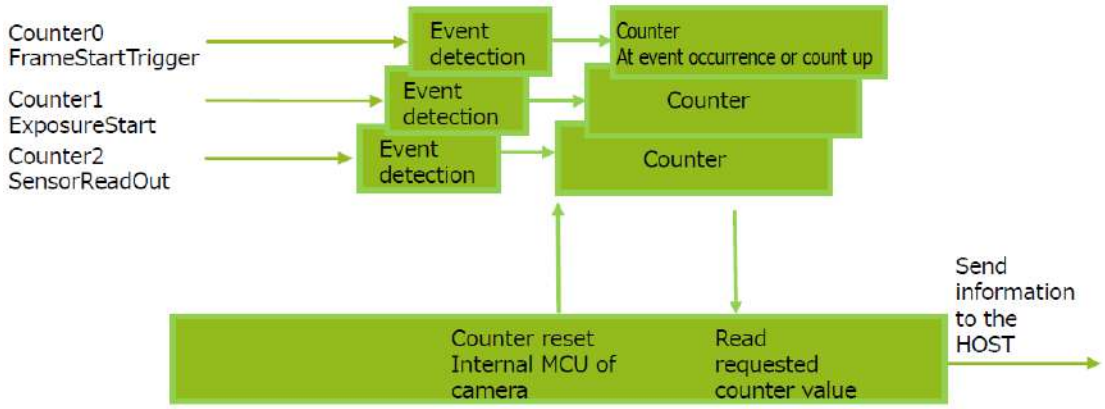
When a problem occurs in a system that includes this camera, comparing the values from multiple counters allows you to verify the extent of normal operability and can be useful when investigating the cause of the problem.

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. Specify a counter (Counter0 ~ 2), and configure the settings.

Item	Setting Value / Selectable Range	Description
Counter 0 ~ 2	Counter 0 ~ 2	Select the counter.
- CounterEventSource	Counter0: Off, FrameTrigger 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.

Non-Volatile Flash Memory

Technical Notes Storing Data in On-Camera 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.

Video Process Bypass Mode

Related Setting Items: JAI CustomControlFeatureMisc

The video process bypass mode is a function that bypasses internal video processing on the camera. When bypass is enabled, the sensor output and camera output data can be set to the same bit width. Operation using 12-bit outputs must be performed in bypass mode.

Video Process Bypass Mode	ON	OFF
Camera Operation	The following functions will be disabled, regardless of their configurations. Gain[DigitalRed], Gain[DigitalBlue], BlackLevel, LUT, Shading, Binning (H,V)* (AP-3200T-PMCL), Enhancement, ColorMatrix **Note:** The Binning function on AP-1600T-PMCL is enabled or disabled depending on the Binning settings. For more information, see Binning Function.	All video processes are enabled.
Camera Output	Base(RGB8)/Medium(RGB8, RGB10) /Full(RGB8)/EightyBit(RGB8)	Medium (RGB12)

Functions available in VideoProcessBypassMode

The following functions can be used in video process bypass mode.

Gain[AnalogAll], Gain[AnalogRed], Gain[AnalogGreen], Gain[AnalogBlue], AutoGainControl, AutoShutterControl, AutoWhiteBalance, SequencerMode, BlemishCompensation

To Enable Video Process Bypass Mode

Item	Setting Value / Selectable Range	Description
Video Process Bypass Mode	On	Enables Video Process Bypass Mode.

Note: In VideoProcessBypassMode, saturated level of brightness decreases.

Setting List (Feature Properties)

DeviceControl

Display/configure information related to the device.

DeviceControl Item	Setting Range	Default	Description
Device Vendor Name	-	“JAI Corporation”	Display the manufacturer name.
Device Model Name	-	AP-1600T-PMCL AP-3200T-PMCL	Display the model name.
Device Manufacturer Info	-	See the possibilities	Display manufacturer information.
Device Version	-	-	Display the software version.
Device Firmware Version	-	-	Display the firmware version.
DeviceSerialNumber	-	-	
Device User ID	Any	-	Set the user ID for the camera.
Device Temperature Selector	Mainboard	Mainboard	Select the area of the camera's interior for which to display the temperature sensor's reading.
Device Temperature (C)	-	-	Display the internal temperature (˚C) of the camera.
DeviceSerialPortSelector	CameraLink	CameraLink	Fixed to CameraLink.
DeviceSerialPort BaudRate	Baud9600, Baud19200, Baud38400, Baud57600, Baud115200, Baud230400, Baud460800, Baud921600	Baud9600	Displays the baud rate of the serial port.
Device Reset	-	-	Reset the device.

ImageFormatControl

Configure image format settings.

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

Image Format Control Item	Setting Range	Default	Description
Sensor Width	AP-1600T-PMCL: 1456 AP-3200T-PMCL: 2064		Display the maximum image width.
Sensor Height	AP-1600T-PMCL: 1088 AP-3200T-PMCL: 1544		Display the maximum image height.
SensorDigitizationBits	12 Bit	12 Bit	Display the number of bits at which the sensor is operating.
Width Max	AP-1600T-PMCL: 1456 AP-3200T-PMCL: 2064		Display the maximum image width.
Height Max	AP-1600T-PMCL: 1088 AP-3200T-PMCL: 1544		Display the maximum image height.
Width **Related Topic:** ROI (Regional Scanning Function)	AP-1600T-PMCL: 96(48)* ~ 1456(728)*, Default: 1456 AP-3200T-PMCL: 96(48)*~ 2064 (1032)*, Default: 2064 *The parenthesis value applies when BinningHorizontal is set to 2.		Set the image width.
Height	AP-1600T-PMCL: 2 ~ 1088(544)*, Default: 1088 AP-3200T-PMCL: 2 ~ 1544 (772)*, Default: 1544 *The parenthesis value applies when BinningVertical is set to 2.		Set the image height.
Offset X	AP-1600T-PMCL: 0 ~ 1440(720)*, step 16(8)* AP-3200T-PMCL: 0 ~ 2048(1024)*, step 16(8)* *The parenthesis value applies when BinningHorizontal is set to 2.	0	Set the horizontal offset.

Image Format Control Item	Setting Range	Default	Description
Offset Y	AP-1600T-PMCL: 0 ~ 1086(542)*, step 2 AP-3200T-PMCL: 0 ~ 1542 (770)*, step 2 *The parenthesis value applies when BinningVertical is set to 2.	0	Set the vertical offset.
BinningHorizontalMode **Related Topic:** Binning Function	Sum Average	Sum	Set the processing method for horizontal binning.
Binning Horizontal	1: Off 2: x2	1: Off	Set the number of pixels in the horizontal direction for which to perform binning.
BinningVerticalMode	Sum* Average *AP-1600T-PMCL: FIxed to **Sum**.	Sum	Set the processing method for vertical binning.
Binning Vertical	1: Off 2: x2	1: Off	Set the number of pixels in theoertical direction for which to perform binning.
Pixel Format	RGB8 RGB10 RGB12	RGB8	Set the pixel format. RGB12 is available when Video Process Bypass Mode is set to On.
Test Pattern	Off GreyHorizontalRamp GreyVerticalRamp GreyHorizontalRamp Moving HorizontalColorBar VerticalColorBar MovingColorBar	0: Off	Select the test image.

AcquisitionControl

Related Topic: Image Acquisition Controls (Acquisition Control)

Configure image capture settings.

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

Acquisition Control Item	Setting Range	Default	Description
Acquisition Frame Rate (Hz) **Related Topic:** Frame Rate Reference	0.125 ~	-	Set the frame rate as a frequency. (unit: Hz) The maximum value varies depending on the TapGeometory and ROI settings.
Trigger Selector **Related Topic:** Trigger Control	Frame Start	Frame Start	Select the trigger operation.
Trigger Mode	Off, On	Off	Enables/Disables the Trigger mode.
Trigger Software	-	-	Execute a software trigger.
Trigger Source	Low High Software Pulse Generator 0 ~ 3 User Output 0 ~ 3 Line5 - OptIn1 Line6-OptIn2 Line7 - CC1 NAND0 Out NAND1 Out	Line5 - OptIn1	Select the trigger signal source.
Trigger Activation	Rising Edge Falling Edge	Rising Edge	Select the polarity of the trigger signal (i.e., location of signal at which trigger is applied).
Trigger Overlap	Off Readout	Readout	Select the trigger overlap operation.
TriggerDelay (μs)	0 ~ 500000	0	Set the time of exposure start from trigger input.
ExposureModeOption	Off RCT	Off	Set whether to enable RCT mode.

Acquisition Control Item	Setting Range	Default	Description
Exposure Mode **Related Topic:** Exposure Mode	Off Timed Trigger Width	Timed(control via exposure time)	Select the exposure mode.
ExposureTimeMode	Common Individual	Common	When set to Individual, ExposureTime can be adjusted for RGB individually.
ExposureTimeSelector	Common Red Green Blue	Common	
Exposure Time (us)	-	-	Set the exposure time. The specifiable range varies depending on the [StartTriggerMode] and [PixelFormat] setting.
Exposure Auto	Off Continuous Once	Off	Set whether to enable auto exposure.

AnalogControl

Related Topic: Gain Control, Gamma Function

Configure analog control settings.

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

Analog Control Item	Setting Range	Default	Description
IndividualGainMode	Off On	Off	In IndividualGainMode, RGB can be configured individually for the entire gain adjustment range of the sensor.
Gain Selector	- DigitalRed - DigitalBlue IndividualGainMode= ON - AnalogRed - AnalogGreen - AnalogBlue IndividualGainMode= OFF - AnalogAll - AnalogRed - AnalogBlue	Analog All	Select the gain to configure.
Gain	-	x1	Set the gain value for the gain item selected with the GainSelector setting.
Gain Auto	Off Continuous Once	Off	Enable/disable gain auto adjustment. Once automatically changes to Off when the signal level converges once.
Balance White Auto	Off Continuous Once ExposureContinuous ExposureOnce Preset 3200K Preset 5000K Preset 6500K Preset7500K	Off	Enable/disable auto white balance. WB adjustment via gain adjustment: Continuous, Once WB adjustment via exposure time: ExposureContinuous, ExposureOnce
Black Level Selector	Digital All Digital Red Digital Blue	Digital All	Select the black level to configure.
Black Level	DigitalAll:-133 ~ 255 DigitalRed:-64 ~ 64 DigitalBlue:-64 ~ 64	0	Set the black level value.
Gamma Selector	0.45, 0.5, 0.55, 0.6, 0.65, 0.75, 0.8, 0.9, 1.0	0.45	Set the gamma value.

Analog Control Item	Setting Range	Default	Description
LUT Mode	Off Gamma LUT	Off	Select the JAI LUT mode.

LUT Control

> **Related Topic:** LUT (Lookup Table)

Configure LUT settings.

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

LUT Control Item	Setting Range	Default	Description
LUT Selector	Red Green Blue	Red	Select the LUT channel to control.
LUT Index	0 ~ 256	0	Set the LUT index table number.
LUT Value	0 ~ 4095	0	Set the LUT index table number.

Color Transformation Control

Related Topic: Color Space Conversion (ColorTransformationControl)

Configure LUT settings.

Color Transformation Control Item	Setting Range	Default	Description
ColorTransformationMode	RGB XYZ HSI	RGB	Set the output image format.
ColorTransformation RGBMode	Off sRGB AdobeRGB UserCustom	Off	Set the detailed mode when RGB is selected for the color space.
ColorMatrixSelector	ColorMatrixR-R ColorMatrixR-G ColorMatrixR-B ColorMatrixG-R ColorMatrixG-G ColorMatrixG-B ColorMatrixB-R ColorMatrixB-G ColorMatrixB-B	-	Select the ColorMatrix setting component.
ColorMatrixValue	-2.0 ~ 2.0		Set the Color Matrix value.

DigitalIOControl

> **Related Topic:** GPIO (Digital Input/Output Settings)

Configure settings for digital input/output.

Digital IO Control Item	Setting Range	Default	Description
Line Selector	Line1-TTLOut1 Line2-OptOut1 Line5-OptIn1 Line6-OptIn2 Line7-CC1 NAND0In1 N AND0In2 NAND1In1 NAND1In2	Line2-OptOut1	Select the input/ output to configure.
Line Mode	Input Output	Output	Display the input/ output status (whether it is input or output).
Line Inverter	True False	False	Enable/disable polarity inversion for the selected input signal or output signal.
Line Status **Related Topic:** Line Status	True False	False	Display the status of the input signal or output signal (True: High, False: Low).
LineSource	Low High Frame Trigger Wait Frame Active Exposure Active FVAL LVAL Pulse Generator 0 ~ 3 User Output 0 ~ 3 Line5-OptoIn1 Line6-OptoIn2 Line7 - CC1 Nand 0 Out Nand 1 Out	Low	Select the line source signal for the item selected in Line Selector.
Line Format	NoConnect TTL OptoCoupled InternalSignal	-	Display the current I/F type.
LineStatusAll	-	-	Display the input/output signal status.

Digital IO Control Item	Setting Range	Default	Description
OptoInFilterSelector	Off 10μs 100μs 500μs 1ms 5ms 10ms	Off	Remove noise from the OptIn input signal of Digital I/O.
User Output Selector	User Output 0 User Output 1 User Output 2 User Output 3	0: User Output 0	Set the user output signal.
User Output Value	True False	False	Set the User Output value selected in User Output Selector.

Counter and Timer Control

> **Related Topic:** Counter and Timer Control

Configure counter settings. (This camera only supports counter functions.)

Counter and Timer Control Item	Setting Range	Default	Description
CounterSelector	Counter0 ~ 2	Counter0	Select the counter.
CounterEventSource	Counter0: Off, FrameTrigger Counter1 : Off, ExposureStart Counter2 : Off, SensorReadOut	Off	Select the counter event signal for which to read the count value.
Counter Event Activation	RisingEdge FallingEdge	-	Display the timing at which to count.
CounterReset	-	-	Reset the counter.
CounterRefresh	-	-	Update the count value.
Counter Value	-	-	Display the count value.
CounterStatus	CounterIdle CounterActive CounterOverflow	CounterIdle	Display the counter status. CounterIdle: Idle CounterActive: Counting CounterOverflow: Count value exceeded the maximum value

UserSetControl

Related Topic: Step 6: Save the Settings

Load factory default settings or save/load user settings for camera settings.

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

User Set Control Item	Setting Range	Default	Description
User Set Selector	Default User Set1 ~ 3	0: Default (factory default values)	Select the user settings.
User Set Load	-	-	Load user settings.
User Set Save	-	-	Save the current setting values as user settings.

