



*See the possibilities*

# *Spark Series*

## *User Manual*

# ***SP-5000M-PMCL*** ***SP-5000C-PMCL***

*5M CMOS Digital Progressive Scan  
Monochrome and Color Camera*

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## **Warranty**

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

## **Certifications**

### **CE compliance**

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that SP-5000M-PMCL and SP-5000C-PMCL comply with the following provisions applying to its standards.

EN 61000-6-3 (Generic emission standard part 1)  
EN 61000-6-2 (Generic immunity standard part 1)

### **FCC**

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

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

### **Warning**

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

## Supplement

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

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

### 重要注意事项

#### 有毒，有害物质或元素名称及含量表

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

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

○：表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006规定的限量要求以下。

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#### 环保使用期限

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数字「15」为期限15年。

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

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



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数字「15」为期限15年。

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## **Before using this camera**

### **EMVA 1288**

With regard to signal to noise ratio in this manual, specifications measured by EMVA 1288 are used together with specifications by a traditional measurement method.

EMVA 1288 is a more complete measurement that considers multiple noise sources, including random noise, pattern noise, and shading. Additionally, EMVA 1288 incorporates temporal variances in pixel output by capturing 100 frames of data and computing the RMS variations over the captured frames. Because of the comprehensive nature of the noise analysis and the additional consideration for RMS variances over time, EMVA 1288 SNR measurements are inherently lower than the traditional SNR measurements given by manufacturers. However, the comprehensive nature combined with rigid test parameters, means that all manufacturers' are measuring their products equally and EMVA 1288 tested parameters can be compared among different manufacturers' products.

In order to learn more about EMVA 1288, please visit <http://www.emva.org>

### **Frame grabber board**

The SP-5000M-PMCL and SP-5000C-PMCL comply with “Power over Camera Link” which enables power to be supplied to the camera through the Camera Link cable(s). Because the power requirements of the camera exceed the amount of power which can be provided over a single PoCL connection, power must be supplied via both Camera Link cables in order to utilize the PoCL capabilities. If you plan to use this function, please be sure that the frame grabber board you are using also complies with this specification. Alternatively, the camera can be powered via a separate power supply connected to the 12-pin Hirose connector.

The SP-5000M-PMCL and SP-5000C-PMCL employ output formats which comply with the GenICam® standard. They are 1X10-1Y (10-Tap output), 1X8-1Y (8-Tap output), 1X4-1Y (4-Tap output) and 1X2-1Y (2-Tap output). 1X10-1Y is available for 8-bit output, 1X8-1Y is available for 8-bit and 10-bit output, and 1X4-1Y and 1X2-1Y are available for 8-bit, 10-bit and 12-bit output. Please check if the frame grabber used in the system complies with the mentioned formats.

### **Camera control tool**

The SP-5000M-PMCL and SP-5000C-PMCL are designed to use the JAI SDK and Control Tool software to control camera functions. All controllable functions are stored in the camera's XML file. The JAI SDK can be downloaded from [www.jai.com](http://www.jai.com).

A camera control tool for using the Short ASCII command protocol is not available on the JAI website. Please contact your local JAI representative if this is required.

## 1. General

The SP-5000M-PMCL and SP-5000C-PMCL are among the first new “Spark Series” cameras to be introduced. They provide both high resolution and a high frame rate with excellent image quality for machine vision applications. The SP-5000M-PMCL is a monochrome progressive scan COMS camera and the SP-5000C-PMCL is the equivalent Bayer mosaic progressive scan CMOS camera. Both are equipped with CMOS sensors offering a 1-inch image format, a resolution of 5 million pixels, and a 5:4 aspect ratio. They provide a maximum of 134 frames per second for continuous scanning with 2560 x 2048 full pixel resolution in 1x10-1Y output format.

8-bit, 10-bit or 12-bit output can be selected for both monochrome and raw Bayer formats. The new cameras feature a Mini Camera Link interface supporting a “Power over Camera Link” capability. A full pixel readout or partial scan readout mode can be selected depending on applications. The readout format is available for 10-tap, 8-tap, 4-tap or 2-tap output.

The SP-5000M-PMCL and SP-5000C-PMCL have various comprehensive functions needed for automated optical inspection applications, such as solid state device inspection or material surface inspection. They incorporate video processing functions such as a look-up table, flat field shading compensation and blemish compensation in addition to fundamental functions such as trigger, exposure setting and video level control.

The latest version of this manual can be downloaded from: [www.jai.com](http://www.jai.com)

The latest version of the JAI SDK for the SP-5000M-PMCL and SP-5000C-PMCL can be downloaded from: [www.jai.com](http://www.jai.com)

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

## 2. Camera composition

The standard camera composition is as follows.

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

The following optional accessories are available.

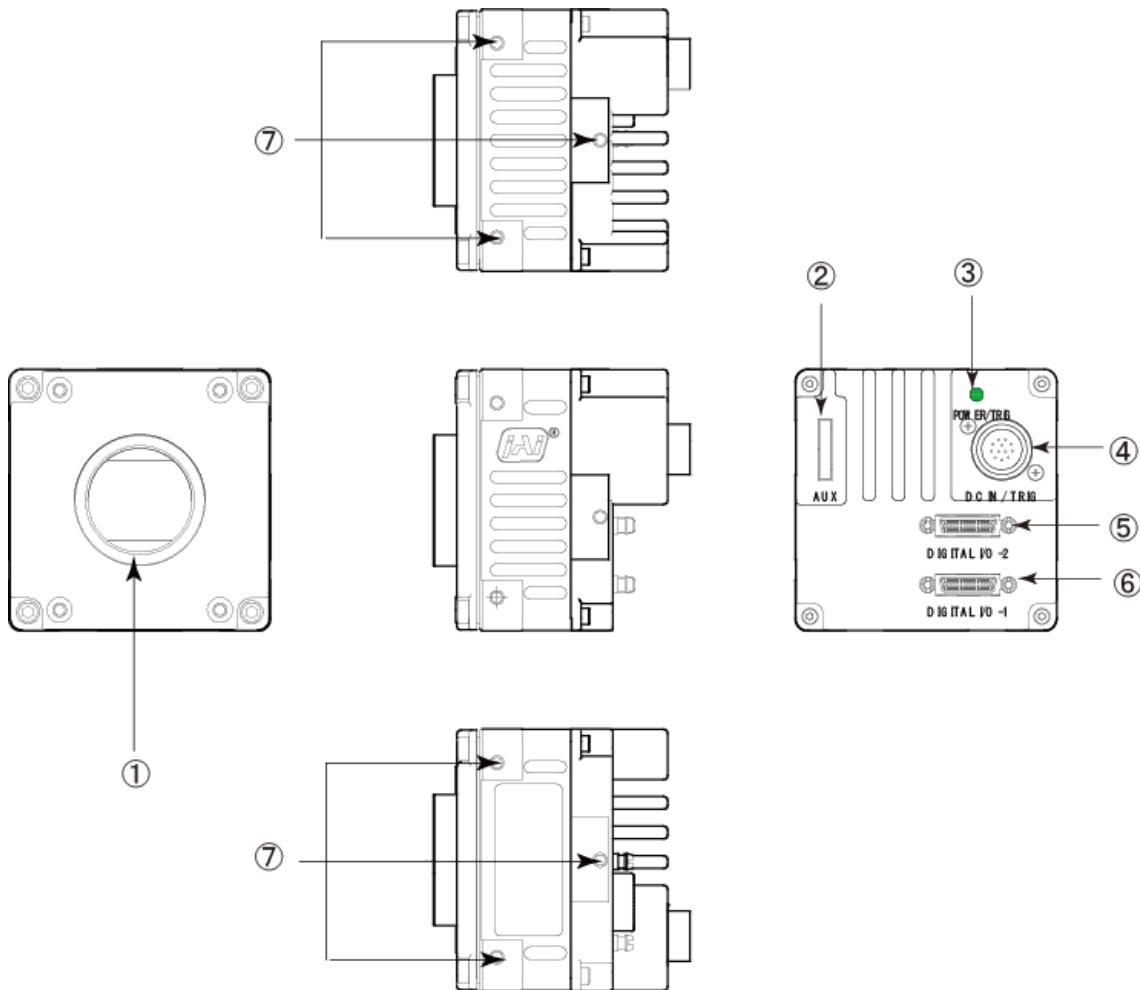
Tripod base	MP-42
Power supply unit	PD-12 series

### **3. Key features**

- New Spark Series 1-inch CMOS 5-megapixel progressive scan camera
- Utilizes Mini Camera Link interface in Medium or Full configurations
- Aspect ratio 5:4, 2560 (H) x 2048 (V) - 5 million effective pixels
- 5  $\mu\text{m}$  square pixels
- S/N 55dB for monochrome and 53dB for color (traditional measurement method)
- 8-bit, 10-bit or 12-bit output for monochrome and Bayer
- 134 frames/second with full resolution in continuous operation for 10-tap output, 120 frames/second for 8-tap output
- Supports ROI (Region Of Interest) modes for faster frame rate
- 0dB to +24dB gain control for both SP-5000M-PMCL and SP-5000C-PMCL
- 10  $\mu\text{s}$  (1/100,000) to 8 seconds exposure control in 1  $\mu\text{s}$  step
- Auto exposure control
- Timed and trigger width exposure control
- RCT and PIV trigger modes for specific applications
- ALC control with combined function of AGC, Auto Shutter and Auto Iris
- Various pre-processing circuits are provided
  - Programmable LUT
  - Gamma correction from 0.45 to 1.0
  - Shading correction
  - Bayer white balance with manual or one-push auto (SP-5000C-PMCL only)
  - Blemish compensation
  - HDR (High Dynamic Range) function (SP-5000M-PMCL only)
- Auto iris lens video output with H-sync
- New Hirose 10P connector for motorized lenses and P-iris lens control as standard and video/DC iris or TTL IN and OUT and LVDS IN interfaces as options
- C-mount for lens mount
- Accepts power over Mini Camera Link or via 12-pin connector
- Setup by Windows XP/Vista/7/8 via serial communication

## 4. Parts locations and their functions

### 4.1 Parts locations and their functions



- |   |                         |  |
|---|-------------------------|--|
| ① | Lens mount              | C-mount (Note *1)  |
| ② | 10-pin connector        | AUX interface connector  |
| ③ | LED                     | Indication for power and trigger input   |
| ④ | 12-pin connector        | DC+12V and trigger input   |
| ⑤ | Camera Link Connector 2 | Digital video output (Medium and Full configuration) (Note *2)                         |
| ⑥ | Camera Link Connector 1 | Digital video output (Base, Medium and Full config.) (Note *2)                         |
| ⑦ | Mounting holes          | M3 depth 5mm for fixing the camera to the tripod base or direct installation (Note *3) |

\*1) Note: Rear protrusion on C-mount lens must be less than 10.0 mm.

\*2) Note: When a Camera Link cable is connected to the camera, please do not excessively tighten screws by using a driver. The Camera Link receptacle on the camera might be damaged. For security, the strength to tighten screws is less than 0.147 Newton meter (Nm). Tightening by hand is sufficient in order to achieve this.

\*3) Note: The part number for the tripod adapter plate (with 1/4"-20 thread) is MP-42 (option).

Fig. 1 Locations

## **4.2 Rear Panel**

The rear panel mounted LED provides the following information:

- Amber: Power connected - initiating  
This light goes OFF after initiating.
- Steady green: Camera is operating in Continuous mode
- Flashing green: The camera is receiving external triggering

Note: The interval of flashing does not correspond with external trigger duration.

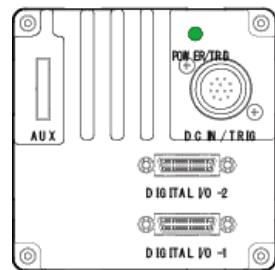


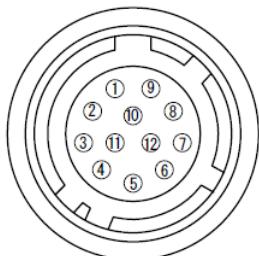
Fig. 2 Rear panel

## 5. Input and output

### 5.1 Connector and its pin configuration

#### 5.1.1 12-Pin connector

##### 5.1.1.1 Figure



Type: HR-10A-10R-12PB(72) Hirose male or equivalent

Fig.3 Hirose 12-pin connector

##### 5.1.1.2 Pin configuration

Table 1 12-pin configuration

Pin no.	Signal	Remarks
1	GND	
2	DC input	+12V ~ +24V (note 3)
3	GND	
4	Video Iris	Video signal output for lens auto iris
5	NC	
6	NC	
7	NC	
8	NC	
9	TTL out 1	Line1 (note 1)
10	TTL In 1	Line4 (note 2)
11	DC input	+12V ~ +24V (note 3)
12	GND	

Note 1) Factory default setting is Exposure Active and negative

Exposure Active inside the camera is positive but for the output, it is inverted to negative.

Note 2) Factory default setting is trigger input.

Note 3) See page 6 for notes about power options for these cameras

#### 5.1.2 Camera Link Connector

##### 5.1.2.1 Figure

Type: 26-pin Mini Camera Link connector (Honda HDR-EC26FYTG2-SL+) See page 6 for notes about Power over Camera Link (PoCL) options for this camera.

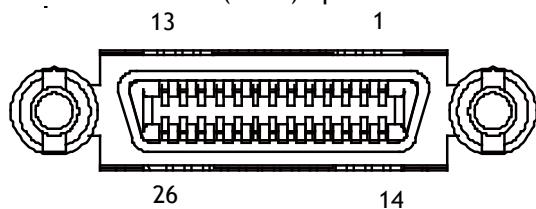


Fig.4 Camera Link connector

### 5.1.2.2 Pin assignment

Table-2 Camera link pin configuration - connector 1

Pin No	In/Out	Name	Note
1,26		Power	Power
2(-),15(+)	O	X_OUT0	Data output
3(-),16(+)	O	X_OUT1	
4(-),17(+)	O	X_OUT2	
5(-),18(+)	O	X_Clk	Clock for CL
6(-),19(+)	O	X_OUT3	Data output
7(+),20(-)	I	SerTC (RxD)	LVDS serial control
8(-),21(+)	O	SerTFG (TxD)	
9(-),22(+)	I	CC1 (Trigger)	Trigger input
10(+),23(-)		CC1 (Reserved)	
11,24		N.C	
12,25		N.C	
13,14		Shield	Power Return

Camera Link connector 2

Pin No	In/Out	Name	Note
1,26		Power	Power
2(-),15(+)	O	Y_OUT0	Data output
3(-),16(+)	O	Y_OUT1	
4(-),17(+)	O	Y_OUT2	
5(-),18(+)	O	Y_Clk	Clock for CL
6(-),19(+)	O	Y_OUT3	Data output
7(+),20(-)	I	N.C	
8(-),21(+)	O	Z_OUT0	Data output
9(-),22(+)	I	Z_OUT1	
10(+),23(-)		Z_OUT2	
11,24		Z_Clk	Clock for CL
12,25		Z_OUT3	Data output
13,14		Shield	Power Return

### 5.1.3 AUX Standard Hirose 10-Pin connector

#### 5.1.3.1 Figure and pin configuration

Type : HIROSE 10-Pin Connector 3260-10S3(55)

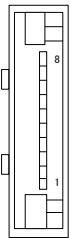


Fig.5 Hirose 10-pin connector

Table -3 AUX Standard Hirose 10-pin connector pin assignment

No	I/O	Name	Note
1	O	DRIVE IRIS+	Motorized Lens
2	O	DRIVE FOCUS+	Motorized Lens
3	O	DRIVE ZOOM+	Motorized Lens
4	O	COMMON	Motorized Lens
5		GND	
6	O	P-IRIS OUT1A	P-Iris Lens
7	O	P-IRIS OUT1B	P-Iris Lens
8	O	P-IRIS OUT2A	P-Iris Lens
9	O	P-IRIS OUT2B	P-Iris Lens
10	O	GND	

#### 5.1.4 AUX Type 2 HIROSE 10-Pin connector (factory option)

Type: HIROSE 10-Pin Connector 3260-10S3(55)

Table-4 10-pin pin configuration (option)

No	I/O	Name	Note
1	O	Video Signal	Video Iris Lens
2	O	Power DC+12V	Video Iris Lens
3		NC	
4		NC	
5		GND	
6	O	DC IRIS DAMP-	DC Iris
7	O	DC IRIS DAMP+	DC Iris
8	O	DC IRIS DRIVE+	DC Iris
9	O	DC IRIS DRIVE-	DC Iris
10		GND	

#### 5.1.5 AUX Type 3 HIROSE 10-Pin connector (factory option)

HIROSE 10-Pin Connector 3260-10S3(55)

Table - 5 10-pin pin configuration (option)

No	I/O	Name	Note
1	O	TTL OUT2	Line8
2	O	TTL OUT3	Line9
3	I	TTL_IN2	Line10
4		NC	
5		GND	
6	I	LVDS_IN1+	Line11
7	I	LVDS_IN1-	
8		NC	
9		GND	
10		GND	

# SP-5000M-PMCL / SP-5000C-PMCL

## 5.2 Camera Link interface

### 5.2.1 Camera Link Interface

Table-6 Camera Link interface

SP-5000M/C-PMCL							
Port	Camera Link Configuration		Base	Medium	Full	80bit	Full
	Camera Link port/bit		2Tap / 12bit	4Tap / 12bit	8 Tap / 8bit	8 Tap / 10bit	10 Tap / 8bit
	GenlCam Tap Geometry		1X2 - 1Y	1X4 - 1Y	1x8 - 1Y	1X8 - 1Y	1X10 - 1Y
D	Port A0	TxIN 0	Tap1 D0	Tap1 D0	Tap1 D0	Tap1 D2	Tap1 D0
	Port A1	TxIN 1	Tap1 D1	Tap1 D1	Tap1 D1	Tap1 D3	Tap1 D1
	Port A2	TxIN 2	Tap1 D2	Tap1 D2	Tap1 D2	Tap1 D4	Tap1 D2
	Port A3	TxIN 3	Tap1 D3	Tap1 D3	Tap1 D3	Tap1 D5	Tap1 D3
	Port A4	TxIN 4	Tap1 D4	Tap1 D4	Tap1 D4	Tap1 D6	Tap1 D4
	Port A5	TxIN 6	Tap1 D5	Tap1 D5	Tap1 D5	Tap1 D7	Tap1 D6
	Port A6	TxIN 27	Tap1 D6	Tap1 D6	Tap1 D6	Tap1 D8	Tap4 D1
	Port A7	TxIN 5	Tap1 D7	Tap1 D7	Tap1 D7	Tap1 D9	Tap1 D5
	Port B0	TxIN 7	Tap1 D8	Tap1 D8	Tap2 D0	Tap2 D2	Tap1 D7
	Port B1	TxIN 8	Tap1 D9	Tap1 D9	Tap2 D1	Tap2 D3	Tap2 D0
	Port B2	TxIN 9	Tap1 D10	Tap1 D10	Tap2 D2	Tap2 D4	Tap2 D1
	Port B3	TxIN 12	Tap1 D11	Tap1 D11	Tap2 D3	Tap2 D5	Tap2 D4
	Port B4	TxIN 13	Tap2 D8	Tap2 D8	Tap2 D4	Tap2 D6	Tap2 D5
	Port B5	TxIN 14	Tap2 D9	Tap2 D9	Tap2 D5	Tap2 D7	Tap2 D6
I	Port B6	TxIN 10	Tap2 D10	Tap2 D10	Tap2 D6	Tap2 D8	Tap2 D2
	Port B7	TxIN 11	Tap2 D11	Tap2 D11	Tap2 D7	Tap2 D9	Tap2 D3
	Port C0	TxIN 15	Tap2 D0	Tap2 D0	Tap3 D0	Tap3 D2	Tap2 D7
	Port C1	TxIN 18	Tap2 D1	Tap2 D1	Tap3 D1	Tap3 D3	Tap3 D2
	Port C2	TxIN 19	Tap2 D2	Tap2 D2	Tap3 D2	Tap3 D4	Tap3 D3
	Port C3	TxIN 20	Tap2 D3	Tap2 D3	Tap3 D3	Tap3 D5	Tap3 D4
	Port C4	TxIN 21	Tap2 D4	Tap2 D4	Tap3 D4	Tap3 D6	Tap3 D5
	Port C5	TxIN 22	Tap2 D5	Tap2 D5	Tap3 D5	Tap3 D7	Tap3 D6
	Port C6	TxIN 16	Tap2 D6	Tap2 D6	Tap3 D6	Tap3 D8	Tap3 D0
	Port C7	TxIN 17	Tap2 D7	Tap2 D7	Tap3 D7	Tap3 D9	Tap3 D1
	-	TxIN 24	LVAL	LVAL	LVAL	LVAL	LVAL
	-	TxIN 25	FVAL	FVAL	FVAL	FVAL	FVAL
	(Port I0)	TxIN 26	DVAL	DVAL	DVAL	Tap1 D0	Tap4 D0
	(Port I1)	TxIN 23	Exposure Active	Exposure Active	Exposure Active	Tap1 D1	Tap3 D7

SP-5000M/C-PMCL							
Port	Camera Link Configuration		Base	Medium	Full	80bit	Full
	Camera Link port/bit		2Tap / 12bit	4Tap / 12bit	8 Tap / 8bit	8 Tap / 10bit	10 Tap / 8bit
	GenlCam Tap Geometry		1X2 - 1Y	1X4 - 1Y	1x8 - 1Y	1X8 - 1Y	1X10 - 1Y
D	Port D0	TxIN 0	—	Tap4 D0	Tap4 D0	Tap4 D2	Tap4 D2
	Port D1	TxIN 1	—	Tap4 D1	Tap4 D1	Tap4 D3	Tap4 D3
	Port D2	TxIN 2	—	Tap4 D2	Tap4 D2	Tap4 D4	Tap4 D4
	Port D3	TxIN 3	—	Tap4 D3	Tap4 D3	Tap4 D5	Tap4 D5
	Port D4	TxIN 4	—	Tap4 D4	Tap4 D4	Tap4 D6	Tap4 D6
	Port D5	TxIN 6	—	Tap4 D5	Tap4 D5	Tap4 D7	Tap5 D0
	Port D6	TxIN 27	—	Tap4 D6	Tap4 D6	Tap4 D8	LVAL
	Port D7	TxIN 5	—	Tap4 D7	Tap4 D7	Tap4 D9	Tap4 D7
	Port E0	TxIN 7	—	Tap3 D0	Tap5 D0	Tap5 D2	Tap5 D1
	Port E1	TxIN 8	—	Tap3 D1	Tap5 D1	Tap5 D3	Tap5 D2
	Port E2	TxIN 9	—	Tap3 D2	Tap5 D2	Tap5 D4	Tap5 D3
	Port E3	TxIN 12	—	Tap3 D3	Tap5 D3	Tap5 D5	Tap5 D6
	Port E4	TxIN 13	—	Tap3 D4	Tap5 D4	Tap5 D6	Tap5 D7
	Port E5	TxIN 14	—	Tap3 D5	Tap5 D5	Tap5 D7	Tap6 D0
I	Port E6	TxIN 10	—	Tap3 D6	Tap5 D6	Tap5 D8	Tap5 D4
	Port E7	TxIN 11	—	Tap3 D7	Tap5 D7	Tap5 D9	Tap5 D5
	Port F0	TxIN 15	—	Tap3 D8	Tap6 D0	Tap6 D2	Tap6 D1
	Port F1	TxIN 18	—	Tap3 D9	Tap6 D1	Tap6 D3	Tap6 D4
	Port F2	TxIN 19	—	Tap3 D10	Tap6 D2	Tap6 D4	Tap6 D5
	Port F3	TxIN 20	—	Tap3 D11	Tap6 D3	Tap6 D5	Tap6 D6
	Port F4	TxIN 21	—	Tap4 D8	Tap6 D4	Tap6 D6	Tap6 D7
	Port F5	TxIN 22	—	Tap4 D9	Tap6 D5	Tap6 D7	Tap7 D0
	Port F6	TxIN 16	—	Tap4 D10	Tap6 D6	Tap6 D8	Tap6 D2
	Port F7	TxIN 17	—	Tap4 D11	Tap6 D7	Tap6 D9	Tap6 D3
	-	TxIN 24	—	LVAL	LVAL	LVAL	Tap7 D2
	(Port I2)	TxIN 25	—	FVAL	FVAL	Tap2 D0	Tap7 D3
	(Port I3)	TxIN 26	—	DVAL	DVAL	Tap2 D1	Tap7 D4
	(Port I4)	TxIN 23	—	Exposure Active	Exposure Active	Tap3 D0	Tap7 D1

SP-5000M/C-PMCL							
Port	Camera Link Configuration		Base	Medium	Full	80bit	
	Camera Link port/bit		2Tap / 12bit	4Tap / 12bit	8 Tap / 8bit	8 Tap / 10bit	
	GenICam Tap Geometry		1X2 - 1Y	1X4 - 1Y	1x8 - 1Y	1X8 - 1Y	
Digital I/O	Port G0	TxIN 0	—	—	Tap 7 D0	Tap 7 D2	Tap7 D5
	Port G1	TxIN 1	—	—	Tap 7 D1	Tap 7 D3	Tap7 D6
	Port G2	TxIN 2	—	—	Tap 7 D2	Tap 7 D4	Tap7 D7
	Port G3	TxIN 3	—	—	Tap 7 D3	Tap 7 D5	Tap8 D0
	Port G4	TxIN 4	—	—	Tap 7 D4	Tap 7 D6	Tap8 D1
	Port G5	TxIN 6	—	—	Tap 7 D5	Tap 7 D7	Tap8 D3
	Port G6	TxIN 27	—	—	Tap 7 D6	Tap 7 D8	LVAL
	Port G7	TxIN 5	—	—	Tap 7 D7	Tap 7 D9	Tap8 D2
	Port H0	TxIN 7	—	—	Tap 8 D0	Tap 8 D2	Tap8 D4
	Port H1	TxIN 8	—	—	Tap 8 D1	Tap 8 D3	Tap8 D5
	Port H2	TxIN 9	—	—	Tap 8 D2	Tap 8 D4	Tap8 D6
	Port H3	TxIN 12	—	—	Tap 8 D3	Tap 8 D5	Tap 9 D1
	Port H4	TxIN 13	—	—	Tap 8 D4	Tap 8 D6	Tap 9 D2
	Port H5	TxIN 14	—	—	Tap 8 D5	Tap 8 D7	Tap 9 D3
	Port H6	TxIN 10	—	—	Tap 8 D6	Tap 8 D8	Tap8 D7
	Port H7	TxIN 11	—	—	Tap 8 D7	Tap 8 D9	Tap 9 D0
	(Port I5)	TxIN 15	—	—		Tap 3 D1	Tap 9 D4
	(Port I6)	TxIN 18	—	—		Tap 4 D0	Tap 9 D7
	(Port I7)	TxIN 19	—	—		Tap 4 D1	Tap10 D0
	(Port K0)	TxIN 20	—	—		Tap 5 D0	Tap10 D1
	(Port K1)	TxIN 21	—	—		Tap 5 D1	Tap10 D2
	(Port K2)	TxIN 22	—	—		Tap 6 D0	Tap10 D3
	(Port K3)	TxIN 16	—	—		Tap 6 D1	Tap 9 D5
	(Port K4)	TxIN 17	—	—		Tap 7 D0	Tap 9 D6
	-	TxIN 24	—	—	LVAL	LVAL	Tap10 D5
	(Port K5)	TxIN 25	—	—	FVAL	Tap 7 D1	Tap10 D6
	(Port K6)	TxIN 26	—	—	DVAL	Tap 8 D0	Tap10 D7
	(Port K7)	TxIN 23	—	—	Exposure Active	Tap 8 D1	Tap10 D4

**Note**

- In this table, not all tap geometry items are described. For instance, 1X4-1Y shows only 12-bit. In case of 10-bit, upper 2 bits (D10 and D11) are not used and in case of 8-bit, upper 4 bits (D8 through D11) are not used.
- Please check whether the frame grabber complies with those formats if you use 80-bit (8-tap/10-bit) camera configuration.
- If you use 80-bit (8-tap/10-bit) camera configuration, DVAL and Exposure Active (JAI custom) are not output through the Camera Link interface. FVAL is only output via Digital I/O-1 connector.

**5.2.2 Camera Link pixel clock frequency**

In the SP-5000M-PMCL and SP-5000C-PMCL, the Camera Link pixel clock can be selected from 82.3 MHz, 75.4 MHz and 61.7 MHz. If the 61.7 MHz clock is used, the transfer length through the camera link cable will be extended to 10m. On the other hand, the frame rate will be reduced. The default setting is 82.3 MHz.

Camera Link Pixel Clock	Maximum length	1X2-1Y	1X4-1Y	1X8-1Y	1X10-1Y
61.7 MHz	10 m	23 fps	—	—	—
	7 m		46 fps	93 fps	115 fps
75.4 MHz	7 m	28 fps	56 fps	112 fps	—
	5 m				134 fps
82.3 MHz	5 m	30 fps	61 fps	120 fps	134 fps

Note: The maximum lengths shown in the above table are guidelines. Operating at these lengths may generate bit noise, depending on the cable used.

## 5.3 Digital IN/OUT interface

In the SP-5000M-PMCL and SP-5000C-PMCL, the software control tool can assign the necessary signals used in the system to digital inputs and outputs (see Section 5.3.7.1 for block diagram).

### 5.3.1 Line Selector

In the Line Selector, the following input and output signals can be assigned.

Table-7 Line selector

Line Selector item	Description
Line 1 TTL 1 Out	TTL 1 output from Hirose 12P #9 pin
Line 8 TTL 2 OUT	TTL 2 output from AUX Hirose 10P #1 pin
Line 10 TTL 3 OUT	TTL 3 output from AUX Hirose 10P #2 pin
NAND 0 IN 1	No. 1 input to the first NAND gate
NAND 0 IN 2	No. 2 input to the first NAND gate
NAND 1 IN 1	No. 1 input to the second NAND gate
NAND 1 IN 2	No. 2 input to the second NAND gate

### 5.3.2 Line Source

Line source signal can be selected from the following table to connect it to the line item which is selected in the line selector.

Table-8 Line Source

Line Source item	Description
Low	Connect Low Level signal to line item selected in Line Selector, <b>Default setting</b>
High	Connect High Level signal to line item selected in Line Selector
Frame Trigger Wait	Connect Frame Trigger Wait signal to line item selected in Line Selector
Frame Active	Connect Frame Active signal to line item selected in Line Selector
Exposure Active	Connect Exposure Active signal to line item selected in Line Selector
FVAL	Connect FVAL signal to line item selected in Line Selector
LVAL	Connect LVAL signal to line item selected in Line Selector
PulseGenerator0 Out	Connect Pulse Generator 0 signal to line item selected in Line Selector
PulseGenerator1 Out	Connect Pulse Generator 1 signal to line item selected in Line Selector
PulseGenerator2 Out	Connect Pulse Generator 2 signal to line item selected in Line Selector
PulseGenerator3 Out	Connect Pulse Generator 3 signal to line item selected in Line Selector
TTL 1 In	Connect TTL 1 IN signal to line item selected in Line Selector
CL CC1 In	Connect CL CC1 IN signal to line item selected in Line Selector
NAND 0 Out	Connect NAND 0 signal to line item selected in Line Selector
NAND 1 Out	Connect NAND 1 signal to line item selected in Line Selector
Line 10 TTL 2 In	Connect TTL 2 IN signal to Line 10 (Option)
Line 11 LVDS 1 In	Connect LVDS 1 IN signal to Line 11 (Option)
Note]	
As for LVAL, some line items cannot be connected. Refer to "5.3.7.2 GPIO matrix table"	

### 5.3.3 Line Mode

Indicates the status of the item selected in Line Selector. (INPUT or OUTPUT)

### 5.3.4 Line Inverter

Inverts the signal polarity for the item selected in Line Selector.  
(False=Positive, True=Negative)

### 5.3.5 Line Status

Indicates the status of the selected signal (input or output) (True=High, False=Low)

### 5.3.6 Line Format

Indicates the interface information of the input and output lines.

Not connected, TTL, LVDS or Opto-coupled

Note: In the SP-5000-PMCL, Opto-coupled interface is not available.

### 5.3.7 GPIO

GPIO is a general interface for input and output and controls the I/O for trigger signals and other valid signals and pulse generators. By using this interface you can control an external light source, make a delay function for an external trigger signal, or make a precise exposure setting together with a PWC trigger.

