See the possibilities

Spark Series

User Manual

SP-5000M-PMCL
SP-5000C-PMCL

5M CMOS Digital Progressive Scan Monochrome and Color Camera

Document Version: Ver.2.3
SP-5000-PMCL_Ver.2.3_May.2023

1046E-1305

Notice

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

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

Warranty

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

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that SP-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.

KC

상 호 : JAI Ltd.,Japan
기자재 명칭 : Industrial camera
모 델 명 : SP-5000M-PMCL
제조자 및 제조국가: JAI Ltd.,Japan / JAPAN
R-REM-JAi-SP-5000C-PMCL

상 호 : JAI Ltd.,Japan
기자재 명칭 : Industrial camera
모 델 명 : SP-5000C-PMCL
제조자 및 제조국가: JAI Ltd.,Japan / JAPAN
R-REM-JAi-SP-5000C-PMCL

제조년월은 제품상자의 라벨을 참조하십시요

Supplement

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

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

重要注意事项

有毒，有害物质或元素名称及含量表

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

部件名称	有毒有害物质或元素					
	铅（Pb）	汞（Hg）	镉（Cd）	六价铬（Cr(VI)）	多溴联苯（PPB）	多溴二苯醚（PBDE）
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GB/T 26572-2011规定的限量要求以下。
×: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572-2011规定的限量要求。
（企业可在此处,根据实际情况对上表中打 "×" 的技术原因进行进一步说明。）

环保使用期限

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

数字「15」为期限15年。

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	×	○	○	○	○	○
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GB/T 26572-2011规定的限量要求以下。
×: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572-2011规定的限量要求。
（企业可在此处,根据实际情况对上表中打 "×" 的技术原因进行进一步说明。）

环保使用期限

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

数字「15」为期限15年。

- Contents -

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, 1X4-1Y and 1X2-1Y are available for 8-bit and 10-bit output, Please check if the frame grabber used in the system complies with the mentioned formats.

Caution when certain commands are executed

When the following commands are executed, the video output may be interrupted instantaneously.
1. Base Gain
2. HDR mode (ON/OFF)
3. Setting HDR SLOPE when HDR mode is ON

When this occurs, it is necessary to disable the frame grabber board.

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 .

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 137 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
The latest version of the JAI SDK for the SP-5000M-PMCL and SP-5000C-PMCL can be downloaded from: 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.

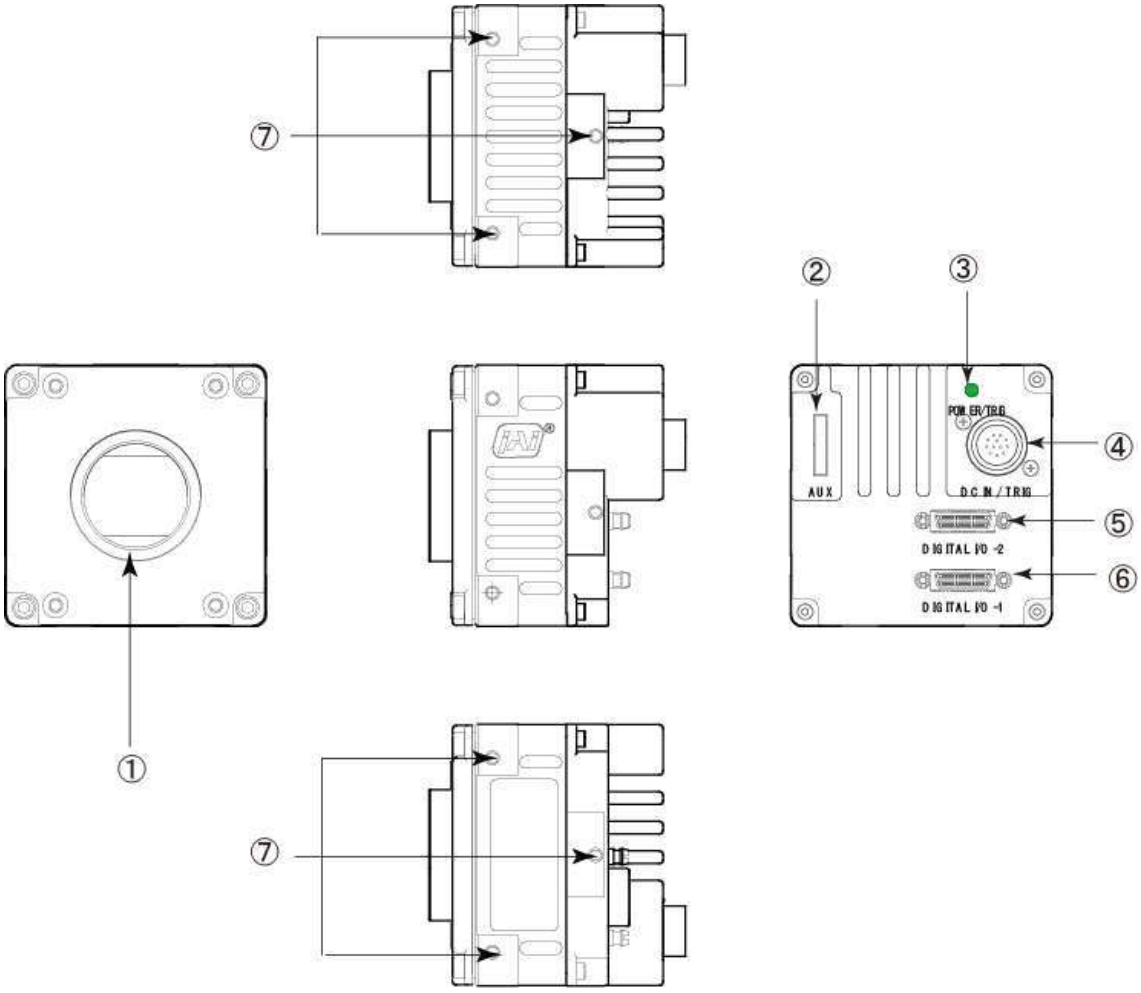
Tripod base	MP-42
Power supply unit	PD-12 series

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 µm square pixels
- S/N 55dB for monochrome and 50dB for color (traditional measurement method)
- 8-bit, 10-bit or 12-bit output for monochrome and Bayer
- 137 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 µs (1/100,000) to 8 seconds exposure control in 1 µs 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
- C-mount for lens mount
- Accepts power over Mini Camera Link or via 12-pin connector

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 (Note *4)
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).
*4) Note: Lens control is not supported on the 10-pin connector on cameras with hardware revision K (mono model) / J (color model) or later.

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.

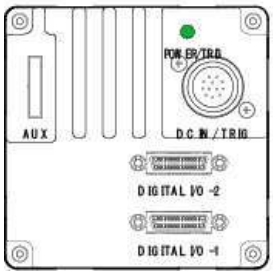


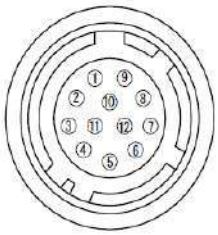
Fig. 2 Rear panel

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 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.

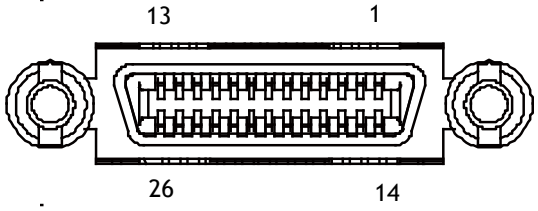


Fig.4 Camera Link connector

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

Caution: Lens control is not supported on the 10-pin connector on cameras with hardware revision K (mono model) / J (color model) or later. On these cameras, only AUX Type 3 (factory option) connector can be used.

5.1.3.1 Figure and pin configuration

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

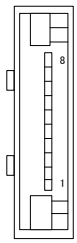


Fig.5 Hirose 10-pin connector

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 OUT A+	P-Iris Lens
7	O	P-IRIS OUT A-	P-Iris Lens
8	O	P-IRIS OUT B+	P-Iris Lens
9	O	P-IRIS OUT B-	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	

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
	GenICam Tap Geometry		1X2 - 1Y	1X4 - 1Y	1x8 - 1Y	1X8 - 1Y	1X10 - 1Y
Digital I/O-1	Port A0	TxIN 0	Tap1 D0	Tap 1 D0	Tap 1 D0	Tap 1 D2	Tap 1 D0
	Port A1	TxIN 1	Tap1 D1	Tap 1 D1	Tap 1 D1	Tap 1 D3	Tap 1 D1
	Port A2	TxIN 2	Tap1 D2	Tap 1 D2	Tap 1 D2	Tap 1 D4	Tap 1 D2
	Port A3	TxIN 3	Tap1 D3	Tap 1 D3	Tap 1 D3	Tap 1 D5	Tap 1 D3
	Port A4	TxIN 4	Tap1 D4	Tap 1 D4	Tap 1 D4	Tap 1 D6	Tap 1 D4
	Port A5	TxIN 6	Tap1 D5	Tap 1 D5	Tap 1 D5	Tap 1 D7	Tap 1 D6
	Port A6	TxIN 27	Tap1 D6	Tap 1 D6	Tap 1 D6	Tap 1 D8	Tap 4 D1
	Port A7	TxIN 5	Tap1 D7	Tap 1 D7	Tap 1 D7	Tap 1 D9	Tap 1 D5
	Port B0	TxIN 7	Tap1 D8	Tap 1 D8	Tap 2 D0	Tap 2 D2	Tap 1 D7
	Port B1	TxIN 8	Tap1 D9	Tap 1 D9	Tap 2 D1	Tap 2 D3	Tap 2 D0
	Port B2	TxIN 9	Tap1 D10	Tap 1 D10	Tap 2 D2	Tap 2 D4	Tap 2 D1
	Port B3	TxIN 12	Tap1 D11	Tap 1 D11	Tap 2 D3	Tap 2 D5	Tap 2 D4
	Port B4	TxIN 13	Tap2 D8	Tap 2 D8	Tap 2 D4	Tap 2 D6	Tap 2 D5
	Port B5	TxIN 14	Tap2 D9	Tap 2 D9	Tap 2 D5	Tap 2 D7	Tap 2 D6
	Port B6	TxIN 10	Tap2 D10	Tap 2 D10	Tap 2 D6	Tap 2 D8	Tap 2 D2
	Port B7	TxIN 11	Tap2 D11	Tap 2 D11	Tap 2 D7	Tap 2 D9	Tap 2 D3
	Port C0	TxIN 15	Tap2 D0	Tap 2 D0	Tap 3 D0	Tap 3 D2	Tap 2 D7
	Port C1	TxIN 18	Tap2 D1	Tap 2 D1	Tap 3 D1	Tap 3 D3	Tap 3 D2
	Port C2	TxIN 19	Tap2 D2	Tap 2 D2	Tap 3 D2	Tap 3 D4	Tap 3 D3
	Port C3	TxIN 20	Tap2 D3	Tap 2 D3	Tap 3 D3	Tap 3 D5	Tap 3 D4
	Port C4	TxIN 21	Tap2 D4	Tap 2 D4	Tap 3 D4	Tap 3 D6	Tap 3 D5
	Port C5	TxIN 22	Tap2 D5	Tap 2 D5	Tap 3 D5	Tap 3 D7	Tap 3 D6
	Port C6	TxIN 16	Tap2 D6	Tap 2 D6	Tap 3 D6	Tap 3 D8	Tap 3 D0
	Port C7	TxIN 17	Tap2 D7	Tap 2 D7	Tap 3 D7	Tap 3 D9	Tap 3 D1
	-	TxIN 24	LVAL	LVAL	LVAL	LVAL	LVAL
	-	TxIN 25	FVAL	FVAL	FVAL	FVAL	FVAL
	(Port I0)	TxIN 26	DVAL	DVAL	DVAL	Tap 1 D0	Tap 4 D0
	(Port I1)	TxIN 23	Exposure Active	Exposure Active	Exposure Active	Tap 1 D1	Tap 3 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
	GenICam Tap Geometry		1X2 - 1Y	1X4 - 1Y	1x8 - 1Y	1X8 - 1Y	1X10 - 1Y
Digital I/O-2 (1/2)	Port D0	TxIN 0	–	Tap 4 D0	Tap 4 D0	Tap 4 D2	Tap 4 D2
	Port D1	TxIN 1	–	Tap 4 D1	Tap 4 D1	Tap 4 D3	Tap 4 D3
	Port D2	TxIN 2	–	Tap 4 D2	Tap 4 D2	Tap 4 D4	Tap 4 D4
	Port D3	TxIN 3	–	Tap 4 D3	Tap 4 D3	Tap 4 D5	Tap 4 D5
	Port D4	TxIN 4	–	Tap 4 D4	Tap 4 D4	Tap 4 D6	Tap 4 D6
	Port D5	TxIN 6	–	Tap 4 D5	Tap 4 D5	Tap 4 D7	Tap 5 D0
	Port D6	TxIN 27	–	Tap 4 D6	Tap 4 D6	Tap 4 D8	LVAL
	Port D7	TxIN 5	–	Tap 4 D7	Tap 4 D7	Tap 4 D9	Tap 4 D7
	Port E0	TxIN 7	–	Tap 3 D0	Tap 5 D0	Tap 5 D2	Tap 5 D1
	Port E1	TxIN 8	–	Tap 3 D1	Tap 5 D1	Tap 5 D3	Tap 5 D2
	Port E2	TxIN 9	–	Tap 3 D2	Tap 5 D2	Tap 5 D4	Tap 5 D3
	Port E3	TxIN 12	–	Tap 3 D3	Tap 5 D3	Tap 5 D5	Tap 5 D6
	Port E4	TxIN 13	–	Tap 3 D4	Tap 5 D4	Tap 5 D6	Tap 5 D7
	Port E5	TxIN 14	–	Tap 3 D5	Tap 5 D5	Tap 5 D7	Tap6 D0
	Port E6	TxIN 10	–	Tap 3 D6	Tap 5 D6	Tap 5 D8	Tap 5 D4
	Port E7	TxIN 11	–	Tap 3 D7	Tap 5 D7	Tap 5 D9	Tap 5 D5
	Port F0	TxIN 15	–	Tap 3 D8	Tap6 D0	Tap 6 D2	Tap6 D1
	Port F1	TxIN 18	–	Tap 3 D9	Tap6 D1	Tap 6 D3	Tap6 D4
	Port F2	TxIN 19	–	Tap 3 D10	Tap6 D2	Tap 6 D4	Tap6 D5
	Port F3	TxIN 20	–	Tap 3 D11	Tap6 D3	Tap 6 D5	Tap6 D6
	Port F4	TxIN 21	–	Tap 4 D8	Tap6 D4	Tap 6 D6	Tap6 D7
	Port F5	TxIN 22	–	Tap 4 D9	Tap6 D5	Tap 6 D7	Tap7 D0
	Port F6	TxIN 16	–	Tap 4 D10	Tap6 D6	Tap 6 D8	Tap6 D2
	Port F7	TxIN 17	–	Tap 4 D11	Tap6 D7	Tap 6 D9	Tap6 D3
	-	TxIN 24	–	LVAL	LVAL	LVAL	Tap7 D2
	(Port I2)	TxIN 25	–	FVAL	FVAL	Tap 2 D0	Tap7 D3
	(Port I3)	TxIN 26	–	DVAL	DVAL	Tap 2 D1	Tap7 D4
	(Port I4)	TxIN 23	–	Exposure Active	Exposure Active	Tap 3 D0	Tap7 D1