Sequencer Control

Related Topic: Sequencer Function

Configure sequencer settings.

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

Sequencer Control Item	Setting Range	Default	Description
SequencerMode	On Off	Off	Enable/disable [SequencerMode].
SequencerModeSelect	Trigger Sequencermode Command Sequencermode	Trigger Sequencermode	Select the sequencer mode.
SequencerConfiguration Mode	On Off	On	Select **On** to change the settings within the index.
SequencerSetSelector	1 ~ 128	1	Select the TriggerSequencer mode and CommandSequencer mode index.
SequencerFrameNumber	1 ~ 255	1	Set the number of frames to display for the selected SequencerIndex. (Enabled only for TriggerSequencer.)
SequencerSetNext	1 ~ 128	1	) Set the next index to be displayed for the selected SequencerIndex. (Enabled only for TriggerSequencer.)

Sequencer Control Item	Setting Range	Default	Description
SequencerWidth	**AP-1600T-PMCL** 96 (48) ~ 1456 (728) step 16 (8) Default: 1456 **AP-3200T-PMCL** 96 (48) ~ 2064 (1032) step 16 (8) Default: 2064 The parenthesis value applies when BinningHorizontal is set to 2.		Set the width of the selected SequencerIndex.
SequencerHeight	**AP-1600T-PMCL** 2 ~ 1088 (544), step 2 Default: 1088 **AP-3200T-PMCL** 2 ~ 1544 (772), step 2 Default: 1544 The parenthesis value applies when BinningVertical is set to 2.		Set the height of the selected SequencerIndex.
SequencerOffsetX	**AP-1600T-PMCL** 0 ~ 1440 (720), step 16 (8) Default: 0 **AP-3200T-PMCL** 2 ~ 2048 (1024), step 16 (8) Default: 0 The parenthesis value applies when BinningHorizontal is set to 2.		Set the horizontal offset.
SequencerOffsetY	**AP-1600T-PMCL** 0 ~ 1086 (542), step 2 Default: 0 **AP-3200T-PMCL** 2 ~ 1542 (770), step 2 Default: 0 The parenthesis value applies when BinningVertical is set to 2.		Set the vertical offset.
SequencerGain AnalogAll	1.0 ~ 8.0	1.0	Set the GainAnalogAll value.
SequencerGain AnalogRed	0.47 ~ 4.0 / 1.0 ~ 64.0	1.0	Set the GainAnalogRedl value.
SequencerGain AnalogGreen	1.0 Fixed / 1.0 ~ 64.0	1.0	Set the GainAnalogGreenl value.
SequencerGain AnalogBlue	0.47 ~ 4.0 / 1.0 ~ 64.0	1.0	Set the GainAnalogBlue value.
SequencerExposure TimeCommon(us)			Set the exposure time for the selected SequencerIndex.

Sequencer Control Item	Setting Range	Default	Description
SequencerExposure TimeRed(us)			
SequencerExposure TimeGreen(us)			
SequencerExposure TimeBlue(us)			
SequencerLutEnable	True False		
SequencerBlackLevel DigitalAll	- 133 ~ 255	0	Set the black level value for the selected SequencerIndex.
SequencerBinning Horizontal	1: Off 2: x2	1	For the selected SequencerIndex, set the number of pixels in the horizontal direction for which to perform binning.
SequencerBinning Vertical	1: Off 2: x2	1	For the selected SequencerIndex, set the number of pixels in the vertical direction for which to perform binning.
SequencerLutMode	Gamma LUT	Gamma	Set the sequence LUT mode.
SequencerSetActive	-	-	Displays the active LUT number.
SequencerCommand Index	-	1	Set this to change the SequencerIndex. (Enabled only for CommandSequencer.)
SequencerSetStart	-	1	◦ Specify the first index number to switch to when starting [TriggerSequencerMode].
SequencerReset	-	-	In TriggerSequencerMode, reset the current index number to the number configured in SequencerSetStart.

Transport Layer Control

Related Topic: Camera Output Formats

Configure Camera Link Transport Layer settings.

Transport Layer Control Item	Setting Range	Default	Description
ClConfiguration	Base Medium Full EightyBit	Medium	
Camera Link Clock Frequency	37.1MHz 74.3MHz 84.9MHz	74.3MHz	Set the Camera Link clock.

JAI Custom Control PulseGenerators

Configure pulse generator settings.

Pulse Generators Item	Setting Range	Default	Description
Clock Pre-scaler	1~ 4096	165	Set the division value for the prescaler (12-bit) using the pixel clock as the base clock.
Pulse Generator Clock (MHz)	0.018127 ~ 74.25	-	Set the clock used for the pulse generator. This value is calculated based on the Clock Pre-Scaler value.
Pulse Generator Selector	Pulse Generator 0 ~ 3	Pulse Generator 0	Select the pulse generator.
Pulse GeneratorLength	1 ~ 1048575	30000	Set the maximum count up value using clock value.
Pulse Generator LengthMs (ms)	1 / PulseGeratorClock(MHz) ~ 1048575 / PulseGeneratorClock (MHz)	66.6667	Set the maximum count up value using ms. This value is calculated based on the Pulse Generator Length value. The setting range varies depending on the Clock Pre-Scaler value.
Pulse Generator Frequency (Hz)	((PulseGeneratorClock (MHz)) ÷ 1048575) x 1000000 ~ (PulseGeneratorClock (MHz) x 1000000)	15	Set the maximum count up value using frequency. This value is calculated based on the Pulse Generator Length value.
Pulse Generator Start Point	0 ~ 1048574	0	Set the start point for the High interval using clock value. When the counter reaches this value, the output becomes 1.
Pulse Generator Start PointMs (ms)	0 ~ (1048575 / PulseGeneratorClock (MHz))	0	Set the start point for the High interval using ms. When the counter reaches this value, the output becomes 1. The setting range varies depending on the Clock Pre-Scaler value.
Pulse Generator End Point	1 ~ 1048575	15000	Set the start point for the Low interval using clock value. When the counter reaches this value, the output becomes 0.
Pulse Generator End PointMS (ms)	(1 / PulseGeneratorClock (MHz)) ~ (1048575 / PulseGeneratorClock (MHz))	33.3333	Set the start point for the Low interval using ms. When the counter reaches this value, the output becomes 0. The setting range varies depending on the Clock Pre-Scaler value.
Pulse Generator pulse- width (ms)	-	33.3333	Display High interval width for the pulse in ms. This is a calculation of the time between the Start Point and End Point. The setting range varies depending on the Clock Pre-Scaler value.
Pulse Generator Repeat Count	0 ~ 255	0	Set the repeat count for the counter. When this is set to 0, the counter will be free-running with limitless repeating.

Pulse Generators Item	Setting Range	Default	Description
Pulse Generator Clear Activation	Off LevelHigh LevelLow Rising Edge Falling Edge	0: Off	Set the clear signal condition for the count clear input of the pulse generator.
Pulse Generator Clear Source	Low High AcquisitionTriggerWait AcquisitionActive FrameTriggerWait FrameActive ExposureActive FVAL LVAL PulseGenerator0 ~ 3 UserOutput 0 ~ 3 Line5-Opt In 1 Line6-OptoIn2 Nand0Out Nand1Out	0: Low	Select the count clear input signal source.
Pulse Generator Clear Inverter	True False	0: False	Select whether to invert the polarity of the count clear input signal.
Pulse Generator Clear Sync Mode	Async Mode Sync Mode	Async Mode	Select the sync mode for the count clear input signal.

JAI CustomControlALC

Related Topic: ALC (Automatic Level Control)

Configure JAI ALC settings. These settings are also used for AGC (auto gain control).

ALC Control Item	Setting Range	Default	Description
ALCControlReference	PeakChannel SelectedChannel	Selected Channel	PeakChannel: Use the channel with the highest average image level as a reference. SelectedChannel: Specify the channel (Red, Green, or Blue) to use as a reference in ALCControlChannel.
ALCControlChannel	Red Green Blue	Green	Select the channel to use as a reference. When ALCControlReference is se to PeakChannel, this setting is disabled.
ALCReference	30 ~ 95	50	Set the target level for ALC. (unit: %)
ALCAreaSelector	LowRight LowMid-Right LowMid-Left LowLeft Mid-LowRight Mid-LowMid-Right Mid-LowMid-Left Mid-LowLeft Mid-HighRight Mid-HighMid-Right Mid-HighMid-Left Mid-HighLeft HighRight HighMid-Right HighMid-Left HighLeft	LowRight	Select the area for which to configure ALCAreaEnable.
ALCAreaEnable	True False	False	Enable/disable the photometry area selected in ALCAreaSelector.
ALCAreaEnableAll	True False	True	On: Operate ALC with all areas designated as photometry areas, regardless of the individual enabled/disabled photometry area states configured in [ALCAreaSelector]. Off: Operate ALC according to the individual enabled/disabled photometry area states configured in [ALCAreaSelector].
AutoShutterControl ExposureMin	100 ~ 13426	100	Set the minimum value for the ExposureAuto(ASC) control range.
AutoShutterControl ExposueMax	101 ~ 13427	-	Set the maximum value for the ExposureAuto(ASC) control range.

ALC Control Item	Setting Range	Default	Description
AutoGainControlGainRawMin	100 ~ (AutoGainControlGainRawMax - 1)	100	Set the minimum value for the GainAuto(ASC) control range.
AutoGainControlGainRawMax	(AutoGainControlGainRawMin + 1) ~ 800	400 or 800	Set the maximum value for the GainAuto(ASC) control range. The default value depends on the Gain setting.
ALCControlMode	Standard Ratio	Standard	Specify the ALC control speed. Standard: Control the speed in ALCControlSpeed. Set from 1 ~ 8 (fastest). Ratio: Control the speed in ALCControlRatio. Set from 1 ~ 100 %(fastest).
ALCControlSpeed	1 (slow) ~ 8 (fast)	4	Set the response speed for AGC/ ASC. (8 is the fastest.) (When ALCControlMode is set to Standard.)
ALCControlRatio	1 ~ 100 (%)	90	Set the response speed for AGC/ ASC. (100 is the fastest.) (When ALCControlMode is set to Ratio.)
ALCStatus	Off ASC AGC	-	Allows confirmation of the current operation area during ALC operation.
AutoControlStatus	Executing ASC Executing AGC Executing ASC and AGC Executing AWB Executing ASC and AWB Executing AGC and AWB Executing ASC and AGC and AWB Convergen Idle	-	Allows confirmation of the AGC, ASC, and AWB convergence status.

JAI CustomControlAWB

Related Topic: ALC (Automatic Level Control)

Configure AWB settings.

AWB Control Item	Setting Range	Default	Description
AWBAreaSelector	LowRight LowMid-Right LowMid-Left LowLeft Mid-LowRight Mid-LowMid-Right Mid-LowMid-Left Mid-LowLeft Mid-HighRight Mid-HighMid-Right Mid-HighMid-Left Mid-HighLeft HighRight HighMid-Right HighMid-Left HighLeft	LowRight	Select the area for which to configure AWBAreaEnable.
AWBAreaEnable	True False	False	Enable/disable the photometry area selected in AWBAreaSelector.
AWBAreaEnableAll	True False	False	True: Operate AWB with all areas designated as photometry areas, regardless of the individual enabled/disabled photometry area states configured in [AWBAreaSelector]. False: Operate AWB according to the individual enabled/disabled photometry area states configured in [AWBAreaSelector].
AWBControlSpeed	1 (slow) ~ 8 (fast)	4	Set the AWB control speed. (8 is the fastest.)
AWBControlStatus	Complete TooBright TooDark Timeout Executing TriggerError Convergent ConditionError Idle	Idle	

JAI CustomControlBlemish

> **Related Topic:** BlemishCompensation

Configure settings for JAI white blemish correction.

Blemish Control Item	Setting Range	Default	Description
BlemishEnable	False True	True	Enable/disable blemish correction.
BlemishDetect	-	-	Execute blemish detection.
BlemishStore	-	-	Save the location information of detected blemishes.
BlemishSelector	Red Green Blue	-	Specify the sensor for which to configure Blemish.
BlemishDetect Threshold	0 ~ 100	10	Set the blemish detection threshold.
BlemishCompensation Index	1 ~ 200	-	Select the index for the target blemish coordinates (BlemishDataPosition X/Y).
BlemishCompensation PositionX	AP-1600T-PMCL: -1 ~ 1455 AP-3200T-PMCL: -1 ~ 2063	-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	AP-1600T-PMCL: -1 ~ 1087 AP-3200T-PMCL: -1 ~ 1543	-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.
BlemishCompensation Number	-	-	Display the number of target blemishes.

JAI CustomControlShading

> **Related Topic:** Shading Correction

Configure settings for other JAI functions.

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

Shading Control Item	Setting Range	Default	Description
ShadingCorrectionMode	FlatShading ColorShading	FlatShading	Select the shading correction method.
ShadingMode	Off User1 ~ 3	Off	Set the area to which to save shading correction data. When this is set to [Off], shading correction data is not saved.
PerformShading Calibration	-	-	Execute shading correction.
ShadingDetectResult	-	-	Display the shading correction results.

JAI CustomControlSensorMultiROI

Related Topic: Sensor Multi ROI Function

Configure settings for sensor Multi ROI.

Notes:

- This function is only supported on AP-1600T-PMCL.
- ☐ Settings that can only be configured when image acquisition on the camera is stopped.

SensorMultiROI Control Item	Setting Range	Default	Description
SensorMultiRoiMode	Off On	Off	Enable/disable sensor Multi Roi. *)This function can be enabled only when SequecerMode is Off and MultiRoiMode is Off.
SensorMultiRoiIndex	Index1 Index2	Index1	Select the index for the sensor Multi Roi mode.
SensorMultiRoiWidth	96 ~ 1456	-	Set the width for the selected sensor Multi Roi index.
SensorMultiRoiHeight	2 ~ 1088	-	Set the height for the selected sensor Multi Roi index.
SensorMultiRoiOffsetX	0 ~ 1440 The index 2 depends on the setting value of index 1.	-	Set the horizontal offset for the selected sensor Multi Roi index.
SensorMultiRoiOffsetY	0 ~ 1086 The index 2 depends on the setting value of index 1.	0	Set the vertical offset for the selected sensor Multi Roi index.
SensorMultiROI HorizontalEnable	False True	-	Enable / disable each SensorMultiRoiIndex.
SensorMultiROI VerticalEnable	False True	-	Enable / disable each SensorMultiRoiIndex.