#### 5.3.7.1 Basic block diagram

The basic block diagram is as follows.

In the SP-5000-PMCL, the pixel clock is 48 MHz.

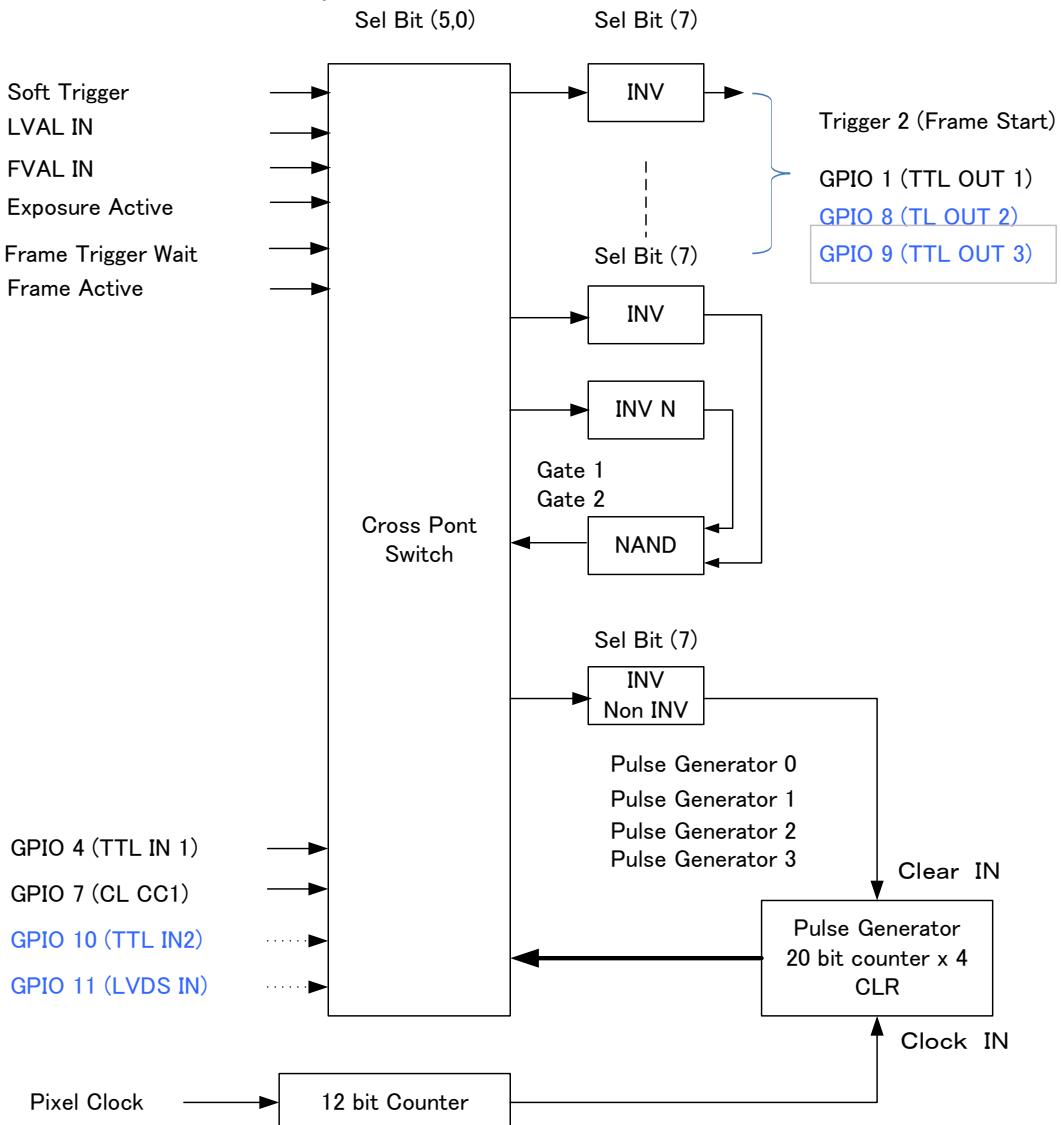


Fig.6      GPIO interface

Note: Items written in blue letters are available if the AUX Type 3 option is selected.

### 5.3.7.2 Input and output matrix table

The relation between input and output is as follows.

Table-9 GPIO matrix table

Selector (Cross point switch output)	Trigger Selector	Line Selector						Pulse Generator Selector				
		Line 1 - 12P TTL Out	Line 8 - TTL 2 Out	Line 9 - TTL 3 Out	NAND 1 In 1	NAND 1 In 2	NAND 2 In 1	NAND 2 In 2	Pulse Generator 0	Pulse Generator 1	Pulse Generator 2	Pulse Generator 3
Source signal (Cross point switch input)	Trigger Source (Frame Start)											
Low	○	○	○	○	○	○	○	○	○	○	○	○
High	○	○	○	○	○	○	○	○	○	○	○	○
Soft Trigger	○	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Exposure Active	✗	○	○	○	○	○	○	○	○	○	○	○
Frame Trigger Wait	✗	○	○	○	○	○	○	○	○	○	○	○
Frame Active	✗	○	○	○	○	○	○	○	○	○	○	○
FVAL	✗	○	○	○	○	○	○	○	○	○	○	○
LVAL	✗	✗	✗	✗	✗	✗	✗	✗	○	○	○	○
Pulse Generator 0	○	○	○	○	○	○	○	○	✗	○	○	○
Pulse Generator 1	○	○	○	○	○	○	○	○	○	✗	○	○
Pulse Generator 2	○	○	○	○	○	○	○	○	○	○	✗	○
Pulse Generator 3	○	○	○	○	○	○	○	○	○	○	○	✗
Line 4 - TTL In1	○	○	○	○	○	○	○	○	○	○	○	○
Line 7 - CL CC1 in	○	○	○	○	○	○	○	○	○	○	○	○
NAND 0 Out	○	○	○	○	✗	✗	○	○	○	○	○	○
NAND 1 Out 1	○	○	○	○	○	○	✗	✗	○	○	○	○
Line 10 - TTL 2 In	○	○	○	○	○	○	○	○	○	○	○	○
Line 11 - LVDS 1 In	○	○	○	○	○	○	○	○	○	○	○	○
	Trigger Source	Line Source						Pulse Generator Clear Source				

Note: In the above table, TTL 2 IN, LVDS IN, TTL 2 Out and TTL 3 Out are available only if AUX Type 3 option is used.

## 5.4 Pulse Generator

The SP-5000-PMCL has a frequency divider using the sensor clock as the basic clock and four pulse generators. In each Pulse Generator, various Clear settings are connected to GPIO. The following shows Pulse Generator default settings.

Table - 10 Pulse Generator default settings

Display Name	Value								
Clock Pre-scaler	1								
Pulse Generator Selector	Pulse Generator								
	Length	Start Point	End Point	Repeat Count	Clear Source	Clear Inverter	Clear Activation	Clear Sync Mode	
	- Pulse Generator 0	1	0	1	0	Off	True	Off	Async Mode
	- Pulse Generator 1	1	0	1	0	Off	True	Off	Async Mode
	- Pulse Generator 2	1	0	1	0	Off	True	Off	Async Mode
	- Pulse Generator 3	1	0	1	0	Off	True	Off	Async Mode

Note:]

When Pulse Generator Repeat Count is set to "0", the camera is operating in free-running mode. However, based on the above default settings, Length=1, Start Point=0 and End Point=1, Pulse Generator stops at High output. Therefore, if Start Point=0 and End Point=1 are configured, Length should be "2" as the minimum active width.

#### 5.4.1 Clock Pre-scaler

Clock pre-scaler (Divide Value) can set the dividing value of the frequency divider (12-bit length) and the sensor clock is used for this. Four built-in pulse generators work by the same clock. In the SP-5000-PMCL, the sensor clock is 48 MHz.

#### 5.4.2 Pulse Generator Selector

This is where you select one of the 4 pulse generators in order to set or modify its parameters.

Table - 11 Pulse Generator setting

Trigger Selector item	Description
Pulse Generator 0	If Pulse Generator 0 is selected, Length, Start Point, End Point, Repeat Count, Clear Source, Clear Inverter, Clear Activation and Clear Sync Mode of Pulse Generator 0 are displayed under the selector.
Pulse Generator 1	If Pulse Generator 1 is selected, Length, Start Point, End Point, Repeat Count, Clear Source, Clear Inverter, Clear Activation and Clear Sync Mode of Pulse Generator 1 are displayed under the selector.
Pulse Generator 2	If Pulse Generator 2 is selected, Length, Start Point, End Point, Repeat Count, Clear Source, Clear Inverter, Clear Activation and Clear Sync Mode of Pulse Generator 2 are displayed under the selector.
Pulse Generator 3	If Pulse Generator 3 is selected, Length, Start Point, End Point, Repeat Count, Clear Source, Clear Inverter, Clear Activation and Clear Sync Mode of Pulse Generator 3 are displayed under the selector.

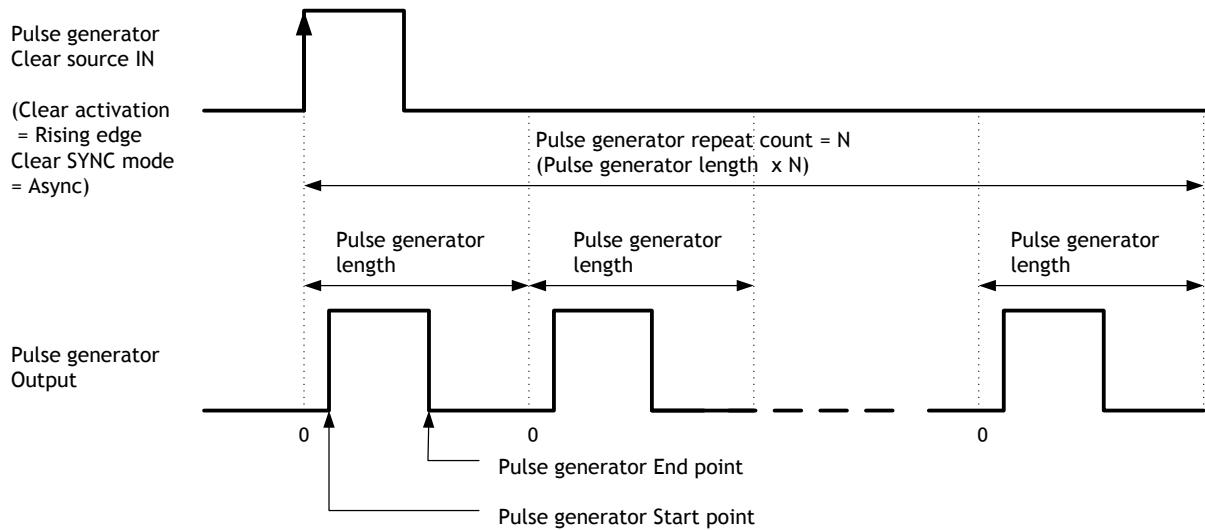


Fig.7      Pulse Generator pulse construction

#### 5.4.3 Pulse Generator Length

Set the counter up value for the selected pulse generator. If Repeat Count value is “0” and if Pulse Generator Clear signal is not input, the pulse generator generates the pulse repeatedly until reaching this counter up value.

#### 5.4.4 Pulse Generator Start Point

Set the active output start count value for the selected pulse generator. However, please note that a maximum 1 clock jitter for the clock which is divided in the clock pre-scaler can occur.

#### 5.4.5 Pulse Generator End Point

Set the active output ending count value for the selected pulse generator.

#### 5.4.6 Pulse Generator Repeat Count

Set the repeating number of the pulse for the selected pulse generator. After Trigger Clear signal is input, the pulse generator starts the count set in Repeat Count. Accordingly, an active pulse which has a start point and end point can be output repeatedly. However, if Repeat Count is set to “0”, it works as free-running counter.

#### 5.4.7 Pulse Generator Clear Activation

Set the clear conditions of clear count pulse for the selected pulse generator.

#### 5.4.8 Pulse Generator Clear Sync Mode

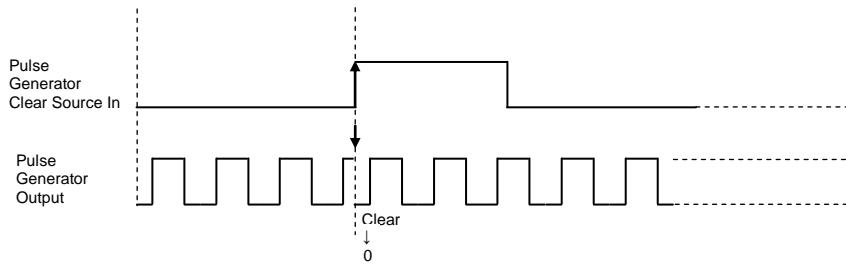
Set the count clear method for the selected pulse generator.

In case of Async Mode, if the clear signal is input during the length setting value, the counter will stop counting according to the clear signal input.

In case of Sync Mode, if the clear signal is input during the length setting value, the counter will continue to count until the end of the length setting value and then clear the count.

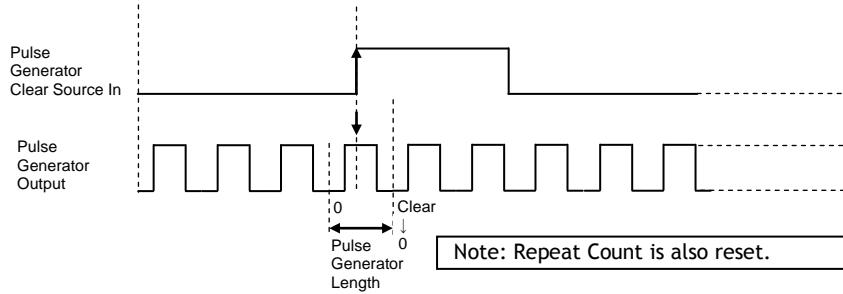
Both modes clear the repeat count when the counter is cleared.

(Example 1) Clear Activation = Rising Edge, Clear Sync Mode = Async Mode,  
Clear Inverter = False



**Fig.8** Counter clear in Async mode

(Example 2) Clear Activation = Rising Edge, Clear Sync Mode = Sync Mode,  
Clear Inverter = False



**Fig.9** Counter clear in Sync mode

## **5.4.9 Pulse Generator Clear Source**

The following clear sources can be selected as the pulse generator clear signal.

Table - 12    Pulse generator clear source

Pulse Generator Clear Source item	Description
Low	Connect Low level signal to Clear Source for the selected pulse generator. <b>Default setting</b>
High	Connect High level signal to Clear Source for the selected pulse generator.
Frame Trigger Wait	Connect Frame Trigger Wait signal to Clear Source for the selected pulse generator.
Frame Active	Connect Frame Active signal to Clear Source for the selected pulse generator.
Exposure Active	Connect Exposure Active signal to Clear Source for the selected pulse generator.
FVAL	Connect FVAL signal to Clear Source for the selected pulse generator.
LVAL	Connect LVAL signal to Clear Source for the selected pulse generator.
PulseGenerator0 Out	Connect Pulse Generator 0 output to Clear Source for the selected pulse generator.
PulseGenerator1 Out	Connect Pulse Generator 1 output to Clear Source for the selected pulse generator.
PulseGenerator2 Out	Connect Pulse Generator 2 output to Clear Source for the selected pulse generator.
PulseGenerator3 Out	Connect Pulse Generator 3 output to Clear Source for the selected pulse generator.
TTL 1 In	Connect TTL 1 IN signal to Clear Source for the selected pulse generator.
CL CC1 In	Connect CL CC1 IN signal to Clear Source for the selected pulse generator.
Nand0 Out	Connect NAND 0 output signal to Clear Source for the selected pulse generator.
Nand1 Out	Connect NAND 1 output signal to Clear Source for the selected pulse generator.
Line 10 TTL 2 In	Connect TTL 2 IN signal to Line 10.
Line 11 LVDS 1 In	Connect LVDS 1 IN signal to Line 11.
Note: The pulse generator output cannot be used as the clear input to the same pulse generator. Refer to “5.3.7.2.GPIO matrix table” .	

#### 5.4.10 Pulse Generator Inverter

Clear Source Signal can be have polarity inverted.

#### 5.4.11 Pulse Generator Setting table

Table - 13 Pulse Generator setting parameters

Display Name	Value
Clock Pre-scaler	1 to 4096
Pulse Generator Clock (MHZ)	[Pixel Clock:48MHz] : [Clock Pre-scaler]
Pulse Generator Selector	<ul style="list-style-type: none"> <li>- Pulse Generator 0</li> <li>- Pulse Generator 1</li> <li>- Pulse Generator 2</li> <li>- Pulse Generator 3</li> </ul>
- Pulse Generator Length	1 to 1048575
- Pulse Generator Length (ms)	$([\text{Clock Source}] : [\text{Clock Pre-scaler}])^{-1} \times [\text{Pulse Generator Length}]$
- Pulse Generator Frequency (Hz)	$[\text{Pulse Generator Length (ms)}]^{-1}$
- Pulse Generator Start Point	0 to 1048574
- Pulse Generator Start Point (ms)	$([\text{Clock Source}] : [\text{Clock Pre-scaler}])^{-1} \times [\text{Pulse Generator Start Point}]$
- Pulse Generator End Point	1 to 1048575
- Pulse Generator End Point (ms)	$([\text{Clock Source}] : [\text{Clock Pre-scaler}])^{-1} \times [\text{Pulse Generator End Point}]$
- Pulse Generator pulse-width (ms)	$[\text{Pulse Generator End Point (ms)}] - [\text{Pulse Generator Start Point (ms)}]$
- Pulse Generator Repeat Count	0 to 255
- Pulse Generator Clear Activation Clear Mode for the Pulse Generators	<ul style="list-style-type: none"> <li>- Off</li> <li>- High Level</li> <li>- Low level</li> <li>- Rising Edge</li> <li>- Falling Edge</li> </ul>
- Pulse Generator Clear Sync Mode	<ul style="list-style-type: none"> <li>- Async mode</li> <li>- Sync mode</li> </ul>
- Pulse Generator Clear Source	<ul style="list-style-type: none"> <li>- Low</li> <li>- High</li> <li>- Frame Trigger Wait</li> <li>- Frame Active</li> <li>- Exposure Active</li> <li>- Fval</li> <li>- Lval</li> <li>- PulseGenerator0</li> <li>- PulseGenerator1</li> <li>- PulseGenerator2</li> <li>- PulseGenerator3</li> <li>- TTL_In1</li> <li>- CL_CC1_In</li> <li>- Nand0 Out</li> <li>- Nand1 Out</li> <li>- Line 10 - TTL 2 In</li> <li>- Line 11 - LVDS 1 In</li> </ul>
- Pulse Generator Inverter(Polarity) Pulse Generator Clear Inverter	<ul style="list-style-type: none"> <li>- False</li> <li>- True</li> </ul>

Note:

1. If Pulse Generator Repeat Count is set to "0", the pulse generator works in free-running mode.
2. The output of the same pulse generator cannot be connected to Clear input.

## 6. Sensor layout, output format and timing

### 6.1 Sensor layout

The CMOS sensors used in the SP-5000M-PMCL and SP-5000C-PMCL have the following pixel layout.

#### 6.1.1 Monochrome sensor

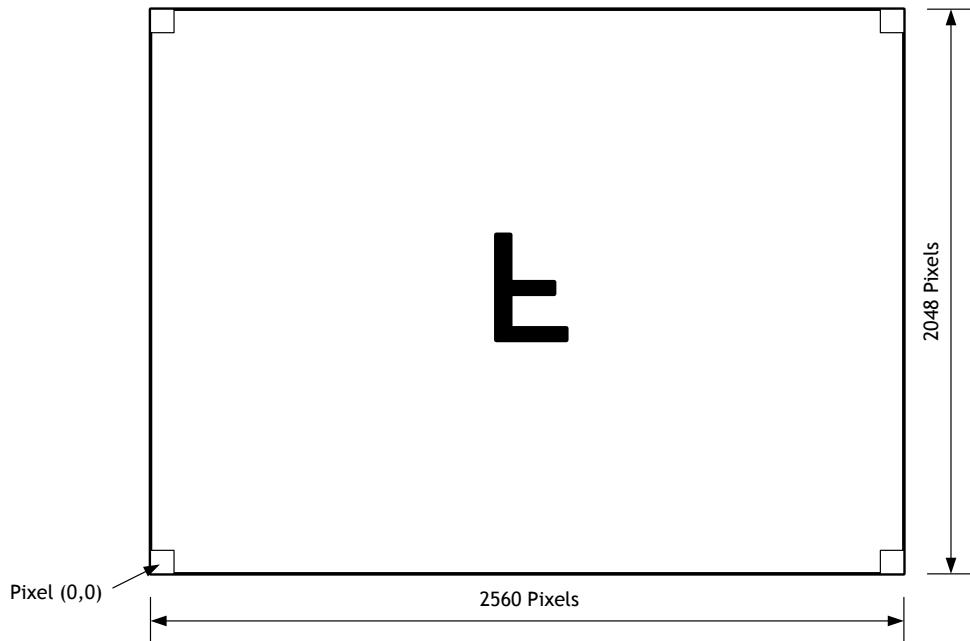


Fig. 10 Monochrome sensor layout

#### 6.1.2 Bayer sensor

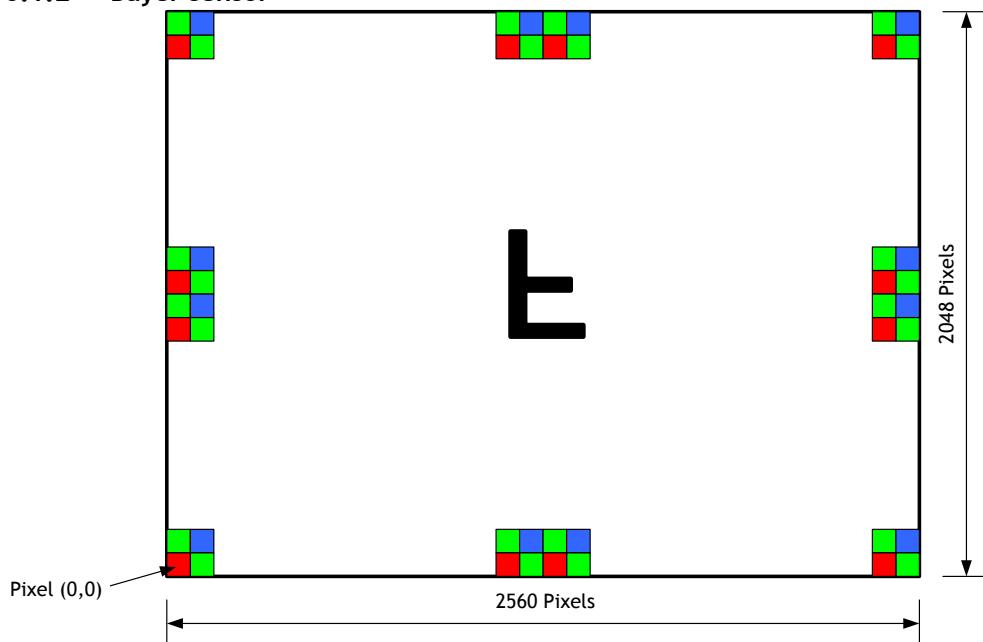


Fig. 11 Color sensor layout

## 6.2 Camera output format (Tap Geometry)

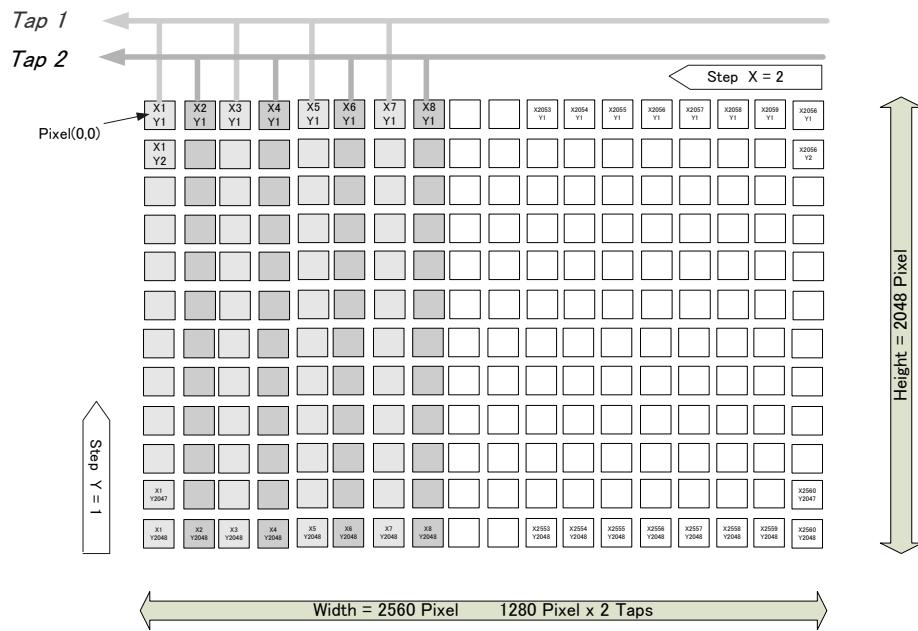
Table - 14 Output format

Camera output format	Bit assignment	Refer to drawing
1X2-1Y	8-bit, 10-bit, 12-bit	6.2.1
1X4-1Y	8-bit, 10-bit, 12-bit	6.2.2
1X8-1Y	8-bit, 10-bit	6.2.3
1X10-1Y	8-bit	6.2.4

Note: The camera output description is based on GenICam SFNC Ver.1.5.1.

### 6.2.1 1X2-1Y

1X2-1Y is a 2-tap readout system specified in GenICam Tap Geometry and it outputs as the following.



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## 6.2.2 1X4-1Y

1X4-1Y is a 4-tap readout system specified in GenICam Tap Geometry and it outputs as the following.

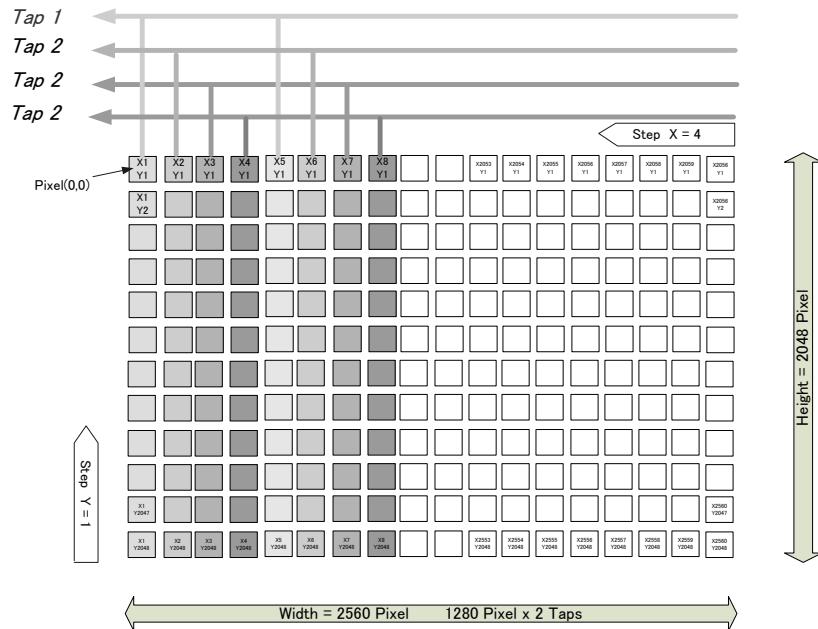


Fig. 13 1X4-1Y output format

### 6.2.3 1X8-1Y

1X8-1Y is an 8-tap readout system and outputs as follows.

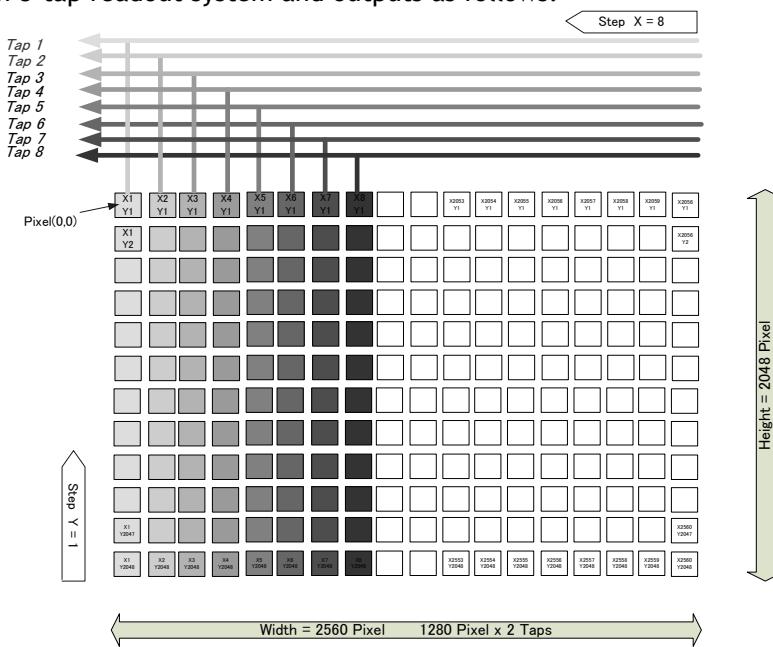


Fig. 14. 1X8-1Y output format

#### 6.2.4 1X10-1Y

1X10-1Y is a 10-tap readout system and outputs as follows.

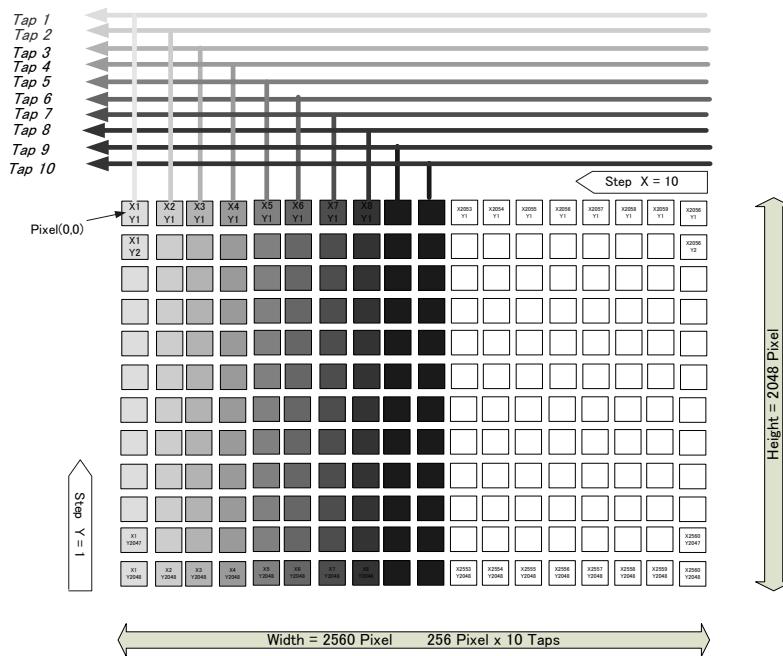


Fig.15 1X10-1Y Output format

### 6.3 Output timing and output image

#### 6.3.1 Horizontal timing

The horizontal frequency is changed by setting the Tap Geometry.

In the SP-5000M-PMCL and SP-5000C-PMCL, H-binning is available but the horizontal frequency is not changed. Therefore, the frame rate is not increased in H-Binning mode.