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
	GenICam Tap Geometry		1X2 - 1Y	1X4 - 1Y	1x8 - 1Y	1X8 - 1Y	1X10 - 1Y
Digital I/O-2 (2/2)	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

1. In this table, not all tap geometry items are described. For instance, 1X4-1Y shows only 12-bit. In case of 8-bit, upper 4 bits (D8, D9, D10 and D11) and in case of 10-bit, upper 2 bits(D10 an D11) are not used.
2. Please check whether the frame grabber complies with those formats if you use 80-bit (8-tap/10-bit) camera configuration.
3. 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				137 fps
82.3 MHz	5 m	30 fps	61 fps	120 fps	137 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 12P #9 pin
Line 4 TTL 1 In	TTL 1 input from 12P #10 pin
CC1	Trigger input through camera link
Line 8 TTL 2 OUT	TTL 2 output from AUX Hirose 10P #1 pin
Line 9 TTL 3 OUT	TTL 3 output from AUX Hirose 10P #2 pin
Line 10 TTL 2 In	TTL 2 input from AUX Hirose 10P #3 pin
Line 11 LVDS In	LVDS input from AUX Hirose 10P #6,7 pins
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

Note: Line 8,9,10 and 11 are available if the factory option AUX Type 3 is configured.

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, **Default setting**
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 Associated GenICam register inofmration

GenICam Name	Access	Values	Category
LineSelector	R/W	Line1 - TTL Out 1 Line4 – TTL In 1 CC1 Line8 – TTL Out 2(Option) Line9 - TTL Out 3(Option) Line10 - TTL In 2(Option) Line11- LVDS In(Option) Nand Gate 0 In1 Nand Gate 0 In2 Nand Gate 1 In1 Nand Gate 1 In2	Digital IO Control
LineMode	R/W	Input Output	
LineInverter	R/W	False/True	
LineStatus	R/O	False/True	
LineSource	R/W	Low High FrameTriggerWait FrameActive ExposureActive Fval Lval PulseGenerator0 PulseGenerator1 PulseGenerator2 PulseGenerator3 TTL_In CL_CC1_In Nand0 Nand1	
LineFormat	R/W	No Connect InternalSignal TTL LVDS OptoCoupled	

5.3.8 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.

5.3.8.1 Basic block diagram

The basic block diagram is as follows.
In the SP-5000-PMCL, the pixel clock is 48 MHz.

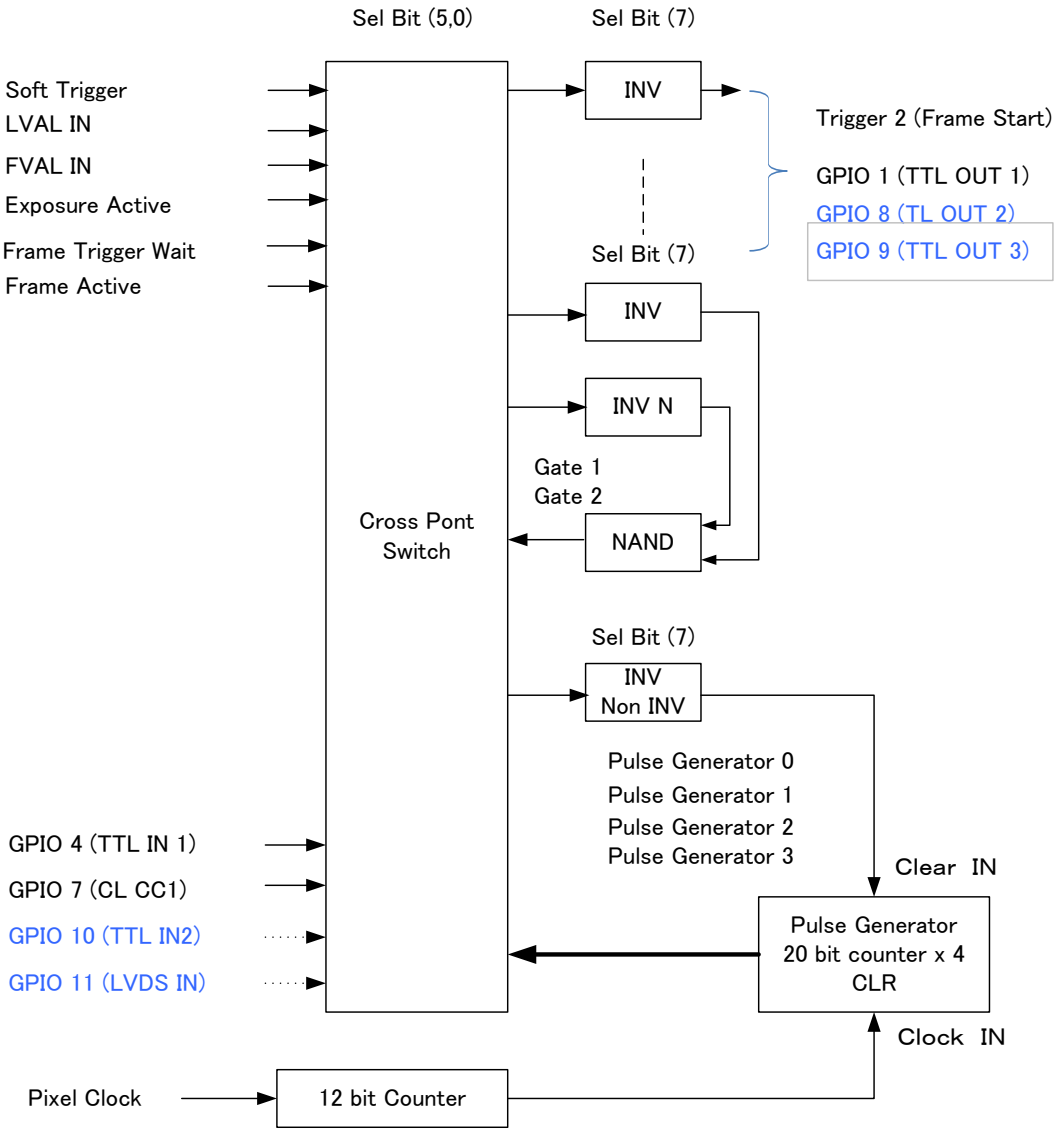


Fig.6 GPIO interface

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

5.3.8.2 Input and output matrix table

The relation between input and output is as follows.

Table-9 GPIO matrix table

Selector (Cross point switch output) / Source signal (Cross point switch input)	Trigger Selector	Line Selector							Pulse Generator Selector			
	Trigger Source (Frame Start)	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
Low	O	O	O	O	O	O	O	O	O	O	O	O
High	O	O	O	O	O	O	O	O	O	O	O	O
Soft Trigger	O	×	×	×	×	×	×	×	×	×	×	×
Exposure Active	×	O	O	O	O	O	O	O	O	O	O	O
Frame Trigger Wait	×	O	O	O	O	O	O	O	O	O	O	O
Frame Active	×	O	O	O	O	O	O	O	O	O	O	O
FVAL	×	O	O	O	O	O	O	O	O	O	O	O
LVAL	×	×	×	×	×	×	×	×	O	O	O	O
Pulse Generator 0	O	O	O	O	O	O	O	O	×	O	O	O
Pulse Generator 1	O	O	O	O	O	O	O	O	O	×	O	O
Pulse Generator 2	O	O	O	O	O	O	O	O	O	O	×	O
Pulse Generator 3	O	O	O	O	O	O	O	O	O	O	O	×
Line 4 - TTL In1	O	O	O	O	O	O	O	O	O	O	O	O
Line 7 - CL CC1 in	O	O	O	O	O	O	O	O	O	O	O	O
NAND 0 Out	O	O	O	O	×	×	O	O	O	O	O	O
NAND 1 Out 1	O	O	O	O	O	O	×	×	O	O	O	O
Line 10 - TTL 2 In	O	O	O	O	O	O	O	O	O	O	O	O
Line 11 - LVDS 1 In	O	O	O	O	O	O	O	O	O	O	O	O
	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							
Pulse Generator Selector	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.

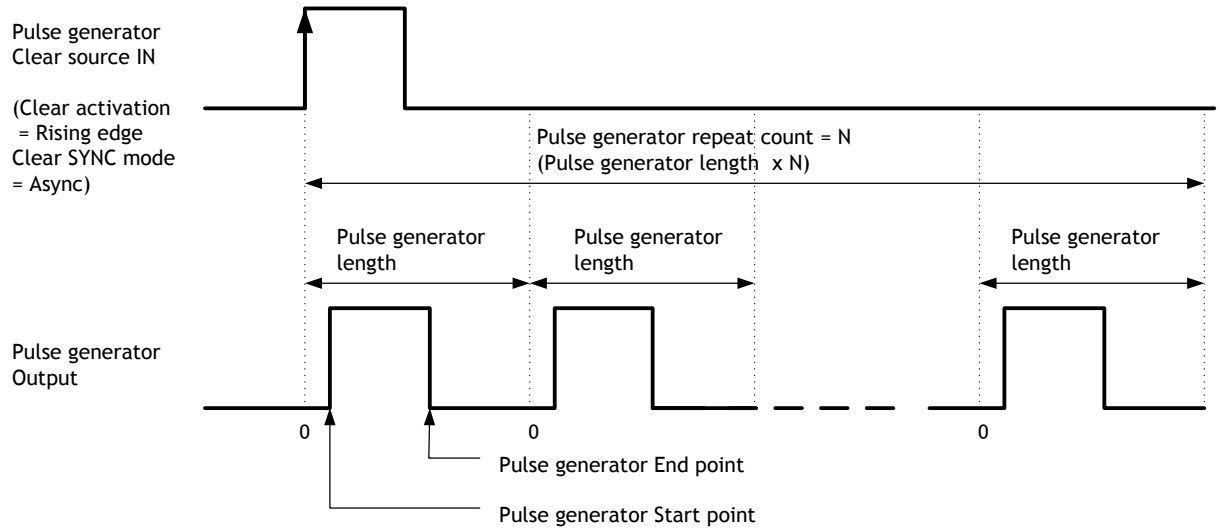


Fig.7 Pulse Generator pulse construction

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.

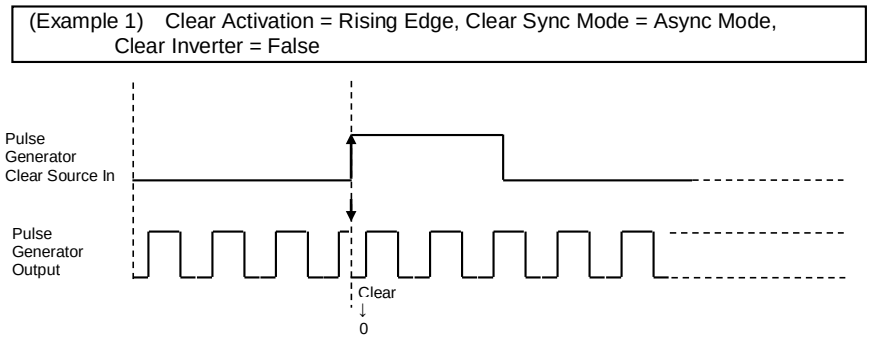


Fig.8 Counter clear in Async mode

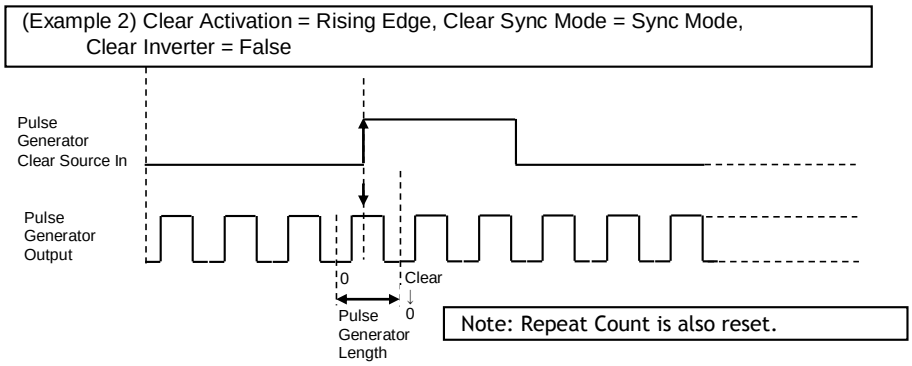


Fig.9 Counter clear in Sync mode

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. **Default setting**
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	- Pulse Generator 0
	- Pulse Generator 1
	- Pulse Generator 2
	- Pulse Generator 3
- Pulse Generator Length	1 to 1048575
- Pulse Generator Length (ms)	([Clock Source]÷[Clock Pre-scaler])$^{-1}$ x [Pulse Generator Length]
- Pulse Generator Frequency (Hz)	[Pulse Generator Length (ms)]$^{-1}$
- Pulse Generator Start Point	0 to 1048574
- Pulse Generator Start Point (ms)	([Clock Source]÷[Clock Pre-scaler])$^{-1}$ x [Pulse Generator Start Point]
- Pulse Generator End Point	1 to 1048575
- Pulse Generator End Point (ms)	([Clock Source]÷[Clock Pre-scaler])$^{-1}$ x [Pulse Generator End Point]
- Pulse Generator pulse-width (ms)	[Pulse Generator End Point (ms)]－[Pulse Generator Start Point (ms)]
- Pulse Generator Repeat Count	0 to 255
- Pulse Generator Clear Activation Clear Mode for the Pulse Generators	- Off
	- High Level
	- Low level
	- Rising Edge
	- Falling Edge
- Pulse Generator Clear Sync Mode	- Async mode
	- Sync mode
- Pulse Generator Clear Source	- Low
	- High
	- Frame Trigger Wait
	- Frame Active
	- Exposure Active
	- Fval
	- Lval
	- PulseGenerator0
	- PulseGenerator1
	- PulseGenerator2
	- PulseGenerator3
	- TTL_In1
	- CL_CC1_In
	- Nand0 Out
	- Nand1 Out
	- Line 10 - TTL 2 In
	- Line 11 - LVDS 1 In
- Pulse Generator Inverter(Polarity) Pulse Generator Clear Inverter	- False
	- True