JAI CustomControlFeatureMisc

Configure settings for other JAI functions.

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

Misc. Control Item	Setting Range	Default	Description
VideoProcessBypassMode **Related Topic:** Video Process Bypass Mode	On Off	Off	Enable/disable VideoProcessBypass mode.
EnhancerSelector **Related Topic:** Edge Enhancer, Color Enhancer	Edge Color	-	Specify the operation mode for Enhancer.
EnhancerEnable	True False	-	Enable/disable EdgeEnhancer and ColorEnhancer.
ColorEnhancerSelector	Red Cyan Green Magenta Blue Yellow	-	Index for advanced ColorEnhancer settings.
ColorEnhancerValue	0 ~ 1.0	0	Specify the ColorEnhancer emphasis levels for each color component.
EdgeEnhancerLevel	Low Middle High Strong	Middle	Set the Level for EdgeEnhancer.
VideoSendMode	NormalMode TriggerSequencerMode CommandSequencerMode SensorMultiMode	NormalMode	Set the VideoSendMode.

Short ASCII Command List

All configuration of the camera is done via the RS-232C port. The camera can be set up from a PC running terminal emulator software.

Below is the description of the ASCII based short command protocol.

Communication Setting

Baud Rate	9600 (Startup)
Data Length	8bit
Start Bit	1bit
Stop Bit	1 bit
Parity	None
Xon/Xoff Control	None

Protocol (Short ASCII Command)

Transmit the Setting Command to Camera

NN is any kind of the command.

NN=[Param.]<CR><LF>

Send to camera: GA=0 <CR><LF>

Camera response: COMPLETE<CR><LF>

When camera receives a valid command, camera will return 'COMPLETE'. If camera receives an invalid command, camera will return following:

Send to camera: GAX=0 <CR><LF>

Camera response: 01 Unknown Command!!<CR><LF>

Send to camera: GA=10000 <CR><LF>

Camera response: 02 Bad Parameters!!<CR><LF>

Transmit the Request Command to Camera

The status of camera's settings can be queried by transmitting NN?<CR><LF>, where NN is any valid command.

The camera will return the current setting data.

Send to camera: GA? <CR><LF>

Camera response: GA=0<CR><LF>

Switching baud rate between PC and camera

Camera always starts up with 9600bps. This can be switched to higher baud rates after a communication has been established. When switching to other baud rate the procedure is as follows.

e.g. Change baud rate to 115200bps

1. Confirm baud rates camera supported
   Send to camera: SBDRT? <CR><LF>
   Camera response: SBDRT=31(0x1F)<CR><LF>
2. Request new baud rate 115200bps
   Send to camera: CBDRT=16(0x10) <CR><LF>
   Camera response: COMPLETE<CR><LF>
3. Rewrite new baud rate again with new baud rate (Confirmation command)
   Send to camera: CBDRT=16(0x10) <CR><LF>
   Camera response: COMPLETE<CR><LF>

In case the camera does not receive the confirming command with new baud rate within 250ms after sending the acknowledge it falls back to the original baud rate (9600bps).

GenCP Bootstrap Register

> **Note:** For more information on each setting, see DeviceControl (Setting List).

Name	Access	Short ASCII	Values	Default	Description
DeviceVendorName	R/O	DVN	"JAI Corporation"	-	DVN?<CR><LF>
DeviceModelName	R/O	MD	AP-1600T-PMCL AP-3200T-PMCL	-	MD?<CR><LF>
DeviceVersion	R/O	DV	Indicate device version (e.g. “0.1.0.0”)	-	DV?<CR><LF>
DeviceSerial Number	R/O	ID	Serial Number	-	ID?<CR><LF>
DeviceUserID	R/W	UD	User can save and load free text. (64 or less characters)	-	UD=[Param.]<CR><LF > UD?<CR><LF>

Technology Specific Bootstrap Register

Name	Access	Short ASCII	Values	MIN	MAX	Default	Description
DeviceSerialPort SupportedBaudRate	R/O	SBDRT	READ: Indicate supported Baudrate. 1(0x01):BaudRateMax_9600 3(0x03):BaudRateMax_19200 7(0x07):BaudRateMax_38400 15(0x0F):BaudRateMax_ 57600 31(0x1F):BaudRateMax_ 115200 63(0x3F):BaudRateMax_ 230400 127(0x7F):BaudRateMax_ 460800 255(0xFF):BaudRateMax_ 921600 Multiple bits may be set according	1 (0x01)	255 (0xFF)	31 (0x1F)	SBDRT?<CR><LF> Display the supported transmission baud rate as bit fields This camera supports 9600bps, 19200bps, 38400bps,57600bps, and 115200bps.

Name	Access	Short ASCII	Values	MIN	MAX	Default	Description
DeviceSerialPort BaudRate	R/W	CBDRT	READ: Indicate current baud rate WRITE: Set any bit of baud rate 1(0x01):Baud9600 2(0x02):Baud19200 4(0x04):Baud38400 8(0x08):Baud57600 16(0x10):Baud115200 A single bit may be set according to the current baudrate setting.0 is an invalid value.	1 (0x01)	16 (0x80)	1 (0x01)	CBDRT=[Param.]<CR><LF> CBDRT?<CR><LF> In case of WRITE execution (change baud rate), it needs to control in the proper sequence between Host and Camera. Display the currently configured transmission baud rate. To change the transmission baud rate, use this command.

Device Control (Command List)

> **Note:** For more information on each setting, see DeviceControl (Setting List).

Name	Interface Access	Short ASCII	Values	Default	Description
DeviceFirmware Version	R/O	VN	-	-	VN?<CR><LF>
DeviceFpgaVersion	R/O	FPVN	-	-	FPVN?<CR><LF> Version of the FPGA in the device.
DeviceManifestXML Version	R/O	XMLVR	-	-	XMLVR?<CR><LF> Indicates the version number of the GenICam XML file.
DeviceTemperature	R/O	TMP0	-7040 ~ 16000	0	TMP0?<CR><LF> Value/128 = Device Temperature in degrees Celsius (C)
DeviceReset	W/O	CRS00	1	-	CRS00=1<CR><LF> Resets the device to its power up state. After reset, the device must be rediscovered.

Image Format Control (Command List)

> **Note:** For more information on each setting, see ImageFormatControl (Setting List).

<table>
<tr><th>Name</th><th>Access</th><th>Short ASCII</th><th>Values</th><th>DEFAULT</th><th>Description</th></tr>
<tr><td>Width</td><td>R/W</td><td>WTC</td><td>Min ~ (Max-OffsetX)
<table><tr><th></th><th>Min</th><th>Max</th><th>Default</th></tr><tr><td>AP-1600T-PMCL</td><td rowspan="2">96 (48)*</td><td>1456 (728)*</td><td>1456</td></tr><tr><td>AP-3200T-PMCL</td><td>2064 (1032)*</td><td>2064</td></tr></table>*The parenthesis value applies when BinningHorizontal is set to 2.</td><td></td><td>WTC=[Param.]<CR><LF>
WTC?<CR><LF></td></tr>
<tr><td>Height</td><td>R/W</td><td>HTL</td><td>Min ~ (Max-OffsetY)
<table><tr><th></th><th>Min</th><th>Max</th><th>Default</th></tr><tr><td>AP-1600T-PMCL</td><td rowspan="2">2</td><td>1088(544)*</td><td>1088</td></tr><tr><td>AP-3200T-PMCL</td><td>1544 (772)*</td><td>1544</td></tr></table>The parenthesis value applies when BinningVertical is set to 2.</td><td></td><td>HTL=[Param.]<CR><LF>
HTL?<CR><LF>
(2 line/ Step)</td></tr>
<tr><td>OffsetX</td><td>R/W</td><td>OFC</td><td>Min ~ (Max – Width)
<table><tr><th></th><th>Min</th><th>Max</th><th>Default</th></tr><tr><td>AP-1600T-PMCL</td><td rowspan="2">0</td><td>1440(720)*</td><td>0</td></tr><tr><td>AP-3200T-PMCL</td><td>2048(1024)*</td><td>0</td></tr></table>*The parenthesis value applies when BinningHorizontal is set to 2.</td><td></td><td>OFC=[Param.]<CR><LF>
OFC?<CR><LF></td></tr>
<tr><td>OffsetY</td><td>R/W</td><td>OFL</td><td>Min ~ (Max–Height)
<table><tr><th></th><th>Min</th><th>Max</th><th>Default</th></tr><tr><td>AP-1600T-PMCL</td><td rowspan="2">0</td><td>1086(542)*</td><td>0</td></tr><tr><td>AP-3200T-PMCL</td><td>1542 (770)*</td><td>0</td></tr></table>*The parenthesis value applies when BinningVertical is set to 2.</td><td></td><td>OFL=[Param.]<CR><LF>
OFL?<CR><LF>
(2 line/ Step)</td></tr>
<tr><td>BinningHorizontal Mode</td><td>R/W</td><td>HBM</td><td>0: Average
1: Sum</td><td>1</td><td>HBM=[Param.]<CR><LF>
HBM?<CR><LF></td></tr>
<tr><td>BinningHorizontal</td><td>R/W</td><td>HB</td><td>1: Binning Off
2: Binning 2 mode</td><td>1</td><td>HB=[Param.]<CR><LF>
HB?<CR><LF></td></tr>
<tr><td>BinningVertical Mode</td><td>R/W</td><td>VBM</td><td>0: Average
1: Sum*
*AP-1600T-PMCL: FIxed to Sum.</td><td>1</td><td>VBM=[Param.]<CR><LF>
VBM?<CR><LF></td></tr>
<tr><td>BinningVertical</td><td>R/W</td><td>VB</td><td>1: Binning Off
2: Binning 2 mode</td><td>1</td><td>VB=[Param.]<CR><LF>
VB?<CR><LF></td></tr>
</table>

Name	Access	Short ASCII	Values	DEFAULT	Description
PixelFormat	R/(W)	BA	3: RGB8 4: RGB10 5: RGB12* *VideoProcessbypass On only	3	BA=[Param.]<CR><LF> BA?<CR><LF>
TestPattern	R/W	TPN	0: Off 1: GreyHorizontalRamp 2: GreyVerticalRamp 3: GreyHorizontal RampMoving 4: Horizontal Colorbar 5: Vertical Colorbar 6: Moving Colorbar	0	TPN=[Param.]<CR><LF> TPN?<CR><LF>

Acquisition Control (Command List)

> **Note:** For more information on each setting, see AcquisitionControl (Setting List).

Name	Access	Short ASCII	Values	DEFAULT	Description
AcquisitionFrame Period[us]	R/W	AR	Min: See the table 1 in Appendix (Command List). Max: 8000000	See the table 1 in Appendix (Command List).	AR=[Param.]<CR><LF> AR?<CR><LF>
TriggerMode	R/W	TM	0: Off 1: On	0	TM=[Param.]<CR><LF> TM?<CR><LF>
TriggerSoftware	W/O	STRG	1	-	STRG=1<CR><LF>
FrameStartTrigSource	R/W	TI	0:Low 1:High 2:Software 10:PulseGenerator0 11:PulseGenerator1 12:PulseGenerator2 13:PulseGenerator3 14:UserOutput0 15:UserOutput1 16:UserOutput2 17:UserOutput3 21:Line5 - OptIn1 22:Line6 - OptIn2 23:Line7 - CC1 26:NAND0Out 27:NAND1Out	21	TI=[Param.]<CR><LF> TI?<CR><LF>
TriggerActivation	R/W	TA	0: RisingEdge 1: FallingEdge 2: LevelHigh 3: LevelLow	0* *All Trigger Selector	TA=[Param.]<CR><LF> TA?<CR><LF>
TriggerOverlap	R/W	TO	0:Off 1:Read Out	1	TO=[Param.]<CR><LF> TO?<CR><LF>
TriggerDelay (us)	R/W	TD	0 ~ 500000	0	TD=[Param.]<CR><LF> TD?<CR><LF> (TriggerDelay [FrameStart] only)

Name	Access	Short ASCII	Values	DEFAULT	Description
ExposureModeOption	R/W	TRGOP	0: Off 1: RCT	0	TRGOP=[Param.]<CR><LF> TRGOP?<CR><LF>
ExposureMode	R/W	EM	0: Off 1: Timed 2: TriggerWidth	1	EM=[Param.]<CR><LF> EM?<CR><LF>
ExposureTimeMode	R/W	ETM	0:Common 1:Individual	0	ETM=[Param.]<CR><LF> ETM?<CR><LF>
ExposureTime [ExposureTimeSelect or]Common	R/W	PE	See the tables in Appendix (Command List)	FramePeriod - 18H	PE=[Param.]<CR><LF> PE?<CR><LF>
ExposureTime [ExposureTimeSelect or]Red	R/W	PER	See the tables in Appendix (Command List)	FramePeriod - 18H	PEE=[Param.]<CR><LF> PEE?<CR><LF>
ExposureTime [ExposureTimeSelect or]Green	R/W	PEG	See the tables in Appendix (Command List)	FramePeriod - 18H	PEG=[Param.]<CR><LF> PEG?<CR><LF>
ExposureTime [ExposureTimeSelect or]Blue	R/W	PEB	See the tables in Appendix (Command List)	FramePeriod - 18H	PEB=[Param.]<CR><LF> PEB?<CR><LF>
ExposureAuto	R/W	ASC	0: Off 1: Continuous 2: Once	0	ASC=[Param.]<CR><LF> ASC?<CR><LF>

Analog Control (Command List)

> **Note:** For more information on each setting, see AnalogControl (Setting List).