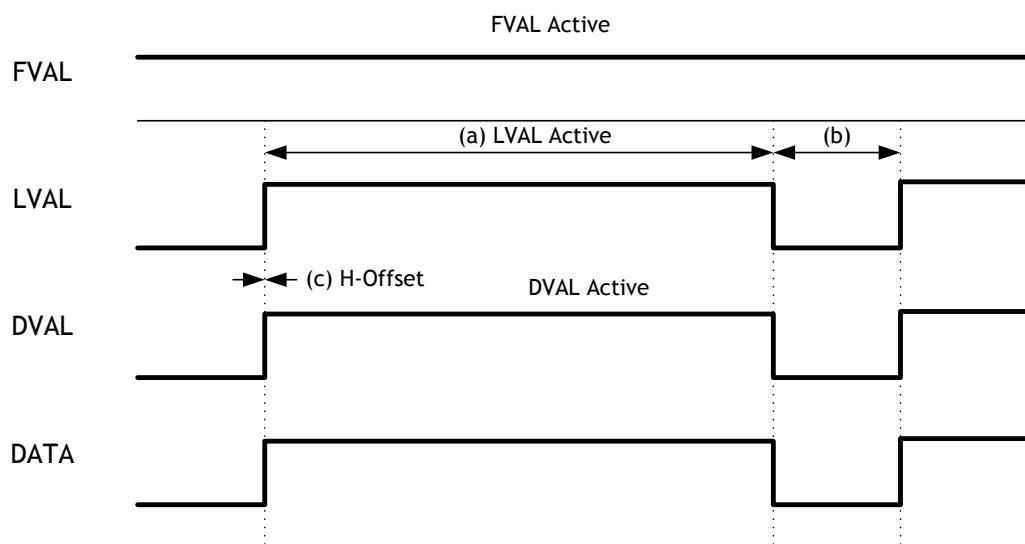


Fig. 16 Horizontal timing per 1 tap in Camera Link output

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**Table 15. Continuous Trigger / Horizontal timing 1X10-1Y (1/2)**

Tap Geometry	Pixel Clock	Link	Camera	Camera Settings						(a) LVAL Active	(b) LVAL Non-Active	(c) H-Offset	
				AOI				Binning	1: OFF 2* ON				
				Width	Offset X	Height	Offset Y	Horizontal	Vertical	[Unit: Clock]	[Unit: Clock]	[Unit: Clock]	
1X10 -1Y	82.3 MHz	2560	0	2048	0	1	1	256	27 to 30	0			
		1280	0	2048	0	2	1	128	155 to 158	0			
		2560	0	1024	0	1	2	256	27 to 30	0			
		1280	0	1024	0	2	2	128	155 to 158	0			
	75.4 MHz	2560	0	2048	0	1	1	256	4 to 6	0			
		1280	0	2048	0	2	1	128	132 to 134	0			
		2560	0	1024	0	1	2	256	4 to 6	0			
		1280	0	1024	0	2	2	128	132 to 134	0			
	61.7 MHz	2560	0	2048	0	1	1	256	4 to 6	0			
		1280	0	2048	0	2	1	128	132 to 134	0			
		2560	0	1024	0	1	2	256	4 to 6	0			
		1280	0	1024	0	2	2	128	132 to 134	0			

**Table 16. Continuous Trigger / Horizontal timing 1X10-1Y (2/2)**

Tap Geometry	Pixel Clock	Link	Camera	Camera Settings						1Line Total Clock	Horizontal Frequency	Horizontal Period
				AOI				Binning 1: OFF 2: ON				
				Width	Offset X	Height	Offset Y	Horizontal	Vertical	[Unit: Clock]	[Unit: kHz]	[Unit: us]
1X10 -1Y	82.3 MHz	2560	0	2048	0	1	1	a	283 to 286	290.763 to 287.713	3.439 to 3.476	
			b						284.56	289.169	3.458	
		1280	0	2048	0	2	1	a	283 to 286	290.763 to 287.713	3.439 to 3.476	
			b						284.56	289.169	3.458	
	75.4 MHz	2560	0	1024	0	1	2	a	283 to 286	290.763 to 287.713	3.439 to 3.476	
			b						284.56	289.169	3.458	
		1280	0	1024	0	2	2	a	283 to 286	290.763 to 287.713	3.439 to 3.476	
			b						284.56	289.169	3.458	
	61.7 MHz	2560	0	2048	0	1	1	a	260 to 262	290.112 to 287.897	3.447 to 3.473	
			b						260.86	289.155	3.458	
		1280	0	2048	0	2	1	a	260 to 262	290.112 to 287.897	3.447 to 3.473	
			b						260.86	289.155	3.458	
	61.7 MHz	2560	0	1024	0	1	2	a	260 to 262	290.112 to 287.897	3.447 to 3.473	
			b						260.86	289.155	3.458	
		1280	0	1024	0	2	2	a	260 to 262	290.112 to 287.897	3.447 to 3.473	
			b						260.86	289.155	3.458	

Note: a: Actual operating value      b: Calculation value

# SP-5000M-PMCL / SP-5000C-PMCL



See the possibilities

Table 17. Continuous Trigger / Horizontal timing 1X8-1Y (1/2)

Tap Geometry	Camera Link Pixel Clock	Camera Settings						(a) LVAL Active [Unit: Clock]	(b) LVAL Non-Active [Unit: Clock]	(c) H-Offset [Unit: Clock]
		AOI			Binning					
Width	Offset X	Height	Offset Y	Horizontal	Vertical					
1X8 -1Y	82.3 MHz	2560	0	2048	0	1 (Off)	1 (Off)	320	4 to 7	0
		1280	0	2048	0	2 (On)	1 (Off)	160	164 to 167	0
		2560	0	1024	0	1 (Off)	2 (On)	320	4 to 7	0
		1280	0	1024	0	2 (On)	2 (On)	160	164 to 167	0
	75.4 MHz	2560	0	2048	0	1 (Off)	1 (Off)	320	4 to 7	0
		1280	0	2048	0	2 (On)	1 (Off)	160	164 to 167	0
		2560	0	1024	0	1 (Off)	2 (On)	320	4 to 7	0
		1280	0	1024	0	2 (On)	2 (On)	160	164 to 167	0
	61.7 MHz	2560	0	2048	0	1 (Off)	1 (Off)	320	3 to 5	0
		1280	0	2048	0	2 (On)	1 (Off)	164	164	0
		2560	0	1024	0	1 (Off)	2 (On)	320	3 to 5	0
		1280	0	1024	0	2 (On)	2 (On)	160	164	0

## SP-5000M-PMCL / SP-5000C-PMCL

**Table 18. Continuous Trigger / Horizontal timing 1X8-1Y (2/2)**

Tap Geometry	Camera	AOI						1Line Total Clock [Unit: Clock]	Horizontal Frequency [Unit: kHz]	Horizontal Period [Unit: us]
		Width	Offset X	Height	Offset Y	Horizontal	Vertical			
1X8 -1Y	82.3 MHz	2560	0	a b	0	1 (Off)	1 (Off)	a b	324 to 327 325.71	253.969 to 252.639
		1280	0	a b	0	2 (On)	1 (Off)	a b	324 to 327 325.71	253.969 to 252.639
		2560	0	a b	0	1 (Off)	2 (On)	a b	324 to 327 325.71	253.969 to 252.639
		1280	0	a b	0	2 (On)	2 (On)	a b	324 to 327 325.71	253.969 to 252.639
	75.4 MHz	2560	0	a b	0	1 (Off)	1 (Off)	a b	324 to 327 325.29	232.806 to 230.670 231.882
		1280	0	a b	0	2 (On)	1 (Off)	a b	324 to 327 325.29	232.806 to 230.670 231.882
		2560	0	a b	0	1 (Off)	2 (On)	a b	324 to 327 325.29	232.806 to 230.670 231.882
		1280	0	a b	0	2 (On)	2 (On)	a b	324 to 327 325.29	232.806 to 230.670 231.882
	61.7 MHz	2560	0	a b	0	1 (Off)	1 (Off)	a b	323 to 325 324.00	191.065 to 189.889 190.475
		1280	0	a b	0	2 (On)	1 (Off)	a b	328 324.00	188.152 190.475
		2560	0	a b	0	1 (Off)	2 (On)	a b	323 to 325 324.00	191.065 to 189.889 190.475
		1280	0	a	0	2 (On)	2 (On)	a b	328 324.00	188.152 190.475

Note: a: Actual operating value    b: Calculation value

# SP-5000M-PMCL / SP-5000C-PMCL



*See the possibilities*

**Table 19. Continuous Trigger / Horizontal timing 1X4-1Y (1/2)**

Tap Geometry	Pixel Clock	Camera Link	Camera Settings				(a) LVAL Active	(b) LVAL Non-Active	(c) H-Offset	
			AOI			Binning				
Width	Offset X	Height	Offset Y	Horizontal	Vertical	[Unit: Clock]	[Unit: Clock]	[Unit: Clock]		
1X4-1Y	82.3 MHz	2560	0	2048	0	1 (Off)	1 (Off)	640	3 to 6	0
		1280	0	2048	0	2 (On)	1 (Off)	320	323 to 326	0
		2560	0	1024	0	1 (Off)	2 (On)	640	3 to 6	0
		1280	0	1024	0	2 (On)	2 (On)	320	323 to 326	0
	75.4 MHz	2560	0	2048	0	1 (Off)	1 (Off)	640	3 to 6	0
		1280	0	2048	0	2 (On)	1 (Off)	320	323 to 326	0
		2560	0	1024	0	1 (Off)	2 (On)	640	3 to 6	0
		1280	0	1024	0	2 (On)	2 (On)	320	323 to 326	0
	61.7 MHz	2560	0	2048	0	1 (Off)	1 (Off)	640	4 to 7	0
		1280	0	2048	0	2 (On)	1 (Off)	320	324 to 327	0
		2560	0	1024	0	1 (Off)	2 (On)	640	4 to 7	0
		1280	0	1024	0	2 (On)	2 (On)	320	324 to 327	0

## SP-5000M-PMCL / SP-5000C-PMCL

**Table 20. Continuous Trigger / Horizontal timing 1X4-1Y (2/2)**

Camera Settings							1Line Total Clock [Unit: Clock]	Horizontal Frequency [Unit: kHz]	Horizontal Period [Unit: us]		
Tap Geometry	Camera Link Pixel Clock	AOI			Binning						
		Width	Offset X	Height	Offset Y	Horizontal	Vertical				
1X4 -1Y	82.3 MHz	2560	0	2048	0	1 (Off)	1 (Off)	a 643 to 646	127.972 to 127.378	7.814 to 7.851	
						b 644.57		127.632		7.835	
		1280	0	2048	0	2 (On)	1 (Off)	a 643 to 646	127.972 to 127.378	7.814 to 7.851	
						b 644.57		127.632		7.835	
	75.4 MHz	2560	0	1024	0	1 (Off)	2 (On)	a 643 to 646	127.972 to 127.378	7.814 to 7.851	
						b 644.57		127.632		7.835	
		1280	0	1024	0	2 (On)	2 (On)	a 643 to 646	127.972 to 127.378	7.814 to 7.851	
						b 644.57		127.632		7.835	
	61.7 MHz	2560	0	2048	0	1 (Off)	1 (Off)	a 643 to 646	117.308 to 116.861	8.525 to 8.557	
						b 644.29		117.073		8.542	
		1280	0	2048	0	2 (On)	1 (Off)	a 643 to 646	117.308 to 116.861	8.525 to 8.557	
						b 644.29		117.073		8.542	
		2560	0	1024	0	1 (Off)	2 (On)	a 643 to 646	117.308 to 116.861	8.525 to 8.557	
						b 644.29		117.073		8.542	
		1280	0	1024	0	2 (On)	2 (On)	a 643 to 646	117.308 to 116.861	8.525 to 8.557	
						b 644.29		117.073		8.542	

Note: a: Actual operating value    b: Calculation value

Table 21. Continuous Trigger / Horizontal timing 1X2-1Y (1/2)

Tap Geometry	Pixel Clock	Camera Link	Camera Settings				(a) LVAL Active	(b) LVAL Non-Active	(c) H-Offset
			Width	Offset X	Height	Offset Y			
1X2 -1Y	82.3 MHz	2560	2560	0	2048	0	1 (Off)	1 (Off)	1280
			1280	0	2048	0	2 (On)	1 (Off)	640
			2560	0	1024	0	1 (Off)	2 (On)	1280
			1280	0	1024	0	2 (On)	2 (On)	640
	75.4 MHz	2560	2560	0	2048	0	1 (Off)	1 (Off)	1280
			1280	0	2048	0	2 (On)	1 (Off)	640
			2560	0	1024	0	1 (Off)	2 (On)	1280
			1280	0	1024	0	2 (On)	2 (On)	640
	61.7 MHz	2560	2560	0	2048	0	1 (Off)	1 (Off)	1280
			1280	0	2048	0	2 (On)	1 (Off)	640
			2560	0	1024	0	1 (Off)	2 (On)	1280
			1280	0	1024	0	2 (On)	2 (On)	640

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**Table 22. Continuous Trigger / Horizontal timing 1X2-1Y (2/2)**

Camera Settings								1Line Total Clock [Unit: Clock]	Horizontal Frequency [Unit: kHz]	Horizontal Period [Unit: us]			
Geometry	Link Pixel Clock	AOI			Binning								
		Width	Offset X	Height	Offset Y	Horiz ontal	Verti cal						
1X2 -1Y	82.3 MHz	2560	0	2048	0	1 (Off)	1 (Off)	a 1284 to 1287	64.086 to 63.936	15.604 to 15.641			
						b	1285.72		64.000	15.625			
		1280	0	2048	0	2 (On)	1 (Off)	a 1284 to 1287	64.086 to 63.936	15.604 to 15.641			
						b	1285.72		64.000	15.625			
	75.4 MHz	2560	0	1024	0	1 (Off)	2 (On)	a 1284 to 1287	64.086 to 63.936	15.604 to 15.641			
						b	1285.72		64.000	15.625			
		1280	0	1024	0	2 (On)	2 (On)	a 1284 to 1287	64.086 to 63.936	15.604 to 15.641			
						b	1285.72		64.000	15.625			
61.7 MHz	82.3 MHz	2560	0	2048	0	1 (Off)	1 (Off)	a 1284 to 1287	58.745 to 58.608	17.023 to 17.062			
						b	1285.44		58.680	17.042			
		1280	0	2048	0	2 (On)	1 (Off)	a 1284 to 1287	58.745 to 58.608	17.023 to 17.062			
						b	1285.44		58.680	17.042			
	75.4 MHz	2560	0	1024	0	1 (Off)	2 (On)	a 1284 to 1287	58.745 to 58.608	17.023 to 17.062			
						b	1285.44		58.680	17.042			
		1280	0	1024	0	2 (On)	2 (On)	a 1284 to 1287	58.745 to 58.608	17.023 to 17.062			
						b	1285.44		58.680	17.042			
61.7 MHz	82.3 MHz	2560	0	2048	0	1 (Off)	1 (Off)	a 1283 to 1286	48.101 to 47.989	20.789 to 20.838			
						b	1284.42		48.048	20.812			
		1280	0	2048	0	2 (On)	1 (Off)	a 1283 to 1286	48.101 to 47.989	20.789 to 20.838			
						b	1284.42		48.048	20.812			
	75.4 MHz	2560	0	1024	0	1 (Off)	2 (On)	a 1283 to 1286	48.101 to 47.989	20.789 to 20.838			
						b	1284.42		48.048	20.812			
		1280	0	1024	0	2 (On)	2 (On)	a 1283 to 1286	48.101 to 47.989	20.789 to 20.838			
						b	1284.42		48.048	20.812			

Note: a: Actual operating value      b: Calculation value

### 6.3.2 Vertical timing

Figure 17 shows the vertical timing of Camera Link output during continuous trigger operation. However, with 1X8-1Y 10-bit and 1X10-1Y 8-bit geometries, which are 80-bit configurations, DVAL and Exposure Active, which are normally output to Camera Link spare bits, are not output through the Camera Link interface as data bits are applied to those bits.

In the SP-5000M-PMCL, H-Binning and V-Binning functions are available but H-Binning function does not make the frame rate faster.

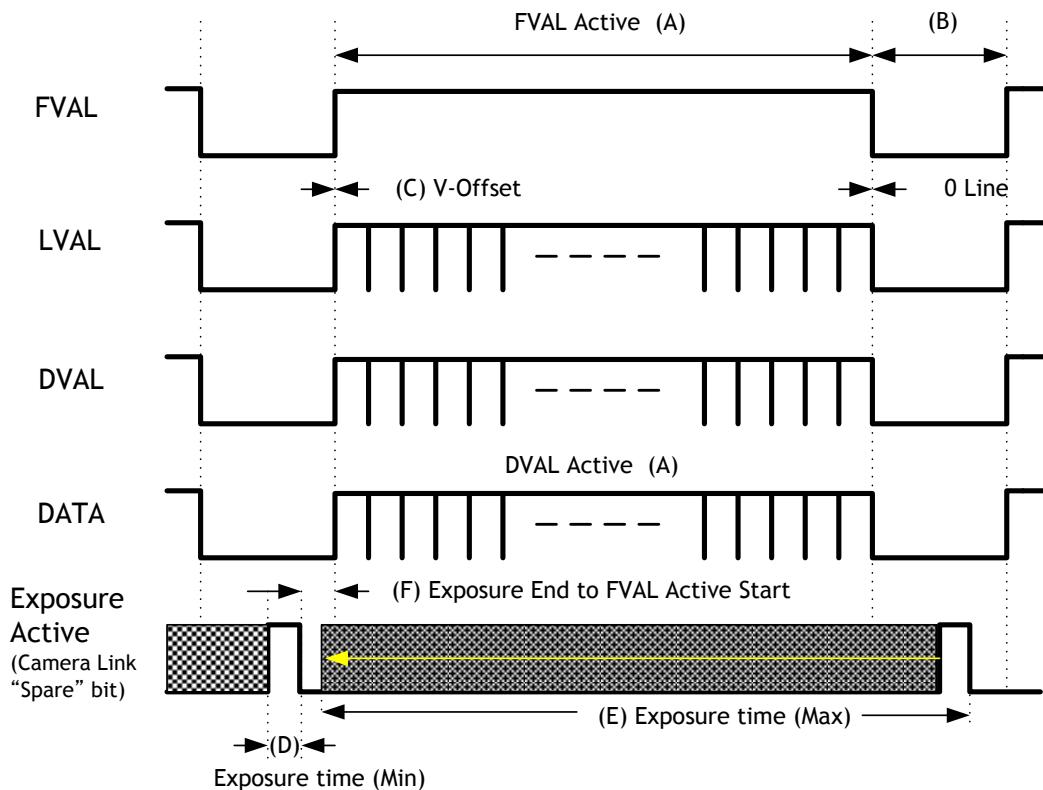


Fig. 17 Vertical timing

In the SP-5000-PMCL, if the trigger overlap is set to “Readout”, the image readout is stopped at the start point of the exposure and delayed in order to avoid interference from the exposure. Therefore, the FVAL Active period is extended by the period for which the readout has been stopped.

Table 23. FVAL Active extended time if FVAL Active is overlapped

Tap Geometry	Camera Link Clock	Exposure Active – At FVAL Active Overlap, FVAL Active extended time	
		[Unit: us]	[Unit: Line]
1X10-1Y	82.3 MHz	55.60	16
	75.4 MHz	55.40	16
	61.7 MHz	67.70	16
1X8-1Y	82.3 MHz	63.40	16
	75.4 MHz	69.10	16
	61.7 MHz	84.10	16
1X4-1Y	82.3 MHz	125.40	16
	75.4 MHz	136.60	16
	61.7 MHz	167.40	16
1X2-1Y	82.3 MHz	250.00	16
	75.4 MHz	273.00	16
	61.7 MHz	333.50	16

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**Table 24. Continuous Trigger / Vertical timing 1X10-1Y, 1X8-1Y (1/3)**

Camera Settings								(A) FVAL & DVAL Active [Unit: Line]	(B) FVAL Non -Active [Unit: Line]	(C) V -Offset [Unit: Line]	(D) Exposure Time (Min) [Unit: us]		
Tap Geometry	Frame Period (Typ.)	ROI			Binning								
		Width	X Offset	Height	Y Offset	Horizontal	Vertical						
1X10 -1Y	82.3 MHz	7463	2560	0	2048	0	1 (Off)	1 (Off)	2048	110.1 or 111.1	0	10	
			1280	0	2048	0	2 (On)	1 (Off)	1028	110.5 or 111.5			
		3732	2560	0	1024	0	1 (Off)	2 (On)	2048	56.1 or 57.1			
			1280	0	1024	0	2 (On)	2 (On)	1028	56.5 or 57.5			
			2560	0	2048	0	1 (Off)	1 (Off)	2048	306.0 or 307.0			
	75.4 MHz	8141	1280	0	2048	0	2 (On)	1 (Off)	1028	306.5 or 307.5	0	10	
			2560	0	1024	0	1 (Off)	2 (On)	2048	154.0 or 155.0			
		4071	1280	0	1024	0	2 (On)	2 (On)	1028	154.5 or 155.5			
			2560	0	2048	0	1 (Off)	1 (Off)	2048	305.0 or 306.0			
			1280	0	2048	0	2 (On)	1 (Off)	1028	305.5 or 306.5			
1X8 -1Y	61.7 MHz	9951	2560	0	1024	0	1 (Off)	2 (On)	2048	153.0 or 154.0	0	10	
			1280	0	1024	0	2 (On)	2 (On)	1028	153.5 or 154.5			
		4976	2560	0	2048	0	1 (Off)	1 (Off)	2048	57.0 or 58.0	0	10	
			1280	0	2048	0	2 (On)	1 (Off)	1028	57.5 or 58.5			
			2560	0	1024	0	1 (Off)	2 (On)	2048	29.0 or 30.0			
	82.3 MHz	8333	1280	0	2048	0	2 (On)	1 (Off)	1028	29.5 or 30.5			
			2560	0	1024	0	1 (Off)	2 (On)	2048	60.0 or 61.0	0	10	
		4167	1280	0	2048	0	2 (On)	1 (Off)	1028	60.5 or 61.5			
			2560	0	1024	0	2 (On)	2 (On)	2048	30.0 or 31.0			
			1280	0	2048	0	2 (On)	2 (On)	1028	30.5 or 31.5			
1X8 -1Y	75.4 MHz	9091	2560	0	2048	0	1 (Off)	1 (Off)	2048	68.0 or 69.0	0	10	
			1280	0	2048	0	2 (On)	1 (Off)	1028	68.5 or 69.5			
		4546	2560	0	1024	0	1 (Off)	2 (On)	2048	34.0 or 35.0			
	61.7 MHz		1280	0	1024	0	2 (On)	2 (On)	1028	34.5 or 35.5			
			2560	0	2048	0	1 (Off)	1 (Off)	2048	34.0 or 35.0			
			1280	0	2048	0	2 (On)	1 (Off)	1028	34.5 or 35.5			

[Note] The above FVAL Active period is the value, when the exposure time is set at "10".

As mentioned before, if the next frame readout is overlapped on the previous frame readout, FVAL Active period is reduced by 16 lines.

# SP-5000M-PMCL / SP-5000C-PMCL



*See the possibilities*

**Table 25. Continuous Trigger / Vertical timing 1X10-1Y (2/3)**

Camera Settings								Frame Rate [Unit: Hz]	(E) Exposure Time (Max.) [Unit: us]	(F) Exposure End to FVAL Active Start [Unit: Line] [Unit: us]					
Tap Geometry	Frame Period (Typ.)	ROI			Binning										
		Width	X Offset	Height	Y Offset	Horizontal	Vertical								
1X10-1Y	82.3 MHz	7463	2560	0	2048	0	1 (Off)	1 (Off)	133.93	[Frame Period] - 100 = 7463 - 100 = 7363	9.1 to 10.1	31.5 to 34.9			
			1280	0	2048	0	2 (On)	1 (Off)			8.1 to 9.1	28.1 to 31.6			
		3732	2560	0	1024	0	1 (Off)	2 (On)	267.71	3732 - 100 = 3632	9.1 to 10.1	31.5 to 34.9			
			1280	0	1024	0	2 (On)	2 (On)			8.1 to 9.1	28.2 to 31.6			
		8141	2560	0	2048	0	1 (Off)	1 (Off)	122.78	8141 - 100 = 8041	9.1 to 10.1	31.5 to 34.9			
			1280	0	2048	0	2 (On)	1 (Off)			8.1 to 9.1	28.2 to 31.6			
	75.4 MHz	4071	2560	0	1024	0	1 (Off)	2 (On)	245.44	4071 - 100 = 3971	9.1 to 10.1	31.5 to 34.9			
			1280	0	1024	0	2 (On)	2 (On)			8.2 to 9.1	28.2 to 31.6			
		9951	2560	0	2048	0	1 (Off)	1 (Off)	100.46	9951 - 100 = 9851	7.8 to 8.8	33.1 to 37.3			
			1280	0	2048	0	2 (On)	1 (Off)			7.0 to 8.0	29.8 to 34.0			
		4976	2560	0	1024	0	1 (Off)	2 (On)	200.82	4976 - 100 = 4876	7.8 to 8.8	33.1 to 37.2			
			1280	0	1024	0	2 (On)	2 (On)			7.0 to 8.0	29.8 to 33.9			

# SP-5000M-PMCL / SP-5000C-PMCL

**Table 26. Continuous Trigger / Vertical timing 1X8-1Y (3/3)**

Camera Settings								Frame Rate [Unit: Hz]	(E) Exposure Time (Max.) [Unit: us]	(F) Exposure End to FVAL Active Start [Unit: Line] [Unit: us]		
Tap Geometry	Link Pixel Clock	Camera	Frame Period (Typ.)	ROI			Binning					
				Width	X Offset	Height	Y Offset	Horizontal	Vertical			
1X8 -1Y	82.3 MHz	8333	2560	0	2048	0	1 (Off)	1 (Off)	119.96	8333 - 100 = 8233	8.3 to 9.2	32.9 to 36.4
			1280	0	2048	0	2 (On)	1 (Off)			7.4 to 8.4	29.3 to 33.1
		9091	2560	0	1024	0	1 (Off)	2 (On)	239.79	4167 - 100 = 4067	8.2 to 9.3	32.5 to 36.7
			1280	0	1024	0	2 (On)	2 (On)			7.4 to 8.4	29.2 to 33.1
		75.4 MHz	2560	0	2048	0	1 (Off)	1 (Off)	109.95	9091 - 100 = 8991	7.7 to 8.7	33.2 to 37.5
			1280	0	2048	0	2 (On)	1 (Off)			6.9 to 7.9	29.9 to 34.2
	61.7 MHz	11111	2560	0	1024	0	1 (Off)	2 (On)	219.81	4546 - 100=4446	7.7 to 8.7	33.2 to 37.5
			1280	0	1024	0	2 (On)	2 (On)			6.9 to 7.9	29.9 to 34.2
			2560	0	2048	0	1 (Off)	1 (Off)	89.97	11111 - 100=11011	7.6 to 8.6	40.0 to 45.2
			1280	0	2048	0	2 (On)	1 (Off)			7.0 to 8.0	36.7 to 41.9
			2560	0	1024	0	1 (Off)	2 (On)	179.86	5556 - 100=5456	7.6 to 8.6	40.0 to 45.17
			1280	0	1024	0	2 (On)	2 (On)			7.6 to 8.7	40.0 to 45.2

# SP-5000M-PMCL / SP-5000C-PMCL



*See the possibilities*

**Table 27. Continuous Trigger / Vertical timing 1X4-1Y, 1X2-1Y (1/3)**

Camera Settings								(A)	(B)	(C)	(D)	
Tap Geometry	Frame Period (Typ.)	ROI			Binning		FVAL & DVAL Active [Unit: Line]	FVAL Non-Active [Unit: Line]	V-Offset [Unit: Line]	Exposure Time (Min)		
		Width	X Offset	Height	Y Offset	Horizontal						
1X4-1Y	82.3 MHz	16393	2560	0	2048	0	1 (Off)	1 (Off)	2048	45.0 or 46.0	0	10
			1280	0	2048	0	2 (On)	1 (Off)	1028	45.5 or 46.5		
		8197	2560	0	1024	0	1 (Off)	2 (On)	2048	22.0 or 23.0		
			1280	0	1024	0	2 (On)	2 (On)	1028	22.5 or 23.5		
	75.4 MHz	17883	2560	0	2048	0	1 (Off)	1 (Off)	2048	45.0 or 46.0	0	10
			1280	0	2048	0	2 (On)	1 (Off)	1028	45.5 or 46.5		
		8942	2560	0	1024	0	1 (Off)	2 (On)	2048	23.0 or 24.0		
			1280	0	1024	0	2 (On)	2 (On)	1028	23.5 or 24.5		
	61.7 MHz	21858	2560	0	2048	0	1 (Off)	1 (Off)	2048	42.0 or 43.0	0	10
			1280	0	2048	0	2 (On)	1 (Off)	1028	42.5 or 43.5		
		10929	2560	0	1024	0	1 (Off)	2 (On)	2048	21.0 or 22.0		
			1280	0	1024	0	2 (On)	2 (On)	1028	21.5 or 22.5		
1X2-1Y	82.3 MHz	33333	2560	0	2048	0	1 (Off)	1 (Off)	2048	85.0 or 86.0	0	10
			1280	0	2048	0	2 (On)	1 (Off)	1028	85.5 or 86.5		
		16667	2560	0	1024	0	1 (Off)	2 (On)	2048	42.0 or 43.0		
			1280	0	1024	0	2 (On)	2 (On)	1028	42.5 or 43.5		
	75.4 MHz	36363	2560	0	2048	0	1 (Off)	1 (Off)	2048	85.0 or 86.0	0	10
			1280	0	2048	0	2 (On)	1 (Off)	1028	85.5 or 86.5		
		18182	2560	0	1024	0	1 (Off)	2 (On)	2048	43.0 or 44.0		
			1280	0	1024	0	2 (On)	2 (On)	1028	43.5 or 44.5		
	61.7 MHz	44444	2560	0	2048	0	1 (Off)	1 (Off)	2048	87.0 or 88.0	0	10
			1280	0	2048	0	2 (On)	1 (Off)	1028	87.5 or 88.5		
		22222	2560	0	1024	0	1 (Off)	2 (On)	2048	43.0 or 44.0		
			1280	0	1024	0	2 (On)	2 (On)	1028	43.5 or 44.5		

[Note] The above FVAL Active period is the value, when the exposure time is set at "10".

As mentioned before, if the next frame readout is overlapped on the previous frame readout, FVAL Active period is reduced by 16 lines. In 1X4-1Y and 1X2-1Y tap geometries, FVAL active starting point becomes earlier depending on the exposure time value. Therefore, FVAL Active period is shortened further.

# SP-5000M-PMCL / SP-5000C-PMCL

Table 28. Continuous Trigger / Vertical timing 1X4-1Y (2/3)

Camera Settings								(E) Frame Rate [Unit: Hz]	(F) Exposure Time (Max.) [Unit: us]	(F) Active End to FVAL Active Start			
Tap Geometry	Frame Period (Typ.)	ROI		Binning		[Unit: Line] Max	[Unit: us] Min			Max	Min		
		Width	Offset X	Height	Offset Y	Horizontal	Vertical						
1X4-1Y	82.3 MHz	16393	2560	0	2048	0	1 (Off)	1 (Off)	60.97 =16293	11.0 to 12.0	5.1 to 6.1	86.5 to 94.2	40.3 to 48.1
			1280	0	2048	0	2 (On)	1 (Off)		10.6 to 11.6	4.7 to 5.7	83.1 to 90.9	37.0 to 44.7
		8197	2560	0	1024	0	1 (Off)	2 (On)	121.95 =8097	11.0 to 12.0	5.1 to 6.1	86.5 to 94.2	40.3 to 48.1
			1280	0	1024	0	2 (On)	2 (On)		10.6 to 11.6	4.7 to 5.7	83.1 to 90.9	36.9 to 44.7
	75.4 MHz	17883	2560	0	2048	0	1 (Off)	1 (Off)	55.90 =17783	11.6 to 12.6	4.9 to 5.9	99.3 to 107.6	41.8 to 50.1
			1280	0	2048	0	2 (On)	1 (Off)		11.2 to 12.2	4.5 to 5.5	95.9 to 104.3	38.4 to 46.9
		8942	2560	0	1024	0	1 (Off)	2 (On)	111.78 =8842	11.6 to 12.6	4.9 to 5.9	99.2 to 107.7	41.7 to 50.2
			1280	0	1024	0	2 (On)	2 (On)		11.2 to 12.2	4.5 to 5.5	95.9 to 104.4	38.4 to 46.9
	61.7 MHz	21858	2560	0	2048	0	1 (Off)	1 (Off)	45.73 =21758	12.8 to 13.8	4.4 to 5.4	133.7 to 144.1	45.6 to 56.0
			1280	0	2048	0	2 (On)	1 (Off)		12.5 to 13.5	4.0 to 5.0	130.4 to 140.8	42.3 to 52.7
		10929	2560	0	1024	0	1 (Off)	2 (On)	91.45 =10829	12.8 to 13.8	4.4 to 5.4	133.8 to 144.1	45.6 to 56.0
			1280	0	1024	0	2 (On)	2 (On)		12.5 to 13.5	4.0 to 5.0	130.4 to 140.8	42.3 to 52.7

[Note] In 1X4-1Y Tap Geometry, “Exposure Active End to FVAL Active Start” period varies depending on the exposure time setting. When the exposure time is set at “10”, it is the maximum period and if the exposure time is incremented by 1 us, it is decreased.