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

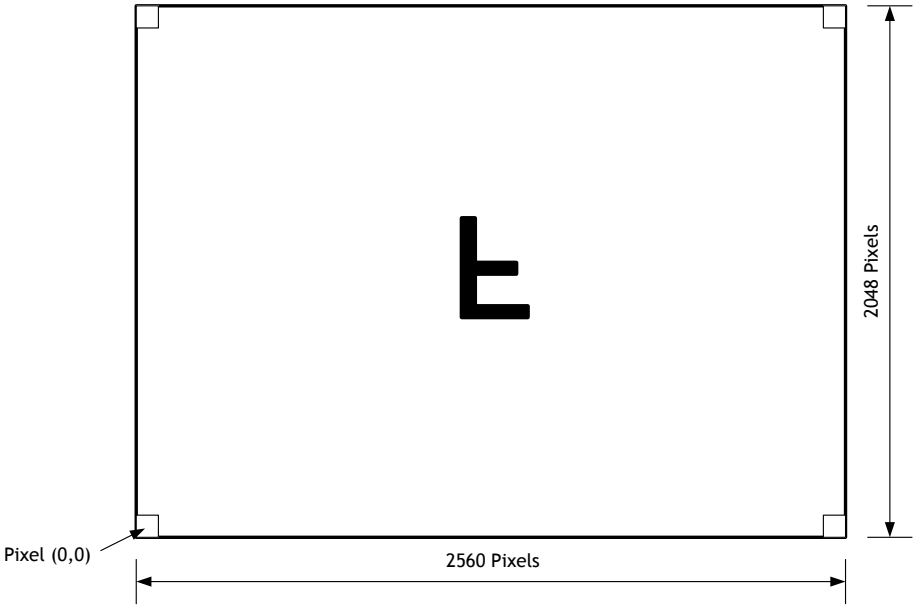


Fig. 10 Monochrome sensor layout

6.1.2 Bayer sensor

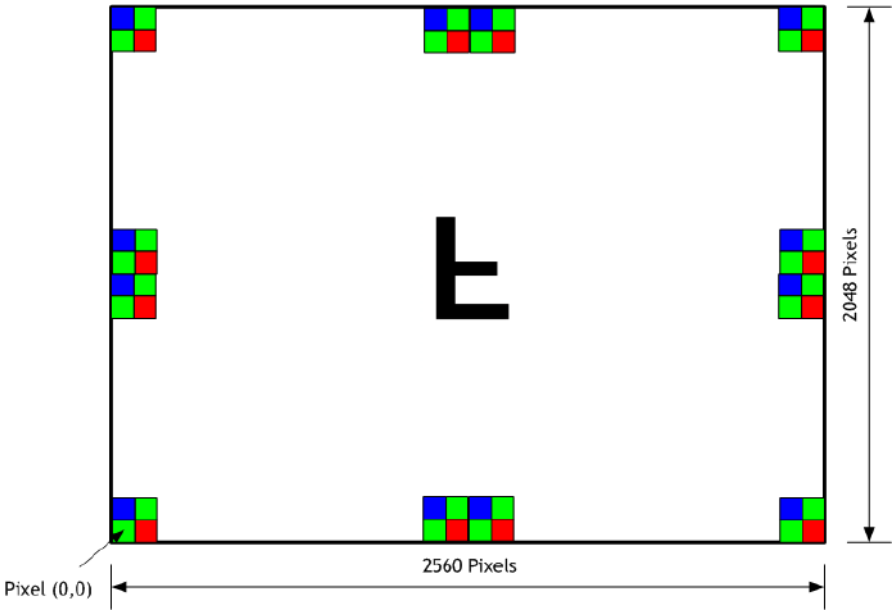


Fig. 11 Color sensor layout

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	6.2.2
1X4-1Y	8-bit, 10-bit, 12-bit	6.2.3
1X8-1Y	8-bit, 10-bit	6.2.4
1X10-1Y	8-bit	6.2.5

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

6.2.1 Associated GenICam register information

GenICam Name	Access	Values	Category
Pixel Format	R/W	Mono model: Mono8 Mono10 Mono12 Bayer model: BayerGR8 BayerGR10 BayerGR12	Image Format Control
Device Tap Geometry	R/W	Geometry_1X2_1Y Geometry_1X4_1Y Geometry_1X8_1Y Geometry_1X10_1Y	Transport Layer Control

6.2.2 1X2-1Y

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

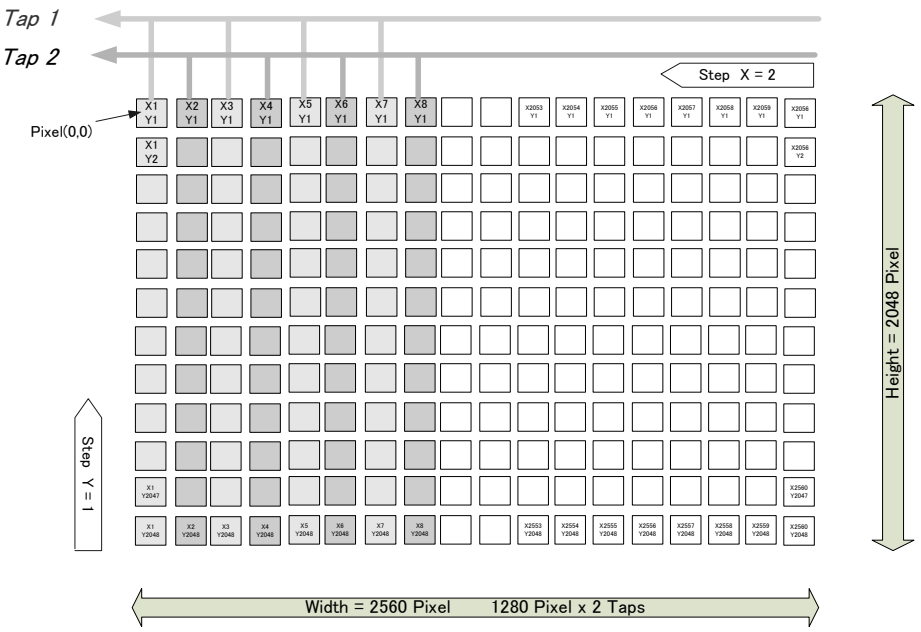


Fig.12 1X2-1Y output format

6.2.3 1X4-1Y

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

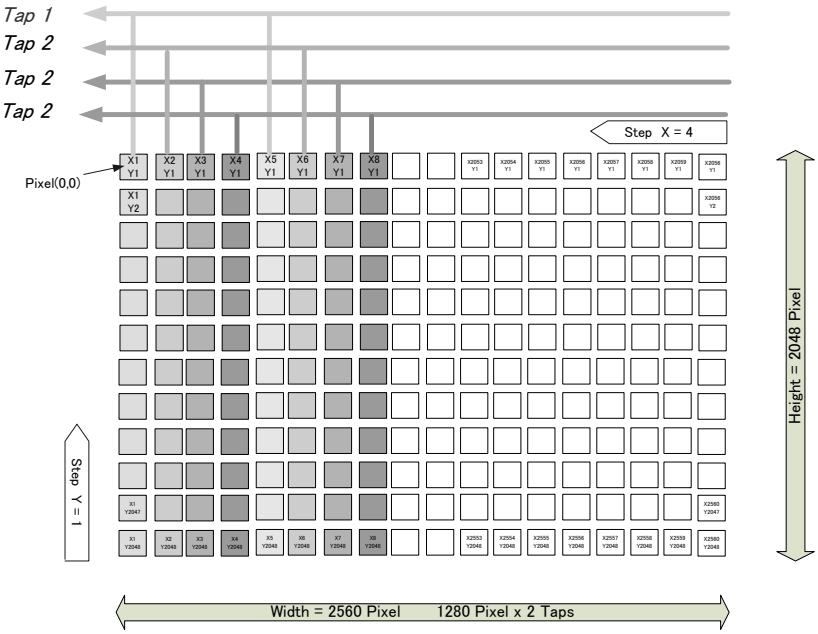


Fig. 13 1X4-1Y output format

6.2.4 1X8-1Y

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

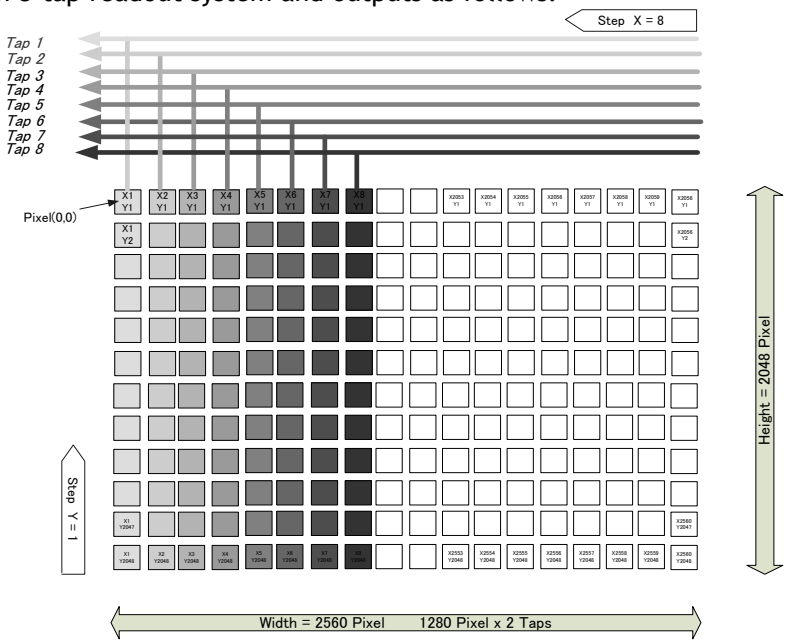


Fig. 14. 1X8-1Y output format

6.2.5 1X10-1Y

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

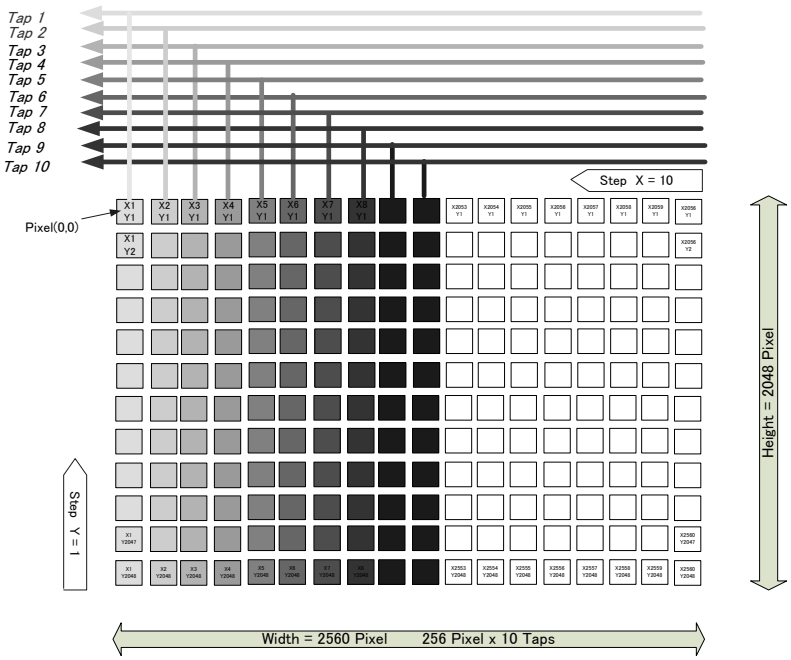


Fig.15 1X10-1Y Output format

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.