Name	Access	Short ASCII	Values	DEFAULT	Description
IndividualGainMode	R/W	IGM	0: Off 1:On	0	IGM= [Param.]<CR><LF> IGM?<CR><LF>
Gain [GainSelector] Analog All	R/W	FGA	IndividualGainMode=Off: 100 ~ 800 IndividualGainMode=On: invalid	100	FGA= [Param.]<CR><LF> FGA?<CR><LF>
Gain [GainSelector] AnalogRed	R/W	FGR	IndividualGainMode=Off: 47 ~ 400 IndividualGainMode=On: 100 ~ 6400	100	FGR= [Param.]<CR><LF> FGR?<CR><LF>
Gain [GainSelector] AnalogGreen	R/W	FGG	IndividualGainMode=Off: 47 ~ 400 IndividualGainMode=On: 100 ~ 6400	100	FGG= [Param.]<CR><LF> FGG?<CR><LF>
Gain [GainSelector] AnalogBlue	R/W	FGB	IndividualGainMode=Off: 47 ~ 400 IndividualGainMode=On: 100 ~ 6400	100	FGB= [Param.]<CR><LF> FGB?<CR><LF>
Gain [GainSelector] DigitalRed	R/W	PGR	90 ~ 110	100	PGR= [Param.]<CR><LF> PGR?<CR><LF>
Gain [GainSelector] DigitalBlue	R/W	PGB	90 ~ 110	100	PGB= [Param.]<CR><LF> PGB?<CR><LF>
GainAuto	R/W	AGC	0: Off 1: Continuous 2: Once	0	AGC= [Param.]<CR><LF> AGC?<CR><LF>

Name	Access	Short ASCII	Values	DEFAULT	Description
BalanceWhiteAuto	R/W	AWB	**IndividualGainMode=Off** 0:Off 1:Continuous 2:Once 3:ExposureContinuous * 4:ExposureOnce * 5:Preset3200K 6:Preset5000K 7:Preset6500K 8:Preset7500K **IndividualGainMode=On** 0:Off 3:ExposureContinuous 4:ExposureOnce (*It can not be selected when ExposureTimeMode = Common.)	0	AWB= [Param.]<CR><LF> AWB?<CR><LF>
BlackLevel [BlackLevel Selector] DigitalAll	R/W	BL	-133 ~ 255	0	BL=[Param.]<CR><LF> BL?<CR><LF>
BlackLevel [BlackLevel Selector] DigitalRed	R/W	BLR1	- 64 ~ 64	0	BLR1= [Param.]<CR><LF> BLR1?<CR><LF>
BlackLevel [BlackLevel Selector] DigitalBlue	R/W	BLB1	- 64 ~ 64	0	BLB1= [Param.]<CR><LF> BLB1?<CR><LF>
Gamma	R/W	GMA	45: 0.45 50: 0.5 55: 0.55 60: 0.6 65: 0.65 75: 0.75 80: 0.8 90: 0.9 100: 1.0	45	GMA= [Param.]<CR><LF> GMA?<CR><LF>
LUTMode	R/W	LUTC	0:OFF 1:Gamma 2:LUT	0	LUTC= [Param.]<CR><LF> LUTC?<CR><LF>

LUT Control (Command List)

> **Note:** For more information on each setting, see LUT Control (Setting List).

Name	Access	Short ASCII	Values	DEFAULT	Description
LUT Index and Value [LUTSelector]Red	R/W	LUTR	Param 1: LUT index (0 ~ 256)	0	LUTR=[Param1], [Param2]<CR><LF> LUTR? [Param1]<CR><LF>
			Param 2: LUTdata (0 ~ 4095)	γ=1 equivalent value	
LUT Index and Value [LUTSelector]Green	R/W	LUTG	Param 1: LUT index (0 ~ 256)	0	LUTG=[Param1], [Param2]<CR><LF> LUTG? [Param1]<CR><LF>
			Param 2: LUTdata (0 ~ 4095)	γ=1 equivalent value	
LUT Index and Value [LUTSelector]Blue	R/W	LUTB	Param 1: LUT index (0 ~ 256)	0	LUTB=[Param1], [Param2]<CR><LF> LUTB? [Param1]<CR><LF>
			Param 2: LUTdata (0 ~ 4095)	γ=1 equivalent value	

Color Transformation Control (Command List)

> **Notes:**
> - This function is enabled only when Video Process Bypass Mode is set to **Off**.
> - For more information on each setting, see Color Transformation Control (Setting List).

Color Transformation Control Name	Access	Short ASCII	Values	Default Value	Description
ColorTransformationMode	R/W	CTM	0:RGB 1: HSI 2: XYZ	0	CTM=[Param.]<CR><LF> CTM?<CR><LF>
ColorTransformation RGBMode	R/W	CTRM	0: Off 1: sRGB 2: AdobeRGB 3: UserCustom	0	CTRM= [Param.]<CR><LF> CTRM?<CR><LF>
ColorMatrixValue [ColorMatrixSelector] ColorMatrixR-R	R/W	CMVRR	- 20 (= - 2.0) ~ 20 (= 2.0)	10	CMVRR= [Param.]<CR><LF> CMVRR?<CR><LF>
ColorMatrixValue [ColorMatrixSelector] ColorMatrixR-G	R/W	CMVRG	- 20 (= - 2.0) ~ 20 (= 2.0)	0	CMVRG= [Param.]<CR><LF> CMVRG?<CR><LF>

Color Transformation Control Name	Access	Short ASCII	Values	Default Value	Description
ColorMatrixValue [ColorMatrixSelector] ColorMatrixR-B	R/W	CMVRB	- 20 (= - 2.0) ~ 20 (= 2.0)	0	CMVRB= [Param.]<CR><LF> CMVRB?<CR><LF> Specify the ColorMatrix value.
ColorMatrixValue [ColorMatrixSelector] ColorMatrixG-R	R/W	CMVGR	- 20 (= - 2.0) ~ 20 (= 2.0)	0	CMVGR= [Param.]<CR><LF> CMVGR?<CR><LF>
ColorMatrixValue [ColorMatrixSelector] ColorMatrixG-G	R/W	CMVGG	- 20 (= - 2.0) ~ 20 (= 2.0)	10	CMVGG= [Param.]<CR><LF> CMVGG?<CR><LF>
ColorMatrixValue [ColorMatrixSelector] ColorMatrixG-B	R/W	CMVGB	- 20 (= - 2.0) ~ 20 (= 2.0)	0	CMVGB= [Param.]<CR><LF> CMVGB?<CR><LF>
ColorMatrixValue [ColorMatrixSelector] ColorMatrixB-R	R/W	CMVBR	- 20 (= - 2.0) ~ 20 (= 2.0)	0	CMVBR= [Param.]<CR><LF> CMVBR?<CR><LF>
ColorMatrixValue [ColorMatrixSelector] ColorMatrixB-G	R/W	CMVBG	- 20 (= - 2.0) ~ 20 (= 2.0)	0	CMVBG= [Param.]<CR><LF> CMVBG?<CR><LF>
ColorMatrixValue [ColorMatrixSelector] ColorMatrixB-B	R/W	CMVBB	- 20 (= - 2.0) ~ 20 (= 2.0)	10	CMVBB= [Param.]<CR><LF> CMVBB?<CR><LF>

Digital IO Control (Command List)

> **Note:** For more information on each setting, see DigitalIOControl (Setting List).

Name	Access	Short ASCII	Values	DEFAULT	Description
LineInverter_ Line1Out	R/W	LI0	0: False 1: True	0	LI0=[Param.]<CR><LF> LI0?<CR><LF>
LineInverter_ Line2Out	R/W	LI1	0: False 1: True	0	LI0=[Param.]<CR><LF> LI0?<CR><LF>
LineInverter_ NANDGate0In1	R/W	ND0INV1	0: False 1: True	0	ND0INV1=[Param.]<CR><LF> ND0INV1?<CR><LF>

Name	Access	Short ASCII	Values	DEFAULT	Description
LineInverter_ NANDGate0In2	R/W	ND0INV2	0: False 1: True	0	ND0INV2=[Param.]<CR><LF> ND0INV2?<CR><LF>
LineInverter_ NANDGate1In1	R/W	ND1INV1	0: False 1: True	0	ND1INV1=[Param.]<CR><LF> ND1INV1?<CR><LF>
ineInverter_ NANDGate1In2	R/W	ND1INV2	0: False 1: True	0	ND1INV2=[Param.]<CR><LF> ND1INV2?<CR><LF>
LineSource_ Line1	R/W	LS0	0: Low 1: High 5: FrameTriggerWait 6: FrameActive 7: ExposureActive 8: Fval 9: Lval 10: PulseGenerator0 11: PulseGenerator1 12: PulseGenerator2 13: PulseGenerator3 14: UserOutput0 15: UserOutput1 16: UserOutput2 17: UserOutput3 21: Line5 – OptIn1 22: Line6 – OptIn2 23: Line7 - CC1 26: NAND0Out 27: NAND1Out	-	LS0=[Param.]<CR><LF> LS0?<CR><LF> **Default:** LineSelector ≠ Line1-TTL Out1 →0 LineSelector=Line1-TTL Out1 →6
LineSource_ Line2	R/W	LS1	Same as LS0.	Same as LS0.	LS2=[Param.]<CR><LF> LS2?<CR><LF>
LineSource_ NANDGate0In1	R/W	ND0IN1	Same as LS0.	Same as LS0.	ND0IN1=[Param.]<CR><LF> ND0IN1?<CR><LF>
LineSource_ NANDGate0In2	R/W	ND0IN2	Same as LS0.	Same as LS0.	ND0IN2=[Param.]<CR><LF> ND0IN2?<CR><LF>
LineSource_ NANDGate1In1	R/W	ND1IN1	Same as LS0.	Same as LS0.	ND1IN1=[Param.]<CR><LF> ND1IN1?<CR><LF>
LineSource_ NANDGate1In2	R/W	ND1IN2	Same as LS0.	Same as LS0.	ND1IN2=[Param.]<CR><LF> ND1IN2?<CR><LF>

Name	Access	Short ASCII	Values	DEFAULT	Description
OptInFilterSelector	R/W	OPTFL	0: Off 1: 10us 2: 100us 3: 500us 4: 1ms 5: 5ms 6: 10ms	0	OPTFL =[Param.]<CR><LF> OPTFL?<CR><LF>
UserOutputValue_ UserOutput0	R/W	USC0	0: False 1: True	0	USC0=[Param.]<CR><LF> USC0?<CR><LF>
UserOutputValue_ UserOutput1	R/W	USC1	0: False 1: True	0	USC1=[Param.]<CR><LF> USC1?<CR><LF>
UserOutputValue_ UserOutput2	R/W	USC2	0: False 1: True	0	USC1=[Param.]<CR><LF> USC1?<CR><LF>
UserOutputValue_ UserOutput3	R/W	USC3	0: False 1: True	0	USC1=[Param.]<CR><LF> USC1?<CR><LF>

Counter and Timer Control (Command List)

> **Note:** For more information on each setting, see Counter and Timer Control (Setting List).

Name	Access	Short ASCII	Values	Default	Description
CounterEventSource [CounterSelector] Counter0	R/W	CE0	0:Off 1:FrameTrigger	0	CE0=[Param.]<CR><LF> CE0?<CR><LF>
CounterEventSource [CounterSelector] Counter1	R/W	CE1	0:Off 1:ExposureStart	0	CE1=[Param.]<CR><LF> CE1?<CR><LF>
CounterEventSource [CounterSelector] Counter2	R/W	CE2	0:Off 1:SensorReadout	0	CE2=[Param.]<CR><LF> CE2?<CR><LF>
CounterReset [CounterSelector] Counter0 (FrameTrigger)	W/O	CR0	0	-	CR0=[Param.]<CR><LF> CounterEventSource != Off: Counter0 -> Reset to 0, and continue to count. CounterEventSource = Off: Counter0 -> Reset to 0.

Name	Access	Short ASCII	Values	Default	Description
CounterReset [CounterSelector] Counter1 (ExposureStart)	W/O	CR1	0	-	CR1=[Param.]<CR><LF> CounterEventSource != Off: Counter1 -> Reset to 0, and continue to count. CounterEventSource = Off: Counter1 -> Reset to 0.
CounterReset [CounterSelector] Counter2 (SensorReadout)	W/O	CR2	0	-	CR2=[Param.]<CR><LF> CounterEventSource != Off: Counter2 -> Reset to 0, and continue to count. CounterEventSource = Off: Counter2 -> Reset to 0.
CounterValue [CounterSelector] Counter0	R/O	CV0	0 ~ 65535	0	CV0?<CR><LF>
CounterValue [CounterSelector] Counter1	R/O	CV1	0 ~ 65535	0	CV1?<CR><LF>
CounterValue [CounterSelector] Counter2	R/O	CV2	0 ~ 65535	0	CV2?<CR><LF>

User Set Control (Command List)

> **Note:** For more information on each setting, see UserSetControl (Setting List).

Name	Access	Short ASCII	Values	Default	Description
UserSetLoad	R/W	LD	0: Default 1: UserSet1 2: UserSet2 3: UserSet3	0	LD=[Param.]<CR><LF> LD?<CR><LF>
UserSetSave	W/O	SA	1: UserSet1 2: UserSet2 3: UserSet3	1	SA=[Param.]<CR><LF>

Sequencer Control (Command List)

> **Note:** For more information on each setting, see Sequencer Control (Setting List).