Table 29. Continuous Trigger / Vertical timing 1X2-1Y (3/3)

Camera Settings								(E) Frame Rate [Unit: Hz]	(F) Exposure Time (Max.) [Unit: us]	(F) Exposure Active End to FVAL Active Start					
Tap Geometry	Frame Period (Type)	ROI			Binning					[Unit: Line] Max	[Unit: us] Min	Max	Min		
		Width	Offset X	Height	Offset Y	Horizontal	Vertical								
1X2-1Y	82.3 MHz	33333	2560	0	2048	0	1 (Off)	1 (Off)	29.99	33333 - 100 =33233	14.5 to 15.5	3.6 to 4.6	226.9 to 242.2	56.0 to 71.4	
			1280	0	2048	0	2 (On)	1 (Off)			14.3 to 15.3	3.4 to 4.4	223.5 to 238.9	52.6 to 68.0	
		16667	2560	0	1024	0	1 (Off)	2 (On)	59.98	16667 - 100 =16567	14.5 to 15.5	3.6 to 4.6	226.7 to 242.3	55.9 to 71.4	
			1280	0	1024	0	2 (On)	2 (On)			14.3 to 15.3	3.4 to 4.4	223.4 to 238.9	52.7 to 68.1	
		36363	2560	0	2048	0	1 (Off)	1 (Off)	27.49	36363 - 100 =36263	14.8 to 15.8	3.4 to 4.4	252.3 to 269.2	58.8 to 75.7	
			1280	0	2048	0	2 (On)	1 (Off)			14.6 to 15.6	3.3 to 4.3	248.9 to 265.9	55.5 to 72.4	
	75.4 MHz	18182	2560	0	1024	0	1 (Off)	2 (On)	54.96	18182 - 100 =18082	14.8 to 15.8	3.4 to 4.4	252.3 to 269.2	58.8 to 75.7	
			1280	0	1024	0	2 (On)	2 (On)			14.6 to 15.6	3.3 to 4.2	249.0 to 265.9	55.5 to 72.4	
		44444	2560	0	2048	0	1 (Off)	1 (Off)	22.49	44444 - 100 =44344	15.4 to 16.4	3.2 to 4.2	320.2 to 340.9	66.3 to 87.1	
			1280	0	2048	0	2 (On)	1 (Off)			15.2 to 16.2	3.0 to 4.0	316.9 to 337.5	63.1 to 83.7	
	61.7 MHz	22222	2560	0	1024	0	1 (Off)	2 (On)	44.98	22222 - 100 =22122	15.4 to 16.4	3.2 to 4.2	320.1 to 340.9	66.3 to 87.1	
			1280	0	1024	0	2 (On)	2 (On)			15.2 to 16.2	3.0 to 4.0	316.8 to 337.6	63.1 to 83.7	

[Note] In 1X2-1Y Tap Geometry, "Exposure Active End to FVAL Active Start" period varies depending on the exposure time setting. When the exposure time is set at "10", it is the maximum period and if the exposure time is incremented by 1 us, it is decreased.

### 6.3.3 ROI (Region Of Interest) setting

In the SP-5000-PMCL, a subset of the image can be output by setting Width, Height, Offset-X, and Offset-Y. If the height is decreased, the number of lines read out is decreased and as the result, the frame rate is increased. However, in the horizontal direction, the horizontal frequency is not changed if the width is decreased. In the SP-5000M-PMCL, the minimum width is "16" and minimum height is "1". In the SP-5000C-PMCL, the minimum width is "16" and minimum height is "2".

Setting example (1)

Binning Horizontal = 1  
Binning Vertical = 1

Setting example (2)

Binning Horizontal = 2  
Binning Vertical = 2

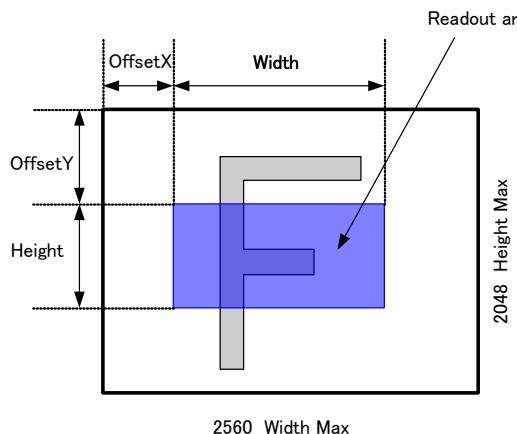


Fig. 18 Setting example ( No binning)

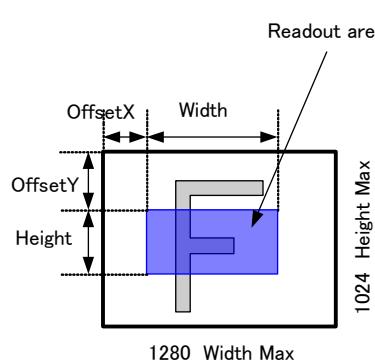


Fig.19 Setting example (Binning)

#### 6.4 Digital output bit allocation

Table -30 Output level

CCD out		Digital Out		
		8-bit	10-bit	12-bit
Black	0%	8LSB	32LSB	128LSB
Monochrome	100%	222LSB	890LSB	3560LSB
Color				
Monochrome	115%	255LSB	1023LSB	4095LSB
Color				

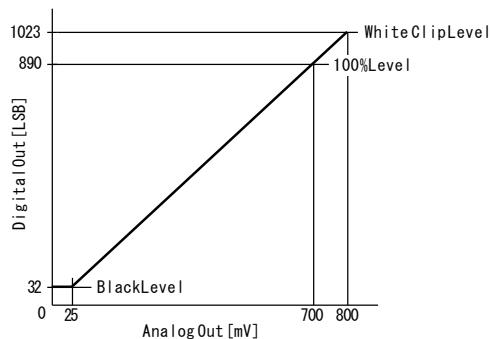


Fig. 20 Bit allocation (10-bit)

## 7. Operating modes

### 7.1. Acquisition control (change the frame rate)

#### 7.1.1 Acquisition control

With Trigger OFF (free-running mode) the frame rate is less than Height Max.rmal ROI setting.. As described before, in Multi ROI operation, h is the same for all 8 default frame rates. However, it is possible to specify a free-running frame rate (i.e., no trigger needed) that is slower than the default rate. This can be useful when a longer exposure time is needed for a specific ROI.

Modification of the frame rate is done by entering a value in the AcquisitionFrameRate control corresponding to the number of microseconds to be allocated to each frame period. Allowed values range from 167 µs to 8,000,000 (8 seconds) depending on the ROI and the tap geometry specified. However if the value entered is less than the time required for the default frame rate, the setting is ignored and the default frame rate is used. For example, in 1X10-1Y camera output format with an 82.3 MHz Camera Link pixel clock, the minimum frame period for the smallest possible ROI (1 line) requires 167 microseconds, so any entry less than 167 will always be ignored in this configuration.

The setting range in Acquisition Frame Rate is:

Shortest	to	Longest
Time required to expose and read out all pixels in the area set by ROI command	to	0.125 Hz = 8 seconds

#### How to set:

ROI should be set first.

The available number shown in Acquisition Frame Rate will correspond to the standard frame period for the specified ROI.

The value can be increased up to 8,000,000 (8 seconds).

If ROI is changed from a smaller size to a larger size, the default frame rate of the ROI is automatically recalculated inside the camera and changed to the slower frame rate of the larger ROI.

#### ROI setting:

Height: 1 line to 2048 lines for SP-5000M-PMCL  
2 lines to 2048 lines for SP-5000C-PMCL

As for the details of ROI settings, refer to section 6.3.3.

#### 7.1.2 Frame Rate Calculation

The frame rate can be calculated by using the following tables.

## SP-5000M-PMCL / SP-5000C-PMCL

Table 31. Frame rate calculation (Continuous Trigger, HDR Mode = “Off” )

Tap Geometry	Camera Link Clock	V -Binning	Continuous Trigger / HDR Mode = “Off” ART Command Minimum value setting calculation [Unit: us]
1X10-Y	82.3 MHz	Off	= ROUND(((Height) x 284.56)+13495) ÷ (82.286MHz x 10^6)
	82.3 MHz	On	= ROUND(((Height) x 284.56)+(13495 ÷ 2)) ÷ (82.286MHz x 10^6)
	75.4 MHz	Off	= ROUND(((Height) x 260.86)+13495) ÷ (75.429MHz x 10^6)
	75.4 MHz	On	= ROUND(((Height) x 260.86)+(13495 ÷ 2)) ÷ (75.429MHz x 10^6)
	61.7 MHz	Off	= ROUND(((Height) x 261.00)+13495) ÷ (61.714MHz x 10^6)
	61.7 MHz	On	= ROUND(((Height) x 261.00)+(13495 ÷ 2)) ÷ (61.714MHz x 10^6)
1X8-Y	82.3 MHz	Off	= ROUND(((Height) x 325.71)+13495) ÷ (82.286MHz x 10^6)
	82.3 MHz	On	= ROUND(((Height) x 325.71)+(13495 ÷ 2)) ÷ (82.286MHz x 10^6)
	75.4 MHz	Off	= ROUND(((Height) x 325.29)+13495) ÷ (75.429MHz x 10^6)
	75.4 MHz	On	= ROUND(((Height) x 325.29)+(13495 ÷ 2)) ÷ (75.429MHz x 10^6)
	61.7 MHz	Off	= ROUND(((Height) x 324.00)+13495) ÷ (61.714MHz x 10^6)
	61.7 MHz	On	= ROUND(((Height) x 324.00)+(13495 ÷ 2)) ÷ (61.714MHz x 10^6)
1X4-Y	82.3 MHz	Off	= ROUND(((Height) x 644.57)+23369) ÷ (82.286MHz x 10^6)
	82.3 MHz	On	= ROUND(((Height) x 644.57)+(23369 ÷ 2)) ÷ (82.286MHz x 10^6)
	75.4 MHz	Off	= ROUND(((Height) x 644.29)+23369) ÷ (75.429MHz x 10^6)
	75.4 MHz	On	= ROUND(((Height) x 644.29)+(23369 ÷ 2)) ÷ (75.429MHz x 10^6)
	61.7 MHz	Off	= ROUND(((Height) x 645.43)+23369) ÷ (61.714MHz x 10^6)
	61.7 MHz	On	= ROUND(((Height) x 645.43)+(23369 ÷ 2)) ÷ (61.714MHz x 10^6)
1X2-Y	82.3 MHz	Off	= ROUND(((Height) x 1285.72)+64677) ÷ (82.286MHz x 10^6)
	82.3 MHz	On	= ROUND(((Height) x 1285.72)+(64677 ÷ 2)) ÷ (82.286MHz x 10^6)
	75.4 MHz	Off	= ROUND(((Height) x 1285.44)+64677) ÷ (75.429MHz x 10^6)
	75.4 MHz	On	= ROUND(((Height) x 1285.44)+(64677 ÷ 2)) ÷ (75.429MHz x 10^6)
	61.7 MHz	Off	= ROUND(((Height) x 1284.42)+64677) ÷ (61.714MHz x 10^6)
	61.7 MHz	On	= ROUND(((Height) x 1284.42)+(64677 ÷ 2)) ÷ (61.714MHz x 10^6)

Table 32. Frame rate calculation (Continuous Trigger, HDR Mode = “ON” )

Tap Geometry	Camera Link Clock	Continuous Trigger / HDR Mode = “On” ART Command Minimum value setting calculation [Unit: us]
1X10-1Y	82.3 MHz	= ROUND(((Height) x 284.56) + 4855 - 284.56 + ([Width]÷10) ) ÷ 82.286MHz x 10^6) + [Exposure Time]
	75.4 MHz	= ROUND(((Height) x 260.86) + 4855 - 260.86 + ([Width]÷10) ) ÷ 75.429MHz x 10^6) + [Exposure Time]
	61.7 MHz	= ROUND(((Height) x 261.00) + 4855 - 261.00 + ([Width]÷10) ) ÷ 61.714MHz x 10^6) + [Exposure Time]
1X8-1Y	82.3 MHz	= ROUND(((Height) x 325.71) + 5513 - 325.71 + ([Width]÷8) ) ÷ 82.286MHz x 10^6) + [Exposure Time]
	75.4 MHz	= ROUND(((Height) x 325.29) + 5513 - 325.29 + ([Width]÷8) ) ÷ 75.429MHz x 10^6) + [Exposure Time]
	61.7 MHz	= ROUND(((Height) x 324.00) + 5513 - 324.00 + ([Width]÷8) ) ÷ 61.714MHz x 10^6) + [Exposure Time]
1X4-1Y	82.3 MHz	= ROUND(((Height) x 644.57) + 10944 - 644.57 + ([Width]÷4) ) ÷ 82.286MHz x 10^6) + [Exposure Time]
	75.4 MHz	= ROUND(((Height) x 644.29) + 10944 - 644.29 + ([Width]÷4) ) ÷ 75.429MHz x 10^6) + [Exposure Time]
	61.7 MHz	= ROUND(((Height) x 645.43) + 10944 - 645.43 + ([Width]÷4) ) ÷ 61.714MHz x 10^6) + [Exposure Time]
1X2-Y	82.3 MHz	= ROUND(((Height) x 1285.72) + 21888 - 1285.72 + ([Width]÷2) ) ÷ 82.286MHz x 10^6) + [Exposure Time]
	75.4 MHz	= ROUND(((Height) x 1285.44) + 21888 - 1285.44 + ([Width]÷2) ) ÷ 75.429MHz x 10^6) + [Exposure Time]
	61.7 MHz	= ROUND(((Height) x 1284.42) + 21888 - 1284.42 + ([Width]÷2) ) ÷ 61.714MHz x 10^6) + [Exposure Time]

[Note] The same formula is applied if Binning function is enabled.

Table 33. Frame rate setting range(Typical) (Continuous Trigger) (1/2)

Camera Settings					ART Command value : limited reference				
Tap Geometry	Pixel Clock	Camera Link	Binning	Height	HDR Mode	Min.		Max.	
						Setting value	Actual period	Setting value	Actual time /period
1X10 -1Y	82.3 MHz		1 (Off)	2048	Off	7246 (138.007fps)	137.9 fps	8 000 000	8 sec / 0.125 Hz
			2 (On)	1024	Off	3623 (276.014fps)	275.7 fps		
	75.4 MHz		1 (Off)	2048	Off	7262 (137.703fps)	137.6 fps		
			2 (On)	1024	Off	3631 (275.406fps)	275.1 fps		
	61.7 MHz		1 (Off)	2048	Off	8880 (112.613fps)	112.5 fps		
			2 (On)	1024	Off	4440 (225.225fps)	225.2 fps		
	82.3 MHz		1 (Off)	2048	On	7151 (139.841fps)	139.7 fps		
			2 (On)	1024	On	3610 (277.008fps)	276.7 fps		
	75.4 MHz		1 (Off)	2048	On	7157 (139.723fps)	139.6 fps		
			2 (On)	1024	On	3616 (276.549fps)	276.3 fps		
	61.7 MHz		1 (Off)	2048	On	8750 (114.286fps)	114.2 fps		
			2 (On)	1024	On	4419 (226.296fps)	226.1 fps		
1X8 -1Y	82.3 MHz		1 (Off)	2048	Off	8271 (120.904fps)	120.8 fps		
			2 (On)	1024	Off	4135 (241.838fps)	241.8 fps		
	75.4 MHz		1 (Off)	2048	Off	9011 (110.975fps)	110.9 fps		
			2 (On)	1024	Off	4505 (221.976fps)	221.9 fps		
	61.7 MHz		1 (Off)	2048	Off	10971 (91.149fps)	91.1 fps		
			2 (On)	1024	Off	5485 (182.315fps)	182.3 fps		
	82.3 MHz		1 (Off)	2048	On	8183 (122.205fps)	122.1 fps		
			2 (On)	1024	On	4130 (242.131fps)	241.9 fps		
	75.4 MHz		1 (Off)	2048	On	8915 (101.885fps)	112.1 fps		
			2 (On)	1024	On	4499 (222.272fps)	222.1 fps		
	61.7 MHz		1 (Off)	2048	On	10851 (92.157fps)	92.1 fps		
			2 (On)	1024	On	5475 (182.648fps)	182.5 fps		

## [Note]

- (1) The SP-5000-PMCL has maximum 1 line jitter even in continuous trigger operation. Therefore, the actual frame rate might be slower than the setting value.
- (2) If HDR Mode is set to "On", the exposure of the next frame cannot be done while the previous frame is read out. Due to this, the frame rate is slower than with HDR Mode "Off".
- (3) If HDR Mode is set to "On", the fastest frame rate can be achieved when the exposure time is set to "10". As mentioned before, the image readout and exposure cannot be overlapped when HDR mode is ON, thus the fastest frame rate is influenced by the exposure time.

## SP-5000M-PMCL / SP-5000C-PMCL

Table 34. Frame rate setting range(Typical) (Continuous Trigger) (2/2)

Camera Settings					ART Command: Limited Reference			
Tap Geometry	Pixel Clock	Link	Camera	Vertical Binning	Min.		Max.	
					Setting Value	Actual Period	Setting Value	Actual time /period
1X4 -1Y	82.3 MHz			1 (Off)	2048	Off	16327 (61.248fps)	61.2 fps
				2 (On)	1024	Off	8163 (122.504fps)	122.5 fps
	75.4 MHz			1 (Off)	2048	Off	17803 (56.170fps)	56.1 fps
				2 (On)	1024	Off	8905 (112.296fps)	112.2 fps
	61.7 MHz			1 (Off)	2048	Off	21797 (45.878fps)	45.8 fps
				2 (On)	1024	Off	10889 (91.836fps)	91.7 fps
	82.3 MHz			1 (Off)	2048	On	16186 (61.782fps)	61.7 fps
				2 (On)	1024	On	8164 (122.489fps)	122.4 fps
	75.4 MHz			1 (Off)	2048	On	17648 (56.664fps)	56.6
				2 (On)	1024	On	8902 (112.334fps)	112.2 fps
	61.7 MHz			1 (Off)	2048	On	21606 (112.334fps)	46.2 fps
				2 (On)	1024	On	10897 (91.768fps)	91.7 fps
1X2 -1Y	82.3 MHz			1 (Off)	2048	Off	32786 (30.501fps)	30.5 fps
				2 (On)	1024	Off	16393 (61.002fps)	61.0 fps
	75.4 MHz			1 (Off)	2048	Off	35759 (27.965fps)	27.9 fps
				2 (On)	1024	Off	17879 (55.932fps)	55.9 fps
	61.7 MHz			1 (Off)	2048	Off	43672 (22.898fps)	22.8 fps
				2 (On)	1024	Off	21836 (45.796fps)	45.7 fps
	82.3 MHz			1 (Off)	2048	On	32276 (30.983fps)	30.9 fps
				2 (On)	1024	On	16276 (61.440fps)	61.4 fps
	75.4 MHz			1 (Off)	2048	On	35202 (28.407fps)	28.4 fps
				2 (On)	1024	On	17751 (56.335fps)	56.3 fps
	61.7 MHz			1 (Off)	2048	On	43022 (23.244fps)	23.2 fps
				2 (On)	1024	On	21693 (46.098fps)	46.0 fps

8 sec / 0.125 Hz

## 7.2. Exposure setting

### 7.2.1 Mode

Exposure Mode sets which exposure mode is to be used.

If the trigger is used, Frame Start must also be used.

When Exposure Mode is set to Timed or Trigger Width, the combination of Exposure Mode and Frame Start can set various operations.

The following table shows the operation depending on the combination.

Table -35 Exposure mode and trigger control matrix table

Exposure Mode	Trigger Control	Trigger mode OFF	Trigger mode ON
		Behavior	
OFF	OFF or ON	Free-running No exposure control	-
Timed (EPS) Timed(RCT) Timed (PIV)	OFF	Free-running Exposure control available	-
	ON	-	Operate in EPS, RCT or PIV
Trigger width	OFF	Free-running No exposure control	-
	ON	-	Exposure control by trigger width

#### Trigger Control select

Frame Start trigger: Sets whether the start of the frame is controlled externally or not.

Trigger mode ON: If Acquisition Active is active and Exposure Mode chooses Timed or Trigger Width, the exposure will be started by using the signal set in Frame Trigger as the trigger.

Trigger mode OFF: If Acquisition Active is active, the camera operates in free-running mode.

#### Exposure mode can be selected from the followings.

OFF: No shutter control

Timed: The exposure will be done in the preset period. The setting can be done in  $\mu$ sec units.

Frame Start OFF: Free-running mode and exposure control is available.

Frame Start ON: EPS operation mode

In this status, if RCT or PIV is selected as the Trigger option, the camera will operate in each mode respectively.

Trigger Width: The exposure will be controlled by the width of the trigger pulse.

Frame Start OFF: Free-running mode and control the exposure

Frame Start ON: PWC operation mode

### 7.2.2 ExposureTime

This command is effective only when Exposure Mode is set to Timed. It is for setting exposure time. The setting step for exposure time is 1  $\mu$ sec per step.

Minimum: 10  $\mu$ sec

Maximum: 8 seconds

Note: In the continuous trigger mode (Frame Start Trigger Mode: OFF), the maximum setting value of the exposure time is limited by the frame rate setting. In the SP-5000-PMCL, the maximum value of exposure time is “Frame Rate - 100”. If the exposure mode is OFF, the maximum value of exposure time is set in the camera. If the frame period is changed, then the maximum value of exposure time is renewed.

### **7.2.3 ExposureAuto**

This is a function to control the exposure automatically. It is effective only for Timed. ALC Reference controls the target brightness level.

There are three modes: OFF, Once and Continuous.

- |             |   |
|-------------|---|
| OFF:        | No exposure control   |
| Once:       | Exposure adjusts when the function is set, then remains at that setting |
| Continuous: | Exposure continues to be adjusted automatically                         |

In this mode, the following settings are available.

- |                    |   |
|--------------------|---|
| ALC Speed:         | Rate of adjustment speed can be set (common with Gain Auto)                     |
| Exposure Auto Max: | The maximum value for the exposure time to be controlled can be set             |
| Exposure Auto Min: | The minimum value for the exposure time to be controlled can be set             |
| ALC Reference:     | The reference level of the exposure control can be set (common with Gain Auto)  |
| ALC Channel Area:  | The measurement area of the exposure control can be set (common with Gain Auto) |

## **7.3 Trigger control**

### **7.3.1 Trigger Selector**

Selects the trigger operation. In the SP-5000-PMCL, only Frame Start is available.

Table - 36 Trigger selector

Trigger Selector Item	Description
Frame Start	Frame Start Trigger

### **7.3.2 Trigger Mode**

Select either free-running operation or external trigger operation.

- |                                |
|--------------------------------|
| OFF: Free-running operation    |
| ON: External trigger operation |

### **7.3.3 TriggerSource**

Select the trigger source to be used for trigger operation (Frame Start for the SP-5000-PMCL) from the following:

- OFF
- Line 4 ( TTL IN1)
- Line 7 (Camera Link CC1 IN)
- Soft trigger
- Pulse generator 0
- Pulse generator 1
- Pulse generator 2
- Pulse generator 3

#### 7.3.4 TriggerActivation

This command can select how to activate the trigger.

Rising edge: At the rising edge of the pulse, the trigger is activated.

Falling edge: At the falling edge of the pulse, the trigger is activated.

Level High: During the high level of trigger, the accumulation is activated

Level Low: During the low level of trigger, the accumulation is activated

If Exposure Mode is set to Trigger Width, Level High or Level Low must be used.

Table - 37 Trigger Activation

	Trigger Activation Setting			
Exposure Mode	Rising Edge	Falling Edge	Level High	Level Low
Timed	○	○	×	×
Trigger width	×	×	○	○
Timed PIV	○	○	×	×
Timed RCT	○	○	×	×

#### 7.3.5 Triggeroverlap

This function defines whether or not a trigger pulse can be accepted while data is being read out.

OFF : The trigger pulse is not accepted during CMOS readout.

Read Out : The trigger pulse can be accepted during CMOS readout.

### 7.4. Normal continuous operation (Timed Exposure Mode/Trigger Mode OFF)

This is used for applications which do not require triggering. In this mode, the video signal for the auto-iris lens is available.

For the video timing, refer to chapter 6.3.

Table - 38 Minimum interval (1X8-1Y)

Trigger Mode	Readout Mode	Time (Min. trigger period )
Timed Exposure Mode Trigger Mode OFF (Note 1 )	Full	30.9 ms
	AOI Center 2/3	21.5 ms
	AOI Center 1/2	15.5 ms
	AOI Center 1/4	7.7 ms
	AOI Center 1/8	3.9 ms
	V Binning ON (Full) (Note2)	15.5 ms

Note 1 : Readout setting in Trigger Overlap is not available

Note 2: SP-5000M-PMCL only

#### 7.5. Timed mode (EPS operation)

This mode captures image(s) with a preset exposure time by using the external trigger. An additional setting determines if the trigger pulse can be accepted during the exposure period.

##### Primary settings to use this mode

Acquisition Mode = Single frame, Multi-frame or Continuous

Trigger Mode = ON

Exposure Mode = Timed

Table - 39 Trigger minimum interval (Trigger Overlap = Readout) (1X8-1Y)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
Timed Exposure Mode Trigger Mode ON	Full	30.9 ms + 8.01 µs
	AOI Center 2/3	21.5 ms + 8.01 µs
	AOI Center 1/2	15.5 ms + 8.01 µs
	AOI Center 1/4	7.7 ms + 8.01 µs
	AOI Center 1/8	3.9 ms + 8.01 µs
	V Binning ON (Full) (Note 1)	15.5 ms + 8.01 µs

Note1 : SP-5000M-PMCL only

Note2 : If Trigger Overlap is OFF, the accumulation time is added to the above table.

### 7.5.1 If Overlap setting is OFF

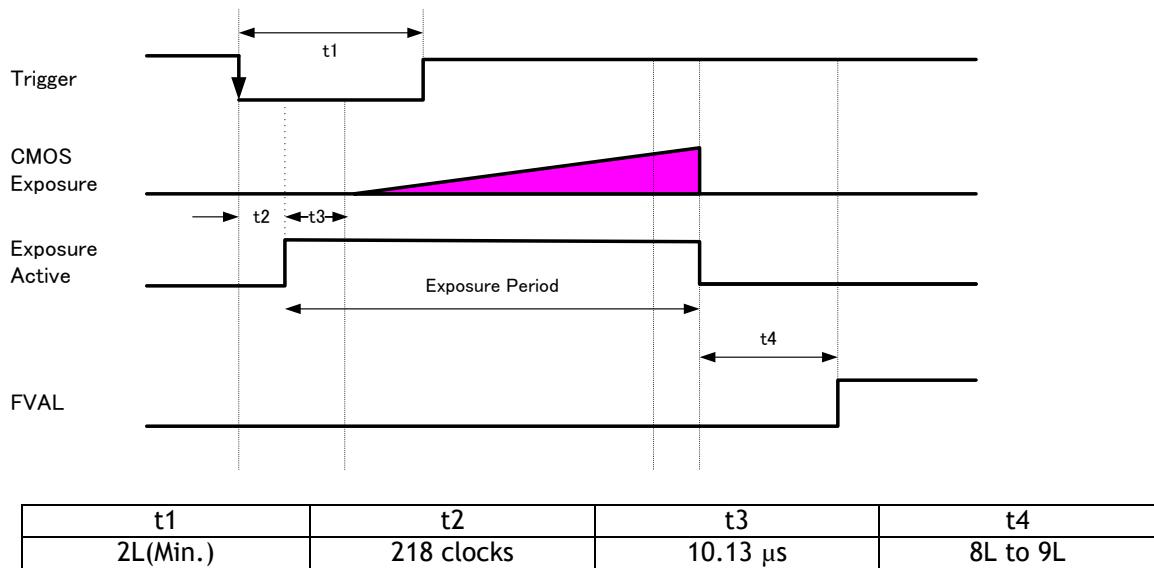


Fig. 21 Overlap OFF

### 7.5.2 If Overlap setting is Readout

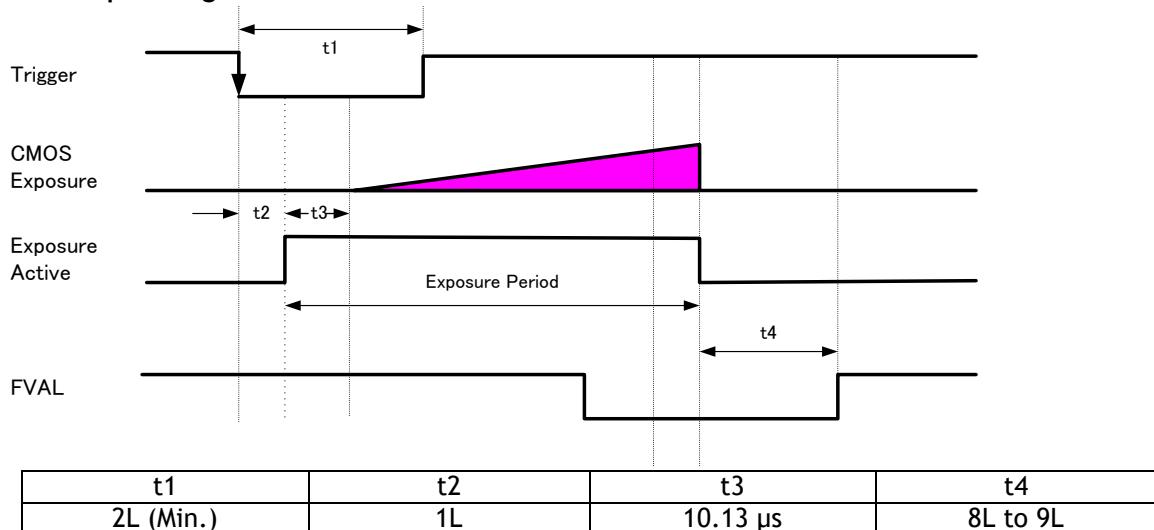


Fig. 22 Overlap Readout

## 7.6 Trigger width mode (PWC)

In this mode, the exposure time is equal to the trigger pulse width. Accordingly, longer exposure times are supported. Additional settings determine if the trigger pulse can be accepted during the exposure period.

### Primary settings to use this mode

Trigger Mode = ON

Exposure Mode = Trigger Width

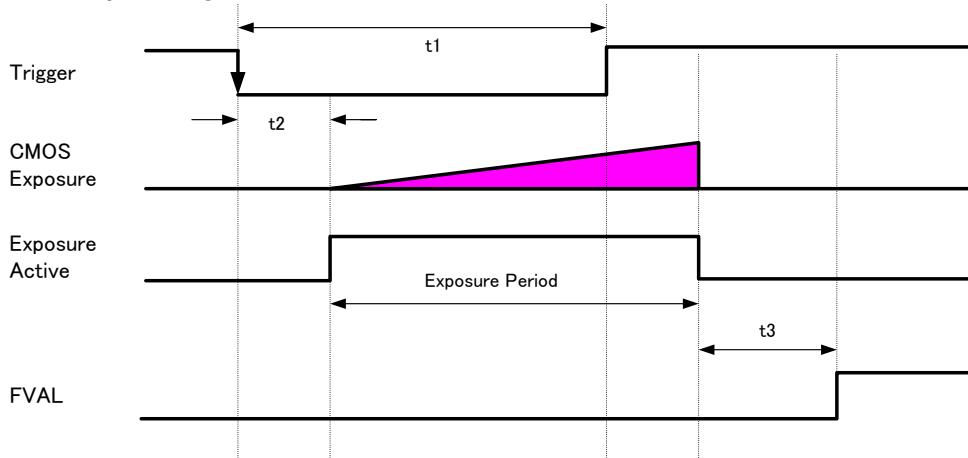
Table - 40 Minimum trigger interval (Trigger Overlap = Readout) (1X8-1Y)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
Trigger Width Exposure Mode	Full	30.9 ms + 8.01 µs
	AOI Center 2/3	21.5 ms + 8.01 µs
	AOI Center 1/2	15.5 ms + 8.01 µs
	AOI Center 1/4	7.7 ms + 8.01 µs
	AOI Center 1/8	3.9 ms + 8.01 µs
	V Binning ON (Full) (Note1)	15.5 ms + 8.01 µs

Note1 : SP-5000M-PMCL only

Note2 : If Trigger Overlap is OFF, the accumulation time is added to the above table.