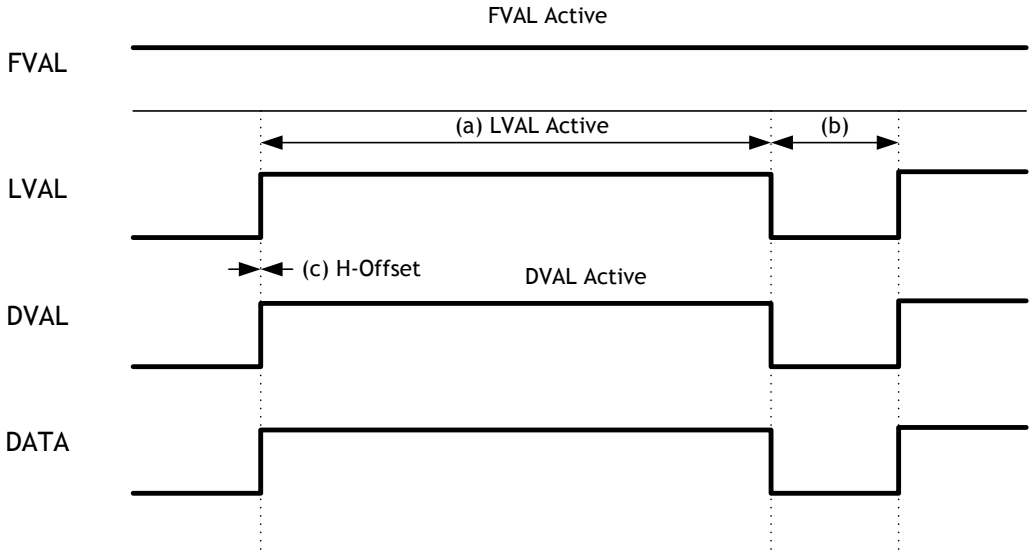


Fig. 16 Horizontal timing per 1 tap in Camera Link output

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

Camera Settings								(a) LVAL Active	(b) LVAL Non-Active	(c) H-Offset
Tap Geometry	Camera Link Pixel	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	258	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)

Camera Settings								Actual vs. Calc. (see note)	1Line Total Clock	Horizontal Frequency	Horizontal Period
Tap Geometry	Camera Link Pixel Clock	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
		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
	75.4 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
		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
	61.7 MHz	2560	0	2048	0	1	1	a	260 to 262	237.362 to 235.550	4.213 to 4.245
								b	261.00	236.452	4.229
		1280	0	2048	0	2	1	a	260 to 262	237.362 to 235.550	4.213 to 4.245
								b	261.00	236.452	4.229
		2560	0	1024	0	1	2	a	260 to 262	237.362 to 235.550	4.213 to 4.245
								b	261.00	236.452	4.229
		1280	0	1024	0	2	2	a	260 to 262	237.362 to 235.550	4.213 to 4.245
								b	261.00	236.452	4.229

Note: a: Actual operating value b: Calculation value

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

Camera Settings								(a) LVAL Active	(b) LVAL Non-Active	(c) H-Offset
Tap Geometry	Camera Link Pixel Clock	AOI				Binning 1:OFF 2:ON				
		Width	Offset X	Height	Offset Y	Horizontal	Vertical	[Unit: Clock]	[Unit: Clock]	[Unit: Clock]
1X8-1Y	82.3 MHz	2560	0	2048	0	1	1	320	4 to 7	0
		1280	0	2048	0	2	1	160	164 to 167	0
		2560	0	1024	0	1	2	320	4 to7	0
		1280	0	1024	0	2	2	160	164 to167	0
	75.4 MHz	2560	0	2048	0	1	1	320	4 to 7	0
		1280	0	2048	0	2	1	160	164 to 167	0
		2560	0	1024	0	1	2	320	4 to 7	0
		1280	0	1024	0	2	2	160	164 to 167	0
	61.7 MHz	2560	0	2048	0	1	1	320	3 to 5	0
		1280	0	2048	0	2	1	164	164	0
		2560	0	1024	0	1	2	320	3 to 5	0
		1280	0	1024	0	2	2	160	164	0

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

Camera Settings								Actual vs. Calc. (see note)	1Line Total Clock [Unit: Clock]	Horizontal Frequency [Unit: kHz]	Horizontal Period [Unit: us]
Tap Geometry	Camera Link Pixel Clock	AOI				Binning 1: OFF 2: ON					
		Width	Offset X	Height	Offset Y	Horizontal	Vertical				
1X8 -1Y	82.3 MHz	2560	0	a	0	1	1	a	324 to 327	253.969 to	3.937 to 3.974
				b				b	325.71	252.639	3.958
		1280	0	a	0	2	1	a	324 to 327	253.969 to	3.937 to 3.974
				b				b	325.71	252.639	3.958
		2560	0	a	0	1	2	a	324 to 327	253.969 to	3.937 to 3.974
				b				b	325.71	252.639	3.958
		1280	0	a	0	2	2	a	324 to 327	253.969 to	3.937 to 3.974
				b				b	325.71	252.639	3.958
	75.4 MHz	2560	0	a	0	1	1	a	324 to 327	232.806 to 230.670	4.295 to 4.335
				b				b	325.29	231.882	4.313
		1280	0	a	0	2	1	a	324 to 327	232.806 to 230.670	4.295 to 4.335
				b				b	325.29	231.882	4.313
		2560	0	a	0	1	2	a	324 to 327	232.806 to 230.670	4.295 to 4.335
				b				b	325.29	231.882	4.313
		1280	0	a	0	2	2	a	324 to 327	232.806 to 230.670	4.295 to 4.335
				b				b	325.29	231.882	4.313
	61.7 MHz	2560	0	a	0	1	1	a	323 to 325	191.065 to 189.889	5.234 to 5.266
				b				b	324.00	190.475	5.250
		1280	0	a	0	2	1	a	328	188.152	5.315
				b				b	324.00	190.475	5.250
		2560	0	a	0	1	2	a	323 to 325	191.065 to 189.889	5.234 to 5.266
				b				b	324.00	190.475	5.250
		1280	0	a	0	2	2	a	328	188.152	5.315
				b				b	324.00	190.475	5.250

Note: a: Actual operating value b: Calculation value

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

Camera Settings								(a) LVAL Active	(b) LVAL Non-Active	(c) H-Offset
Tap Geometry	Camera Link Pixel Clock	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	1	640	3 to 6	0
		1280	0	2048	0	2	1	320	323 to 326	0
		2560	0	1024	0	1	2	640	3 to 6	0
		1280	0	1024	0	2	2	320	323 to 326	0
	75.4 MHz	2560	0	2048	0	1	1	640	3 to 6	0
		1280	0	2048	0	2	1	320	323 to 326	0
		2560	0	1024	0	1	2	640	3 to 6	0
		1280	0	1024	0	2	2	320	323 to 326	0
	61.7 MHz	2560	0	2048	0	1	1	640	4 to 7	0
		1280	0	2048	0	2	1	320	324 to 327	0
		2560	0	1024	0	1	2	640	4 to 7	0
		1280	0	1024	0	2	2	320	324 to 327	0

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

Camera Settings								Actual vs. Calc (see note)	1Line Total Clock [Unit: Clock]	Horizontal Frequency [Unit: kHz]	Horizontal Period [Unit: us]
Tap Geometry	Camera Link Pixel Clock	AOI				Binning 1: OFF 2: ON					
		Width	Offset X	Height	Offset Y	Horizontal	Vertical				
1X4 -1Y	82.3 MHz	2560	0	2048	0	1	1	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	1	a	643 to 646	127.972 to 127.378	7.814 to 7.851
								b	644.57	127.632	7.835
		2560	0	1024	0	1	2	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	2	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	2048	0	1	1	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	1	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	2	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	2	a	643 to 646	117.308 to 116.861	8.525 to 8.557
								b	644.29	117.073	8.542
	61.7 MHz	2560	0	2048	0	1	1	a	644 to 647	95.829 to 95.385	10.435 to 10.484
								b	645.43	95.617	10.458
		1280	0	2048	0	2	1	a	644 to 647	95.829 to 95.385	10.435 to 10.484
								b	645.43	95.617	10.458
		2560	0	1024	0	1	2	a	644 to 647	95.829 to 95.385	10.435 to 10.484
								b	645.43	95.617	10.458
		1280	0	1024	0	2	2	a	644 to 647	95.829 to 95.385	10.435 to 10.484
								b	645.43	95.617	10.458

Note: a: Actual operating value b: Calculation value

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

Camera Settings								(a) LVAL Active	(b) LVAL Non-Active	(c) H-Offset
Tap Geometry	Camera Link Pixel Clock	AOI				Binning 1: OFF 2: ON				
		Width	Offset X	Height	Offset Y	Horizontal	Vertical	[Unit: Clock]	[Unit: Clock]	[Unit: Clock]
1X2 -1Y	82.3 MHz	2560	0	2048	0	1	1	1280	4 to 7	0
		1280	0	2048	0	2	1	640	644 to 647	0
		2560	0	1024	0	1	2	1280	4 to 7	0
		1280	0	1024	0	2	2	640	644 to 647	0
	75.4 MHz	2560	0	2048	0	1	1	1280	4 to 7	0
		1280	0	2048	0	2	1	640	644 to 647	0
		2560	0	1024	0	1	2	1280	4 to 7	0
		1280	0	1024	0	2	2	640	644 to 647	0
	61.7 MHz	2560	0	2048	0	1	1	1280	3 to 6	0
		1280	0	2048	0	2	1	640	643 to 646	0
		2560	0	1024	0	1	2	1280	3 to 6	0
		1280	0	1024	0	2	2	640	643 to 646	0

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

Camera Settings											
Tap Geometry	Camera Link Pixel Clock	AOI				Binning 1: OFF 2: ON		Actual vs. Calc. (see note)	1Line Total Clock [Unit: Clock]	Horizontal Frequency [Unit: kHz]	Horizontal Period [Unit: us]
		Width	Offset X	Height	Offset Y	Horizontal	Vertical				
1X2-1Y	82.3 MHz	2560	0	2048	0	1	1	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	1	a	1284 to 1287	64.086 to 63.936	15.604 to 15.641
								b	1285.72	64.000	15.625
		2560	0	1024	0	1	2	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	2	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	2048	0	1	1	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	1	a	1284 to 1287	58.745 to 58.608	17.023 to 17.062
								b	1285.44	58.680	17.042
		2560	0	1024	0	1	2	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	2	a	1284 to 1287	58.745 to 58.608	17.023 to 17.062
								b	1285.44	58.680	17.042
	61.7 MHz	2560	0	2048	0	1	1	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	1	a	1283 to 1286	48.101 to 47.989	20.789 to 20.838
								b	1284.42	48.048	20.812
		2560	0	1024	0	1	2	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	2	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.

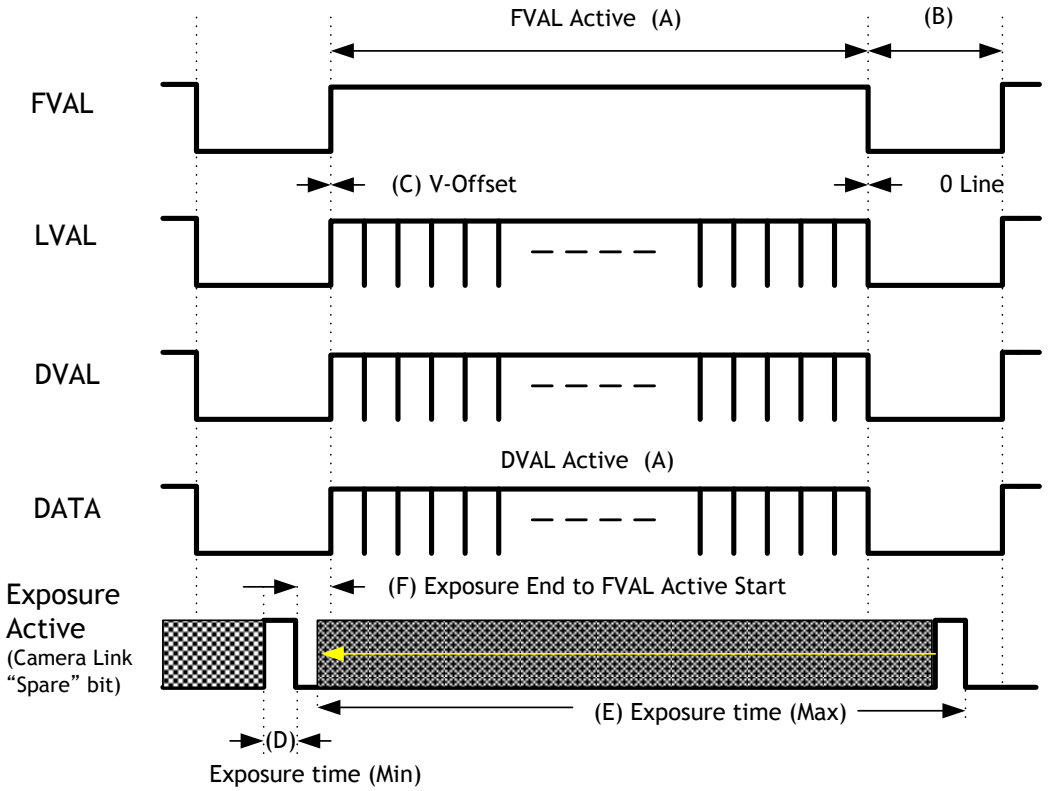


Fig. 17 Vertical timing

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

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

Camera Settings									(A)	(B)	(C)	(D)
Tap Geometry	Camera Link Pixel Clock	Frame Period (Typ.)	ROI				Binning 1: OFF 2: ON		FVAL & DVAL Active	FVAL Non -Active	V -Offset	Exposure Time (Min)
			Width	Offset X	Height	Offset Y	Horizontal	Vertical	[Unit: Line]	[Unit: Line]	[Unit: Line]	[Unit: us]
1X10 -1Y	82.3 MHz	7463	2560	0	2048	0	1	1	2048	110.1 or 111.1	0	10
			1280	0	2048	0	2	1	1028	110.5 or 111.5		
		3732	2560	0	1024	0	1	2	2048	56.1 or 57.1		
			1280	0	1024	0	2	2	1028	56.5 or 57.5		
	75.4 MHz	8141	2560	0	2048	0	1	1	2048	306.0 or 307.0	0	10
			1280	0	2048	0	2	1	1028	306.5 or 307.5		
		4071	2560	0	1024	0	1	2	2048	154.0 or 155.0		
			1280	0	1024	0	2	2	1028	154.5 or 155.5		
	61.7 MHz	9951	2560	0	2048	0	1	1	2048	305.0 or 306.0	0	10
			1280	0	2048	0	2	1	1028	305.5 or 306.5		
		4976	2560	0	1024	0	1	2	2048	153.0 or 154.0		
			1280	0	1024	0	2	2	1028	153.5 or 154.5		
1X8 -1Y	82.3 MHz	8333	2560	0	2048	0	1	1	2048	57.0 or 58.0	0	10
			1280	0	2048	0	2	1	1028	57.5 or 58.5		
		4167	2560	0	1024	0	1	2	2048	29.0 or 30.0		
			1280	0	1024	0	2	2	1028	29.5 or 30.5		
	75.4 MHz	9091	2560	0	2048	0	1	1	2048	60.0 or 61.0	0	10
			1280	0	2048	0	2	1	1028	60.5 or 61.5		
		4546	2560	0	1024	0	1	2	2048	30.0 or 31.0		
			1280	0	1024	0	2	2	1028	30.5 or 31.5		
	61.7 MHz	11111	2560	0	2048	0	1	1	2048	68.0 or 69.0	0	10
			1280	0	2048	0	2	1	1028	68.5 or 69.5		
		5556	2560	0	1024	0	1	2	2048	34.0 or 35.0		
			1280	0	1024	0	2	2	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.