Name	Access	Short ASCII	Values	Default	Description
SequencerMode	R/W	SQM	0: Off 1: On	0	SQM=[Param.]<CR><LF> SQM?<CR><LF>
SequencerMode Select	R/W	SQSEL	0: Trigger Sequencer Mode 1: Command Sequencer Mode	0	SQSEL=[Param.]<CR><LF> SQSEL?<CR><LF>
SequencerFrameNumber [SequencerSetSelector] 1 ~ 128	R/W	SQF1 ~ SQF128	1 ~ 255	1	SQF1 ~ 128= [Param.]<CR><LF> SQF1 ~ 128?<CR><LF>
SequencerSetNext [SequencerSetSelector] 1 ~ 128	R/W	SQNI1 ~ SQNI 128	1 ~ 128	-	SQNI1 ~ 128= [Param.]<CR><LF> SQNI1 ~ 128?<CR><LF>
SequencerWidth [SequencerSetSelector] 1 ~ 128	R/W	SQW1 ~ SQW128	**AP-1600T-PMCL** 96 (48) ~ 1456 (728) step 16 (8) Default: 1456 **AP-3200T-PMCL** 96 (48) ~ 2064 (1032) step 16 (8) Default: 2064 The parenthesis value applies when BinningHorizontal is set to 2.		SQW1 ~ 128= [Param.]<CR><LF> SQW1 ~ 128?<CR><LF>
SequencerHeight [SequencerSetSelector] 1 ~ 128	R/W	SQH1 ~ SQH128	**AP-1600T-PMCL** 2 ~ 1088 (544), step 2 Default: 1088 **AP-3200T-PMCL** 2 ~ 1544 (772), step 2 Default: 1544 The parenthesis value applies when BinningVertical is set to 2.		SQH1 ~ 128= [Param.]<CR><LF> SQH1 ~ 128?<CR><LF>

Name	Access	Short ASCII	Values	Default	Description
SequencerOffsetX [SequencerSetSelector] 1 ~ 128	R/W	SQOX1 ~ SQOX128	**AP-1600T-PMCL** 0 ~ 1440 (720), step 16 (8) Default: 0 **AP-3200T-PMCL** 2 ~ 2048 (1024), step 16 (8) Default: 0 The parenthesis value applies when BinningHorizontal is set to 2.		SQOX1 ~ 128= [Param.]<CR><LF> SQOX1 ~ 128?<CR><LF>
SequencerOffsetY [SequencerSetSelector] 1 ~ 128	R/W	SQOY1 ~ SQOY128	**AP-1600T-PMCL** 0 ~ 1086 (542), step 2 Default: 0 **AP-3200T-PMCL** 2 ~ 1542 (770), step 2 Default: 0 The parenthesis value applies when BinningVertical is set to 2.		SQOY1 ~ 128= [Param.]<CR><LF> SQOY1 ~ 128?<CR><LF>
SequencerGainAnalogAll [SequencerSetSelector] 1 ~ 128	R/W	SQGA1 ~ SQGA128	IndividualGainMode=Off: 100 ~ 800 IndividualGainMode=On: 100(fixed)	100	SQGA1 ~ 128= [Param.]<CR><LF> SQGA1 ~ 128?<CR><LF>
SequencerGainAnalog Red [SequencerSetSelector] 1 ~ 128	R/W	SQGR1 ~ SQGR128	IndividualGainMode=Off: 47 ~ 400 IndividualGainMode=On: 100 ~ 6400	100	SQGR1 ~ 128= [Param.]<CR><LF> SQGR1 ~ 128?<CR><LF>
SequencerGainAnalog Green [SequencerSetSelector] 1 ~ 128	R/W	SQGG1 ~ SQGG128	IndividualGainMode=Off: 100(fixed) IndividualGainMode=On: 100 ~ 6400	100	SQGG1 ~ 128= [Param.]<CR><LF> SQGG1 ~ 128?<CR><LF>
SequencerGainAnalog Blue [SequencerSetSelector] 1 ~ 128	R/W	SQGB1 ~ SQGB128	IndividualGainMode=Off: 47 ~ 400 IndividualGainMode=On: 100 ~ 6400	100	SQGB1 ~ 128= [Param.]<CR><LF> SQGB1 ~ 128?<CR><LF>
SequencerExposureTime Common [SequencerSetSelector] 1 ~ 128	R/W	SQPE1 ~ SQPE128	See tables in Appendix (Command List).	FramePeriod - 18H	SQPE1 ~ 128= [Param.]<CR><LF> SQPE1 ~ 128?<CR><LF> Step 1[us]
SequencerExposureTime Red [SequencerSetSelector] 1 ~ 128	R/W	SQPER1 ~ SQPER128	See tables in Appendix (Command List).	FramePeriod - 18H	SQPER1 ~ 128= [Param.]<CR><LF> SQPER1 ~ 128?<CR><LF> Step 1[us]

Name	Access	Short ASCII	Values	Default	Description
SequencerExposureTime Green [SequencerSetSelector] 1 ~ 128	R/W	SQPEG1 ~ SQPEG128	See tables in Appendix (Command List).	FramePeriod - 18H	SQPEG1 ~ 128=[Param.]<CR><LF> SQPEG1 ~ 128?<CR><LF> Step 1[us]
SequencerExposureTime Blue [SequencerSetSelector] 1 ~ 128	R/W	SQPEB1 ~ SQPEB128	See tables in Appendix (Command List).	FramePeriod - 18H	SQPEB1 ~ 128=[Param.]<CR><LF> SQPEB1 ~ 128?<CR><LF> Step 1[us]
SequencerBinning Horizontal [SequencerSetSelector] 1 ~ 128	R/W	SQHB1 ~ SQHB128	1: Binning Off 2: Binning 2 mode	1	SQHB1 ~ 128=[Param.]<CR><LF> SQHB1 ~ 128?<CR><LF>
SequencerBinning Vertical [SequencerSetSelector] 1 ~ 128	R/W	SQVB1 ~ SQVB128	1: Binning Off 2: Binning 2 mode	1	SQVB1 ~ 128=[Param.]<CR><LF> SQVB1 ~ 128?<CR><LF>
SequencerLUTEnable [SequencerSetSelector] 1 ~ 128	R/W	SQLUT1 ~ SQLUT128	0: False 1: True	0	SQLUT1 ~ 128=[Param.]<CR><LF> SQLUT1 ~ 128?<CR><LF>
SequencerBlackLevel DigitalAll [SequencerSetSelector] 1 ~ 128	R/W	SQBL1 ~ SQBL128	-133 ~ 255	0	SQBL1 ~ 128=[Param.]<CR><LF> SQBL1 ~ 128?<CR><LF>
SequencerLUTMode	R/W	SQLUT	0: Gamma 1: LUT	0	SQLUT=[Param.]<CR><LF> SQLUT?<CR><LF>
SequencerSetActive	R/O	SQIDX	1 ~ 128	1	SQIDX?<CR><LF>
SequencerCommand Index	R/W	CSQI	1 ~ 128	1	CSQI=[Param.]<CR><LF> CSQI?<CR><LF>
SequencerSetStart	R/W	SQSS	1 ~ 128	1	SQSS=[Param.]<CR><LF> SQSS?<CR><LF>
SequencerReset	W/O	SQRST	-	-	SQRST=0<CR><LF>

Transport Layer Control (Command List)

> **Note:** For more information on each setting, see Transport Layer Control (Setting List).

Name	Access	Short ASCII	Values	DEFAULT	Description
ClConfiguration	R/W	CLCFG	0: Base* 1: Medium 2: Full* 3: Eighty Bit* (* Pixel Format=RGB8 Only)	1	CLCFG=[Param.]<CR><LF> CLCFG?<CR><LF>
CameraLinkClock Frequency	R/W	CLCF	0: 37.1MHz 1: 74.3MHz 2: 84.9MHZ	1	CLCF=[Param.]<CR><LF> CLCF?<CR><LF>

Pulse Generator (Command List)

> **Note:** For more information on each setting, see JAI Custom Control PulseGenerators (Setting List).

Name	Access	Short ASCII	Values	Default	Description
ClockPreScaler	R/W	PGDEV	1 ~ 4096	165	PGDEV=[Param.]<CR><LF> PGDEV?<CR><LF>
PulseGeneratorLength [PulseGeneratorSelector] 0 ~ 3	R/W	PGL0 ~ PGL3	1 ~ 1048575	30000	PGL0 ~ 3=[Param.]<CR><LF> PGL0 ~ 3?<CR><LF>
PulseGeneratorStart Point [PulseGeneratorSelector] 0 ~ 3	R/W	PGST0 ~ PGST3	1 ~ 1048574	0	PGST0 ~ 3=[Param.]<CR><LF> PGST0 ~ 3?<CR><LF>
PulseGeneratorEnd Point [PulseGeneratorSelector] 0 ~ 3	R/W	PGEN0 ~ PGEN3	1 ~ 1048574	15000	PGEN0 ~ 3=[Param.]<CR><LF> PGEN0 ~ 3?<CR><LF>
PulseGeneratorRepeatCount [PulseGeneratorSelector] 0 ~ 3	R/W	PGRPT0 ~ PGRPT3	0 ~ 255	0	PGRPT0 ~ 3=[Param.]<CR><LF> PGRPT0 ~ 3?<CR><LF>
PulseGeneratorClearActivation [PulseGeneratorSelector] 0 ~ 3	R/W	PGCM0 ~ PGCM3	0: Off 1: LevelHigh 2: LevelLow 3: RisingEdge 4: FallingEdge	0	PGCM0 ~ 3=[Param.]<CR><LF> PGCM0 ~ 3?<CR><LF>

Name	Access	Short ASCII	Values	Default	Description
PulseGeneratorClearSource [PulseGeneratorSelector] 0 ~ 3	R/W	PGIN0 ~ PGIN3	0: Low 1: High 3: AcquisitionTrigger Wait 4: AcquisitionActive 5: FrameTriggerWait 6: FrameActive 7: ExposureActive 8: Fval 9: Lval 10: PulseGenerator0※ 11: PulseGenerator1※ 12: PulseGenerator2※ 13: PulseGenerator3※ 14: UserOutput0 15: UserOutput1 16: UserOutput2 17: UserOutput3 21: Line5 – OptIn1 22: Line6 – OptIn2 23: Line7 - CC1 26: NAND0Out 27: NAND1Out	0	PGIN0 ~ 3=[Param.]<CR><LF> PGIN0 ~ 3?<CR><LF> ※When PulseGeneratorSelector = PulseGenerator 0 to 3, items of PulseGenerator with the same number out of Value 10 to 13 are invalid.
PulseGeneratorClearInverter [PulseGeneratorSelector] 0 ~ 3	R/W	PGINV0 ~ PGINV3	0: False 1: True	0	PGINV0 ~ 3=[Param.]<CR><LF> PGINV0 ~ 3?<CR><LF>
PulseGeneratorClear SyncMode [PulseGeneratorSelector] 0 ~ 3	R/W	PGSM0 ~ PGSM3	0: AsyncMode 1: SyncMode	0	PGSM0 ~ 3=[Param.]<CR><LF> PGSM0 ~ 3?<CR><LF>

JAI Custom Control ALC (Command List)

> **Note:** For more information on each setting, see JAI CustomControlALC (Setting List).

Name	Access	Short ASCII	Values	DEFAULT	Description
ALCControlReference	R/W	ALCCR	0: PeakChannel 1: SelectedChannel	1	ALCCR=[Param.]<CR><LF> ALCCR?<CR><LF>
ALCControlChannel	R/W	ALCCC	0: Red 1: Green 2: Blue	1	ALCCC=[Param.]<CR><LF> ALCCC?<CR><LF>
ALCReference	R/W	AGCF	30 ~ 95	50	AGCF=[Param.]<CR><LF> AGCF?<CR><LF>
ALCAreaEnable [ALCAreaSelector] LowRight	R/W	ALCLR	0: False 1: True	1	ALCLR=[Param.]<CR><LF> ALCLR?<CR><LF>
ALCAreaEnable [ALCAreaSelector] LowMidRight	R/W	ALCLMR	0: False 1: True	1	ALCLMR= [Param.]<CR><LF> ALCLMR?<CR><LF>
ALCAreaEnable [ALCAreaSelector] LowMidLeft	R/W	ALCLML	0: False 1: True	1	ALCLML=[Param.]<CR><LF> ALCLML?<CR><LF>
ALCAreaEnable [ALCAreaSelector] LowLeft	R/W	ALCLL	0: False 1: True	1	ALCLL=[Param.]<CR><LF> ALCLL?<CR><LF>
ALCAreaEnable [ALCAreaSelector] MidLowRight	R/W	ALCMLR	0: False 1: True	1	ALCMLR= [Param.]<CR><LF> ALCMLR?<CR><LF>
ALCAreaEnable [ALCAreaSelector] MidLowMidRight	R/W	ALCMLMR	0: False 1: True	1	ALCMLMR= [Param.]<CR><LF> ALCMLMR?<CR><LF>
ALCAreaEnable [ALCAreaSelector] MidLowMidLeft	R/W	ALCMLML	0: False 1: True	1	ALCMLML= [Param.]<CR><LF> ALCMLML?<CR><LF>
ALCAreaEnable [ALCAreaSelector] MidLowLeft	R/W	ALCMLL	0: False 1: True	1	ALCMLL=[Param.]<CR><LF> ALCMLL?<CR><LF>
ALCAreaEnable [ALCAreaSelector] MidHighRight	R/W	ALCMHR	0: False 1: True	1	ALCMHR= [Param.]<CR><LF> ALCMHR?<CR><LF>

Name	Access	Short ASCII	Values	DEFAULT	Description
ALCAreaEnable [ALCAreaSelector] MidHighMidLeft	R/W	ALCMHML	0: False 1: True	1	ALCMHMR= [Param.]<CR><LF> ALCMHMR?<CR><LF>
ALCAreaEnable [ALCAreaSelector] MidHighLeft	R/W	ALCMHL	0: False 1: True	1	ALCMHL= [Param.]<CR><LF> ALCMHL?<CR><LF>
ALCAreaEnable [ALCAreaSelector] HighRight	R/W	ALCHR	0: False 1: True	1	ALCHR=[Param.]<CR><LF> ALCHR?<CR><LF>
ALCAreaEnable [ALCAreaSelector] MidHighRight	R/W	ALCMHR	0: False 1: True	1	ALCMHR= [Param.]<CR><LF> ALCMHR?<CR><LF>
ALCAreaEnable [ALCAreaSelector] MidHighLeft	R/W	ALCMHL	0: False 1: True	1	ALCMHL= [Param.]<CR><LF> ALCMHL?<CR><LF>
ALCAreaEnable [ALCAreaSelector] HighRight	R/W	ALCHR	0: False 1: True	1	ALCHR=[Param.]<CR><LF> ALCHR?<CR><LF>
ALCAreaEnable [ALCAreaSelector] MidHighRight	R/W	ALCMHR	0: False 1: True	1	ALCMHR= [Param.]<CR><LF> ALCMHR?<CR><LF>
ALCAreaEnable [ALCAreaSelector] MidHighLeft	R/W	ALCMHL	0: False 1: True	1	ALCMHL= [Param.]<CR><LF> ALCMHL?<CR><LF>
ALCAreaEnable [ALCAreaSelector] HighLeft	R/W	ALCHL	0: False 1: True	1	ALCHL=[Param.]<CR><LF> ALCHL?<CR><LF>
ALCAreaEnableAll	R/W	ALCA	0: False 1: True	1	ALCA=[Param.]<CR><LF> ALCA?<CR><LF>
AutoShutterControl ExposureMin		ASCEI	100 ~ (AutoSchutterControl ExposureMax - 1)	100	ASCEI=[Param.]<CR><LF> ASCEI?<CR><LF>
AutoShutterControl ExposureMax		ASCEA	(AutoSh utterCon trol ExposureMin + 1) ~ Frame Period - 18H	Frame Period - 18H	ASCEA=[Param.]<CR><LF> ASCEA?<CR><LF>
AutoGainControl GainRawMin	R/W	AGCGI	100 ~ (AutoGainControlGain RawMax - 1)	100	AGCGI=[Param.]<CR><LF> AGCGI?<CR><LF>
AutoGainControl GainRawMax	R/W	AGCGA	(AutoGainControlGain RawMin + 1) ~ 800	400 or 800	AGCGA=[Param.]<CR><LF> AGCGA?<CR><LF>
ALCControlMode	R/W	ALCCM	0: Standard 1: Ratio	0	ALCCM=[Param.]<CR><LF> ALCCM?<CR><LF>

Name	Access	Short ASCII	Values	DEFAULT	Description
ALCControlSpeed	R/W	ALCS	1 ~ 8	4	ALCS=[Param.]<CR><LF> ALCS?<CR><LF>
ALCControlRatios	R/W	ALCR	1 ~ 100 %	90	ALCR=[Param.]<CR><LF> ALCR?<CR><LF>
ALCStatus	R/O	ALCST	0: Off 2: ASC 3: AGC	0	ALCST?<CR><LF>
AutoControlStatus	R/O	ATCS	1: ExecutingASC 2: ExecutingAGC 3: ExecutingASCand AGC 4: ExecutingAWB 5: ExecutingASCand AWB 6: ExecutingAGCand AWB 7: ExecutingASCand AGCandAWB 8: Convergent 9: ConditionError 255: Idle	255	ATCS?<CR><LF>

JAI Custom Control AWB (Command List)

Note: For more information on each setting, see JAI CustomControlAWB (Setting List).