### 7.6.1 If Overlap setting is OFF



t1	t2	t3
2L (Min.)	208 clocks	7L to 8L

Fig. 23 Overlap = OFF

**7.6.2 If Overlap setting is Readout**

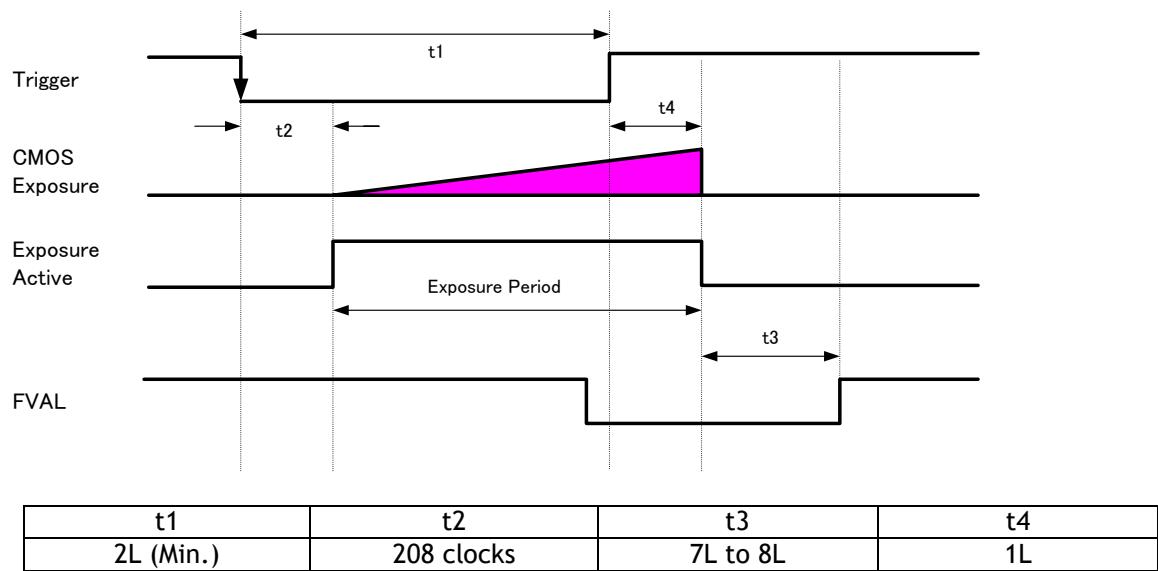


Fig. 24    Overlap: Readout

## 7.7. RCT mode

Until the trigger is input, the camera operates continuously and the video signal for the auto-iris lens is output. At this moment, the video signal, FVAL and LVAL are output but DVAL is not output. When the trigger is input, the fast dump is activated to read out the electronic charge very quickly, after which the accumulation and the readout are performed. When the accumulated signal against the trigger is read out, FVAL, LVAL and DVAL are output too.

### Primary settings to use this mode

Trigger Mode = ON

Exposure Mode = Timed

Trigger Option = RCT

Table - 41 Minimum trigger interval (1X8-1Y)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
Reset Continuous Trigger Mode (Note2)	Full	30.9 ms + Exposure time + 1.562 ms
	AOI Center 2/3	21.5 ms + Exposure time + 1.562 ms
	AOI Center 1/2	15.5 ms + Exposure time + 1.562 ms
	AOI Center 1/4	7.7 ms + Exposure time + 1.562 ms
	AOI Center 1/8	3.9 ms + Exposure time + 1.562 ms
	V Binning ON (Full) (Note1)	15.5 ms + Exposure time + 1.562 ms

Note1 : SP-5000M-PMCL only

Note2 : Trigger Overlap “Readout” is not available for this trigger mode.

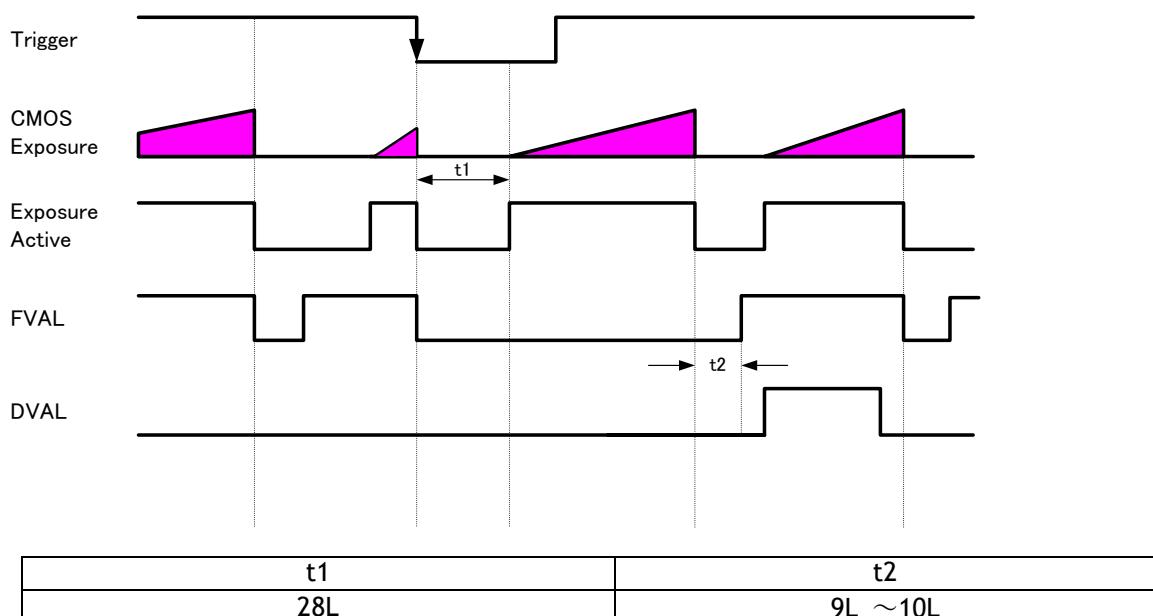


Fig.25 RCT mode timing

## 7.8 PIV (Particle Image Velocimetry)

The Particle Image Velocimetry mode can be used in applications where 2 images need to be taken with a very short time interval. It can only be used with strobe flash as illumination. The first accumulation time is 10  $\mu$ sec to 2 sec. Then, the second exposure will be taken. The first strobe is activated during the first exposure duration and the second strobe is pulsed while the first frame is being read out. In this way, two strobe flashes generate two video outputs.

### Basic settings to use this mode

Trigger Mode = ON

Exposure Mode = Timed

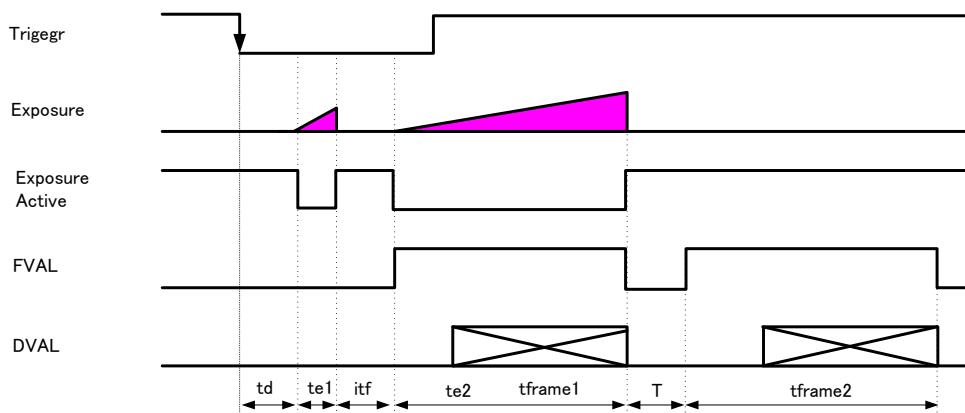
Trigger Option = PIV

Table - 42 Minimum trigger interval (1x8-1Y)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
PIV mode (Note1)	Full	30.9 ms x 2 + Exposure time + 8.01 $\mu$ s
	AOI Center 2/3	21.5 ms x 2 + Exposure time + 8.01 $\mu$ s
	AOI Center 1/2	15.5 ms x 2 + Exposure time + 8.01 $\mu$ s
	AOI Center 1/4	7.7 ms x 2 + Exposure time + 8.01 $\mu$ s
	AOI Center 1/8	3.9 ms x 2 + Exposure time + 8.01 $\mu$ s
	V Binning ON (Full) (Note2)	15.5 ms x 2 + Exposure time + 8.01 $\mu$ s

Note 1. Overlap mode=Readout is not available

Note 2. SP-5000M-PMCL only



Time name	Description	Time
td	Exposure beginning delay	5270 clocks
te1	First exposure time period	10 $\mu$ s to 8s
te2	Second exposure time	8.1 ms
itf	Interframing time	10435 clocks
T	FVAL no active	42 LVAL
tframet1	First frame readout	1 frame
tframe2	Second frame readout	1 frame

Fig. 26 PIV mode

## 7.9 Sequence Mode

This is a function to capture images in sequence based on preset ROI, Exposure Time, Gain and other parameters in the sequence index table. In order activate this function:

### 7.9.1 Video send mode

Sequence Mode has two operating modes and it is set in the video send mode.

Video Send Mode	How to select Index
Trigger Sequence	The index can be selected by the frame start trigger signal. (Setting index is determined by the next index setting)
Command Sequence	Select the index directly by setting the index number by Command Sequence Index command.

### 7.9.2 Sequence mode

#### Basic setting to use this function

Trigger Mode: ON

Exposure mode : Timed

Trigger option : Sequence

Table - 43 Minimum trigger interval (1x8-1Y)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
PIV mode	Full	30.9ms + Exposure time + 8.01μs
	ROI Center 2/3	21.5ms + Exposure time + 8.01μs
	ROI Center 1/2	15.5ms + Exposure time + 8.01μs
	ROI Center 1/4	7.7ms + Exposure time + 8.01μs
	ROI Center 1/8	3.9ms + Exposure time + 8.01μs
	V Binning ON (Full) (Note 1)	15.5ms + Exposure time + 8.01μs

Note 1: SP-5000M-PMCL only

Note 2: The minimum trigger interval assumes that the exposure time is the same for each index in the sequence. If the exposure time is different, the difference in period should be added to the interval calculation.

Note 3: If it is necessary to use different exposure times, it is recommended to arrange the exposure times from the shortest to the longest.

Note 4: In sequence mode, the exposure should be adjusted so that the operation is not in LVAL sync accumulation.

### 7.9.3 Sequence mode timing

The following drawing shows the sequence mode timing concept.

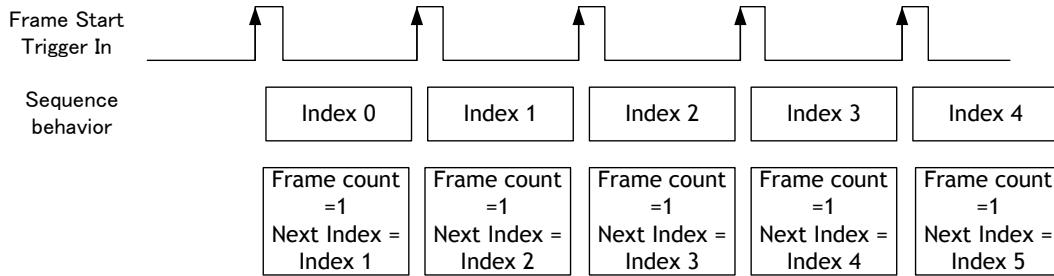


Fig. 27 Behavior of Sequence trigger

In this mode, it is not possible to overlap the next exposure while the previous trigger operation (Index table) is in progress.

Sequence Index Table should proceed through Index 0 and after Index 0 is activated, the next index can be processed.

Table 44. Sequence mode: Sequence Index default value

Sequence ROI Index	Sequence ROI													
	Width	Height	Offset		Gain Selector			Exposure Time	Black Level	Binning		LUT Enable	Frame Count	Next Index
			X	Y	Gain (ALL)	Red	Blue			Horizontal	Vertical			
- Index 0	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 1	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 2	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 3	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 4	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 5	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 6	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 7	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 8	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 9	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0

#### 7.9.4 Sequence ROI setting parameters

Setting parameters for Sequence ROI are as follows.

##### (1) Sequence ROI Index Selector

In Sequence ROI Index Selector, Index 0 to 9 can be selected.

Sequence ROI - Width, Height, Offset X, Offset Y, Gain Selector - Gain/Red/Blue, Exposure Time, Black Level, Binning Horizontal, Binning Vertical, LUT Enable, Frame Count, Next Index for the selected index are displayed.

##### (2) Sequence ROI Width

Set the width of sequence ROI. The setting range is 8 to 2560 pixels.

Rules for setting area and step number are the same as the normal ROI mode set by [Video Send Mode] = “Normal”.

##### (3) Sequence ROI Height

Set the height of sequence ROI. The setting range is 1 to 2048 lines.

Rules for setting area and step number are the same as the normal ROI mode set by [Video Send Mode] = “Normal”.

##### (4) Sequence ROI Offset X

Set Offset X of sequence ROI.

Sequence ROI Binning Horizontal =1 (Off) :

Setting range is 0 to (2560 - [Sequence ROI Width])

Sequence ROI Binning Horizontal =2 (On) :

Setting range is 0 to (1280 - [Sequence ROI Width])

The limitations of step number and other factors are the same as the normal ROI mode set by [Video Send Mode] = “Normal”.

**(5) Sequence ROI Offset Y**

Set Offset Y of sequence ROI.

Sequence ROI Binning Vertical =1 (Off) :

Setting range is 0 to (2048 - [Sequence ROI Height])

Sequence ROI Binning Vertical =2 (On) :

Setting range is 0 to (1024 - [Sequence ROI Height])

The limitations of step number and other factors are the same as the normal ROI mode set by [Video Send Mode] =“Normal”.

**(6) Sequence ROI Gain Selector**

In Sequence ROI Gain Selector, the gain settings for each index are available.

SP-5000C-PMCL: Gain(ALL), Red and Blue can be set.

SP-5000M-PMCL: Only Gain is displayed and can be set.

**(7) Sequence ROI Black Level**

Black Level setting is available for each index.

**(8) Sequence ROI Exposure Time**

Exposure Time setting is available for each index.

**(9) Sequence ROI Binning Horizontal**

ON or OFF of Horizontal Binning for each index can be set.

**(10) Sequence ROI Binning Vertical**

ON or OFF of Vertical Binning for each index can be set.

**(11) Sequence ROI LUT Enable**

Enable or disable of LUT function for each index 0 to 9 can be set.

**(12) Sequence ROI Frame Count**

This can set how many times the selected index is repeated. This is applied to each index.

Triggers are input according to numbers set in Frame Count and index is repeated and moves to the next index. Therefore, the same number of triggers as Frame Count must be input.

**(13) Sequence ROI Next Index**

The number of the index that will follow the current index can be set.

If [Video Send Mode] is set to “Trigger Sequence” and the trigger pulse is input in EPS trigger, the sequence is executed from index 0.

**(14) Sequence ROI Reset Command**

This command resets the current index pointer and reverts to index 0 in the table. Frame Count is also re-initialized.

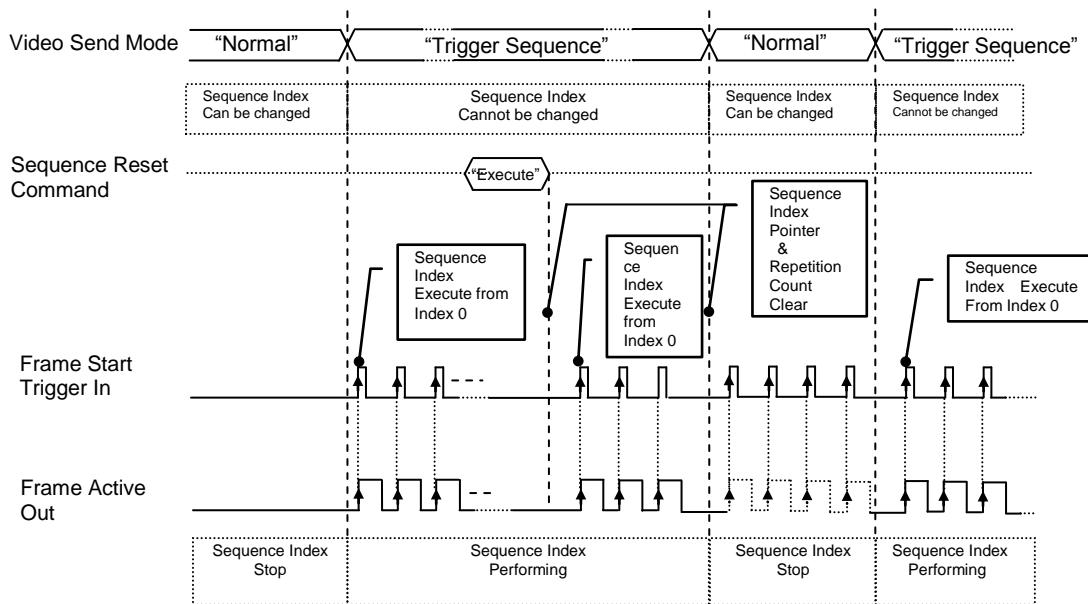


Fig. 28 Sequence trigger timing

## 7.10 Multi ROI function

This function divides one frame image into a maximum of 8 images vertically and reads out all areas in one frame. In this function, width is the same for all 8 images.

### Multi ROI setting

Video Sending Mode: Set to Multi ROI

Table 45 Multi ROI Index table default values

Multi ROI Index Max	1		
Multi ROI Width	2560		
Multi ROI Index Selector	Multi ROI		
	Height	Offset	
- Index 1	1	X	Y
- Index 2	1	0	0
- Index 3	1	0	0
- Index 4	1	0	0
- Index 5	1	0	0
- Index 6	1	0	0
- Index 7	1	0	0
- Index 8	1	0	0

### 7.10.1 Multi ROI setting parameters

(1) Multi ROI Index Max : Setting value = 1 ~ 8

Maximum 8 ROI settings are possible in a frame. Set Index 1 through 8 in Multi ROI Index table as an application requires.

**(2) Multi ROI Width**

The setting range and Step number are the same as the normal ROI setting in which [Width] plus [Offset X] should be equal to [Width Max]. In Multi ROI operation, the maximum offset value in index 1 to index 8 is the object in this calculation.

**(3) Multi ROI Index Selector :**

Index 1 to 8 can be selected. [Height], [Offset X], and [Offset Y] of the selected Multi ROI Index are displayed and can be set.

**(4) Multi ROI Offset X :**

Offset X can be set for each ROI area of Multi ROI Index 1 to 8.

The restriction for setting Step and other factors are the same as the normal ROI setting. As described before, in Multi ROI operation, Multi ROI Width is a common width setting for Multi ROI Index 1 to 8.

**(5) Multi ROI Height :**

Height can be set for each ROI area of Multi ROI Index 1 to 8.

The restriction for setting Step and other factors are the same as the normal ROI setting.

**(6) Multi ROI Offset Y :**

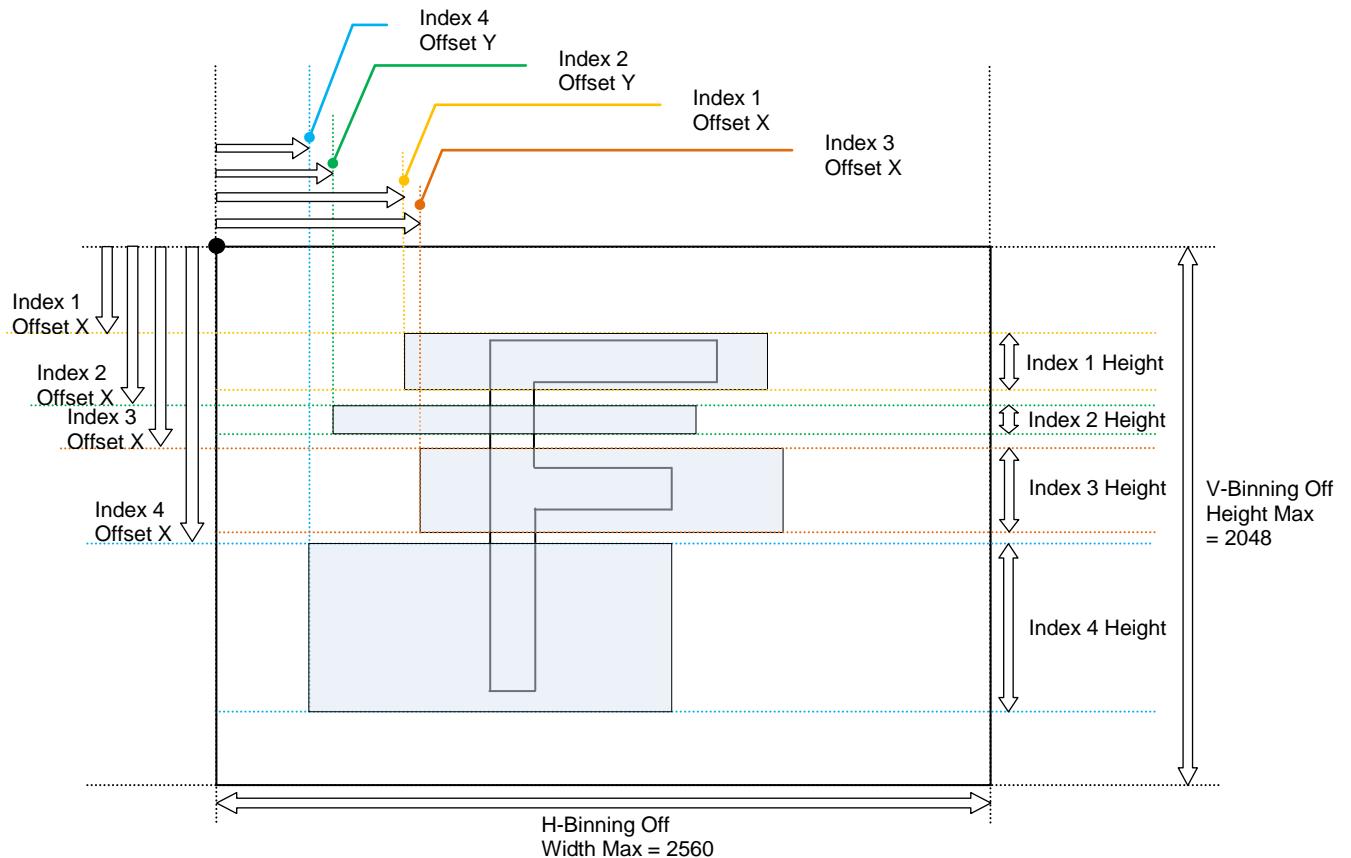
Offset Y can be set for each ROI area of Multi ROI Index 1 to 8.

The restriction for setting Step and other factors is the same as the normal ROI setting.

The sum of Multi ROI Height values of index 1 to 8 should be less than Height Max.

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## ROI setting explanation if Multi ROI Index Max is set to 4



## Video output of Multi ROI

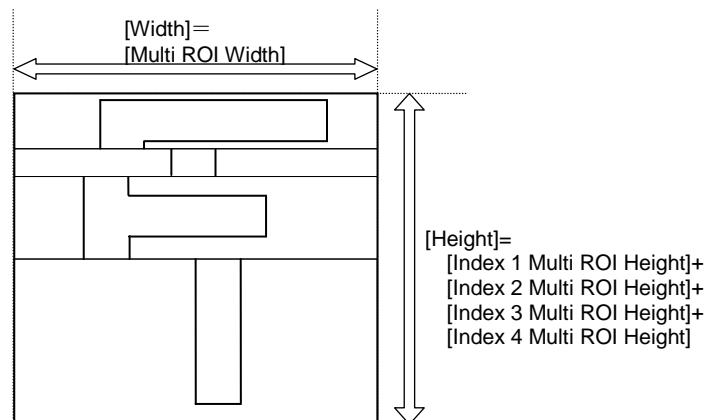


Fig. 29 Multi ROI settings and output image

### 7.11. Operation and function matrix

Table - 46 Operation and function matrix

Exposure operation	Trigger Mode	Trigger Option	Binning Vertical (Note1)	Binning Horizontal (Note1)	Exposure Time	AOI	Auto White Balance (Note2)	Auto Iris Output	Auto Gain	Auto Exposure	Overlap
OFF	OFF	OFF	1	1	×	○	○	○	○	×	×
			2	2	×	○	○	○	○	×	×
Timed	OFF	OFF	1	1	○	○	×	○	○	○	×
			2	2	○	○	×	○	○	○	×
Timed	ON	OFF	1	1	○	○	×	×	×	×	○
			2	2	○	○	×	×	×	×	○
Trigger Width	ON	OFF	1	1	×	○	×	×	×	×	○
			2	2	×	○	×	×	×	×	○
RCT	ON	RCT	1	1	○	○	○	○	○	○	×
			2	2	×	×	○	×	×	×	×
PIV	ON	PIV	1	1	×	○	×	×	×	×	×
			2	2	×	×	×	×	×	×	×
Sequence Trigger	ON	Sequence Trigger	1	1	○	○	×	×	×	×	×
			2	2	○	○	×	×	×	×	×

(Note1) SP-5000M-PMCL only

(Note2) SP-5000C-PMCL only

## **8. Other functions**

### **8.1 Black level control**

This function adjusts the setup level.

Variable range: -256 to 255 LSB (at 10-bit output)

#### **8.1.1 Black Level Selector**

The following items can be adjusted.

Monochrome: Black Level All

Color: Black Level All/ Black Level Red/ Black Level Blue

#### **8.1.2 Black Level**

The black level can be adjusted in the following range.

Monochrome: Black Level All : -256 ~+255

Color: Black Level All : -256 ~+255

Black Level Red/Blue: -512 ~+511

### **8.2 Gain control**

In the SP-5000-PMCL, the gain control uses Analog Base Gain and Digital Gain.

Analog Base Gain can be set at 0dB, +6dB or +12dB. The digital gain is used for the master gain setting.

For setting the gain,

1. Set analog gain (Select from 0dB, +6dB and +12dB)
2. Set digital gain

The master gain (DigitalAll) for both monochrome and color can be set x1(0dB) to x16(+24dB) against the analog base gain. The resolution for gain setting is 0.01%/step which is 0.05dB to 0.08dB, depending on the setting value.

In the SP-5000C-PMCL, blue and red gain can be set from x0.45 to x5.62 against the master gain setting and its resolution is x0.01/step.

Note: If the gain up function is used, it is recommended to use the analog base gain as the master gain setting. For instance, if +12dB gain up is required, the analog base gain is set at +12dB and no digital gain is added. This is because the signal-to-noise is better on analog gain performance. However, the AGC function works only in digital gain.

Additionally, the analog base gain is effective in order to minimize the drop of the histogram at higher gain settings. Please note that the analog base gain has less accuracy due to its variability.

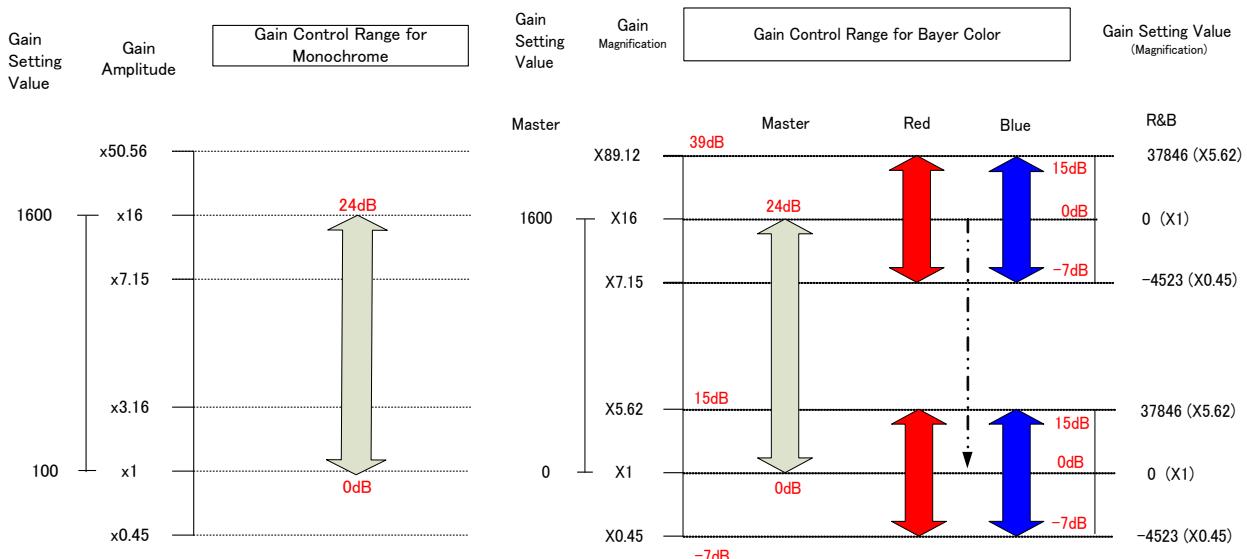


Fig.30 Gain control

### 8.2.1 Gain Selector

The following parameters can be set.

Monochrome: Digital All

Color: Digital All/Digital Red/ Digital Blue

### 8.2.2 Gain

The range for adjustment is as follows.

Monochrome: Digital All: 1 ~ 16 (x1 (0dB) ~x16 (+24dB))

Color: Digital All: 1 ~ 16 (x1 (0dB) ~ x16 (+24dB))

Digital Red: -0.4476 ~ 5.6235 (-7dB ~+15dB)

Digital Blue: 0.4476 ~ 5.6235 (-7dB ~+15dB)

### 8.2.3 Gain Raw

The range for adjustment is as follows.

Mono: Gain Raw Digital All : 100 ~ 1600 (0dB~24dB)

Color: Gain Raw Digital All : 100 ~ 1600(0dB~24dB)

Gain Raw Digital Red / Gain Raw Digital Blue : -4533~37876

### 8.2.4 Gain Auto

This provides automatic control of the gain level.

This is controlled by the command JAI ALC Reference.

There are three modes.

OFF: Adjust manually.

Once: Operate only one time when this command is set

Continuous: Operate the auto gain continuously

The following detailed settings are also available.

ALC Speed: The rate of adjustment of GainAuto can be set (common with Exposure Auto)

Gain Auto Max: The maximum value of GainAuto control range can be set

Gain Auto Min:	The minimum value of GainAuto control range can be set
ALC Reference:	The reference level of Gain Auto control can be set (common with Exposure Auto)
ALC channel area:	The measurement area of GainAuto control can be set, either entire area or individual section (Common with Exposure Auto)

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

Fig.31 ALC channel area

### 8.3. LUT

This function can be used to convert the input to the desired output characteristics. The Look-Up Table (LUT) has 256 points for setup. The output level can be created by multiplying the gain data by the input level.

#### 8.3.1 LUT Enable

ON or OFF LUT function.

#### 8.3.2 LUT Index

The number of LUT data elements is 256. The lowest level is Index 0 and the highest level is Index 255.

#### 8.3.3 LUT Value

There are 256 LUT data elements to which a value can be assigned. The minimum LUT value is 0 and the maximum LUT value is 255.

The data between LUT data elements is calculated from adjacent data elements.

In the color camera, LUT characteristics for R, G and B are the same.

Output Data = Video IN x LUT data

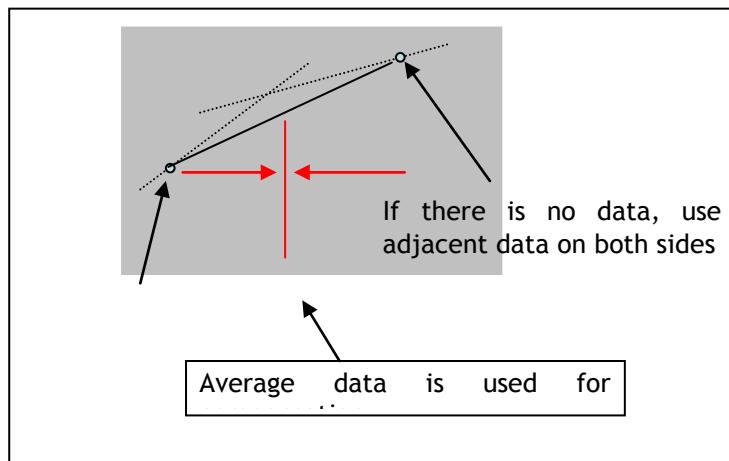


Fig.32 LUT data processing method

#### 8.4 Gamma

This command is used set gamma between gamma 0.45 and gamma 1.0 (OFF). 8 steps are provided. The gamma value is an approximate value.