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

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

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

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

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

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

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

Camera Settings									Frame Rate	(E) Exposure Time (Max.)	(F) Exposure Active End to FVAL Active Start			
Tap Geometry	Camera Link	Frame Period (Typ.)	ROI				Binning 1: OFF 2: ON				[Unit: Line]		[Unit: us]	
			Width	Offset X	Height	Offset Y	Horizontal	Vertical	[Unit: Hz]	[Unit: us]	Max	Min	Max	Min
1X4-1Y	82.3 MHz	16393	2560	0	2048	0	1	1	60.97	16393 - 100 =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	1			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	2	121.95	8197 - 100 =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	2			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	1	55.90	17883 - 100 =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	1			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	2	111.78	8942 - 100 =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	2			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	1	45.73	21858 - 100 =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	1			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	2	91.45	10929 - 100 =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	2			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. Exposure Time=10

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

Camera Settings									Frame Rate [Unit: Hz]	(E) Exposure Time (Max.) [Unit: us]	(F) Exposure Active End to FVAL Active Start			
			ROI				Binning 1: OFF 2: ON				[Unit: Line]		[Unit: us]	
Tap Geometry	Camera Link	Frame Period (Typ.)	Width	Offset X	Height	Offset Y	Horizontal	Vertical			Max	Min	Max	Min
1X2-1Y	82.3 MHz	33333	2560	0	2048	0	1	1	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	1			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	2	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	2			14.3 to 15.3	3.4 to 4.4	223.4 to 238.9	52.7 to 68.1
	75.4 MHz	36363	2560	0	2048	0	1	1	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	1			14.6 to 15.6	3.3 to 4.3	248.9 to 265.9	55.5 to 72.4
		18182	2560	0	1024	0	1	2	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	2			14.6 to 15.6	3.3 to 4.2	249.0 to 265.9	55.5 to 72.4
	61.7 MHz	44444	2560	0	2048	0	1	1	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	1			15.2 to 16.2	3.0 to 4.0	316.9 to 337.5	63.1 to 83.7
		22222	2560	0	1024	0	1	2	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	2			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

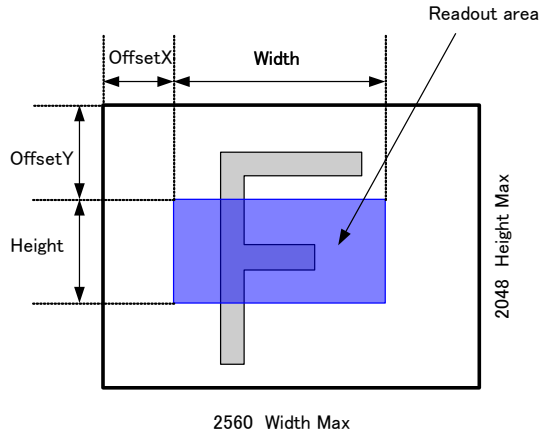


Fig. 18 Setting example (No binning)

Setting example (2)
Binning Horizontal = 2
Binning Vertical = 2

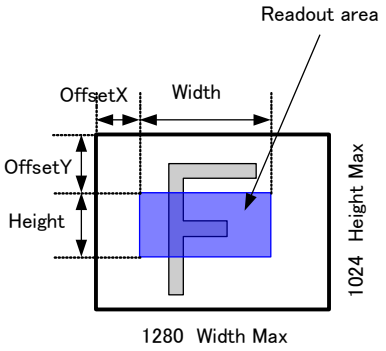


Fig.19 Setting example (Binning)

6.4 Digital output bit allocation

Table -30 Output level

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

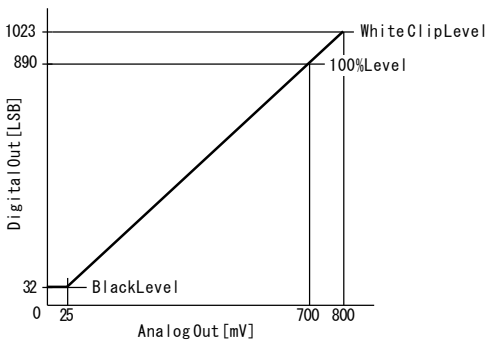


Fig. 20 Bit allocation (10-bit)

7. Operating modes

7.1. Acquisition control

7.1.1 Acquisition control

With Trigger OFF (free-running mode), it is possible to specify a free-running frame rate (i.e., no trigger needed) that is slower than the default rate.

Modification of the frame rate is done by entering a value in the AcquisitionFrameRate control corresponding to the number of frame frequency to be allocated to each frame period. Allowed values range from 5971Hz to 0.125Hz 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 5952Hz, so any entry higher than 5952Hz will always be ignored in this configuration.

The setting range in Acquisition Frame Rate is:

Shortest	to	Longest
Inverse number of time required to drive all pixels in the area set by ROI command or inverse number of time required to transmit one frame data	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 decreased up to 0.125Hz(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.

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)
		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)
		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)
		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)
		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)
		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)
		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)
		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)
		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)
		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)
		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)
		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)
		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])×284.56) + 4855 − 284.56 + ([Width]÷10)) ÷ 82.286MHz x 10^6) + [Exposure Time]
	75.4 MHz	=ROUND((([Height])×260.86) + 4855 − 260.86 + ([Width]÷10)) ÷ 75.429MHz x 10^6) + [Exposure Time]
	61.7 MHz	=ROUND((([Height])×261.00) + 4855 − 261.00 + ([Width]÷10)) ÷ 61.714MHz x 10^6) + [Exposure Time]
1X8-1Y	82.3 MHz	=ROUND((([Height])×325.71) + 5513 − 325.71 + ([Width]÷8)) ÷ 82.286MHz x 10^6) + [Exposure Time]
	75.4 MHz	=ROUND((([Height])×325.29) + 5513 − 325.29 + ([Width]÷8)) ÷ 75.429MHz x 10^6) + [Exposure Time]
	61.7 MHz	=ROUND((([Height])×324.00) + 5513 − 324.00 + ([Width]÷8)) ÷ 61.714MHz x 10^6) + [Exposure Time]
1X4-1Y	82.3 MHz	=ROUND((([Height])×644.57) + 10944− 644.57 + ([Width]÷4)) ÷ 82.286MHz x 10^6) + [Exposure Time]
	75.4 MHz	=ROUND((([Height])×644.29) + 10944 − 644.29 + ([Width]÷4)) ÷ 75.429MHz x 10^6) + [Exposure Time]
	61.7 MHz	=ROUND((([Height])×645.43) + 10944 − 645.43 + ([Width]÷4)) ÷ 61.714MHz x 10^6) + [Exposure Time]
1X2-Y	82.3 MHz	=ROUND((([Height])×1285.72) + 21888− 1285.72 + ([Width]÷2)) ÷ 82.286MHz x 10^6) + [Exposure Time]
	75.4 MHz	=ROUND((([Height])×1285.44) + 21888 − 1285.44 + ([Width]÷2)) ÷ 75.429MHz x 10^6) + [Exposure Time]
	61.7 MHz	=ROUND((([Height])×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			
					Min.		Max.	
Tap Geometry	Camera Link Pixel Clock	Binning Vertical	Height	HDR Mode	Setting value	Actual period	Setting value	Actual time /period
1X10 -1Y	82.3 MHz	1	2048	Off	7246 (138.007fps)	137.9 fps	8 000 000	8 sec / 0.125 Hz
		2	1024	Off	3623 (276.014fps)	275.7 fps		
	75.4 MHz	1	2048	Off	7262 (137.703fps)	137.6 fps		
		2	1024	Off	3631 (275.406fps)	275.1 fps		
	61.7 MHz	1	2048	Off	8880 (112.613fps)	112.5 fps		
		2	1024	Off	4440 (225.225fps)	225.2 fps		
	82.3 MHz	1	2048	On	7151 (139.841fps)	139.7 fps		
		2	1024	On	3610 (277.008fps)	276.7 fps		
	75.4 MHz	1	2048	On	7157 (139.723fps)	139.6 fps		
		2	1024	On	3616 (276.549fps)	276.3 fps		
	61.7 MHz	1	2048	On	8750 (114.286fps)	114.2 fps		
		2	1024	On	4419 (226.296fps)	226.1 fps		
1X8 -1Y	82.3 MHz	1	2048	Off	8271 (120.904fps)	120.8 fps		
		2	1024	Off	4135 (241.838fps)	241.8 fps		
	75.4 MHz	1	2048	Off	9011 (110.975fps)	110.9 fps		
		2	1024	Off	4505 (221.976fps)	221.9 fps		
	61.7 MHz	1	2048	Off	10971 (91.149fps)	91.1 fps		
		2	1024	Off	5485 (182.315fps)	182.3 fps		
	82.3 MHz	1	2048	On	8183 (122.205fps)	122.1 fps		
		2	1024	On	4130 (242.131fps)	241.9 fps		
	75.4 MHz	1	2048	On	8915 (101.885fps)	112.1 fps		
		2	1024	On	4499 (222.272fps)	222.1 fps		
	61.7 MHz	1	2048	On	10851 (92.157fps)	92.1 fps		
		2	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.

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

Camera Settings					ART Command: Limited Reference			
					Min.		Max.	
Tap Geometry	Camera Link Pixel Clock	Binning Vertical	Height	HDR Mode	Setting Value	Actual Period	Setting Value	Actual time /period
1X4 -1Y	82.3 MHz	1	2048	Off	16327 (61.248fps)	61.2 fps	8 000 000	8 sec / 0.125 Hz
		2	1024	Off	8163 (122.504fps)	122.5 fps		
	75.4 MHz	1	2048	Off	17803 (56.170fps)	56.1 fps		
		2	1024	Off	8905 (112.296fps)	112.2 fps		
	61.7 MHz	1	2048	Off	21797 (45.878fps)	45.8 fps		
		2	1024	Off	10889 (91.836fps)	91.7 fps		
	82.3 MHz	1	2048	On	16186 (61.782fps)	61.7 fps		
		2	1024	On	8164 (122.489fps)	122.4 fps		
	75.4 MHz	1	2048	On	17648 (56.664fps)	56.6		
		2	1024	On	8902 (112.334fps)	112.2 fps		
	61.7 MHz	1	2048	On	21606 (112.334fps)	46.2 fps		
		2	1024	On	10897 (91.768fps)	91.7 fps		
1X2 -1Y	82.3 MHz	1	2048	Off	32786 (30.501fps)	30.5 fps		
		2	1024	Off	16393 (61.002fps)	61.0 fps		
	75.4 MHz	1	2048	Off	35759 (27.965fps)	27.9 fps		
		2	1024	Off	17879 (55.932fps)	55.9 fps		
	61.7 MHz	1	2048	Off	43672 (22.898fps)	22.8 fps		
		2	1024	Off	21836 (45.796fps))	45.7 fps		
	82.3 MHz	1	2048	On	32276 (30.983fps)	30.9 fps		
		2	1024	On	16276 (61.440fps)	61.4 fps		
	75.4 MHz	1	2048	On	35202 (28.407fps)	28.4 fps		
		2	1024	On	17751 (56.335fps)	56.3 fps		
	61.7 MHz	1	2048	On	43022 (23.244fps)	23.2 fps		
		2	1024	On	21693 (46.098fps)	46.0 fps		

7.2. Exposure setting

This section describes how to set the exposure settings.

7.2.1 Exposure Mode

The exposure mode can be selected from the following three ways.

Table35. Exposure mode

Exposure Mode setting	Exposure operation
OFF	No exposure control (free-running operation)
Timed	Exposure operation at the value set in Exposure Time. Setting value is usec unit. ・If Trigger Mode setting is OFF, the camera is in free-running operation. ・If Trigger Mode setting is ON, the exposure operation depends on the setting of Trigger Option.
Trigger Width	The exposure is controlled by the pulse width of the external trigger. ・Trigger Mode is forced to ON.

For trigger operation, Exposure Mode must be set to something other than OFF and Trigger Mode of Frame Start must be ON.
If Exposure Mode is set at Timed, the exposure operation can be selected as follows by setting Trigger Option

Table36. Trigger option

Trigger Option setting	Exposure operation
OFF	Timed (EPS) mode
RCT	RCT mode, the video signal is output only if the trigger signal is inout
PIV	PIV (Particle Image Velocimetry) mode
RCT Continuous	RCT mode but, the video signal is also output like a free-running operation

The effect of the combination of Exposure Mode, Trigger Option and Trigger Mode is as follows.