Name	Access	Short ASCII	Values	DEFAULT	Description
AWBAreaEnable [AWBAreaSelector] LowRight	R/W	AWBLR	0: False 1: True	1	AWBLR=[Param.]<CR><LF> AWBLR?<CR><LF>
AWBAreaEnable [AWBAreaSelector] LowMidRight	R/W	AWBLMR	0: False 1: True	1	AWBLMR=[Param.]<CR><LF> AWBLMR?<CR><LF>
ALAWBAreaEnable [AWBAreaSelector] LowMidLeft	R/W	AWBLML	0: False 1: True	1	AWBLML=[Param.]<CR><LF> AWBLML?<CR><LF>
AWBAreaEnable [AWBAreaSelector] LowLeft	R/W	AWBLL	0: False 1: True	1	AWBLL=[Param.]<CR><LF> AWBLL?<CR><LF>
AWBAreaEnable [AWBAreaSelector] MidLowRight	R/W	AWBMLR	0: False 1: True	1	AWBMLR=[Param.]<CR><LF> AWBMLR?<CR><LF>
AWBAreaEnable [AWBAreaSelector] MidLowMidRight	R/W	AWBMLMR	0: False 1: True	1	AWBMLMR=[Param.]<CR><LF> AWBMLMR?<CR><LF>
AWBAreaEnable [AWBAreaSelector] MidLowMidLeft	R/W	AWBMLML	0: False 1: True	1	AWBMLML=[Param.]<CR><LF> AWBMLML?<CR><LF>
AWBAreaEnable [AWBAreaSelector] MidLowLeft	R/W	AWBMLL	0: False 1: True	1	AWBMLL=[Param.]<CR><LF> AWBMLL?<CR><LF>
AWBAreaEnable [AWBAreaSelector] MidHighRight	R/W	AWBMHR	0: False 1: True	1	AWBMHR=[Param.]<CR><LF> AWBMHR?<CR><LF>
AWBAreaEnable [AWBAreaSelector] MidHighMidLeft	R/W	AWBMHML	0: False 1: True	1	AWBMHMR=[Param.]<CR><LF> AWBMHMR?<CR><LF>
AWBAreaEnable [AWBAreaSelector] MidHighLeft	R/W	AWBMHL	0: False 1: True	1	AWBMHL=[Param.]<CR><LF> AWBMHL?<CR><LF>
AWBAreaEnable [AWBAreaSelector] HighRight	R/W	AWBHR	0: False 1: True	1	AWBHR=[Param.]<CR><LF> AWBHR?<CR><LF>

Name	Access	Short ASCII	Values	DEFAULT	Description
AWBAreaEnable [AWBAreaSelector] MidHighRight	R/W	AWBMHR	0: False 1: True	1	AWBMHR=[Param.]<CR><LF> AWBMHR?<CR><LF>
AWBAreaEnable [AWBAreaSelector] MidHighLeft	R/W	AWBMHL	0: False 1: True	1	AWBMHL=[Param.]<CR><LF> AWBMHL?<CR><LF>
AWBAreaEnable [AWBAreaSelector] HighRight	R/W	AWBHR	0: False 1: True	1	AWBHR=[Param.]<CR><LF> AWBHR?<CR><LF>
AWBAreaEnable [AWBAreaSelector] MidHighRight	R/W	AWBMHR	0: False 1: True	1	AWBMHR=[Param.]<CR><LF> AWBMHR?<CR><LF>
AWBAreaEnable [AWBAreaSelector] MidHighLeft	R/W	AWBMHL	0: False 1: True	1	AWBMHL=[Param.]<CR><LF> AWBMHL?<CR><LF>
AWBAreaEnable [AWBAreaSelector] HighLeft	R/W	AWBHL	0: False 1: True	1	AWBHL=[Param.]<CR><LF> AWBHL?<CR><LF>
AWBAreaEnableAll	R/W	AWBA	0: False 1: True	1	AWBA=[Param.]<CR><LF> AWBA?<CR><LF>
AWBControlSpeed	R/W	AWBS	1 ~ 8	4	AWBS=[Param.]<CR><LF> AWBS?<CR><LF>
AutoControlStatus	R/O	AWRS	0: Complete 1: TooBright 2: TooDark 3: Timeout 4: Executing 6: TriggerError 8: Convergent 9: ConditionError 255: Idle	255	AWRS?<CR><LF>

JAI Custom Control Blemish (Command List)

Note: For more information on each setting, see JAI CustomControlBlemish (Setting List).

Name	Access	Short ASCII	Values	Default	Description
BlemishEnable	R/W	BMW	0: False 1: True	1	BMW= [Param.]<CR><LF> BMW?<CR><LF>
BlemishDetect	W/O	BMRCW	1	-	BMRCW=1<CR><LF>
BlemishStore	W/O	BMS	1	-	BMS=1<CR><LF>
BlemishDetect Threshold [BlemishSelector] Red	R/W	BMTHWR	1 ~ 100	10	BMTHWR= [Param.]<CR><LF> BMTHWR?<CR><LF>
BlemishDetect Threshold [BlemishSelector] Green	R/W	BMTHWG	1 ~ 100	10	BMTHWG= [Param.]<CR><LF> BMTHWG?<CR><LF>
BlemishDetect Threshold [BlemishSelector] Blue	R/W	BMTHWB	1 ~ 100	10	BMTHWB= [Param.]<CR><LF> BMTHWB?<CR><LF>
BlemishCompensation Index and PositionX [BlemishSelector]Red	R/W	BMPXWR	Param 1: Blemish index Param 2: Xposition AP-1600T-PMCL: -1 ~ 1455 AP-3200T-PMCL: -1 ~ 2063	-1	BMPXWR=[Param1], [Param2]<CR><LF> BMPXWR? [Param1]<CR><LF>
BlemishCompensation Index and PositionX [BlemishSelector]Green	R/W	BMPXWG	Param 1: Blemish index Param 2: Xposition AP-1600T-PMCL: -1 ~ 1455 AP-3200T-PMCL: -1 ~ 2063	-1	BMPXWG=[Param1], [Param2]<CR><LF> BMPXWG? [Param1]<CR><LF>
BlemishCompensation Index and PositionX [BlemishSelector]Blue	R/W	BMPXWB	Param 1: Blemish index Param 2: Xposition AP-1600T-PMCL: -1 ~ 1455 AP-3200T-PMCL: -1 ~ 2063	-1	BMPXWB=[Param1], [Param2]<CR><LF> BMPXWB? [Param1]<CR><LF>
BlemishCompensation Index and PositionY [BlemishSelector]Red	R/W	BMPYWR	Param 1: Blemish index Param 2:Yposition AP-1600T-PMCL: -1 ~ 1087 AP-3200T-PMCL: -1 ~ 1543	-1	BMPYWR=[Param1], [Param2]<CR><LF> BMPYWR? [Param1]<CR><LF>
BlemishCompensation Index and PositionY [BlemishSelector]Green	R/W	BMPYWG	Param 1: Blemish index Param 2:Yposition AP-1600T-PMCL: -1 ~ 1087 AP-3200T-PMCL: -1 ~ 1543	-1	BMPYWG=[Param1], [Param2]<CR><LF> BMPYWG? [Param1]<CR><LF>

Name	Access	Short ASCII	Values	Default	Description
BlemishCompensation Index and PositionY [BlemishSelector]Blue	R/W	BMPYWB	Param 1: Blemish index Param 2:Yposition AP-1600T-PMCL: -1 ~ 1087 AP-3200T-PMCL: -1 ~ 1543	-1	BMPYWB=[Param1], [Param2]<CR><LF> BMPYWB? [Param1]<CR><LF>
BlemishCompensation DataClear [BlemishSelector]Red	W/O	BMCLRR	BlemishCompensationIndex (1 ~ 200)	-	BMCLRR= [Param.]<CR><LF>
BlemishCompensation DataClear [BlemishSelector]Green	W/O	BMCLRG	BlemishCompensationIndex (1 ~ 200)	-	BMCLRG= [Param.]<CR><LF>
BlemishCompensation DataClear [BlemishSelector]Blue	W/O	BMCLRB	BlemishCompensationIndex (1 ~ 200)	-	BMCLRB= [Param.]<CR><LF>
BlemishCompensation Number [BlemishSelector]Red	R/O	BNUMR	0 ~ 200	0	BNUMR?<CR><LF>
BlemishCompensation Number [BlemishSelector]Green	R/O	BNUMG	0 ~ 200	0	BNUMG?<CR><LF>
BlemishCompensation Number [BlemishSelector]Blue	R/O	BNUMB	0 ~ 200	0	BNUMB?<CR><LF>

JAI Custom Control Shading (Command List)

> **Note:** For more information on each setting, see JAI CustomControlShading (Setting List).

Name	Access	Short ASCII	Values	Default	Description
ShadingCorrection Mode	R/W	SDCM	0: Flat Shading 1: Color Shading	0	SDCM=[Param.]<CR><LF> SDCM?<CR><LF>
ShadingMode	R/W	SDM	0: OFF 1: User 1 2: User 2 3: User 3	0	SDM=[Param.]<CR><LF> SDM?<CR><LF>
PerformShading Calibration	W/O	RS	-	-	RS=0<CR><LF>
ShadingDetectResult	R/O	SDRS	0 = Complete. 1 = Too Bright. 2 = Too dark. 3 = Timeout Error. 5 = CorrectionLimit. 6 = ConditionError	-	SDRS?<CR><LF>

JAI Custom Control Sensor MultiROI (Command List)

Notes:

- This function is only supported on AP-1600T-PMCL.
- For more information on each setting, see JAI CustomControlSensorMultiROI (Setting List).

Name	Access	Short ASCII	Values	Default	Description
SensorMultiRoiMode	R/W	SMRMD	0: Off 1: On	0	SMRMD=[Param.]<CR><LF> SMRMD?<CR><LF>
SensorMultiRoiWidth [SensorMultiRoiIndex] 1 ~ 2	R/W	SMRW1 ~ 2	-	-	SMRW1~2=[Param.]<CR><LF> SMRW1~2?<CR><LF> *SensorMultiRoiHorizontalEnable[Index1][Index2], MIN, MAX will change depending on the state of BinningHorizontal.
SensorMultiRoiHeight [SensorMultiRoiIndex] 1 ~ 2	R/W	SMRH1 ~ 2	-	-	SMRH1~2=[Param.]<CR><LF> SMRH1~2?<CR><LF> *SensorMultiRoiVerticalEnable[Index1][I ndex2], MIN, MAX will change depending on the state of BinningVertical.
SensorMultiRoiOffsetX [SensorMultiRoiIndex] 1 ~ 2	R/W	SMROX1 ~ 2	-	-	SMROX1~2=[Param.]<CR><LF> SMROX1~2?<CR><LF> *SensorMultiRoiHorizontalEnable[Index1][Index2], MIN, MAX will change depending on the state of BinningHorizontal.
SensorMultiRoiOffsetY [SensorMultiRoiIndex] 1 ~ 2	R/W	SMROY1 ~ 2	-	-	SMROY1~2=[Param.]<CR><LF> SMROY1~2?<CR><LF> *SensorMultiRoiVerticalEnable[Index1][I ndex2], MIN, MAX will change depending on the state of BinningVertical.
SensorMultiRoi HorizontalEnable [SensorMultiRoiIndex] 1 ~ 2	R/W	SMROH1 ~ 2	Index1: True (Fixed) Index2: 0: False 1: True	Index1: 1 Index2: 0	SMROH1~2=[Param.]<CR><LF> SMROH1~2?<CR><LF>
SensorMultiRoi VerticalEnable [SensorMultiRoiIndex] 1 ~ 2	R/W	SMROV1 ~ 2	Index1: True (Fixed) Index2: 0: False 1: True	Index1: 1 Index2: 0	SMROV1~2=[Param.]<CR><LF> SMROV1~2?<CR><LF>

JAI Custom Control Misc (Command List)

> **Note:** For more information on each setting, see JAI CustomControlFeatureMisc (Setting List).