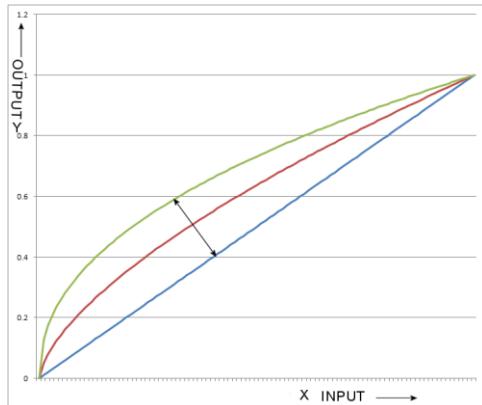


Fig.33 Gamma correction

#### 8.5 Shading Correction

This function compensates for shading (non-uniformity) caused by the lens or the light source used. This compensation can be performed even if shading issues are not symmetrical in horizontal and/or vertical directions.

There are two methods of correction.

##### Flat shading correction:

The method to compensate the shading is to measure the highest luminance level in the image and use that data as the reference. Luminance levels of other areas are then adjusted so that the level of the entire area is equal. The block grid for compensation is 20 (H) x 16(V) and each block contains 128 x 128 pixels. The complementary process is applied to produce the compensation data with less error.

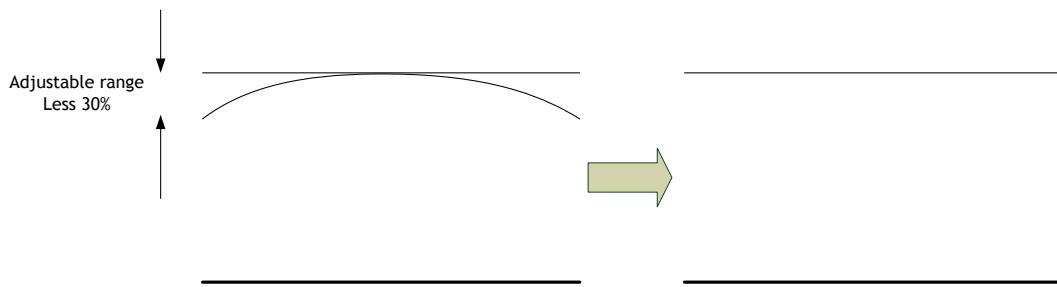


Fig.34 Concept drawing of flat shading correction

##### Color shading correction (For SP-5000C-PMCL only):

In this case, R channel and B channel are adjusted to match with G channel characteristics. The block grid for compensation is 20 (H) x 16(V) and each block contains 128 x 128 pixels. The complementary process is applied to produce the compensation data with less error.

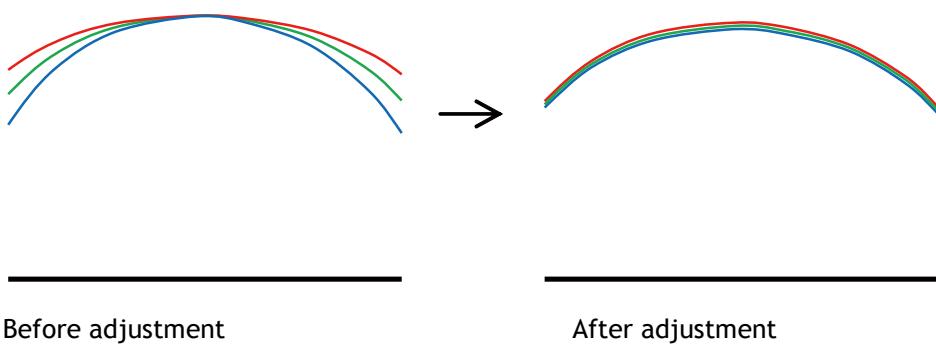


Fig. 35 Concept drawing of color shading correction

Note: Under the following conditions, the shading correction circuit may not work properly.

- If there is some area in the image with a video level less than 70%
- If part of the image or the entire image is saturated
- If the highest video level in the image is less than 300LSB (at 10-bit output)

## 8.6 Blemish compensation

The SP-5000-PMCL has a blemish compensation circuit. This function compensates blemishes on the CMOS sensor (typically pixels with extremely high response or extremely low response). This applies to both monochrome and color versions. Pixels that fulfill the blemish criteria can be compensated by averaging the data from pixels in both adjacent columns and, in the case of the SP-5000C-PMCL, the defective pixels can be compensated by averaging the data from the same Bayer color pixels in adjacent columns. The number of pixels that can be compensated is up to 512 pixels.

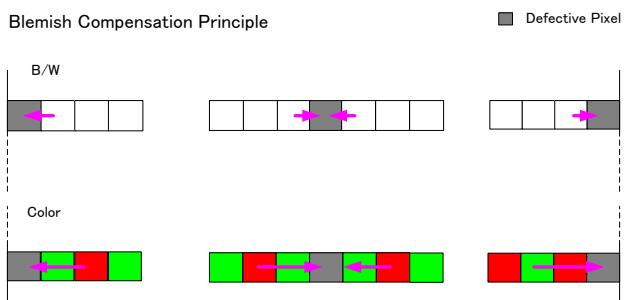


Fig. 36 Blemish compensation

If several consecutive pixels are defective in the horizontal direction, 3 pixels for monochrome and 2 same color pixels for color can be compensated.

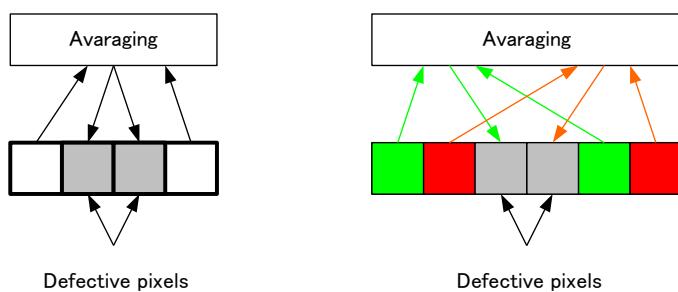


Fig 37. Compensation of consecutive defective pixels

## 8.7 ALC

In the SP-5000-PMCL, auto gain, auto shutter and auto iris functions can be combined to provide a wide ranging automatic exposure control from dark to bright or vice versa. The functions are applied in the sequence shown below and if one function is disabled, the linkage between the other two is maintained.

In order to make the ALC function effective, set the Auto Iris Lens Control Signal Output to “ON”. The auto iris function works together with AGC and Exposure Auto.

If the lighting condition is changed from bright to dark      AIC – ASC – AGC  
 If the lighting condition is changed from dark to bright      AGC – ASC – AIC

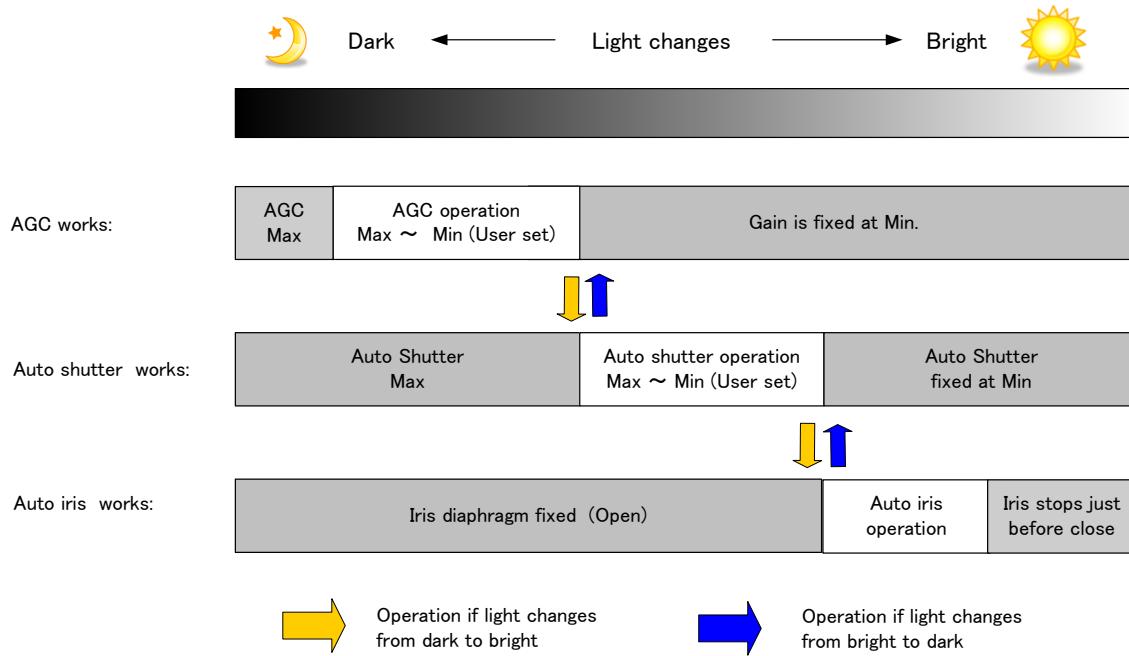


Fig.44 ALC function concept

ALC Reference will determine the target video level for AGC, Auto Shutter and/or Auto iris. For instance, if ALC Reference is set to 100% video level, AGC, Auto Shutter and/or Auto iris will function to maintain 100% video level.

## 8.8 HDR (High Dynamic Range) (SP-5000M-PMCL only)

HDR sensing mode can be set when HDR Mode is set to ON while Exposure Mode is Timed. The parameters to configure dynamic range are HDR\_SLOPE Level 1, Level 2, Level 3 and Level 4. The user can select any one of those parameters as required for their application. In this mode, the timed exposure is used as the reference and the value selected in HDR\_SLOPE will compensate to get an appropriate dynamic range by changing the exposure time.

### Notes:

1. If the exposure mode is OFF and the HDR mode is set to ON, the exposure mode is automatically changed to Timed.
2. If horizontal binning and/or vertical binning are set to ON, the HDR mode cannot be set. In this case, the HDR mode must be set first before H-Binning and/or V-Binning are set.
3. In this mode, exposure overlapped behavior is not available and the frame rate is slower than

the normal operation.

4. The exposure time value is fixed at the value when HDR Mode is activated. When the exposure time is changed, HDR Mode should be off. Once the exposure time is changed, the HDR Mode can be set to ON again.
5. In this mode, Exposure Auto function is disabled.

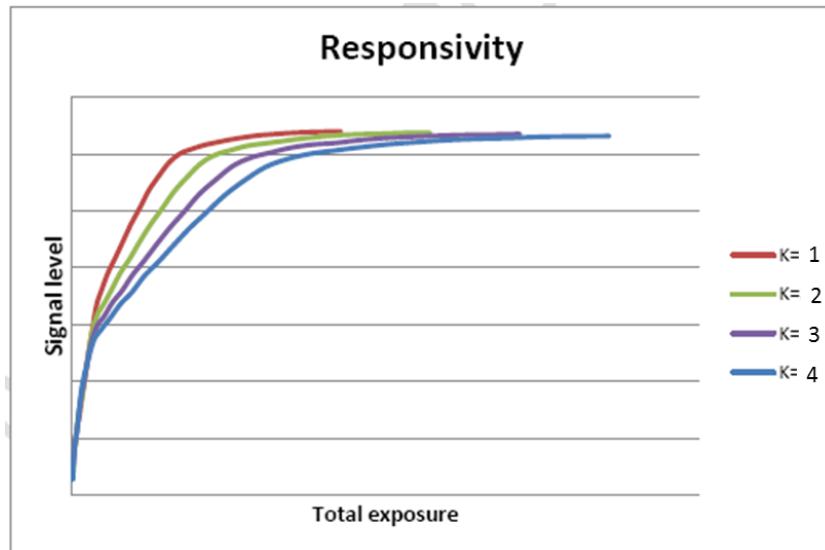


Fig. 39     HDR characteristics

Knee Slope	Dynamic Range [%]
1	(200)
2	(400)
3	(800)
4	(1600)

## 8.9. Lens

The SP-5000M-PMCL and SP-5000C-PMCL can be used with 4 different types of lenses. The lens used must be selected in Lens Select.

Table -47   Lens selector

Lens Select	Description (Control with camera)	Note
P-Iris Lens	1) Iris position can be remotely controlled manually 2) Auto iris control is also available	If P-iris lens is used, the specific model name should be selected in lens select.
Motor controlled lens	1) Iris position can be remotely controlled manually 2) Auto iris control is also available	
Video iris lens	Only auto iris control is available	Option
DC iris lens	Only auto iris control is available	Option

### 8.9.1 About P-Iris

New Spark Series SP-5000M-PMCL and SP-5000C-PMCL come equipped with P-Iris control as part of the standard lens control function. The P-Iris system is a newly developed lens control method designed to control the iris more precisely. Especially for video cameras in surveillance applications utilizing megapixel CCD or CMOS imagers, it becomes a very important factor to control an iris in order to achieve the maximum camera performance. In surveillance applications, depending on shooting conditions, resolution and depth of field are important factors. The iris is deeply related with these factors. If the iris diaphragm is smaller, but not too small, resolution gets better and the depth of field is also deeper. The P-Iris system controls the iris diaphragm precisely and maintains the best image with the highest resolution and depth of field. P-Iris can also combine with gain and electronic shutter to keep the appropriate iris position under changing lighting conditions (ALC function).

### 8.9.2 Setting for P-iris lens being used

P-iris lens uses an absolute setting value control system and therefore, if the following parameters are input, precise iris position control is possible.

#### 8.9.2.1 P-Iris lens select

Select the lens used from the P-iris select list. At this moment, there are no 1-inch P-Iris lenses available in the list.

P-Iris lens select	Description	Control step number	Open F value
TBD			

#### 8.9.2.2 Step max.

The iris control step depends on the lens. This setting uses the value stored in the camera.

#### 8.9.2.3 Position

The iris position can be set between 0 to Step max. 0 means to open the iris and step max is to close the iris.

In the following conditions, the camera initializes P-iris control and acquires iris position.

- 1) When the camera is powered
- 2) When a lens is selected in the P-Iris select list
- 3) If the lens selection is changed in the P-iris lens select list

#### 8.9.2.4 Current F value

The current F value is indicated by using iris position information based on commands sent from the camera to the P-iris lens during auto-iris operation.

The relationship between iris position and F value depends on the lens used.

#### 8.9.2.5 P-Iris Auto min. / P-Iris Auto max.

This function can set the control range when the iris is operated automatically. Auto max. sets the limit when the iris opens and Auto min. sets the limit when the iris closes. Auto max. can be set to fully open but Auto min. is stopped at F5.6 as lens performance typically begins to degrade if the iris closes past this point.

### 8.9.3 Motorized lens

The SP-5000M-PMCL and SP-5000C-PMCL can use a motorized lens for zoom, focus and iris. The following functions are available to control the lens via the 10-pin AUX connector.

#### 8.9.3.1 Iris

Open: While this command is being sent, the iris continues to open.

Close: While this command is being sent, the iris continues to close.

Stop: When this command is supplied, the iris operation stops.

**8.9.3.2 Zoom**

Wide: While this command is being sent, the zoom continues to move towards wide angle.  
Tele: While this command is being sent, the zoom continues to move towards telephoto.  
Stop: When this command is supplied, the zoom operation stops.

**8.9.3.3 Focus+**

Near: While this command is being sent, the focus continues to move towards close range.  
Far: While this command is being sent, the focus continues to move towards infinity.  
Stop: When this command is supplied, the focus operation stops.

## 9. Camera control

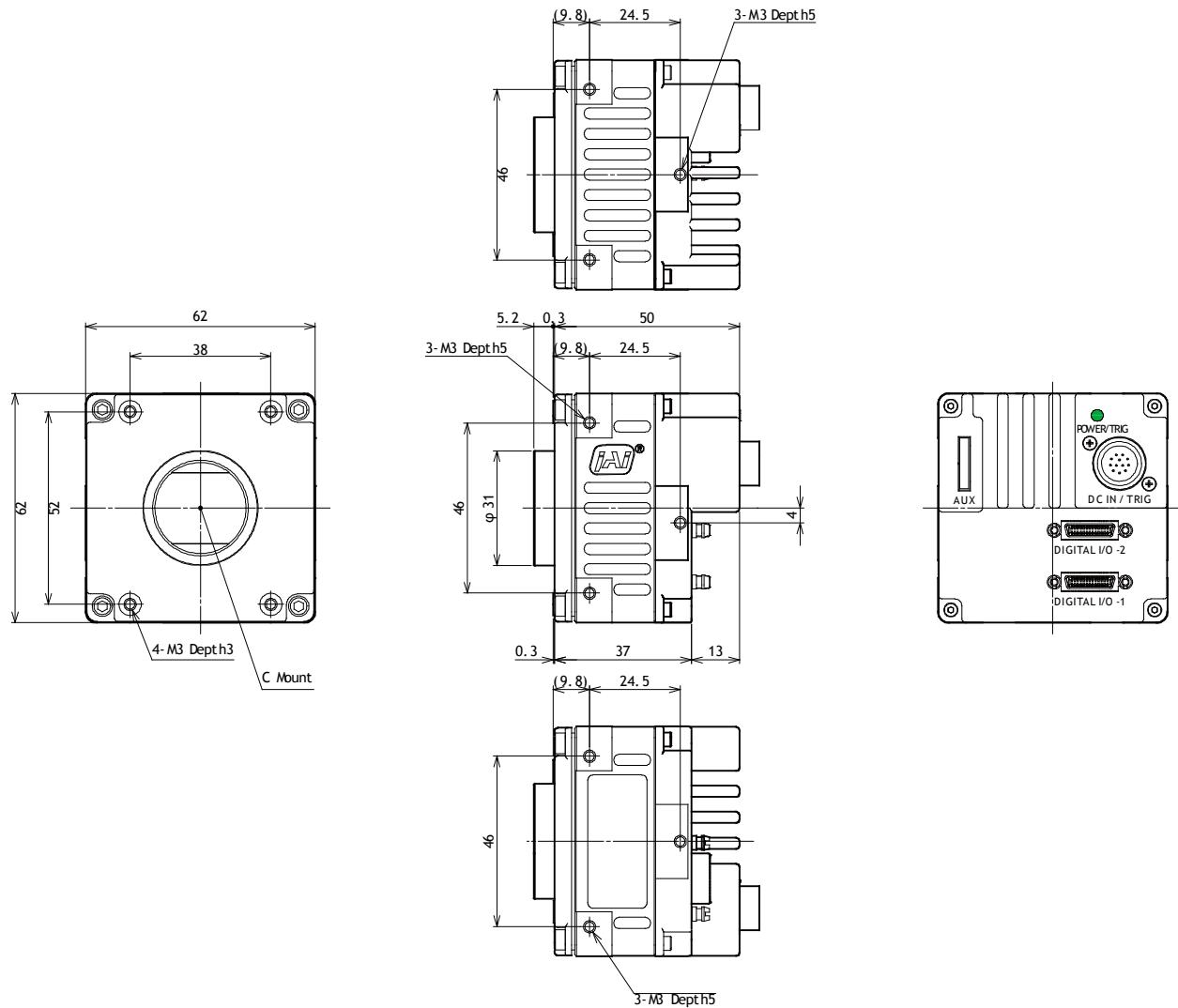
In the SP-5000-PMCL, control of all camera functions is done by the JAI SDK and Control Tool software. All controllable camera functions are stored in an XML file inside of the camera. The JAI SDK and Control Tool software can be downloaded from [www.jai.com](http://www.jai.com).

If you need to use the Short ASCII communication protocol and associated control tool, please contact your local JAI representative.

**Specific notes regarding Control Tool use:**

1. For SP-5000-PMCL, the JAI SDK and Control Tool 2.0 can be used to control the camera, provided the PC on which the JAI software is installed is connected to the camera via a GenCP-compliant Camera Link frame grabber. Many frame grabber vendors also provide their own GenICam control tool software, as do a number of third-party software companies. Software conflicts can occur between these GenICam tools and the JAI SDK and Control Tool causing one or both tools to function improperly. Therefore, if you intend to use the JAI SDK and Control Tool you should A) not install any other GenICam software on your host PC, or B) install the JAI SDK and Control Tool last, after installing any other software. This will, in most cases, ensure that the JAI SDK and Control Tool functions properly. If not, please contact the frame grabber manufacturer or JAI to determine other ways to eliminate any software conflict.
  
2. The frame grabber used must be compliant with Camera Link Specification v1.1 or greater in order to communicate with the JAI SDK and Control Tool. If it is not, the JAI SDK and Control Tool cannot be used, and the Short ASCII communication protocol and associated control tool should be used instead.

## 10. External appearance and dimensions



Dimensions tolerance:  $\pm 0.3$ mm Unit: mm

Fig. 40 Appearance and Dimensions

## 11. Specifications

### 11.1. Camera spectral response

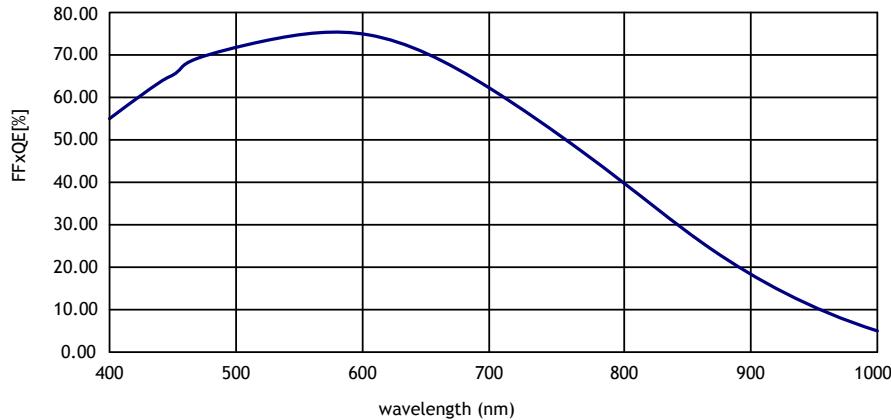


Fig.41 SP-5000M-PMCL Spectral response

### RESPONSIVITY - PD

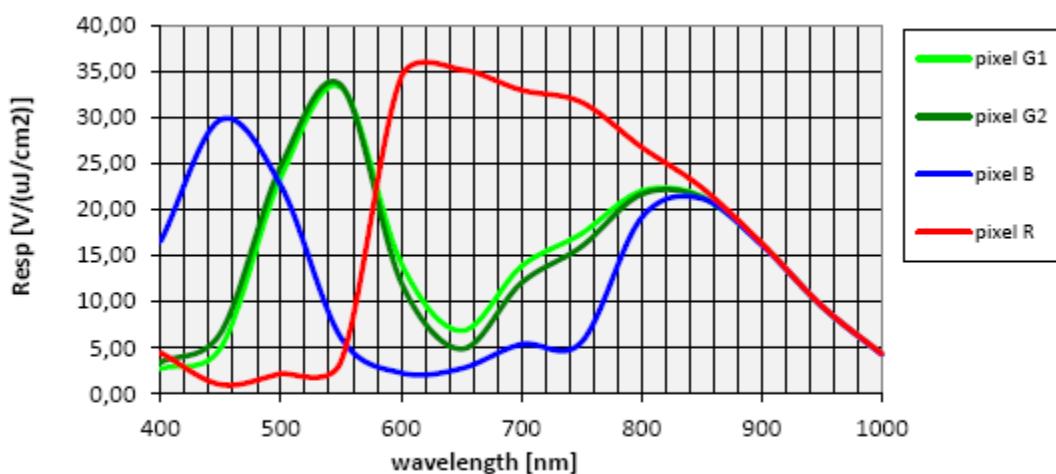


Fig.42 SP-5000C-PMCL Spectral response

## SP-5000M-PMCL / SP-5000C-PMCL

### 11.2. Specification table

Table - 48 Specification table

Specifications		SP-5000M-PMCL	SP-5000C-PMCL		
Scanning system		Progressive scan			
Synchronization		Internal			
Interface	CameraLink Specifications (V.2.0 RC2), Conforming with PoCL specifications				
	Camera Link Pixel Clock: 61.7 MHz, 75.4 MHz, 82.3 MHZ selectable (Default setting: 82.3 MHz)				
Image sensor		1 inch Monochrome CMOS	1 inch Bayer color CMOS		
Aspect ratio		5:4			
Effective image size		12.8 (h) x 10.24 (v) mm	16.39 mm diagonal		
Cell size		5.0 (h) x 5.0 (v) $\mu$ m			
Active pixels		2560 (h) x 2048 (v)			
Pixel clock		48 MHz			
Acquisition Frame rate	1X2 - 1Y	30 fps (Max.) to 0.125s (Min.) 8-bit 30 fps (Max.) to 0.125s (Min.) 10-bit 30 fps (Max.) to 0.125s (Min.) 12-bit	30 fps (Max.) to 0.125s (Min.) 8-bit 30 fps (Max.) to 0.125s (Min.) 10-bit 30 fps (Max.) to 0.125s (Min.) 12-bit		
	1X4 - 1Y	61 fps (Max.) to 0.125s (Min.) 8-bit 61 fps (Max.) to 0.125s (Min.) 10-bit 61 fps (Max.) to 0.125s (Min.) 12-bit	61 fps (Max.) to 0.125s (Min.) 8-bit 61 fps (Max.) to 0.125s (Min.) 10-bit 61 fps (Max.) to 0.125s (Min.) 12-bit		
	1x8 - 1Y	120 fps (Max.) to 0.125s (Min.) 8-bit 120 fps (Max.) to 0.125s (Min.) 10-bit	120 fps (Max.) to 0.125s (Min.) 8-bit 120 fps (Max.) to 0.125s (Min.) 10-bit		
	1x10 - 1Y	134 fps (Max.) to 0.125s (Min.) 8-bit	134 fps (Max.) to 0.125s (Min.) 8-bit		
	Binning	H1/V2 268 fps (Max.) ~0.125s (Min.) 1X10-1Y	—		
		H2/V1 134 fps (Max.) ~0.125s (Min.) 1X10-1Y	—		
	H2/V2	268 fps (Max.) ~0.125s (Min.) 1X10-1Y	—		
EMVA 1288 Parameters		At 10-bit output	At 10-bit output		
Absolute sensitivity Maximum SNR		23.50 p ( $\lambda$ = 525 nm) 41.48 dB	36.08 p ( $\lambda$ = 525 nm) 38.00 dB		
SN ratio (Traditional)		55dB (Typical) (0dB gain, Black))	53dB (Typical) (0dB gain, Green Pixel Black)		
Image Output Format Digital	Full image	2560 (h) x 2048 (v)			
	Height	1 ~2048 lines, 1 line / step			
		2 ~2048 lines, 2 lines / step			
	OFFSET Y	0 ~2047 lines, 1 line / step			
		0 ~2046 lines, 2 lines / step			
	Width	1X2-1Y, 1X4-1Y, 1X8-1Y 16 ~2560 pixels, 16 pixels/step 1X10-1Y 80 ~2560 pixels, 80 pixels/step			
		1X2-1Y, 1X4-1Y, 1X8-1Y 16 ~2560 pixels, 16 pixels/step 1X10-1Y 80 ~2560 pixels, 80 pixels/step			
	OFFSET X				
	1X2-1Y, 1X4-1Y, 1X8-1Y 0 ~2544 pixels, 16 pixels/step 1X10-1Y 0 ~2480 pixels, 80 pixels/step				
	H Binning   H1		2560 pixels		
			2560 pixels		

# SP-5000M-PMCL / SP-5000C-PMCL



See the possibilities

	H2	1280 pixels The frame rate is not changed.	—
V Binning	V1	2048 lines	2048 lines
	V2	1024 lines	—
Bit assignment		8-bit, 10-bit, 12-bit	8-bit, 10-bit, 12-bit
Acquisition Mode		Continuous	
Trigger selector		Frame Start	
Trigger mode		Continuous, Timed(EPS), Trigger Width,	
Trigger option		Overlap ON/OFF, Long time exposure, PIV, Timed (RCT) with ALC Timed (RCT) with ALC continuous	
Trigger input signal		Line4 (TTL IN), Line7 (Camera link CC1), Pulse Generator 0/1/2/3, Soft Trigger, NAND0 (out), NAND1 (out) Optional: Line10 (TTL IN2), Line11 (LVDS IN)	
Exposure Mode	Timed	10 µs (Min) ~ 8 sec. (Max), Step: 1µs (Note 4)	
	Trigger Width	10 µs (Min) ~ ∞ (Max) (Note 4)	
Auto exposure		OFF / Once / Continuous	
Exposure Auto response speed		1 ~8	
Digital I/O		Line Selector (Hirose 12P): GPIO IN / GPIO OUT	
Black level adjust	Reference	33.5LSB 10-bit (Average of 100*100)	
	Adj. range	-256 ~+255LSB 10-bit	
	Resolution	1 STEP = 1LSB	
Analog Base Gain		x1(0dB), x2(+6dB), x4(+12dB)	
Gain Adjust	Manual adj. range	0dB ~+24dB, 0.01%/step	0dB ~+24dB, 0.01%/step
	WB gain	—	R / B : -7dB to +15dB, 0.01dB/ step
	WB area	—	4 x 4
	WB range	—	3000K ~ 9000K
	White balance	—	OFF, Once, continuous
Blemish comp.	Detection	Detect white blemish above the threshold value (Black blemish is detected only by factory )	
	Compensation	Complement by adjacent pixels (Continuous blemishes are not compensated)	
	Correct Numbers	Up to 512 pixels	
ALC (Note 1)		AGC, Auto Shutter, and Auto Iris can be combined and automatically controlled	
Gamma (Note1)		0.45 ~ 1.0 (8 steps are available)	
LUT(Note1)		OFF: γ=1.0, ON=256 points can be set	
Shading compensation(Note1)		Flat field Block based (20 x 16 blocks)	Flat field, Color shading Block based (20 x 16 blocks)
HDR Mode		Level 1, 2, 3 and 4 based of the exposure time setting	—
Power supply	Power input	DC+12V to +24V ± 10% (at the input terminal)	
	Current	380mA (12V input, full image)	
	Power Consumption	4.5W (12V input, full image)	
Lens mount		C mount, Rear protrusion of the lens is less than 10 mm.	
Flange back		C mount : 17.526 mm, Tolerance 0 to -0.05 mm	
Optical filter		Protection glass : Not provided	IR cut filter (Half value is 670 nm)
Operating temperature / Humidity (Performance guaranteed)		-5°C to +45°C / 20% - 80% (non-condensing)	

## **SP-5000M-PMCL / SP-5000C-PMCL**

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Operating temperature / Humidity	-45°C to +70°C / 20% - 80% (non-condensing)
Storage Temp. / Humidity	-45°C to +70°C / 20% - 80 % (non-condensing)
Regulation	CE (EN61000-6-2 and EN61000-6-3), FCC part 15 class B, RoHS, WEEE
Housing Dimensions	62 x 62 x 55.5 mm (W x H x D) (excluding protrusion)
Weight	215 g

- Note 1) These functions are effective on 12-bit output. If the output is 8-bit or 10-bit, there are some restrictions about setting range and functionalities.
- Note 2) The above specifications are based on 82.3 MHz Camera Link Pixel Clock.
- Note 2) Approximately 5 minutes pre-heating is required to achieve these specifications.
- Note 3) The above specifications are subject to change without notice.
- Note 4) Initial units may be limited to 50 us minimum exposure time. Consult JAI.

## Appendix 1 Short ASCII Command Communication Protocol

This chapter described the communication control protocol based on the short ASCII command as the reference

### 1 Communication setting

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

### 2 Protocol (Short ASCII Command)

#### 2.1 Transmit the setting command to camera

NN is any kind of command.

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

e.g.

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 improper command, camera will return one of the following:

e.g.

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

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

e.g.

Send to camera: GA=1000 <CR><LF>

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

#### 2.2 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.

e.g.

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

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

#### 2.3 Switching baud rate between PC and camera

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

e.g. Change baud rate to 115200 bps

1. Confirm baud rates camera supported

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

Camera response: SBDRT=31(0x1F)<CR><LF>

2. Request new baud rate

Send to camera: CBDRT=16(0x10) <CR><LF>

Camera response: COMPLETE<CR><LF>

(Change baud rate to 115200 bps)

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 250 ms after sending the acknowledgement it falls back to the original baud rate (9600 bps).