Table37. The combination of Exposure Mode, Trigger Option and Trigger Mode

Exposure Mode	Trigger Option	Trigger Mode (Frame Start)	Operation
OFF	N/A	N/A	Self-running operation Exposure control by Exposure Time is not possible
Timed	OFF	OFF	Self-running operation Exposure control by Exposure Time is not possible
		ON	Timed (EPS) Operation Exposure can be controlled by Exposure Time
	RCT/ RCT continuous	Forced to ON	RCT Operation Exposure can be controlled by Exposure Time
	PIV	Forced to ON	PIV Operation Exposure can be controlled by Exposure Time
Trigger Width	N/A	Forced to ON	Exposure is controlled by the pulse width of the external trigger

Table 38. Associated GenICam register information

GenICam Name	Access	Values	Category
Exposure Mode	R/W	Off Timed TriggerWidth	Acquisition Control
Trigger Mode	R/W	Off On	Acquisition Control
Trigger Option	R/W	Off RCT PIV RCT Continuous	JAI-Custom

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 μsec per step.

Minimum: 10 μsec
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)

Table 39. Associated GenICam register information

GenICam Name	Access	Values	Category
Exposure Time	R/W	10.0～Max[us]	Acquisition Control
Exposure Time Raw	R/W	10～Max[us]	
Exposure Auto	R/W	Off Once Continuous	
Alc Speed	R/W	1～8	JAI-Custom
ASC Max	R/W	101～Max[us]	
ASC Min	R/W	100～Max[us]	
ALC Reference	R/W	1～100[%]	
ALC Area Selector	R/W	All Low Right Low Mid-Right Low Mid-Left Low Left Mid-Low Right Mid-Low Mid-Right Mid-Low Mid-Left Mid-Low Left Mid-High Right Mid-High Mid-Right Mid-High Mid-Left Mid-High Left High Right High Mid-Right High Mid-Left High Left	
ALC Area Enable	R/W	Off / On	

7.3. Trigger control

7.3.1 Trigger Selector

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

Table 40. 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:

Low
High
Line 4 (TTL IN1)
Line 7 (Camera Link CC1 IN)
Soft trigger
Pulse generator 0
Pulse generator 1
Pulse generator 2
Pulse generator 3
NAND 0
NAND 1

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.

Table41. 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.

7.3.6 Associated GenICam register information

Table 42. Associated GenICam register information

GenICam Name	Access	Values	Category
Trigger Source	R/W	Low High SoftTrigger PulseGenerator0 PulseGenerator1 PulseGenerator2 PulseGenerator3 TTL_In1 CL_CC1_In Nand0 Nand1	Acquisition Control
Trigger Activation	R/W	RisingEdge FallingEdge LevelHigh LevelLow	
TriggerOver Lap	R/W	Off / 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.

Table 43. Minimum interval (1X8-1Y, CL Clock 82.3MHz)

Trigger Mode	Readout Mode	Time (Min. trigger period)
Timed Exposure Mode Trigger Mode OFF (Note 1)	Full	8271us
	AOI Center 2/3	5563us
	AOI Center 1/2	4217us
	AOI Center 1/4	2191us
	AOI Center 1/8	1177us
	V Binning ON (Full) (Note2)	4135us

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

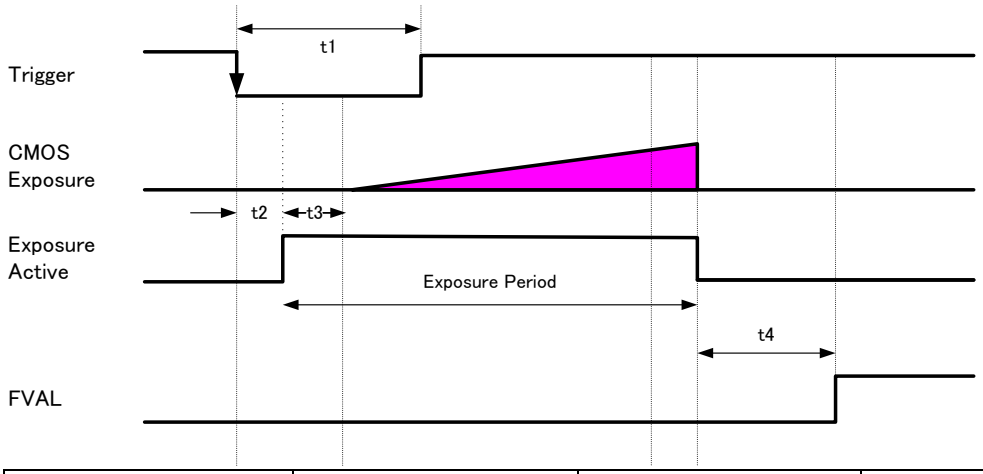
Table 44. Trigger minimum interval (Trigger Overlap = Readout) (1X8-1Y, CL Clock 82.3MHz)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
Timed Exposure Mode Trigger Mode ON	Full	8271µs + 8.01µs
	AOI Center 2/3	5563µs + 8.01µs
	AOI Center 1/2	4127µs + 8.01µs
	AOI Center 1/4	2191µs + 8.01µs
	AOI Center 1/8	1177µs + 8.01µs
	V Binning ON (Full) (Note 1)	4135µs + 8.01µs

Note1 : SP-5000M-PMCL only

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

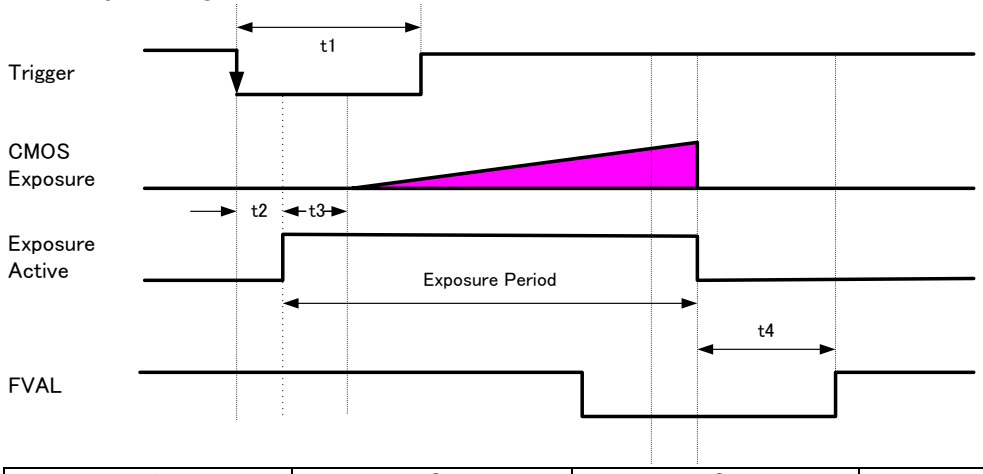
7.5.1 If Overlap setting is OFF



t1	t2	t3	t4
2L(Min.)	218 clocks	10.13 µs	8L to 9L

Fig. 21 Overlap OFF

7.5.2 If Overlap setting is Readout



t1	t2	t3	t4
2L (Min.)	1L	10.13 µs	8L to 9L

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.

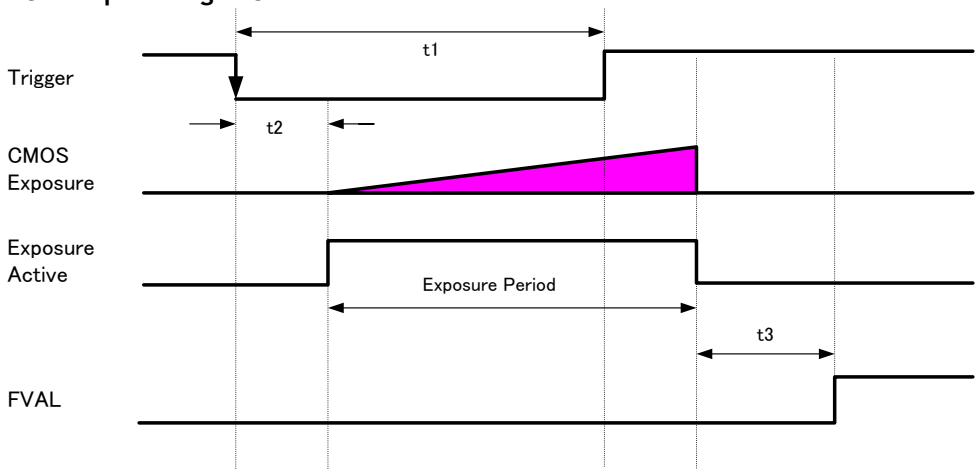
Primary settings to use this mode
Trigger Mode = ON
Exposure Mode = Trigger Width

Table 45. Minimum trigger interval (Trigger Overlap = Readout) (1X8-1Y, CL clock 82.3MHz)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
Trigger Width Exposure Mode	Full	8271µs + 8.01µs
	AOI Center 2/3	5563µs + 8.01µs
	AOI Center 1/2	4127µs + 8.01µs
	AOI Center 1/4	2191µs + 8.01µs
	AOI Center 1/8	1177µs + 8.01µs
	V Binning ON (Full) (Note1)	4135µs + 8.01µs

Note1 : SP-5000M-PMCL only
Note2 : If Trigger Overlap is OFF, the accumulation time is added to the above table.

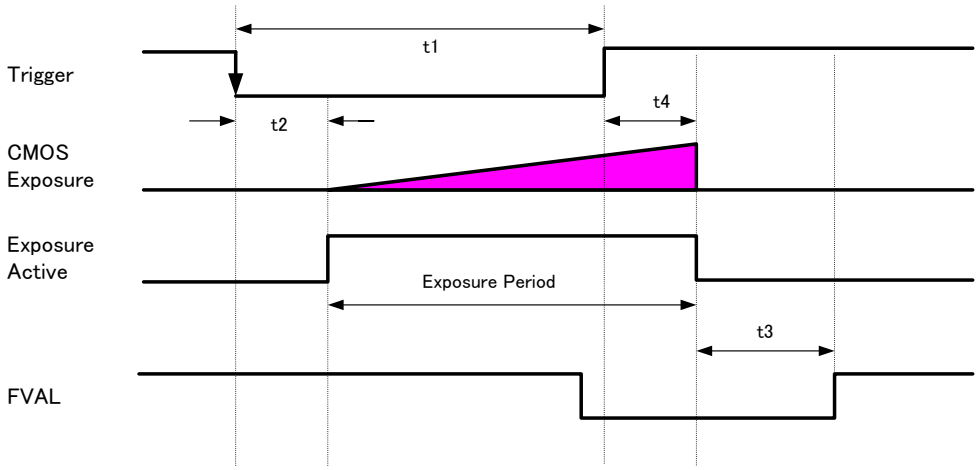
7.6.1 If Overlap setting is OFF



t1	t2	t3
10 + 45µs(Min.)	208 clocks	7L to 8L

Fig. 23 Overlap = OFF

7.6.2 If Overlap setting is Readout



t1	t2	t3	t4
10 + 45μs(Min.)	208 clocks	7L to 8L	1L

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.
RCT mode is effective if ALC control is used while the rigger operation is applied.
RCT continuous mode is also available and in this mode, the video signal is output like a continuous mode and if the trigger is input, it is reset.

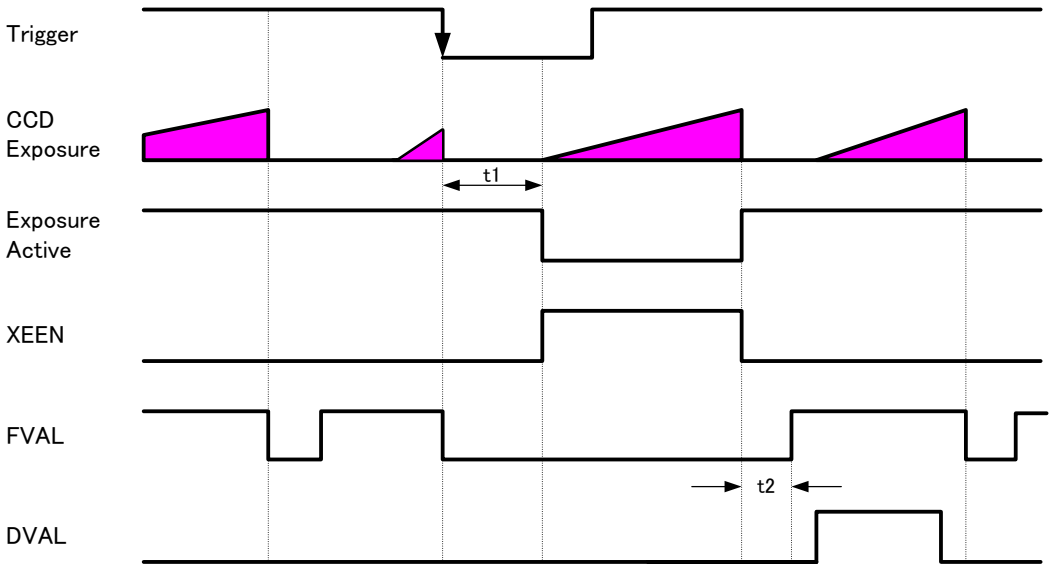
Primary settings to use this mode

Trigger Mode = ON
Exposure Mode = Timed
Trigger Option = RCT

Table 46. Minimum trigger interval (1X8-1Y, CL clock 82.3MHz)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
Reset Continuous Trigger Mode (Note2)	Full	8271μs + Exposure time + 1.562ms
	AOI Center 2/3	5563μs + Exposure time + 1.562ms
	AOI Center 1/2	4217μs + Exposure time + 1.562ms
	AOI Center 1/4	2191μs + Exposure time + 1.562ms
	AOI Center 1/8	1177μs + Exposure time + 1.562ms
	V Binning ON (Full) (Note1)	4135μs + Exposure time + 1.562ms