Name	Access	Short ASCII	Values	Default	Description
VideoProcessBypass Mode	R/W	VPB	0: OFF 1: ON	0	VPB =[Param.]<CR><LF> VPB?<CR><LF>
EnhancerEnable [EnhancerSelect]Edge	R/W	EDGEN	0: False 1: True	0	EDGEN=[Param.]<CR><LF> EDGEN?<CR><LF> (VideoProcessBypass=Off Only)
EnhancerEnable [EnhancerSelect]Color	R/W	COLEN	0: False 1: True	0	COLEN=[Param.]<CR><LF> COLEN?<CR><LF> (VideoProcessBypass=Off Only)
ColorEnhancerValue [ColorEnhancerSelect] Red	R/W	CEVALR	0 ~ 10	0	CEVALR=[Param.]<CR><LF> CEVALR?<CR><LF> (VideoProcessBypass=Off Only)
ColorEnhancerValue [ColorEnhancerSelect] Cyan	R/W	CEVALCY	0 ~ 10	0	CEVALCY=[Param.]<CR><LF> CEVALCY?<CR><LF> (VideoProcessBypass=Off Only)
ColorEnhancerValue [ColorEnhancerSelect] Green	R/W	CEVALG	0 ~ 10	0	CEVALG=[Param.]<CR><LF> CEVALG?<CR><LF> (VideoProcessBypass=Off Only)
ColorEnhancerValue [ColorEnhancerSelect] Magenta	R/W	CEVALMG	0 ~ 10	0	CEVALMG=[Param.]<CR><LF> CEVALMG?<CR><LF> (VideoProcessBypass=Off Only)
ColorEnhancerValue [ColorEnhancerSelect] Blue	R/W	CEVALB	0 ~ 10	0	CEVALB=[Param.]<CR><LF> CEVALB?<CR><LF> (VideoProcessBypass=Off Only)
ColorEnhancerValue [ColorEnhancerSelect] Yellow	R/W	CEVALYL	0 ~ 10	0	CEVALYL=[Param.]<CR><LF> CEVALYL?<CR><LF> (VideoProcessBypass=Off Only)
EdgeEnhancerLevel	R/W	EDGLV	0: Low 1: Middle 2: High 3: Strong	1	EDGLV=[Param.]<CR><LF> EDGLV?<CR><LF> (VideoProcessBypass=Off Only)
VideoSendMode	R/O	VSM	0: Normal Mode 1: TriggerSequencer Mode 2: CommandSequencer Mode 4: SensorMultiRoiMode* (* AP-1600T-PMCL Only)	0	VSM?<CR><LF>

Appendix (Command List)

*1 AcquisitionFramePeriod

*1: AcquisitionFramePeriod(Min): Different by Pixel Format, CIConfiguration and CL Clock Frequency

```
AcquisitionFramePeriod(Min) = ROUND( ( 1 / AcquisitionFrameRate(Max) ) x 1000000 )
[us]
```

Pixel Format	CI Configuration	CL Clock Frequency [MHz]	AcquisitionFrameRate(Max) [fps]		AcquisitionFramePeriod(Min) [us]	
			AP-1600T-PMCL	AP-3200T-PMCL	AP-1600T-PMCL	AP-3200T-PMCL
RGB8	Base	37.1	22.5	11.4	44444	87719
RGB8	Base	74.2	44.9	22.8	22272	43860
RGB8	Base	84.8	51.3	26	19493	38462
RGB10	Medium	37.1	22.5	11.4	44444	87719
RGB10	Medium	74.2	44.9	22.8	22272	43860
RGB10	Medium	84.8	51.3	26	19493	38462
RGB12	Medium	37.1	22.5	11.4	44444	87719
RGB12	Medium	74.2	44.9	22.8	22272	43860
RGB12	Medium	84.8	51.3	26	19493	38462
RGB8	Medium	37.1	44.8	22.7	22321	44053
RGB8	Medium	74.2	89.6	45.4	11161	22026
RGB8	Medium	84.8	102.3	51.9	9775	19268
RGB8	Full	37.1	59.6	30.2	16779	33113
RGB8	Full	74.2	119.3	55.6	8382	17986
RGB8	Full	84.8	126.1	55.6	7930	17986
RGB8	EightyBit	37.1	74.4	37.7	13441	26525
RGB8	EightyBit	74.2	126.1	55.6	7930	17986
RGB8	EightyBit	84.8	126.1	55.6	7930	17986

*2 Exposure Time

*2: Exposure Time (Max): Different by Pixel Format, CIConfiguration and CL Clock Frequency

< ExposureModeOption = Off >

TriggerMode[FrameStart] = Off

Max: (Frame Period※ - 18H) →refer to below chart

TriggerMode[FrameStart] = On

Max: 8sec

< ExposureModeOption = RCT >

(In this case, TriggerMode[FrameStart] change to On)

Max: (100ms - 18H)

※Frame Period = 1 / AcquisitionFrameRate

(AcquisitionFrameRate uses the fastest frame rate value at full size as the Default value)

Pixel Format	CI Configuration	CL Clock Frequency [MHz]	AcquisitionFrameRate(Default) [fps]		Exposure Time(Max)[us]	
			AP-1600T-PMCL	AP-3200T-PMCL	AP-1600T-PMCL	AP-3200T-PMCL
RGB8	Base	37.1	22.5	11.4	43102	85895
RGB8	Base	74.2	44.9	22.8	21905	43449
RGB8	Base	84.8	51.3	26	19213	38083
RGB10	Medium	37.1	22.5	11.4	43102	85895
RGB10	Medium	74.2	44.9	22.8	21905	43449
RGB10	Medium	84.8	51.3	26	19213	38083
RGB12	Medium	37.1	22.5	11.4	43102	85895
RGB12	Medium	74.2	44.9	22.8	21905	43449
RGB12	Medium	84.8	51.3	26	19213	38083
RGB8	Medium	37.1	44.8	22.7	21610	43031
RGB8	Medium	74.2	89.6	45.4	10982	21766
RGB8	Medium	84.8	102.3	51.9	9637	19084
RGB8	Full	37.1	59.6	30.2	16237	32315
RGB8	Full	74.2	119.3	55.6	8252	17775
RGB8	Full	84.8	126.1	55.6	7818	17800
RGB8	EightyBit	37.1	74.4	37.7	13019	25918
RGB8	EightyBit	74.2	126.1	55.6	7802	17775
RGB8	EightyBit	84.8	126.1	55.6	7818	17800

Miscellaneous

Troubleshooting

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

Power Supply and Connections

Issue: The POWER/TRIG LED remains lit amber and does not turn green, even after power is supplied to the camera.

Cause and Solution: Camera initialization may not be complete. Check the Camera Link cable connection.

Image Display

Issue: Gradation in dark areas is not noticeable.

Cause and Solution: 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

Issue: Settings cannot be saved to user memory.

Cause and Solution: You cannot save to user memory while images are being captured by the camera. Stop image capture before performing the save operation.

Issue: I want to restore the factory default settings.

Cause and Solution: Load **Default** under User Set Selector in the Feature Properties tab to restore the factory default settings.

Specifications

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Scanning system</td><td>Progressive scan, 1 tap</td></tr>
<tr><td>Synchronization</td><td>Internal</td></tr>
<tr><td>Interface</td><td>CameraLink (Version 2.0)</td></tr>
<tr><td>Image sensor</td><td>CMOS × 3</td></tr>
<tr><td>Image size (effective image)</td><td>AP-1600T-PMCL: 5.02mm (H) × 3.75mm (V) , 6.27 mm diagonal
AP-3200T-PMCL: 7.12mm (H) × 5.33mm (V) , 8.89 mm diagonal</td></tr>
<tr><td>Pixel size</td><td>3.45 (H) × 3.45 (V) μm</td></tr>
<tr><td>Effective image pixel output</td><td>AP-1600T-PMCL: 1456 (H) × 1088 (V)
AP-3200T-PMCL: 2064 (H) × 1544 (V)</td></tr>
<tr><td>Acquisition Frame Rate (Max)</td><td>
<table>
<tr><th colspan="2"></th><th>AP-1600T-PMCL</th><th>AP-3200T-PMCL</th></tr>
<tr><td>Base</td><td>RGB8</td><td>51.3 fps</td><td>26.0 fps</td></tr>
<tr><td>Medium</td><td>RGB8</td><td>102.4 fps</td><td>26.0 fps</td></tr>
<tr><td>Medium</td><td>RGB10</td><td>51.3 fps</td><td>26.0 fps</td></tr>
<tr><td>Medium</td><td>RGB12</td><td>51.3 fps</td><td>51.9 fps</td></tr>
<tr><td>Full</td><td>RGB8</td><td>126.1 fps</td><td>55.6 fps</td></tr>
<tr><td>EightyBit</td><td>RGB8</td><td>126.1 fps</td><td>55.6 fps</td></tr>
</table>
</td></tr>
<tr><td>EMVA 1288 parameters Absolute sensitivity Maximum SN ratio</td><td>AP-1600T-PMCL: At 12-bit output: 3.88p (λ=525nm), 40.66dB
AP-3200T-PMCL: At 12-bit output: 3.66p (λ=525nm), 40.37dB</td></tr>
<tr><td>Digital Image Output Format</td><td>
<table>
<tr><th colspan="2"></th><th>AP-1600T-PMCL</th><th>AP-3200T-PMCL</th></tr>
<tr><td colspan="2">Full</td><td>1456 (H) × 1088 (V)</td><td>2064 (H) × 1544 (V)</td></tr>
<tr><td rowspan="4">ROI</td><td>Width</td><td>96 ~ 1456 pixels
16 pixels / step</td><td>96 ~ 2064 pixels
16 pixels / step</td></tr>
<tr><td>Offset X</td><td>0 ~ 1440 pixels
16 pixels /step</td><td>0 ~ 2048 pixels
16 pixels /step</td></tr>
<tr><td>Height</td><td>2 ~ 1088 lines
2 line/step</td><td>2 ~ 1544 lines
2 line/step</td></tr>
<tr><td>Offset Y</td><td>0 ~ 1086 lines,
2 line / step</td><td>0 ~ 1542 lines,
2 line / step</td></tr>
<tr><td rowspan="4">Binning</td><td>H1</td><td>1456 (H)</td><td>2064 (H)</td></tr>
<tr><td>H2</td><td>728 (H)</td><td>1032 (H)</td></tr>
<tr><td>V1</td><td>1088 (V)</td><td>1544 (V)</td></tr>
<tr><td>V2</td><td>544 (V)</td><td>772 (V)</td></tr>
<tr><td colspan="2">PixelFormat</td><td colspan="2">RGB8, RGB10, RGB12</td></tr>
</table>
</td></tr>
<tr><td>Acquisition Mode</td><td>Continuous</td></tr>
<tr><td>Trigger Selector (Exposure)</td><td>FrameStart</td></tr>
<tr><td>ExposureMode</td><td>Off, Timed, TriggerWidth (PWC)</td></tr>
<tr><td>Trigger overlap</td><td>Off / Read out</td></tr>
</table>

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Trigger input signals</td><td>Low, High, Software, PulseGenerator0-3, UserOutput0-3, Line5-Opt In 1, Line6-Opt In 2, Line7-CC1, NAND 0 Out, NAND 1 Out</td></tr>
<tr><td>Opto filter</td><td>Off (Default) , 10 µs, 100 µs, 500 µs, 1ms, 5ms, 10ms</td></tr>
<tr><td>ExposureMode</td><td>
<table>
<tr><td rowspan="2">AP-1600T-PMCL</td><td>Timed: 15.26 µs (8bit /10bit) (Min) * ~ 8 s (Max)</td></tr>
<tr><td>TriggerWidth: 15.26 µs (8bit /10bit) (Min) * ~ ∞ (Max)</td></tr>
<tr><td rowspan="2">AP-3200T-PMCL</td><td>Timed: 14.73 µs (8bit/10bit) (Min) * ~ 8 s (Max)</td></tr>
<tr><td>TriggerWidth: 14.73 µs (8bit/10bit) (Min) * ~ ∞ (Max)</td></tr>
<tr><td colspan="2">* Performance verified for up to 1 second.</td></tr>
</table>
The actual exposure time will be consist of the image sensor’s offset duration added to the setting configured on the camera. For more information, see Exposure Mode.</td></tr>
<tr><td>Auto exposure (Exposure Auto)</td><td>Off / Continuous / Once</td></tr>
<tr><td>Auto exposure response speed (AGC/ASC Control Speed)</td><td>1 ~ 8</td></tr>
<tr><td>Video send mode</td><td>NormalMode, TriggerSequencerMode, CommandSequencerMode, SensorMultiMode</td></tr>
<tr><td>Digital I/O</td><td>LineSelector (12P) : GPIO IN / GPIO OUT</td></tr>
<tr><td>Black level adjustment</td><td>
<table>
<tr><td>Default level</td><td>8LSB@8bit</td></tr>
<tr><td rowspan="3">Video level adjustment range</td><td>DigitalAll : -133 ~ +255 LSB @12bit</td></tr>
<tr><td>DigitalRed : - 64 ~ +64 LSB @12bit</td></tr>
<tr><td>DigitalBlue : -64 ~ +64 LSB @12bit</td></tr>
<tr><td>Resolution adjustment</td><td>1LSB@12bit</td></tr>
</table>
</td></tr>
<tr><td>Gain adjustment</td><td>
<table>
<tr><td rowspan="2">Manual adjustment range</td><td>MasterMode</td><td>MasterMode
AnalogAll : 0dB ~ 18dB
AnalogRed : -6.5dB ~ 12dB
AnalogBlue : -6.5dB ~ 12dB
DigitalRed : -0.915dB ~ 0.828dB
DigitalBlue : -0.915dB ~ 0.828dB</td></tr>
<tr><td>IndividualMode</td><td>IndividualMode
AnalogAll : 0dB ~ 36.13dB
AnalogRed : 0dB ~ 36.13dB
AnalogBlue : 0dB ~ 36.13dB
DigitalRed : -0.915dB ~ 0.828dB
DigitalBlue : -0.915dB ~ 0.828dB</td></tr>
<tr><td>Auto gain</td><td colspan="2">Off, Continuous, Once</td></tr>
</table>
</td></tr>
<tr><td>White balance</td><td>
<table>
<tr><td rowspan="2">WBA</td><td>AnalogRed, AnalogBlue : -6.5dB ~ 12dB</td></tr>
<tr><td>DigitalRed, DigitalBlue : -0.915dB ~ 0.828dB</td></tr>
<tr><td>BalanceWhiteAuto</td><td>Off, Continuous, Once, ExposureContinuous, ExposureOnce, Preset3200K, Preset5000K, Preset6500K, Preset7500K</td></tr>
<tr><td>Area</td><td>16 (4 x 4) Area</td></tr>
<tr><td>Adjustment range</td><td>3000K ~ 9000K</td></tr>
</table>
</td></tr>
</table>

Item	Description		
Blemish correction	Detection	Detect white blemishes using threshhold values (100 steps available) (black blemish correction performed only at factory)	
	Correction	Interpolation using adjacent pixels (continuous blemishes not corrected)	
	Correctable pixels	200 pixels per sensor	
ALC	Can be adjusted automatically together with AGC and auto exposure control		
Gamma	0.45, 0.5, 0.55, 0.6, 0.65, 0.75, 0.8, 0.9, 1.0 (9 steps available)		
LUT	OFF: γ = 1.0, ON = 257 points can be set		
Vibration resistance	3G (20 Hz ~ 200 Hz X-Y-Z direction)		
Impact resistance	50G		
Power supply	12-pin connector	Input range	DC + 12 V ~ + 24 V ± 10% (via input terminal)
		Consumption	6.0 W (typ.) (default settings, 25 °C ambient temp., 12 V DC input) 7.6 W (max.)
	PoCL	Input range	DC +10 ~ + 13V
		Consumption	6.0 W (typ.) (default settings, 25 °C ambient temp., 12 V DC input) 7.4 W (max.)
Lens mount	C-mount: Lens mount protrusion length of 4 mm or less is supported		
Flange back	17.526, tolerance: 0 mm to -0.05 m		
Optical filter	IR cut filter		
Verified performance temperature / humidity	−5°C to +45°C* / 20% to 80% (non-condensing)		
Storage temperature / humidity	−25°C to +60°C / 20% to 80% (non-condensing)		
Regulations	CE (EN61000-6-2 and EN61000-6-3), FCC part 15 class B, RoHS, WEEE		
Dimensions (housing)	44 × 44 × 74 mm (WHD) (excluding mount protrusions)		
Weight	170 g		

Notes:

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

Cautions:

About the verified performance temperature

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

- The camera's internal temperature sensor detects temperatures of 72°C or less during operation.
- The top surface of the camera's casing is 57°C or less.