## 2.4 Command list (Short ASCII command)

### 2.4.1 GenCP Bootstrap Register

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFALUT	Description
DeviceVendorName	I String	R/O	DVN	"JAI Ltd., Japan"	—	—	—	DVN?<CR><LF>
DeviceModelName	I String	R/O	MD		—	—	—	MD?<CR><LF>
DeviceVersion	I String	R/O	DV	Indicate device version (e.g. "0.1.0.0")	—	—	—	DV?<CR><LF>
DeviceID	I String	R/O	ID	Revision+Order-Number	—	—	—	ID?<CR><LF>
DeviceUserID	I String	R/W	UD	User can save and load free text. (12 or less characters)				UD=[Param.]<CR><LF> UD?<CR><LF>

### 2.4.2 Technology Specific Bootstra Register

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFALUT	Description
SupportedBaudrates	I Integer	R/O	SBDRT	Indicate Support/Non-support status for each baud rate bit0: 9600bps bit1: 19200bps bit2: 38400bps bit3: 57600bps bit4: 115200bps bit5: 230400bps bit6: 460800bps bit7: 921600bps	0x01	0xFF	0x1F	SBDRT?<CR><LF>  This camera supports 9600bps, 19200bps, 38400bps, 57600bps, and 115200bps.
CurrentBaudrate	I Integer	R/W	CBDR T	READ: Indicate current baud rate WRITE: Set any bit of baud rate bit0: 9600bps bit1: 19200bps bit2: 38400bps bit3: 57600bps bit4: 115200bps bit5: 230400bps bit6: 460800bps bit7: 921600bps	0x01	0x80	1 (9600bps)	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. (Refer to the section 3.3)

#### 2.4.3 Device Control

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFALULT	Description
DeviceFirmwareVersion	I String	R/O	VN	Firm Ver. No.	—	—	—	VN?<CR><LF>
DeviceReset	I Command	W/O	CRS00	1	—	—	—	CRS00=1<CR><LF>

#### 2.4.4 Image Format Control

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFALULT	Description
Height	I Integer	R/W	HTL	Min~(Max - OffsetY)	1(Mono) 2(Bayer)	2048	2048	HTL=[Param.]<CR><LF> HTL?<CR><LF>
Width	I Integer	R/W	WTC	Min~(Max - OffsetX)	16	2560	2560	WTC=[Param.]<CR><LF> WTC?<CR><LF>
Offset Y	I Integer	R/W	OFL	Min~(Max - Height)	0 2047 (Mono) 2046 (Bayer)	0	0	OFL=[Param.]<CR><LF> OFL?<CR><LF>
Offset X	I Integer	R/W	OFC	Min~(Max - Width)	0	2544	0	OFC=[Param.]<CR><LF> OFC?<CR><LF>
BinningHorizontal	I Integer	R/W	HB	1: Normal / 2: Binning mode	1	2	1	HB=[Param.]<CR><LF> HB?<CR><LF> only Mono
BinningVertical	I Integer	R/W	VB	1: Normal / 2: Binning mode	1	2	1	VB=[Param.]<CR><LF> VB?<CR><LF> only Mono
PixelFormat	I Enumeration	R/(W)	BA	Mono model: 0: Mono8 1: Mono10 2: Mono12 Bayer model: 0: BayerRG8 1: BayerRG10 2: BayerRG12	0	2	0	BA=[Param.]<CR><LF> BA?<CR><LF>
TestImageSelector	I Enumeration	R/W	TPN	0: Off 1: GreyHorizontalRamp 2: GreyVerticalRamp 3:GreyHorizontalRampMoving 4: Horizontal Colorbar* 5: Vertical Colorbar* 6: Moving Colorbar* (* Bayer model only)	0	6	0	TPN=[Param.]<CR><LF> TPN?<CR><LF>

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### 2.4.5 Acquisition Control

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFALULT	Description
FrameStartTrig Mode	I Enumeration	R/W	TM	Off/On	0	1	0	TM=[Param.]<CR><LF> TM?<CR><LF>
TrigSoftware	I Command	(R)/W	STRG	0	—	—	—	STRG=0<CR><LF>
FrameStartTrig Source	I Enumeration	R/W	TI	0: Low 1: High 2: SoftTrigger 8: PulseGenerator0 9: PulseGenerator1 10: PulseGenerator2 11: PulseGenerator3 12: TTL_In1 13: CL_CC1_In 14: Nand0 15: Nand1 16: TTL_In2(Option) 17: LVDS_In(Option)	0	17	0	TI=[Param.]<CR><LF> TI?<CR><LF>
FrameStartTrig Activation	I Enumeration	R/W	TA	0: RisingEdge 1: FallingEdge 2: LevelHigh 3: LevelLow	0	3	0	TA=[Param.]<CR><LF> TA?<CR><LF>
FrameStartTrig Over Lap	I Enumeration	R/W	TO	0: Off / 1: ReadOut	0	1	0	TO=[Param.]<CR><LF> TO?<CR><LF>
ExposureMode	I Enumeration	R/W	EM	0: Off 1: Timed 2: TriggerWidth	0	2	0	EM=[Param.]<CR><LF> EM?<CR><LF>
ExposureTimeRaw	I Integer	R/W	PE	Min~Max[us]	10	80000 00	18000	PE=[Param.]<CR><LF> PE?<CR><LF>
ExposureAuto	I Enumeration	R/W	ASC	0: Off 2: Once 1: Continuous	0	2	2	ASC=[Param.]<CR><LF> ASC?<CR><LF>

## 2.4.6 Digital I/O Control

Name	Interface	Access	Short ASCII	Values	MN	MAX	DEFAULT	Description
LineInverter_Line1	I Boolean	R/W	LI0	False/True	0	1	0	LI0=[Param.]<CR><LF> LI0?<CR><LF>
LineInverter_Line8	I Boolean	R/W	LI1	False/True	0	1	0	LI1=[Param.]<CR><LF> LI1?<CR><LF>
LineInverter_Line9	I Boolean	R/W	LI2	False/True	0	1	0	LI2=[Param.]<CR><LF> LI2?<CR><LF>
LineInverter_Nand0In1	I Boolean	R/W	ND0IN V1	False/True	0	1	0	ND0INV1=[Param.]<CR><LF> ND0INV1?<CR><LF>
LineInverter_Nand0In2	I Boolean	R/W	ND0IN V2	False/True	0	1	0	ND0INV2=[Param.]<CR><LF> ND0INV2?<CR><LF>
LineInverter_Nand1In1	I Boolean	R/W	ND1IN V1	False/True	0	1	0	ND1INV1=[Param.]<CR><LF> ND0INV1?<CR><LF>
LineInverter_Nand1In2	I Boolean	R/W	ND1IN V2	False/True	0	1	0	ND1INV2=[Param.]<CR><LF> ND0INV2?<CR><LF>
LineSource_Line1	I Enumeration	R/W	LS0	0: Low 1: High 3: Frame TriggerWait 4: Frame Active 5: Exposure Active 6: Fval 7: Lval 8: Pulse Generator0 9: Pulse Generator1 10: Pulse Generator2 11: Pulse Generator3 12: TTL_In 13: CL_CC1_In 14: Nand0 15: Nand1 16: TTL_In2 (Option) 17: LVDS_In (Option)	0	17	0	LS0=[Param.]<CR><LF> LS0?<CR><LF> For 12pin TTL out
LineSource_Line8	I Enumeration	R/W	LS1	Same as for Line1	0	17	0	LS1=[Param.]<CR><LF> LS1?<CR><LF> For Option TTL out
LineSource_Line9	I Enumeration	R/W	LS2	Same as for Line1	0	17	0	LS2=[Param.]<CR><LF> LS2?<CR><LF> For Option TTL out
LineSource_Nand0In1	I Enumeration	R/W	ND0IN1	Same as for Line1	0	17	0	ND0IN1=[Param.]<CR><LF> ND0IN1?<CR><LF>
LineSource_Nand0In2	I Enumeration	R/W	ND0IN2	Same as for Line1	0	17	0	ND0IN2=[Param.]<CR><LF> ND0IN2?<CR><LF>
LineSource_Nand1In1	I Enumeration	R/W	ND1IN1	Same as for Line1	0	17	0	ND1IN1=[Param.]<CR><LF> ND1IN1?<CR><LF>

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LineSource_Nand1In2	I Enumeration	R/W	ND1IN2	Same as for Line1	0	17	0	ND1IN2=[Param.]<CR><LF> ND1IN2?<CR><LF>
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### 2.4.7 Analogue Control

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFALUT	Description
GainRawDigitalAll	I Integer	R/W	FGA	min~0~max	100	1600	100	FGA=[Param.]<CR><LF> FGA?<CR><LF>
GainRawDigitalRedAll	I Integer	R/W	PGR	min~0~max	-4533	28400	0	PGR=[Param.]<CR><LF> PGR?<CR><LF> (Bayer model only)
GainRawDigitalBlueAll	I Integer	R/W	PGB	min~0~max	-4533	28400	0	PGB=[Param.]<CR><LF> PGB?<CR><LF> (Bayer model only)
GainAuto	I Enumeration	R/W	AGC	0: Off 1: Continuous 2: Once	0	2	0	AGC=[Param.]<CR><LF> AGC?<CR><LF>
BlackLevelRawAll	I Integer	R/W	BL	min~0~max	-256	255	0	BL=[Param.]<CR><LF> BL?<CR><LF>
BlackLevelRawRed	I Integer	R/W	BLR	min~0~max	-512	511	0	BLR1=[Param.]<CR><LF> BLR1?<CR><LF> (Bayer model only)
BlackLevelRawBlue	I Integer	R/W	BLB	min~0~max	-512	511	0	BLB1=[Param.]<CR><LF> BLB1?<CR><LF> (Bayer model only)
BalanceWhiteAuto	I Enumeration	R/W	AWB	0: Off 1: Once 2: Continuous	0	2	0	AWB=[Param.]<CR><LF> AWB?<CR><LF> (Bayer model only)

### 2.4.8 LUT Control

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFALUT	Description
LUTValueRed	I Integer	R/W	LUTR	Param 1: LUT index Param 2:LUTdata (Min~Max) (Bayer model only)	0	4095	γ 09 相当值	LUT*=[Param1],[Param2]<CR><LF> LUT*?[Param1]<CR><LF>
LUTValueGreen(Mono)	I Integer	R/W	LUTG	Param 1: LUT index Param 2:LUTdata (Min~Max)	0	4095		
LUTValueBlue	I Integer	R/W	LUTB	Param 1: LUT index Param 2:LUTdata (Min~Max) (Bayer model only)	0	4095		

#### 2.4.9 Transport Layer Control

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFALUT	Description
DeviceTapGeometry	I Enumeration	R/(W)	TAGM	1: Geometry_1X2_1Y 3: Geometry_1X4_1Y 5: Geometry_1X8_1Y 6: Geometry_1X10_1Y	1	6	5	TAGM=[Param.]<CR><LF> TAGM?<CR><LF>

#### 2.4.10 User Set Control

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFALUT	Description
UserSetLoad	I Command	(R)/W	LD	0: Default 1: UserSet1 2: UserSet2 3: UserSet3	0	3	0	LD=[Param.]<CR><LF> LD?<CR><LF>
UserSetSave	I Command	(R)/W	SA	1: UserSet1 2: UserSet2 3: UserSet3	1	3	1	SA=[Param.]<CR><LF> SA?<CR><LF>

#### 2.4.11 JAI-Custom

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFALUT	Description
BlemishWhiteEnable	I Boolean	R/W	BMW	0: False 1: True	0	1	0	BMW=[Param.]<CR><LF> BMW?<CR><LF>
BlemishWhiteDetect	I Command	W/O	BMRCW	0	0	0	0	BMRCW=0<CR><LF>
BlemishWhiteDetect Threshold	I Integer	R/W	BMTHW	0	0	100	10	BMTHW=[Param.]<CR><LF> BMTHW?<CR><LF>
BlemishWhiteDetect PositionX	I Integer	R/W	BMPXW	Param 1: Blemish index Param 2: X position(Min~Max)	0	2559	0	BMPXW=[Param1],[Param2]<CR><LF> BMPXW? [Param1]<CR><LF>
BlemishWhiteDetect PositionY	I Integer	R/W	BMPYW	Param 1: Blemish index Param 2: Y position(Min~Max)	0	2047	0	BMPYW=[Param1],[Param2]<CR><LF> BMPYW? [Param1]<CR><LF>
ShadingCorrection Mode	I Enumeration	R/W	SDCM	0: Flat Shading 1: Color Shading* (*Bayer model only)	0	1	0	SDCM=[Param.]<CR><LF> SDCM?<CR><LF>
ShadingCorrect	I Command	W/O	RS		0	0	0	BMRCW=0<CR><LF>
RequestShading DetectResult	I Enumeration	R/O	SDRS	0=Complete. 1=Too Bright. 2=Too dark. 3=Timeout Error.	0	6	0	SDRS?<CR><LF>

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				4=Busy. 5=Limit. 6= Trig is not set as Normal.				
ShadingMode	I Enumeration	R/W	SDM	0: OFF 1: User 1 2: User 2 3: User 3	0	3	0	SDM=[Param.]<CR><LF> SDM?<CR><LF>
VideoSendMode	I Enumeration	R/W	VSM	0: Normal 1: Trigger Sequence 2: Command Sequence 3: Multi Roi Mode	0	3	0	VSM=[Param.]<CR><LF> VSM?<CR><LF>
SequenceModelIndex	I Enumeration	R/W	SQI	0: Index0 1: Index1 2: Index2 3: Index3 4: Index4 5: Index5 6: Index6 7: Index7 8: Index8 9: Index9	0	9	0	SQI=[Param.]<CR><LF> SQI?<CR><LF>
SequenceModeFrameCount0	I Integer	R/W	SQF1	Min~Max	1	255	1	SQF1=[Param.]<CR><LF> SQF1?<CR><LF>
SequenceModeFrameCount1	I Integer	R/W	SQF2	Min~Max	1	255	1	SQF2=[Param.]<CR><LF> SQF2?<CR><LF>
SequenceModeFrameCount2	I Integer	R/W	SQF3	Min~Max	1	255	1	SQF3=[Param.]<CR><LF> SQF3?<CR><LF>
SequenceModeFrameCount3	I Integer	R/W	SQF4	Min~Max	1	255	1	SQF4=[Param.]<CR><LF> SQF4?<CR><LF>
SequenceModeFrameCount4	I Integer	R/W	SQF5	Min~Max	1	255	1	SQF5=[Param.]<CR><LF> SQF5?<CR><LF>
SequenceModeFrameCount5	I Integer	R/W	SQF6	Min~Max	1	255	1	SQF6=[Param.]<CR><LF> SQF6?<CR><LF>
SequenceModeFrameCount6	I Integer	R/W	SQF7	Min~Max	1	255	1	SQF7=[Param.]<CR><LF> SQF7?<CR><LF>
SequenceModeFrameCount7	I Integer	R/W	SQF8	Min~Max	1	255	1	SQF8=[Param.]<CR><LF> SQF8?<CR><LF>
SequenceModeFrameCount8	I Integer	R/W	SQF9	Min~Max	1	255	1	SQF9=[Param.]<CR><LF> SQF9?<CR><LF>
SequenceModeFrameCount9	I Integer	R/W	SQF10	Min~Max	1	255	1	SQF10=[Param.]<CR><LF> SQF10?<CR><LF>
SequenceModeNextIndex0	I Enumeration	R/W	SQNI1	Same SequenceRoiIndex as	0	9	0	SQNI1=[Param.]<CR><LF> SQNI1?<CR><LF>
SequenceModeNextIndex1	I Enumeration	R/W	SQNI2	Same SequenceRoiIndex as	0	9	0	SQNI2=[Param.]<CR><LF> SQNI2?<CR><LF>

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*See the possibilities*

SequenceModeN ext Index2	I Enumeration	R/W	SQNI3	Same SequenceRoiIndex as	0	9	0	SQNI3=[Param.]<CR>< LF> SQNI3?<CR><LF>
SequenceModeN ext Index3	I Enumeration	R/W	SQNI4	Same SequenceRoiIndex as	0	9	0	SQNI4=[Param.]<CR>< LF> SQNI4?<CR><LF>
SequenceModeN ext Index4	I Enumeration	R/W	SQNI5	Same SequenceRoiIndex as	0	9	0	SQNI5=[Param.]<CR>< LF> SQNI5?<CR><LF>
SequenceModeN ext Index5	I Enumeration	R/W	SQNI6	Same SequenceRoiIndex as	0	9	0	SQNI6=[Param.]<CR>< LF> SQNI6?<CR><LF>
SequenceModeN ext Index6	I Enumeration	R/W	SQNI7	Same SequenceRoiIndex as	0	9	0	SQNI7=[Param.]<CR>< LF> SQNI7?<CR><LF>
SequenceModeN ext Index7	I Enumeration	R/W	SQNI8	Same SequenceRoiIndex as	0	9	0	SQNI8=[Param.]<CR>< LF> SQNI8?<CR><LF>
SequenceModeN ext Index8	I Enumeration	R/W	SQNI9	Same SequenceRoiIndex as	0	9	0	SQNI9=[Param.]<CR>< LF> SQNI9?<CR><LF>
SequenceModeN ext Index9	I Enumeration	R/W	SQNI10	Same SequenceRoiIndex as	0	9	0	SQNI10=[Param.]<CR>< LF> SQNI10?<CR><LF>
SequenceMode Height0	I Integer	R/W	SQH1	Min~Max	1(Mon o) 2(Bay er)	2048	2048	SQH1=[Param.]<CR><L F> SQH1?<CR><LF>
SequenceMode Height1	I Integer	R/W	SQH2	Min~Max	1(Mon o) 2(Bay er)	2048	2048	SQH2=[Param.]<CR><L F> SQH2?<CR><LF>
SequenceMode Height2	I Integer	R/W	SQH3	Min~Max	1(Mon o) 2(Bay er)	2048	2048	SQH3=[Param.]<CR><L F> SQH3?<CR><LF>
SequenceMode Height3	I Integer	R/W	SQH4	Min~Max	1(Mon o) 2(Bay er)	2048	2048	SQH4=[Param.]<CR><L F> SQH4?<CR><LF>
SequenceMode Height4	I Integer	R/W	SQH5	Min~Max	1(Mon o) 2(Bay er)	2048	2048	SQH5=[Param.]<CR><L F> SQH5?<CR><LF>
SequenceMode Height5	I Integer	R/W	SQH6	Min~Max	1(Mon o) 2(Bay er)	2048	2048	SQH6=[Param.]<CR><L F> SQH6?<CR><LF>
SequenceMode Height6	I Integer	R/W	SQH7	Min~Max	1(Mon o) 2(Bay er)	2048	2048	SQH7=[Param.]<CR><L F> SQH7?<CR><LF>
SequenceMode Height7	I Integer	R/W	SQH8	Min~Max	1(Mon o) 2(Bay er)	2048	2048	SQH8=[Param.]<CR><L F> SQH8?<CR><LF>
SequenceMode Height8	I Integer	R/W	SQH9	Min~Max	1(Mon o) 2(Bay er)	2048	2048	SQH9=[Param.]<CR><L F> SQH9?<CR><LF>

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SequenceMode Height9	I Integer	R/W	SQH10	Min~Max	1(Mono) 2(Bayer)	2048	2048	SQH10=[Param.]<CR><LF> SQH10?<CR><LF>
SequenceMode OffsetY0	I Integer	R/W	SQOY1	Min~Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY1=[Param.]<CR><LF> SQOY1?<CR><LF>
SequenceMode OffsetY1	I Integer	R/W	SQOY2	Min~Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY2=[Param.]<CR><LF> SQOY2?<CR><LF>
SequenceMode OffsetY2	I Integer	R/W	SQOY3	Min~Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY3=[Param.]<CR><LF> SQOY3?<CR><LF>
SequenceMode OffsetY3	I Integer	R/W	SQOY4	Min~Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY4=[Param.]<CR><LF> SQOY4?<CR><LF>
SequenceMode OffsetY4	I Integer	R/W	SQOY5	Min~Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY5=[Param.]<CR><LF> SQOY5?<CR><LF>
SequenceMode OffsetY5	I Integer	R/W	SQOY6	Min~Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY6=[Param.]<CR><LF> SQOY6?<CR><LF>
SequenceMode OffsetY6	I Integer	R/W	SQOY7	Min~Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY7=[Param.]<CR><LF> SQOY7?<CR><LF>
SequenceMode OffsetY7	I Integer	R/W	SQOY8	Min~Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY8=[Param.]<CR><LF> SQOY8?<CR><LF>
SequenceMode OffsetY8	I Integer	R/W	SQOY9	Min~Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY9=[Param.]<CR><LF> SQOY9?<CR><LF>
SequenceMode OffsetY9	I Integer	R/W	SQOY10	Min~Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY10=[Param.]<CR><LF> SQOY10?<CR><LF>
SequenceMode Gain0	I Integer	R/W	SQGA1	Min~Max	100	1600	0	SQGA1=[Param.]<CR><LF> SQGA1?<CR><LF>
SequenceMode Gain1	I Integer	R/W	SQGA2	Min~Max	100	1600	0	SQGA2=[Param.]<CR><LF> SQGA2?<CR><LF>

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See the possibilities

SequenceMode Gain2	I Integer	R/W	SQGA3	Min~Max	100	1600	0	SQGA3=[Param.]<CR><LF> SQGA3?<CR><LF>
SequenceMode Gain3	I Integer	R/W	SQGA4	Min~Max	100	1600	0	SQGA4=[Param.]<CR><LF> SQGA4?<CR><LF>
SequenceMode Gain4	I Integer	R/W	SQGA5	Min~Max	100	1600	0	SQGA5=[Param.]<CR><LF> SQGA5?<CR><LF>
SequenceMode Gain5	I Integer	R/W	SQGA6	Min~Max	100	1600	0	SQGA6=[Param.]<CR><LF> SQGA6?<CR><LF>
SequenceMode Gain6	I Integer	R/W	SQGA7	Min~Max	100	1600	0	SQGA7=[Param.]<CR><LF> SQGA7?<CR><LF>
SequenceMode Gain7	I Integer	R/W	SQGA8	Min~Max	100	1600	0	SQGA8=[Param.]<CR><LF> SQGA8?<CR><LF>
SequenceMode Gain8	I Integer	R/W	SQGA9	Min~Max	100	1600	0	SQGA9=[Param.]<CR><LF> SQGA9?<CR><LF>
SequenceMode Gain9	I Integer	R/W	SQGA10	Min~Max	100	1600	0	SQGA10=[Param.]<CR><LF> SQGA10?<CR><LF>
SequenceMode ExposureTime0	I Integer	R/W	SQPE1	Min~Max	10	8000000	18000	SQPE1=[Param.]<CR><LF> SQPE1?<CR><LF>
SequenceMode ExposureTime1	I Integer	R/W	SQPE2	Min~Max	10	8000000	18000	SQPE2=[Param.]<CR><LF> SQPE2?<CR><LF>
SequenceMode ExposureTime2	I Integer	R/W	SQPE3	Min~Max	10	8000000	18000	SQPE3=[Param.]<CR><LF> SQPE3?<CR><LF>
SequenceMode ExposureTime3	I Integer	R/W	SQPE4	Min~Max	10	8000000	18000	SQPE4=[Param.]<CR><LF> SQPE4?<CR><LF>
SequenceMode ExposureTime4	I Integer	R/W	SQPE5	Min~Max	10	8000000	18000	SQPE5=[Param.]<CR><LF> SQPE5?<CR><LF>
SequenceMode ExposureTime5	I Integer	R/W	SQPE6	Min~Max	10	8000000	18000	SQPE6=[Param.]<CR><LF> SQPE6?<CR><LF>
SequenceMode ExposureTime6	I Integer	R/W	SQPE7	Min~Max	10	8000000	18000	SQPE7=[Param.]<CR><LF> SQPE7?<CR><LF>
SequenceMode ExposureTime7	I Integer	R/W	SQPE8	Min~Max	10	8000000	18000	SQPE8=[Param.]<CR><LF> SQPE8?<CR><LF>
SequenceMode ExposureTime8	I Integer	R/W	SQPE9	Min~Max	10	8000000	18000	SQPE9=[Param.]<CR><LF> SQPE9?<CR><LF>
SequenceMode ExposureTime9	I Integer	R/W	SQPE10	Min~Max	10	8000000	18000	SQPE10=[Param.]<CR><LF> SQPE10?<CR><LF>
SequenceMode Hbinning0	I Enumeration	R/W	SQHB1	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB1=[Param.]<CR><LF> SQHB1?<CR><LF> (Mono model only)

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SequenceMode Hbinning1	I Enumeration	R/W	SQHB2	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB2=[Param.]<CR><LF> SQHB2?<CR><LF> (Mono model only)
SequenceMode Hbinning2	I Enumeration	R/W	SQHB3	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB3=[Param.]<CR><LF> SQHB3?<CR><LF> (Mono model only)
SequenceMode Hbinning3	I Enumeration	R/W	SQHB4	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB4=[Param.]<CR><LF> SQHB4?<CR><LF> (Mono model only)
SequenceMode Hbinning4	I Enumeration	R/W	SQHB5	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB5=[Param.]<CR><LF> SQHB5?<CR><LF> (Mono model only)
SequenceMode Hbinning5	I Enumeration	R/W	SQHB6	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB6=[Param.]<CR><LF> SQHB6?<CR><LF> (Mono model only)
SequenceMode Hbinning6	I Enumeration	R/W	SQHB7	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB7=[Param.]<CR><LF> SQHB7?<CR><LF> (Mono model only)
SequenceMode Hbinning7	I Enumeration	R/W	SQHB8	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB8=[Param.]<CR><LF> SQHB8?<CR><LF> (Mono model only)
SequenceMode Hbinning8	I Enumeration	R/W	SQHB9	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB9=[Param.]<CR><LF> SQHB9?<CR><LF> (Mono model only)
SequenceMode Hbinning9	I Enumeration	R/W	SQHB10	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB10=[Param.]<CR><LF> SQHB10?<CR><LF> (Mono model only)
SequenceMode Vbinning0	I Enumeration	R/W	SQVB1	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB1=[Param.]<CR><LF> SQVB1?<CR><LF> (Mono model only)
SequenceMode Vbinning1	I Enumeration	R/W	SQVB2	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB2=[Param.]<CR><LF> SQVB2?<CR><LF> (Mono model only)
SequenceMode Vbinning2	I Enumeration	R/W	SQVB3	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB3=[Param.]<CR><LF> SQVB3?<CR><LF> (Mono model only)
SequenceMode Vbinning3	I Enumeration	R/W	SQVB4	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB4=[Param.]<CR><LF> SQVB4?<CR><LF> (Mono model only)
SequenceMode Vbinning4	I Enumeration	R/W	SQVB5	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB5=[Param.]<CR><LF> SQVB5?<CR><LF> (Mono model only)
SequenceMode Vbinning5	I Enumeration	R/W	SQVB6	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB6=[Param.]<CR><LF> SQVB6?<CR><LF> (Mono model only)

# SP-5000M-PMCL / SP-5000C-PMCL



*See the possibilities*

SequenceMode Vbinning6	I Enumeration	R/W	SQVB7	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB7=[Param.]<CR><LF> SQVB7?<CR><LF> (Mono model only)
SequenceMode Vbinning7	I Enumeration	R/W	SQVB8	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB8=[Param.]<CR><LF> SQVB8?<CR><LF> (Mono model only)
SequenceMode Vbinning8	I Enumeration	R/W	SQVB9	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB9=[Param.]<CR><LF> SQVB9?<CR><LF> (Mono model only)
SequenceMode Vbinning9	I Enumeration	R/W	SQVB10	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB10=[Param.]<CR><LF> SQVB10?<CR><LF> (Mono model only)
SequenceMode LutEnable0	I Enumeration	R/W	SQLUT1	Off/On	0	1	0	SQLUT1=[Param.]<CR><LF> SQLUT1?<CR><LF>
SequenceMode LutEnable1	I Enumeration	R/W	SQLUT2	Off/On	0	1	0	SQLUT2=[Param.]<CR><LF> SQLUT2?<CR><LF>
SequenceMode LutEnable2	I Enumeration	R/W	SQLUT3	Off/On	0	1	0	SQLUT3=[Param.]<CR><LF> SQLUT3?<CR><LF>
SequenceMode LutEnable3	I Enumeration	R/W	SQLUT4	Off/On	0	1	0	SQLUT4=[Param.]<CR><LF> SQLUT4?<CR><LF>
SequenceMode LutEnable4	I Enumeration	R/W	SQLUT5	Off/On	0	1	0	SQLUT5=[Param.]<CR><LF> SQLUT5?<CR><LF>
SequenceMode LutEnable5	I Enumeration	R/W	SQLUT6	Off/On	0	1	0	SQLUT6=[Param.]<CR><LF> SQLUT6?<CR><LF>
SequenceMode LutEnable6	I Enumeration	R/W	SQLUT7	Off/On	0	1	0	SQLUT7=[Param.]<CR><LF> SQLUT7?<CR><LF>
SequenceMode LutEnable7	I Enumeration	R/W	SQLUT8	Off/On	0	1	0	SQLUT8=[Param.]<CR><LF> SQLUT8?<CR><LF>
SequenceMode LutEnable8	I Enumeration	R/W	SQLUT9	Off/On	0	1	0	SQLUT9=[Param.]<CR><LF> SQLUT9?<CR><LF>
SequenceMode LutEnable9	I Enumeration	R/W	SQLUT10	Off/On	0	1	0	SQLUT10=[Param.]<CR><LF> SQLUT10?<CR><LF>
SequenceMode BlackLevel0	I Integer	R/W	SQBL1	Min~Max	-256	255	0	SQBL1=[Param.]<CR><LF> SQBL1?<CR><LF>
SequenceMode BlackLevel1	I Integer	R/W	SQBL2	Min~Max	-256	255	0	SQBL2=[Param.]<CR><LF> SQBL2?<CR><LF>
SequenceMode BlackLevel2	I Integer	R/W	SQBL3	Min~Max	-256	255	0	SQBL3=[Param.]<CR><LF> SQBL3?<CR><LF>
SequenceMode BlackLevel3	I Integer	R/W	SQBL4	Min~Max	-256	255	0	SQBL4=[Param.]<CR><LF> SQBL4?<CR><LF>
SequenceMode BlackLevel4	I Integer	R/W	SQBL5	Min~Max	-256	255	0	SQBL5=[Param.]<CR><LF> SQBL5?<CR><LF>

## SP-5000M-PMCL / SP-5000C-PMCL

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SequenceMode BlackLevel5	I Integer	R/W	SQBL6	Min~Max	-256	255	0	SQBL6=[Param.]<CR><LF> SQBL6?<CR><LF>
SequenceMode BlackLevel6	I Integer	R/W	SQBL7	Min~Max	-256	255	0	SQBL7=[Param.]<CR><LF> SQBL7?<CR><LF>
SequenceMode BlackLevel7	I Integer	R/W	SQBL8	Min~Max	-256	255	0	SQBL8=[Param.]<CR><LF> SQBL8?<CR><LF>
SequenceMode BlackLevel8	I Integer	R/W	SQBL9	Min~Max	-256	255	0	SQBL9=[Param.]<CR><LF> SQBL9?<CR><LF>
SequenceMode BlackLevel9	I Integer	R/W	SQBL10	Min~Max	-256	255	0	SQBL10=[Param.]<CR><LF> SQBL10?<CR><LF>
SequenceMode GainRed0	I Integer	R/W	SQPGR 1	Min~Max	-4533	17713	0	SQPGR1=[Param.]<CR><LF> SQPGR1?<CR><LF> (Bayer model only)
SequenceMode GainRed1	I Integer	R/W	SQPGR 2	Min~Max	-4533	17713	0	SQPGR2=[Param.]<CR><LF> SQPGR2?<CR><LF> (Bayer model only)
SequenceMode GainRed2	I Integer	R/W	SQPGR 3	Min~Max	-4533	17713	0	SQPGR3=[Param.]<CR><LF> SQPGR3?<CR><LF> (Bayer model only)
SequenceMode GainRed3	I Integer	R/W	SQPGR 4	Min~Max	-4533	17713	0	SQPGR4=[Param.]<CR><LF> SQPGR4?<CR><LF> (Bayer model only)
SequenceMode GainRed4	I Integer	R/W	SQPGR 5	Min~Max	-4533	17713	0	SQPGR5=[Param.]<CR><LF> SQPGR5?<CR><LF> (Bayer model only)
SequenceMode GainRed5	I Integer	R/W	SQPGR 6	Min~Max	-4533	17713	0	SQPGR6=[Param.]<CR><LF> SQPGR6?<CR><LF> (Bayer model only)
SequenceMode GainRed6	I Integer	R/W	SQPGR 7	Min~Max	-4533	17713	0	SQPGR7=[Param.]<CR><LF> SQPGR7?<CR><LF> (Bayer model only)
SequenceMode GainRed7	I Integer	R/W	SQPGR 8	Min~Max	-4533	17713	0	SQPGR8=[Param.]<CR><LF> SQPGR8?<CR><LF> (Bayer model only)
SequenceMode GainRed8	I Integer	R/W	SQPGR 9	Min~Max	-4533	17713	0	SQPGR9=[Param.]<CR><LF> SQPGR9?<CR><LF> (Bayer model only)
SequenceMode GainRed9	I Integer	R/W	SQPGR 10	Min~Max	-4533	17713	0	SQPGR10=[Param.]<CR><LF> SQPGR10?<CR><LF> (Bayer model only)
SequenceMode GainBlue0	I Integer	R/W	SQPGB 1	Min~Max	-4533	17713	0	SQPGB1=[Param.]<CR><LF> SQPGB1?<CR><LF> (Bayer model only)