Note1 : SP-5000M-PMCL only
Note2 : Trigger Overlap “Readout” is not available for this trigger mode.



t1	t2
28L	9L ～10L

Fig.25 RCT mode timing

7.8 PIV (Particle Image Velocimetry)

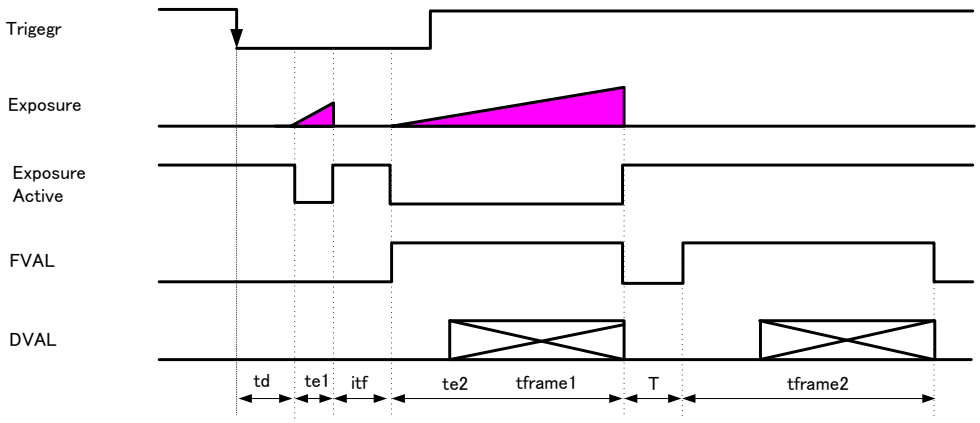
The Particle Image Velocimetry mode can be used in applications where 2 images need to be taken with a very short time interval. It can only be used with strobe flash as illumination. The first accumulation time is 10 μsec to 2 sec. Then, the second exposure will be taken. The first strobe is activated 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 47. Minimum trigger interval (1x8-1Y, CL clock 82.3MHZ)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
PIV mode (Note1)	Full	8271μs x 2 + Exposure time + 8.01μs
	AOI Center 2/3	5563μs x 2 + Exposure time + 8.01μs
	AOI Center 1/2	4217μs x 2 + Exposure time + 8.01μs
	AOI Center 1/4	2191μs x 2 + Exposure time + 8.01μs
	AOI Center 1/8	1177μs x 2 + Exposure time + 8.01μs
	V Binning ON (Full) (Note2)	4135μs x 2 + Exposure time + 8.01μs

Note 1. Overlap mode=Readout is not available
Note 2. SP-5000M-PMCL only



Time name	Description	Time
td	Exposure beginning delay	10.486μs
te1	First exposure time period	10μs to 2s
te2	Second exposure time	2515L
itf	Interframing time	3L
T	FVAL no active	10 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 48. Minimum trigger interval (1x8-1Y, CL clock 82.3MHZ)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
PIV mode	Full	8271μs + Exposure time + 8.01μs
	ROI Center 2/3	5563μs + Exposure time + 8.01μs
	ROI Center 1/2	4217μs + Exposure time + 8.01μs
	ROI Center 1/4	2191μs + Exposure time + 8.01μs
	ROI Center 1/8	1177μs + Exposure time + 8.01μs
	V Binning ON (Full) (Note 1)	4135μs + 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.

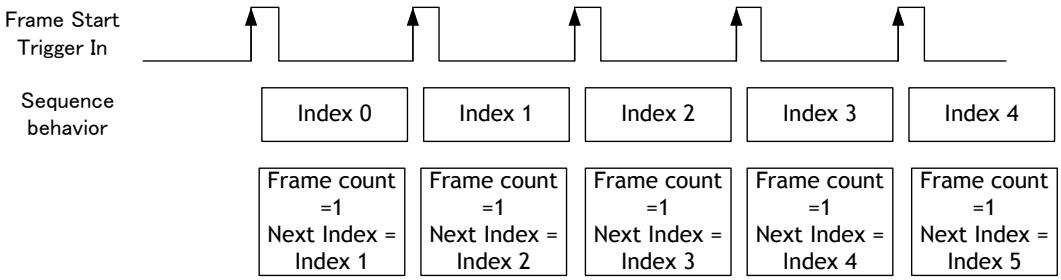


Fig. 27 Behavior of Sequence trigger

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 40. 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.

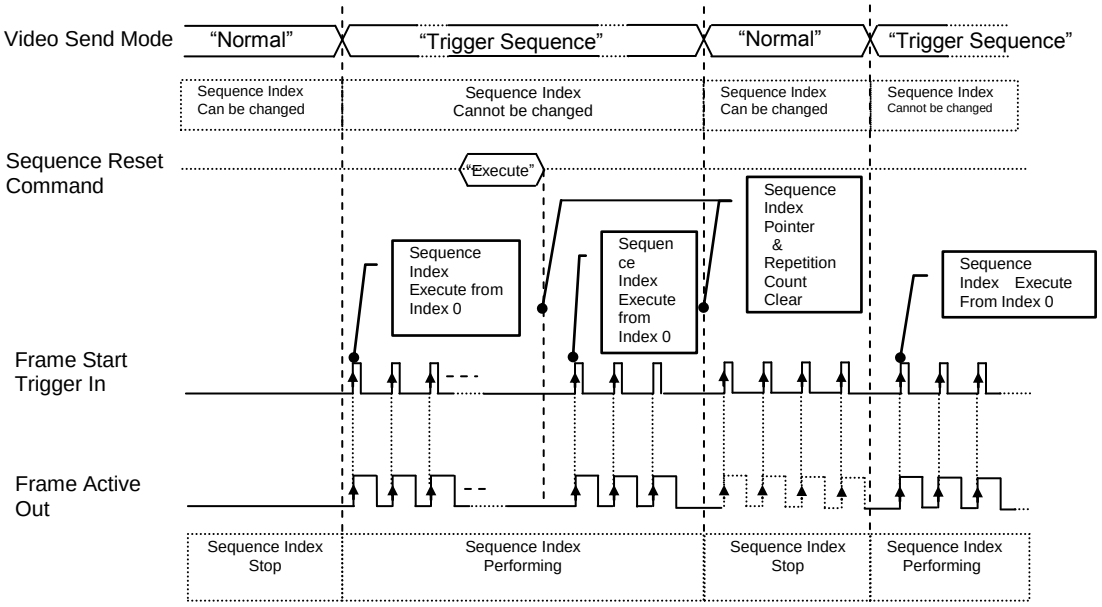


Fig. 28 Sequence trigger timing

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 50. Multi ROI Index table default values

Multi ROI Index Max	1		
Multi ROI Width	2560		
Multi ROI Index Selector	Multi ROI		
	Height	Offset	
		X	Y
- Index 1	1	0	0
- 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.

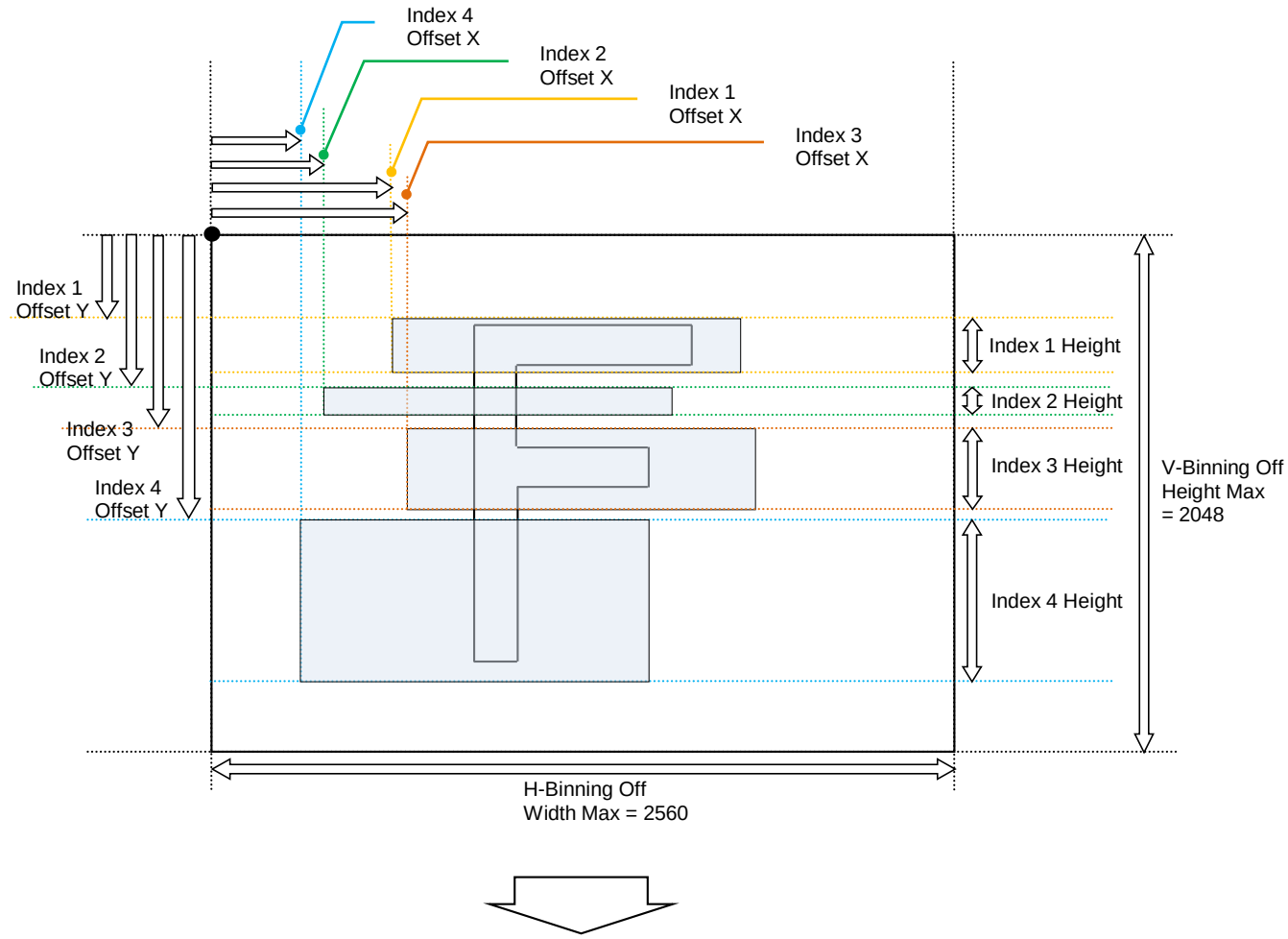
(5) Multi ROI Height :

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.

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



Video output of Multi ROI

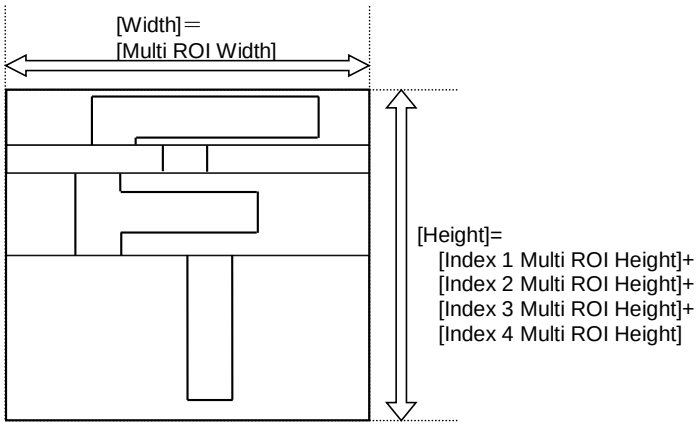


Fig. 29 Multi ROI settings and output image

7.11. Operation and function matrix

Table 51. Operation and function matrix

Exposure operation	Trigger Mode	Trigger Option	Binning Vertical (Note1)	Binning Horizontal (Note1)	Exposure Time	ROI	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	○	○	○	○ (Note3)	○	×	○
			2	2	○	○	–	○ (Note3)	○	×	○
Trigger Width	ON	OFF	1	1	×	○	○	○ (Note3)	○	×	○
			2	2	×	○	–	○ (Note3)	○	×	○
RCT	ON	RCT	1	1	○	○	○	○	○	○	×
			2	2	×	×	–	×	×	×	×
PIV	ON	PIV	1	1	×	○	×	×	×	×	×
			2	2	×	×	–	×	×	×	×

(Note1) SP-5000M-PMCL only
(Note2) SP-5000C-PMCL only
(Note3) If the trigger interval is long period, the iris may occur the hunting.

8. Other functions

8.1 Black level control

This function adjusts the setup level.
Variable range: 0 to 100 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

8.1.3 Associated GenICam register information

GenICam Name	Access	Values	Category
Black Level Selector	R/W	Black Level All Black Level Red Black Level Blue	Analog Control
Black Level Raw	R/W	Min～Max	

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.

Note1: 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.

Note2: While the analog gain is used at 0dB and the digital gain setting is high value, the video level may fluctuates around 5 % on an irregular base. In this case, please set the analog base gain to +6dB or +12dB.

Note3: When the analog gain is change, it will take 6 to 8 seconds and during this process, FVAL will be temporally disabled. Due to this, the image may be disturbed after being changed.