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

Package Contents

- Camera (1)
- Sensor protection cap (1)
- Dear customer (sheet) (1)

Optional Accessories (Sold Separately)

- MP-44 Tripod Adapter Plate

Frame Rate Reference

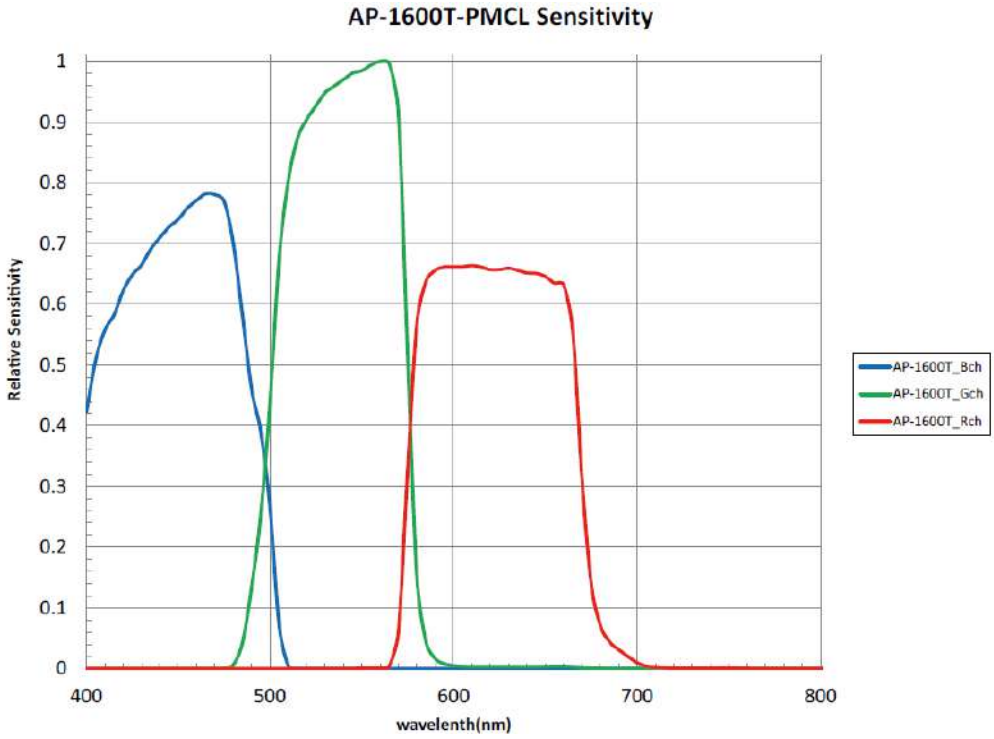
AP-1600T-PMCL

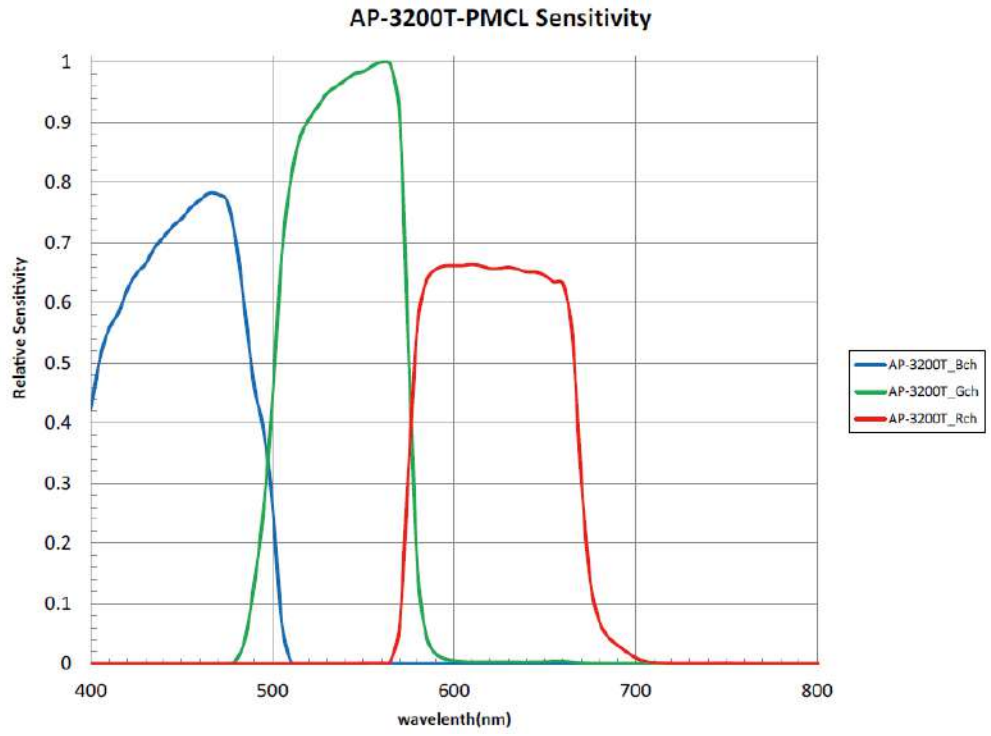
Pixel Count	Resolution (Screen Size)	ROI/Binning	PixelSize (µm)	Image Size (mm)	Frame Rate
1.6 MP	1456 × 1088	Full Pixel	3.45 × 3.45	5.02 x 3.75 (6.27)	126.1 fps (@24 bit)
1.3 MP	1280 × 1024	ROI	3.45 × 3.45	4.42 x 3.53 (5.66)	133.7 fps (@24bit)
0.5 MP	800 × 600	ROI	3.45 × 3.45	2.76 x 2.07 (3.45)	221.7 fps (@24bit)
0.3 MP	640 × 480	ROI	3.45 × 3.45	2.21 x 1.66 (2.76)	272.5 fps (@24bit)
0.3 MP	640 × 480	ROI + 2x2 Binning	6.9 × 6.9	4.42 x 3.31 (5.52)	488.6 fps (@24bit)

AP-3200T-PMCL

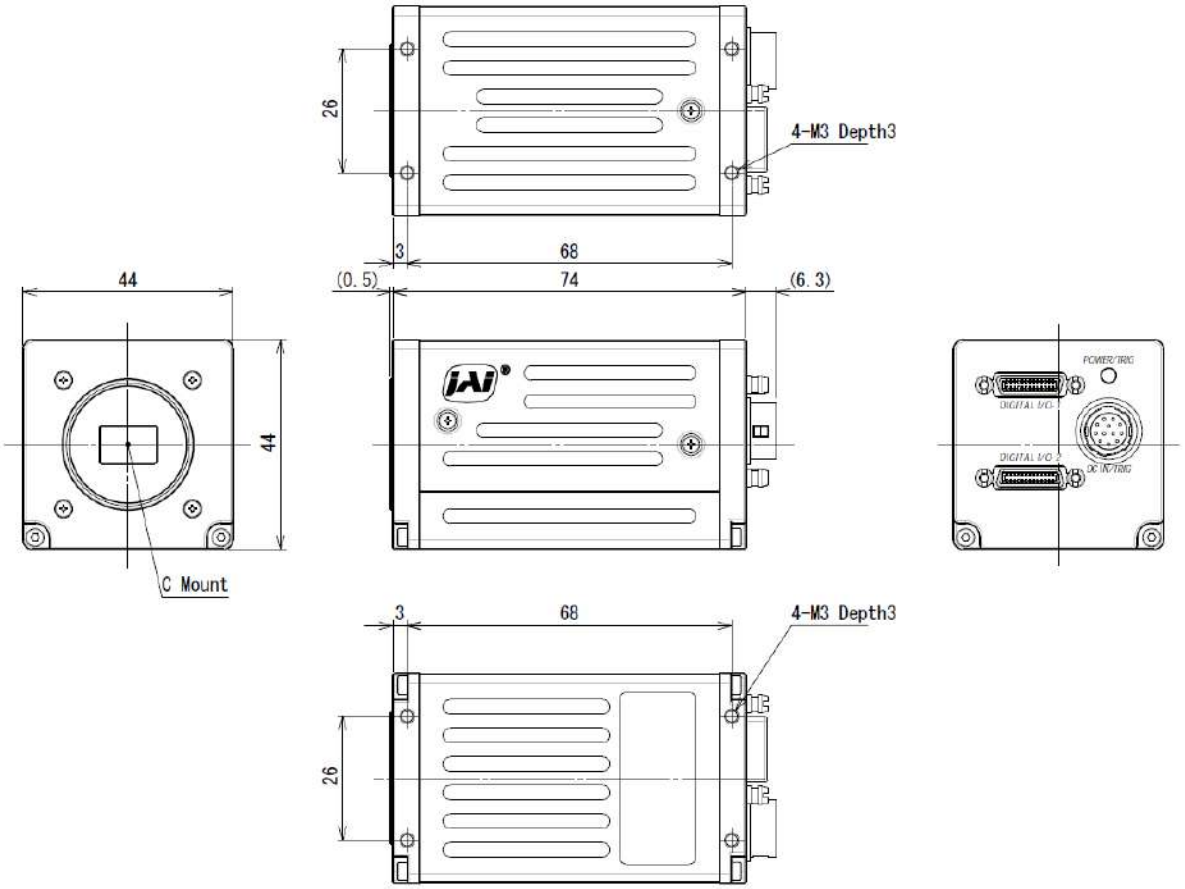
Pixel Count	Resolution (Screen Size)	ROI/Binning	PixelSize (µm)	Image Size (mm)	Frame Rate
3.2 MP	2064 × 1544	Full Pixel	3.45 × 3.45	1/1.8" (8.89 mm)	55.6 fps (@24 bit)
2 MP	1920 × 1080	ROI	3.45 × 3.45	1/2" (7.6 mm)	78.8 fps (@24 bit)
1.3 MP	1280 × 1024	ROI	3.45 × 3.45	1/2.8" (5.66 mm)	83.0 fps (@24 bit)
0.5 MP	800 × 600	ROI	3.45 × 3.45	1/4.6" (3.45 mm)	138.4 fps (@24 bit)
0.5 MP	800 × 600	ROI + 2 × 2 Binning	6.9 × 6.9	1/2.3" (6.9 mm)	138.4 fps (@24 bit)
0.3 MP	640 × 480	ROI	3.45 × 3.45	1/5.75" (2.76 mm)	170.8 fps (@24 bit)
0.3 MP	640 × 480	ROI + 2 × 2 Binning	6.9 × 6.9	1/2.9" (5.52 mm)	170.8 fps (@24 bit)

Spectral Response





Dimensions



Notes:

- Dimensional tolerance: ± 0.3mm
- Unit: mm

Comparison of the Decibel Display and Multiplier Display

Decibels (dB)	Multipliers (×)	Remarks
-6	0.501	Near minimum value of Gain[AnalogRed/AnalogBlue] 1)
-5	0.562	
-4	0.631	
-3	0.708	
-2	0.794	
-1	0.891	Near minimum value of Gain[DigitalRed/DigitalBlue] 2)
0	1	Minimum value of Gain[AnalogAll] Minimum value of Gain[AnalogIndividualRed/Green/Blue]
1	1.122	Near maximum value of Gain[DigitalRed/DigitalBlue] 3)
2	1.259	
3	1.413	
4	1.585	
5	1.778	
6	1.995	
7	2.239	
8	2.512	
9	2.818	
10	3.162	
11	3.548	
12	3.981	Near maximum value of Gain[AnalogRed/AnalogBlue] 4)
13	4.467	
14	5.012	
15	5.623	
16	6.31	
17	7.0790	
18	7.943	Near maximum value of Gain[AnalogAll] 5)
19	8.913	
20	10	
21	11.22	
22	12.589	
23	14.125	
24	15.849	
25	17.783	
26	19.953	
27	22.387	
28	25.119	
29	28.184	
30	31.623	
31	35.481	

Decibels (dB)	Multipliers (×)	Remarks
32	39.811	
33	44.668	
34	50.119	
35	56.235	
36	63.096	Near maximum value of Gain[AnalogIndividualRed/Green/Blue] 6)

Notes:

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

User's Record

Model name: ……

Revision: ……

Serial No: ……

Firmware version: ……

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

Revision History

Revision	Date	Device Version	Changes
2.0	2023/08/22	DV0206	• Combined the AP-1600T-PMCL and AP-3200T-PMCL user manuals, and the Short ASCII Command List. • Added ALCControlReference, ALCControlChannel, ALCControlMode, and ALCControlRatio (ALC (Automatic Level Control)). • Updated China RoHS. • Corrected/updated topics, including Binning Function, and Video Process Bypass Mode.

Previous Revisions

AP-1600T-PMCL

Revision	Date	Changes
1.4	July 2022	Corrected China RoHS, Added the Non-Volatile Flash Memory topic.
1.3	Jun. 2019	Fixed Vertical Timing Chart (LVAL)
1.2	Mar. 2019	Fixed Contents and Index
1.1	Nov. 2018	Added KC.
1.0	Apr. 2018	First Version

AP-3200T-PMCL

Revision	Date	Changes
1.3	July 2022	Corrected China RoHS, Added the Non-Volatile Flash Memory topic.
1.2	Jun. 2019	Fixed Vertical Timing Chart (LVAL)
1.1	Mar. 2019	Added KC. Fixed Contents and Index.
1.0	Apr. 2018	First Version

Trademarks

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