# SP-5000M-PMCL / SP-5000C-PMCL



*See the possibilities*

SequenceMode GainBlue1	I Integer	R/W	SQPGB 2	Min~Max	-4533	17713	0	SQPGB2=[Param.]<CR><LF> SQPGB2?<CR><LF> (Bayer model only)
SequenceMode GainBlue2	I Integer	R/W	SQPGB 3	Min~Max	-4533	17713	0	SQPGB3=[Param.]<CR><LF> SQPGB3?<CR><LF> (Bayer model only)
SequenceMode GainBlue3	I Integer	R/W	SQPGB 4	Min~Max	-4533	17713	0	SQPGB4=[Param.]<CR><LF> SQPGB4?<CR><LF> (Bayer model only)
SequenceMode GainBlue4	I Integer	R/W	SQPGB 5	Min~Max	-4533	17713	0	SQPGB5=[Param.]<CR><LF> SQPGB5?<CR><LF> (Bayer model only)
SequenceMode GainBlue5	I Integer	R/W	SQPGB 6	Min~Max	-4533	17713	0	SQPGB6=[Param.]<CR><LF> SQPGB6?<CR><LF> (Bayer model only)
SequenceMode GainBlue6	I Integer	R/W	SQPGB 7	Min~Max	-4533	17713	0	SQPGB7=[Param.]<CR><LF> SQPGB7?<CR><LF> (Bayer model only)
SequenceMode GainBlue7	I Integer	R/W	SQPGB 8	Min~Max	-4533	17713	0	SQPGB8=[Param.]<CR><LF> SQPGB8?<CR><LF> (Bayer model only)
SequenceMode GainBlue8	I Integer	R/W	SQPGB 9	Min~Max	-4533	17713	0	SQPGB9=[Param.]<CR><LF> SQPGB9?<CR><LF> (Bayer model only)
SequenceMode GainBlue9	I Integer	R/W	SQPGB 10	Min~Max	-4533	17713	0	SQPGB10=[Param.]<CR><LF> SQPGB10?<CR><LF> (Bayer model only)
CommnadSeque nce Index	I Enumera tion	R/W	SQI	Same as SequenceModeIndex	0	9	0	CSQI=[Param.]<CR><LF> CSQI?<CR><LF>
CurrentSequenc e Index	I Enumera tion	R/O	SQIDX	Same as SequenceModeIndex	0	9	0	SQIDX?<CR><LF>
SequenceReset	I Enumera tion	W/O	SQRST	0	0	0	0	SQRST=[Param.]<CR><LF>
SequenceLutMo de	I Enumera tion	R/W	SQLUT	0: Gamma 1: LUT	0	1	0	SQLUT=[Param.]<CR><LF> SQLUT?<CR><LF>
MultiRoiIndexM ax	I Integer	R/W	MRIM	Min~Max	1	8	1	MRIM=[Param.]<CR><LF> MRIM?<CR><LF>
MultiRoiWidth	I Integer	R/W	MRW	Min~Max	8	5120	8	MRW=[Param.]<CR><LF> MRW?<CR><LF>
MultiRoiHeight1	I Integer	R/W	MRH1	Min~Max	0	3840	1	MRH1=[Param.]<CR><LF> MRH1?<CR><LF>
MultiRoiHeight2	I Integer	R/W	MRH2	Min~Max	0	3840	1	MRH2=[Param.]<CR><LF> MRH2?<CR><LF>

## SP-5000M-PMCL / SP-5000C-PMCL

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MultiRoiHeight3	I Integer	R/W	MRH3	Min~Max	0	3840	1	MRH3=[Param.]<CR><LF> MRH3?<CR><LF>
MultiRoiHeight4	I Integer	R/W	MRH4	Min~Max	0	3840	1	MRH4=[Param.]<CR><LF> MRH4?<CR><LF>
MultiRoiHeight5	I Integer	R/W	MRH5	Min~Max	0	3840	1	MRH5=[Param.]<CR><LF> MRH5?<CR><LF>
MultiRoiHeight6	I Integer	R/W	MRH6	Min~Max	0	3840	1	MRH6=[Param.]<CR><LF> MRH6?<CR><LF>
MultiRoiHeight7	I Integer	R/W	MRH7	Min~Max	0	3840	1	MRH7=[Param.]<CR><LF> MRH7?<CR><LF>
MultiRoiHeight8	I Integer	R/W	MRH8	Min~Max	0	3840	1	MRH8=[Param.]<CR><LF> MRH8?<CR><LF>
MultiRoiOffsetX1	I Integer	R/W	MROX1	Min~Max	0	5118	0	MROX1=[Param.]<CR><LF> MROX1?<CR><LF>
MultiRoiOffsetX2	I Integer	R/W	MROX2	Min~Max	0	5118	0	MROX2=[Param.]<CR><LF> MROX2?<CR><LF>
MultiRoiOffsetX3	I Integer	R/W	MROX3	Min~Max	0	5118	0	MROX3=[Param.]<CR><LF> MROX3?<CR><LF>
MultiRoiOffsetX4	I Integer	R/W	MROX4	Min~Max	0	5118	0	MROX4=[Param.]<CR><LF> MROX4?<CR><LF>
MultiRoiOffsetX5	I Integer	R/W	MROX5	Min~Max	0	5118	0	MROX5=[Param.]<CR><LF> MROX5?<CR><LF>
MultiRoiOffsetX6	I Integer	R/W	MROX6	Min~Max	0	5118	0	MROX6=[Param.]<CR><LF> MROX6?<CR><LF>
MultiRoiOffsetX7	I Integer	R/W	MROX7	Min~Max	0	5118	0	MROX7=[Param.]<CR><LF> MROX7?<CR><LF>
MultiRoiOffsetX8	I Integer	R/W	MROX8	Min~Max	0	5118	0	MROX8=[Param.]<CR><LF> MROX8?<CR><LF>
MultiRoiOffsetY1	I Integer	R/W	MROY1	Min~Max	0	3839	0	MROY1=[Param.]<CR><LF> MROY1?<CR><LF>
MultiRoiOffsetY2	I Integer	R/W	MROY2	Min~Max	0	3839	0	MROY2=[Param.]<CR><LF> MROY2?<CR><LF>
MultiRoiOffsetY3	I Integer	R/W	MROY3	Min~Max	0	3839	0	MROY3=[Param.]<CR><LF> MROY3?<CR><LF>
MultiRoiOffsetY4	I Integer	R/W	MROY4	Min~Max	0	3839	0	MROY4=[Param.]<CR><LF> MROY4?<CR><LF>
MultiRoiOffsetY5	I Integer	R/W	MROY5	Min~Max	0	3839	0	MROY5=[Param.]<CR><LF> MROY5?<CR><LF>

# SP-5000M-PMCL / SP-5000C-PMCL



*See the possibilities*

MultiRoiOffsetY6	I Integer	R/W	MROY6	Min~Max	0	3839	0	MROY6=[Param.]<CR><LF> MROY6?<CR><LF>
MultiRoiOffsetY7	I Integer	R/W	MROY7	Min~Max	0	3839	0	MROY7=[Param.]<CR><LF> MROY7?<CR><LF>
MultiRoiOffsetY8	I Integer	R/W	MROY8	Min~Max	0	3839	0	MROY8=[Param.]<CR><LF> MROY8?<CR><LF>
LUTMode	I Enumeration	R/W	LUTC	0: Off 1: Gamma 2: LUT	0	2	0	LUTC=[Param.]<CR><LF> LUTC?<CR><LF>
AlcSpeed	I Integer	R/W	ALCS	Min~Max	1	8	4	ALCS=[Param.]<CR><LF> ALCS?<CR><LF> for AGC and ASC
ExposureAutoMax	I Integer	R/W	ASCEA	Min~Max[us]	101	8000000	18000	ASCEA=[Param.]<CR><LF> ASCEA?<CR><LF> Maximum value is varied depending on frame rate.
ExposureAutoMin	I Integer	R/W	ASCEI	Min~Max	100	7999999	100	ASCEI=[Param.]<CR><LF> ASCEI?<CR><LF> Maximum value is varied depending on frame rate.
RequestExposureAutoResult	I Enumeration	R/O	ASRS	0=Complete. 1=Too Bright. 2=Too dark. 3=Timeout Error. 4=Busy. 5=Limit. 6= Trig is not set as Normal.	0	6	0	ASRS?<CR><LF>
TriggerOption	I Enumeration	R/W	TRGOP	0: Off 1: RCT 2: PIV 3: Smear-less 4: RCT Continuous	0	4	0	TRGOP=[Param.]<CR><LF> TRGOP?<CR><LF>
AlcReference	I Integer	R/W	AGCF	Min~Max[%]	1	100	50	AGCF=[Param.]<CR><LF> AGCF?<CR><LF>
GainAutoMax	I Integer	R/W	AGCGA	Min~Max	101	1600	1600	AGCGA=[Param.]<CR><LF> AGCGA?<CR><LF>
GainAutoMin	I Integer	R/W	AGCGI	Min~Max	100	1599	100	AGCGI=[Param.]<CR><LF> AGCGI?<CR><LF>
RequestGainAutoResult	I Enumeration	R/O	AGRS	0=Complete. 1=Too Bright. 2=Too dark. 3=Timeout Error. 4=Busy. 5=Limit. 6= Trig is not set as Normal.	0	6	0	AGRS?<CR><LF>
AutolrisLensControlSignalOutput	I Enumeration	R/W	AIC	0: Off 1: On	0	1	0	AIC=[Param.]<CR><LF> AIC?<CR><LF>

# SP-5000M-PMCL / SP-5000C-PMCL

LensSelect	I Enumeration	R/W	AIS	0: None 1: P-IRIS Lens 2: MOTOR Iris Lens 3: Video Iris Lens 4: DC Iris Lens	0	4	0	AIS=[Param.]<CR><LF> AIS?<CR><LF>
VideoirisStateControl	I Enumeration	R/W	ISC	0: Video 1: Close 2: Open	0	1	2	ISC=[Param.]<CR><LF> ISC?<CR><LF>
ALCChannelAreaAll	I Enumeration	R/W	ALCA	0: Off / 1: On	0	1	0	ALCA=[Param.]<CR><LF> ALCA?<CR><LF>
ALCChannelAreaLowRight	I Enumeration	R/W	ALCLR	0: Off / 1: On	0	1	1	ALC**=[Param.]<CR><LF> ALC**?<CR><LF>
ALCChannelAreaLowMidRight	I Enumeration	R/W	ALCLMR	0: Off / 1: On	0	1	1	
ALCChannelAreaLowMidLeft	I Enumeration	R/W	ALCLML	0: Off / 1: On	0	1	1	
ALCChannelAreaLowLeft	I Enumeration	R/W	ALCLL	0: Off / 1: On	0	1	1	
ALCChannelAreaMidLowRight	I Enumeration	R/W	ALCMLR	0: Off / 1: On	0	1	1	
ALCChannelAreaMidLowMidRight	I Enumeration	R/W	ALCMLMR	0: Off / 1: On	0	1	1	
ALCChannelAreaMidLowMidLeft	I Enumeration	R/W	ALCMLML	0: Off / 1: On	0	1	1	
ALCChannelAreaMidLowLeft	I Enumeration	R/W	ALCMLL	0: Off / 1: On	0	1	1	
ALCChannelAreaMidHighRight	I Enumeration	R/W	ALCMHR	0: Off / 1: On	0	1	1	
ALCChannelAreaMidHighMidRight	I Enumeration	R/W	ALCMHMR	0: Off / 1: On	0	1	1	
ALCChannelAreaMidHighMidLeft	I Enumeration	R/W	ALCMHML	0: Off / 1: On	0	1	1	
ALCChannelAreaMidHighLeft	I Enumeration	R/W	ALCMHL	0: Off / 1: On	0	1	1	
ALCChannelAreaHighRight	I Enumeration	R/W	ALCHR	0: Off / 1: On	0	1	1	
ALCChannelAreaHighMidRight	I Enumeration	R/W	ALCHMR	0: Off / 1: On	0	1	1	
ALCChannelAreaHighMidLeft	I Enumeration	R/W	ALCHML	0: Off / 1: On	0	1	1	
ALCChannelAreaHighLeft	I Enumeration	R/W	ALCHL	0: Off / 1: On	0	1	1	

# SP-5000M-PMCL / SP-5000C-PMCL



See the possibilities

AWBChannelAreaAll	I Enumeration	R/W	AWBA	0: Off / 1: On	0	1	0	AWBA=[Param.]<CR><LF> AWBA?<CR><LF>
AWBChannelAreaLowRight	I Enumeration	R/W	AWBLR	0: Off / 1: On	0	1	1	
AWBChannelAreaLowMidRight	I Enumeration	R/W	AWBMR	0: Off / 1: On	0	1	1	
AWBChannelAreaLowMidLeft	I Enumeration	R/W	AWBML	0: Off / 1: On	0	1	1	
AWBChannelAreaLowLeft	I Enumeration	R/W	AWBLL	0: Off / 1: On	0	1	1	
AWBChannelAreaMidLowRight	I Enumeration	R/W	AWBMLR	0: Off / 1: On	0	1	1	
AWBChannelAreaMidLowMidRight	I Enumeration	R/W	AWBMLMR	0: Off / 1: On	0	1	1	
AWBChannelAreaMidLowMidLeft	I Enumeration	R/W	AWBMLML	0: Off / 1: On	0	1	1	
AWBChannelAreaMidLowLeft	I Enumeration	R/W	AWBMLL	0: Off / 1: On	0	1	1	
AWBChannelAreaMidHighRight	I Enumeration	R/W	AWBMR	0: Off / 1: On	0	1	1	
AWBChannelAreaMidHighMidRight	I Enumeration	R/W	AWBMHMR	0: Off / 1: On	0	1	1	
AWBChannelAreaMidHighMidLeft	I Enumeration	R/W	AWBMHML	0: Off / 1: On	0	1	1	
AWBChannelAreaMidHighLeft	I Enumeration	R/W	AWBMLH	0: Off / 1: On	0	1	1	
AWBChannelAreaHighRight	I Enumeration	R/W	AWBHR	0: Off / 1: On	0	1	1	
AWBChannelAreaHighMidRight	I Enumeration	R/W	AWBMR	0: Off / 1: On	0	1	1	
AWBChannelAreaHighMidLeft	I Enumeration	R/W	AWBML	0: Off / 1: On	0	1	1	
AWBChannelAreaHighLeft	I Enumeration	R/W	AWBHL	0: Off / 1: On	0	1	1	
RequestBalanceWhiteAutoResult	I Enumeration	R/O	AWRS	0=Complete. 1=Too Bright. 2=Too dark. 3=Timeout Error. 4=Busy. 5=Limit. 6= Trig is not set as Normal.	0	6	0	AWRS?<CR><LF> (Bayer model only)

## SP-5000M-PMCL / SP-5000C-PMCL

CurrentAreaNoRequest	I Integer	R/O	EA	0: Factory area 1: User 1 area 2: User 2 area 3: User 3 area	0	3	0	EA?<CR><LF> The camera return the latest used DATA AREA.	
PirisLensSelect	I Enumeration	R/W	PLS	No lens available				PLS=[Param.]<CR><LF> PLS?<CR><LF>	
PirisStepMax	I Integer	R/O	PIS	Indicate control maximum value	P-IRIS step	0	255	128	PIS?<CR><LF> Different depending on PirisLensSelect value
PirisPosition	I Integer	R/W	PIP	Min~Max		0	255	128	PIP=[Param.]<CR><LF> PIP?<CR><LF> Maximum value is PirisStepMax
PirisAutoMin	I Enumeration	R/W	PLI	0: FULL OPEN 1: F1.4 2: F2 3: F2.8 4: F4 5: F5.6 6: F8 7: F11 8: F16 9: F22 10: F32 11: CLOSE		0	11	1	PLI=[Param.]<CR><LF> PLI?<CR><LF> Minimum value and Maximum value are different depending on PirisLensSelect value
PirisAutoMax	I Enumeration	R/W	PLA	Same as above.		0	11	5	PLI=[Param.]<CR><LF> PLI?<CR><LF> Minimum value and Maximum value are different depending on PirisLensSelect value
PirisCurrentFvalue	I Enumeration	R/O	PCV	Same as above.		0	11	0	PCV?<CR><LF>
AcquisitionFrameLine	I Integer	R/W	AR	Min~Max		1	325786	774	AR=[Param.]<CR><LF> AR?<CR><LF> Maximum value is calculated depending on Height and Offset Y settings
GammaSelector	I Integer	R/W	GMA	0( $\gamma=1$ ) ~ 8( $\gamma=0.45$ ) ~ 15( $\gamma=TBD$ )		0	15	8	GMA=[Param.]<CR><LF> GMA?<CR><LF>
Temperature	I Integer	R/O	TMP0	value		—	—	—	TMP0?<CR><LF> (Value ÷ 128) = Temperature[°C]
GpioPulseGenDivide Value	I Integer	R/W	PGDEV	Min~Max		1	4096	1	PGDEV=[Param.]<CR><LF> PGDEV?<CR><LF>
GpioPulseGenLength0	I Integer	R/W	PGLO	Min~Max		1	1048575	1	PGLO=[Param.]<CR><LF> PGLO?<CR><LF>

# SP-5000M-PMCL / SP-5000C-PMCL



See the possibilities

GpioPulseGenLength1	I Integer	R/W	PGL1	Min~Max	1	10485 75	1	PGL1=[Param.]<CR><LF> PGL1?<CR><LF>
GpioPulseGenLength2	I Integer	R/W	PGL2	Min~Max	1	10485 75	1	PGL2=[Param.]<CR><LF> PGL2?<CR><LF>
GpioPulseGenLength3	I Integer	R/W	PGL3	Min~Max	1	10485 75	1	PGL3=[Param.]<CR><LF> PGL3?<CR><LF>
GpioPulseGenStart Point0	I Integer	R/W	PGST0	Min~Max	0	10485 74	0	PGST0=[Param.]<CR><LF> PGST0?<CR><LF>
GpioPulseGenStart Point1	I Integer	R/W	PGST1	Min~Max	0	10485 74	0	PGST1=[Param.]<CR><LF> PGST1?<CR><LF>
GpioPulseGenStart Point2	I Integer	R/W	PGST2	Min~Max	0	10485 74	0	PGST2=[Param.]<CR><LF> PGST2?<CR><LF>
GpioPulseGenStart Point3	I Integer	R/W	PGST3	Min~Max	0	10485 74	0	PGST3=[Param.]<CR><LF> PGST3?<CR><LF>
GpioPulseGenEnd Point0	I Integer	R/W	PGEN0	Min~Max	1	10485 75	1	PGEN0=[Param.]<CR><LF> PGEN0?<CR><LF>
GpioPulseGenEnd Point1	I Integer	R/W	PGEN1	Min~Max	1	10485 75	1	PGEN1=[Param.]<CR><LF> PGEN1?<CR><LF>
GpioPulseGenEnd Point2	I Integer	R/W	PGEN2	Min~Max	1	10485 75	1	PGEN2=[Param.]<CR><LF> PGEN2?<CR><LF>
GpioPulseGenEnd Point3	I Integer	R/W	PGEN3	Min~Max	1	10485 75	1	PGEN3=[Param.]<CR><LF> PGEN3?<CR><LF>
GpioPulseGenRepeat Count0	I Integer	R/W	PGRPT0	Min~Max	0	255	0	PGRPT0=[Param.]<CR><LF> PGRPT0?<CR><LF>
GpioPulseGenRepeat Count1	I Integer	R/W	PGRPT1	Min~Max	0	255	0	PGRPT1=[Param.]<CR><LF> PGRPT1?<CR><LF>
GpioPulseGenRepeat Count2	I Integer	R/W	PGRPT2	Min~Max	0	255	0	PGRPT2=[Param.]<CR><LF> PGRPT2?<CR><LF>
GpioPulseGenRepeat Count3	I Integer	R/W	PGRPT3	Min~Max	0	255	0	PGRPT3=[Param.]<CR><LF> PGRPT3?<CR><LF>
GpioPulseGenCl ear Mode0	I Enumeration	R/W	PGCM0	0: Free Run 1: Level High 2: Level Low 3: Rising Edge 4: Falling Edge	0	4	0	PGCM0=[Param.]<CR><LF> PGCM0?<CR><LF>
GpioPulseGenCl ear Mode1	I Enumeration	R/W	PGCM1	Same as above.	0	4	0	PGCM1=[Param.]<CR><LF> PGCM1?<CR><LF>
GpioPulseGenCl ear Mode2	I Enumeration	R/W	PGCM2	Same as above.	0	4	0	PGCM2=[Param.]<CR><LF> PGCM2?<CR><LF>
GpioPulseGenCl ear Mode3	I Enumeration	R/W	PGCM3	Same as above.	0	4	0	PGCM3=[Param.]<CR><LF> PGCM3?<CR><LF>

## SP-5000M-PMCL / SP-5000C-PMCL

GpioPulseGenSync Mode0	I Enumeration	R/W	PGSM0	0: Async Mode 1: Sync Mode	0	1	0	PGSM0=[Param.]<CR><LF> PGSM0?<CR><LF>
GpioPulseGenSync Mode1	I Enumeration	R/W	PGSM1	Same as above.	0	1	0	PGSM1=[Param.]<CR><LF> PGSM1?<CR><LF>
GpioPulseGenSync Mode2	I Enumeration	R/W	PGSM2	Same as above.	0	1	0	PGSM2=[Param.]<CR><LF> PGSM2?<CR><LF>
GpioPulseGenSync Mode3	I Enumeration	R/W	PGSM3	Same as above.	0	1	0	PGSM3=[Param.]<CR><LF> PGSM3?<CR><LF>
GpioPulseGenInput0	I Enumeration	R/W	PGIN0	0:Low 1:High 2:Soft 3:AcquisitionTriggerWait 4:FrameTriggerWait 5:FrameActive 6:ExposureActive 7:FVAL 8:LVAL 9:PG0 10:PG1 11:PG2 12:PG3 13: TTL in 14:CL CC1 in 15:nand0 16:nand1 17: OPTTL in2 18: OPLVDS in	0	18	0	PGIN0=[Param.]<CR><LF> PGIN0?<CR><LF>
GpioPulseGenInput1	I Enumeration	R/W	PGIN1	Same as above.	0	18	0	PGIN1=[Param.]<CR><LF> PGIN1?<CR><LF>
GpioPulseGenInput2	I Enumeration	R/W	PGIN2	Same as above.	0	18	0	PGIN2=[Param.]<CR><LF> PGIN2?<CR><LF>
GpioPulseGenInput3	I Enumeration	R/W	PGIN3	Same as above.	0	18	0	PGIN3=[Param.]<CR><LF> PGIN3?<CR><LF>
GpioPulseGenInvert0	I Enumeration	R/W	PGINV0	0:Non-Inv 1:Inv	0	1	0	PGIN0=[Param.]<CR><LF> PGIN0?<CR><LF>
GpioPulseGenInvert1	I Enumeration	R/W	PGINV1	Same as above.	0	1	0	PGIN1=[Param.]<CR><LF> PGIN1?<CR><LF>
GpioPulseGenInvert2	I Enumeration	R/W	PGINV2	Same as above.	0	1	0	PGIN2=[Param.]<CR><LF> PGIN2?<CR><LF>
GpioPulseGenInvert3	I Enumeration	R/W	PGINV3	Same as above.	0	1	0	PGIN3=[Param.]<CR><LF> PGIN3?<CR><LF>

# SP-5000M-PMCL / SP-5000C-PMCL



*See the possibilities*

GpioNand0Input Source1	I Enumeration	R/W	ND0IN1	0: Low 1: High 2: FrameTriggerWait 3: FramActive 4: ExposureActive 5: Fval 6: PulseGenerator0 7: PulseGenerator1 8: PulseGenerator2 9: PulseGenerator3 10: TTL_In1 11: CL_CC1_In	0	11	0	ND0IN1=[Param.]<CR><LF> ND0IN1?<CR><LF>
GpioNand1Input Source1	I Enumeration	R/W	ND1IN1	Same as above.	0	11	0	ND1IN1=[Param.]<CR><LF> ND1IN1?<CR><LF>
GpioNand0Input Source2	I Enumeration	R/W	ND0IN2	0: Low 1: High 2: FrameTriggerWait 3: FramActive 4: ExposureActive 5: Fval 6: PulseGenerator0 7: PulseGenerator1 8: PulseGenerator2 9: PulseGenerator3 10: TTL_In1 11: CL_CC1_In	0	11	0	ND0IN2=[Param.]<CR><LF> ND0IN2?<CR><LF>
GpioNand1Input Source2	I Enumeration	R/W	ND1IN2	Same as above.	0	11	0	ND1IN2=[Param.]<CR><LF> ND1IN2?<CR><LF>
GpioNand0Input Invert1	I Enumeration	R/W	ND0INV 1	0: Non-Inv 1: Inv	0	1	0	ND0INV1=[Param.]<CR><LF> ND0INV1?<CR><LF>
GpioNand1Input Invert1	I Enumeration	R/W	ND1INV 1	Same as above.	0	1	0	ND1INV1=[Param.]<CR><LF> ND1INV1?<CR><LF>
GpioNand0Input Invert2	I Enumeration	R/W	ND0INV 2	0: Non-Inv 1: Inv	0	1	0	ND0INV2=[Param.]<CR><LF> ND0INV2?<CR><LF>
GpioNand1Input Invert2	I Enumeration	R/W	ND1INV 2	Same as above.	0	1	0	ND1INV2=[Param.]<CR><LF> ND1INV2?<CR><LF>
MotorLensIris	I Enumeration	R/W	MLI	0: Stop 1: Open 2: Close	0	2	0	MLI=[Param.]<CR><LF> MLI?<CR><LF>
MotorLensZoom	I Enumeration	R/W	MLZ	0: Stop 1: Wide 2: Tele	0	2	0	MLZ=[Param.]<CR><LF> MLZ?<CR><LF>
MotorLensFocus	I Enumeration	R/W	MLF	0: Stop 1: Wide 2: Tele	0	2	0	MLF=[Param.]<CR><LF> MLF?<CR><LF>
LUTSequenceR	I Enumeration	R/W	LUTSR	Min~Max	0	4095	0	LUTSR=[Param.]<CR><LF> LUTSR?<CR><LF>
LUTSequenceG	I Enumeration	R/W	LUTSG	Min~Max	0	4095	0	LUTSG=[Param.]<CR><LF> LUTSG?<CR><LF>
LUTSequenceB	I Enumeration	R/W	LUTSB	Min~Max	0	4095	0	LUTSB=[Param.]<CR><LF> LUTSB?<CR><LF>

## SP-5000M-PMCL / SP-5000C-PMCL

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BlemishNum	I Integer	R/O	BNUM	Min~Max	0	512	0	BNUM?<CR><LF>
CameraLinkClockFrequency	I Enumeration	R/W	CLCF	0= 82.3MHz 1= 75.4MHz 2= 61.7MHz	0	2	0	CLCF=[Param.]<CR><LF> CLCF?<CR><LF>
VideoProcessByPass	I Enumeration	R/W	VPB	0: Off / 1: On	0	1	0	VPB=[Param.]<CR><LF> VPB?<CR><LF>
HighDynamicRangeMode	I Enumeration	R/W	HES	0: Off / 1: On	0	1	0	HES=[Param.]<CR><LF> HES?<CR><LF>
HighDynamicRangeSlope	I Enumeration	R/W	HKS	0: 70dB 1: 80dB 2: 90dB 3: 100dB	0	3	0	HKS=[Param.]<CR><LF> HKS?<CR><LF>

## Appendix 2

### 1. Precautions

Personnel not trained in dealing with similar electronic devices should not service this camera. The camera contains components sensitive to electrostatic discharge. The handling of these devices should follow the requirements of electrostatic sensitive components.

Do not attempt to disassemble this camera.

Do not expose this camera to rain or moisture.

Do not face this camera towards the sun, extreme bright light or light reflecting objects.

When this camera is not in use, put the supplied lens cap on the lens mount.

Handle this camera with the maximum care.

Operate this camera only from the type of power source indicated on the camera.

Power off the camera during any modification such as changes of jumper and switch setting.

### 2. Typical Sensor Characteristics

The following effects may be observed on the video monitor screen. They do not indicate any fault of the camera, but are associated with typical sensor characteristics.

#### V. Aliasing

When the CMOS camera captures stripes, straight lines or similar sharp patterns, jagged edges may appear on the monitor.

#### Blemishes

All cameras are shipped without visible image sensor blemishes.

Over time some pixel defects can occur. This does not have a practical effect on the operation of the camera. These will show up as white spots (blemishes).

Exposure to cosmic rays can cause blemishes to appear on the image sensor. Please take care to avoid exposure to cosmic rays during transportation and storage. It is recommended using sea shipment instead of air flight in order to limit the influence of cosmic rays on the camera. Pixel defects/blemishes also may emerge due to prolonged operation at elevated ambient temperature, due to high gain setting, or during long time exposure. It is therefore recommended to operate the camera within its specifications.

#### Patterned Noise

When the sensor captures a dark object at high temperature or is used for long time integration, fixed pattern noise may appear on the video monitor screen.

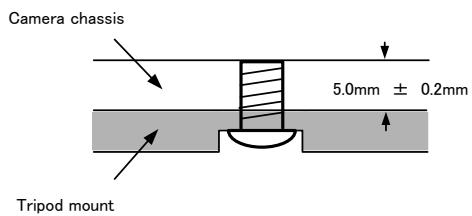
### 3. Caution when mounting a lens on the camera

When mounting a lens on the camera dust particles in the air may settle on the surface of the lens or the image sensor of the camera. It is therefore important to keep the protective caps on the lens and on the camera until the lens is mounted. Point the lens mount of the camera downward to prevent dust particles from landing on the optical surfaces of the camera. This work should be done in a dust free environment. Do not touch any of the optical surfaces of the camera or the lens.

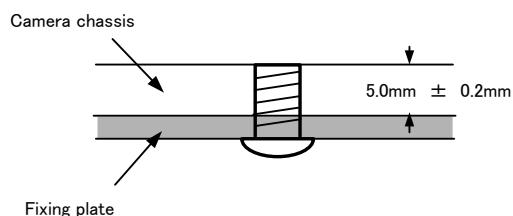
### 4. Caution when mounting the camera

When you mount the camera on your system, please make sure to use screws of the recommended length described in the following drawing. Longer screws may cause serious damage to the PCB inside the camera.

If you mount the tripod mounting plate, please use the provided screws.



Attaching the tripod mount



Mounting the camera to fixing plate

## **5. Exportation**

When exporting this product, please follow the export regulation of your own country.

## **6. References**

1. This manual and a datasheet for SP-5000M-PMCL / SP-5000C-PMCL can be downloaded from [www.jai.com](http://www.jai.com)
2. Camera control software can be downloaded from [www.jai.com](http://www.jai.com)

## Manual change history

## User's Record

**Camera type:** SP-5000M-PMCL / SP-5000C-PMCL

**Revision:** .....

**Serial No.** .....

**Firmware version.** .....

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

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## User's Mode Settings.

## User's Modifications.

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