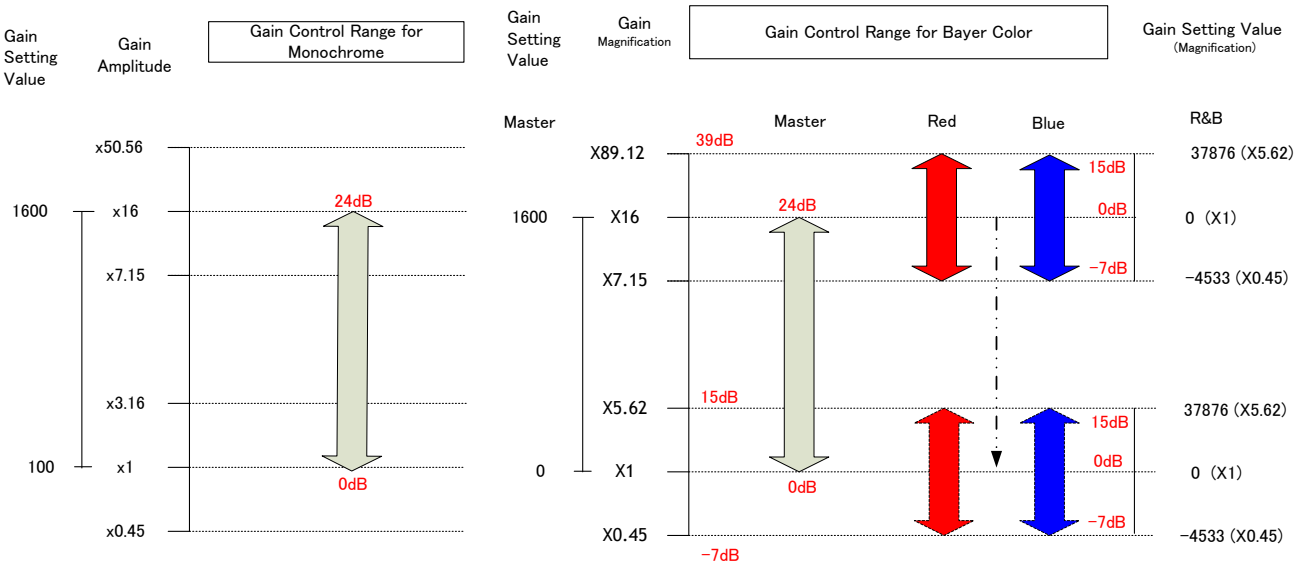


Fig.30 Gain control

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

8.2.5 Associated GenICam register information

GenICam Name	Access	Values	Category
Gain Selector	R/W	Digital All Digital Red All Digital Blue All	Analog Control
Gain	R/W	Min～Max[倍]	
Gain Raw	R/W	Min～Max	
Gain Auto	R/W	Off Once Continuous	
Alc Speed	R/W	1～8	JAI-Custom
AGC Max	R/W	101～Max[us]	
AGC Min	R/W	100～Max[us]	
ALC Reference	R/W	1～100[%]	
ALC Area Selector	R/W	All Low Right Low Mid-Right Low Mid-Left Low Left Mid-Low Right Mid-Low Mid-Right Mid-Low Mid-Left Mid-Low Left Mid-High Right Mid-High Mid-Right Mid-High Mid-Left Mid-High Left High Right High Mid-Right High Mid-Left High Left	
ALC Area Enable	R/W	Off / On	

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 Mode

Can be selected from OFF, Gamma or LUT table.

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 is 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

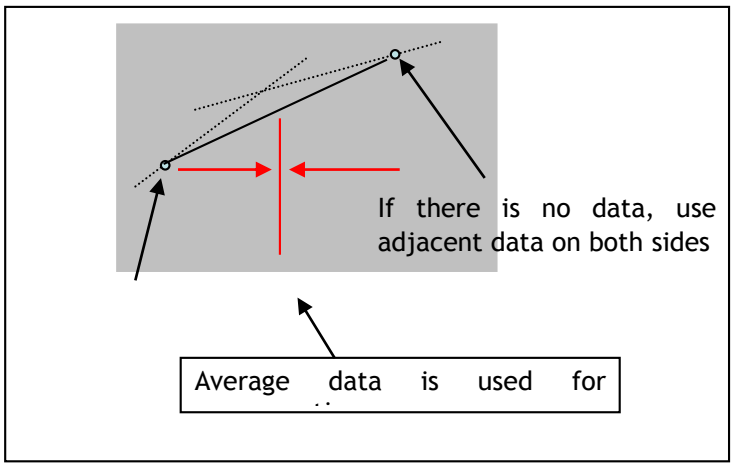


Fig.32 LUT data processing method

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.

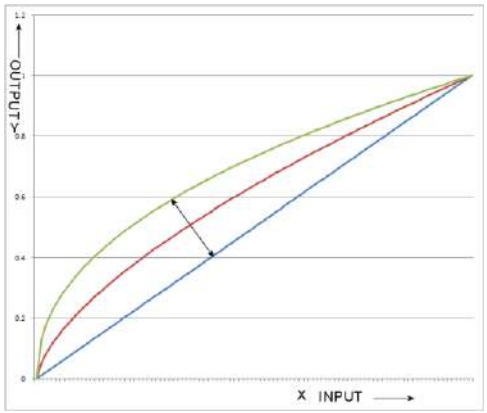


Fig.33 Gamma correction

8.4.1 Linear and Dark Compression

GO-5000-PMCL has a dark compression circuit to improve the signal-to-noise ratio in the dark portion of the image.

Dark Compression	Function
Linear(Factory default)	No compression, Gamma=1.0
Dark Compression	Compress the signal level in the dark portion. It can improve the signal to noise ratio, but on the other hand, the linearity will be deteriorated.

The following drawing is characteristics of linear and dark compression.

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.

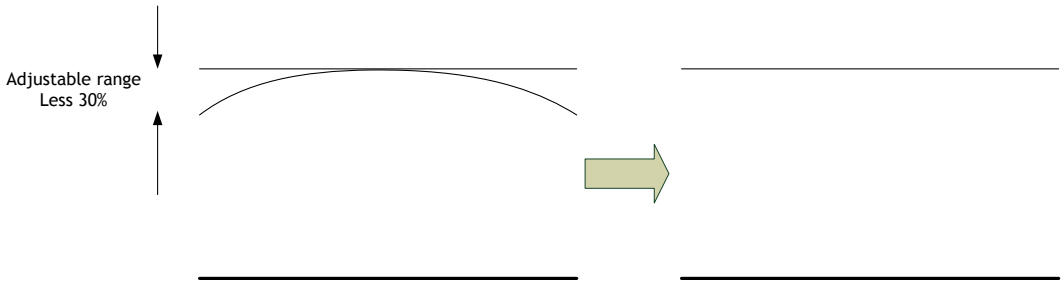
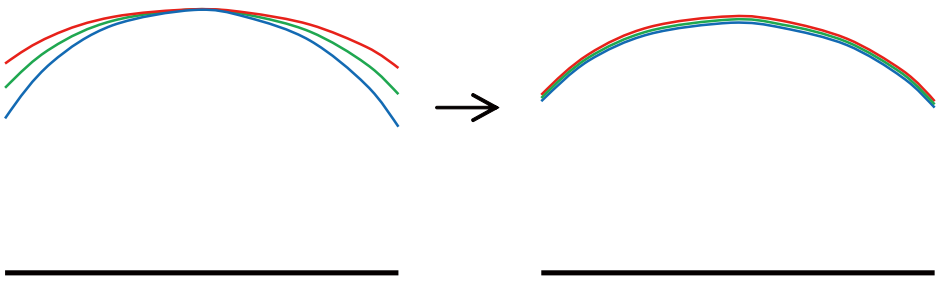


Fig.34 Concept drawing of flat shading correction

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.



Before adjustment After adjustment

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.

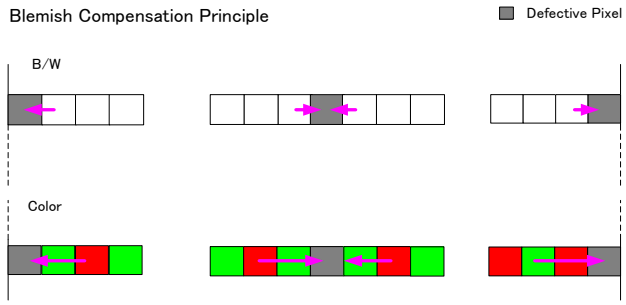


Fig. 36 Blemish compensation

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

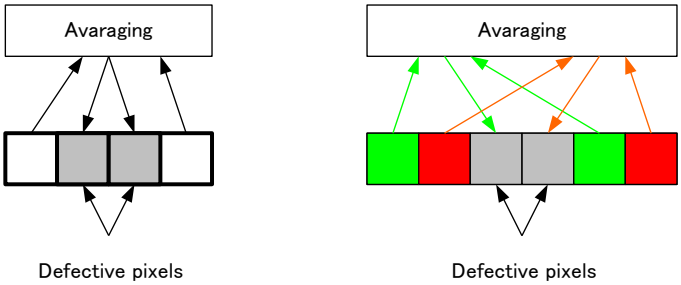


Fig 37. Compensation of consecutive defective pixels

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

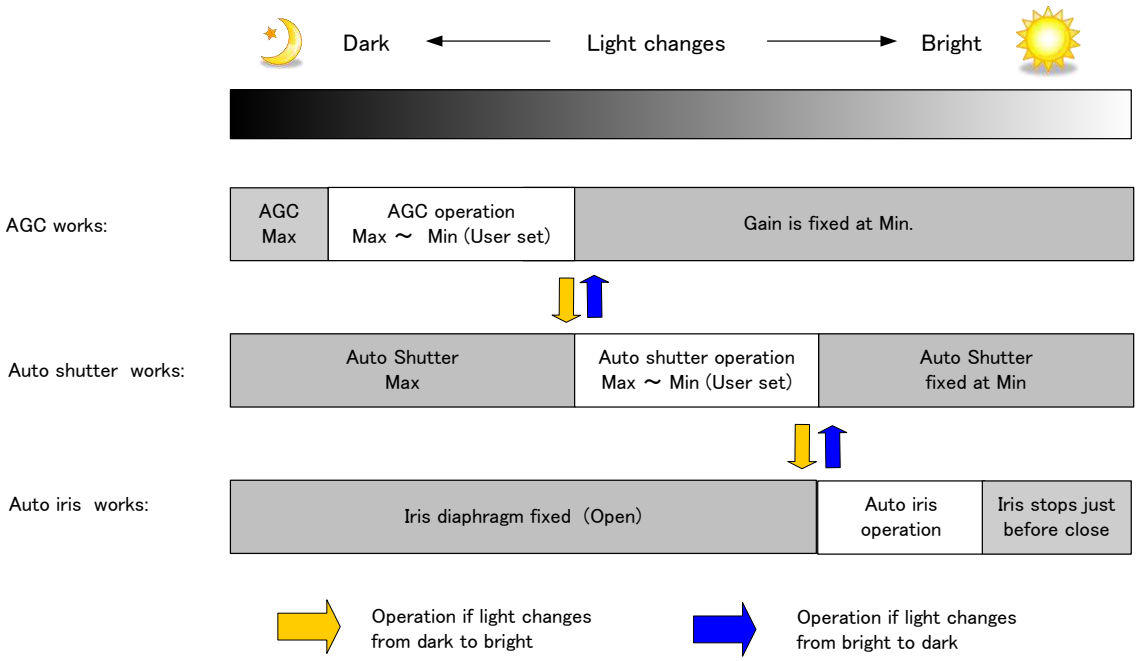


Fig.44 ALC function concept

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.

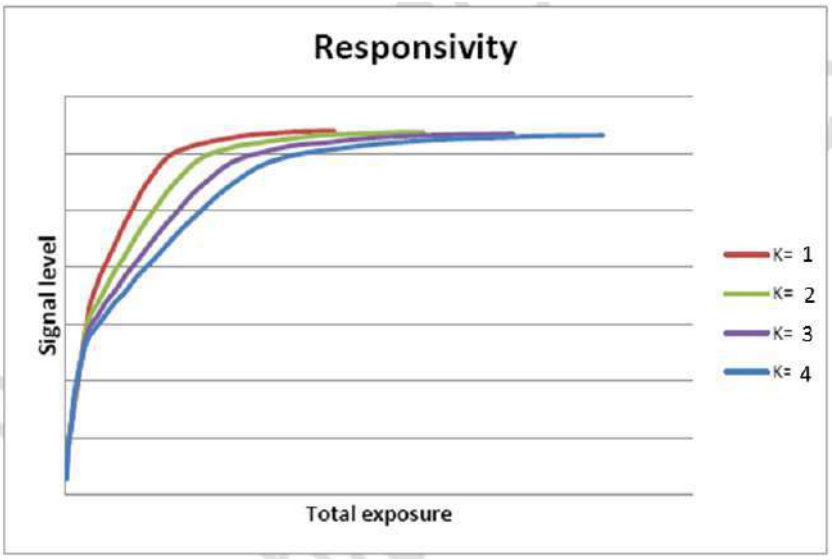


Fig. 39 HDR characteristics

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.

Caution: Lens control is not supported on cameras with hardware revision K (mono model) / J (color model) or later.

Table 52. 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. When P-Iris Les Select is opened, the following lenses are indicated but they are 2/3 inch format. If they are used, the corner of the image is eclipsed.

P-Iris lens select	Description	Control step number	Open F value
LM16JC5MM	Kowa 16mm 2/3”	74	F1.4
LM35JC5MM	Kowa 35mm 2/3”	73	F2.0
CINEGON 1.9/10	Schneider 10mm 1”	37	F1.9
CINEGON 1.8/4.8	Schneider 4.8mm 2/3”	37	F1.8
SCHNEIDER COMPACTIRIS	P-Iris unit	37	=
MG3518KC	CBC 35mm 2/3”	81	F1.8
Others	Other lenses are not specified in this list		

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 P-Iris Position Limit

This is the maximum value of P-Iris Position if the p-iris select is set to “Others”.

8.9.2.5 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.

8.9.2.6 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 settings

9.1 Camera Control Tool

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.

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.

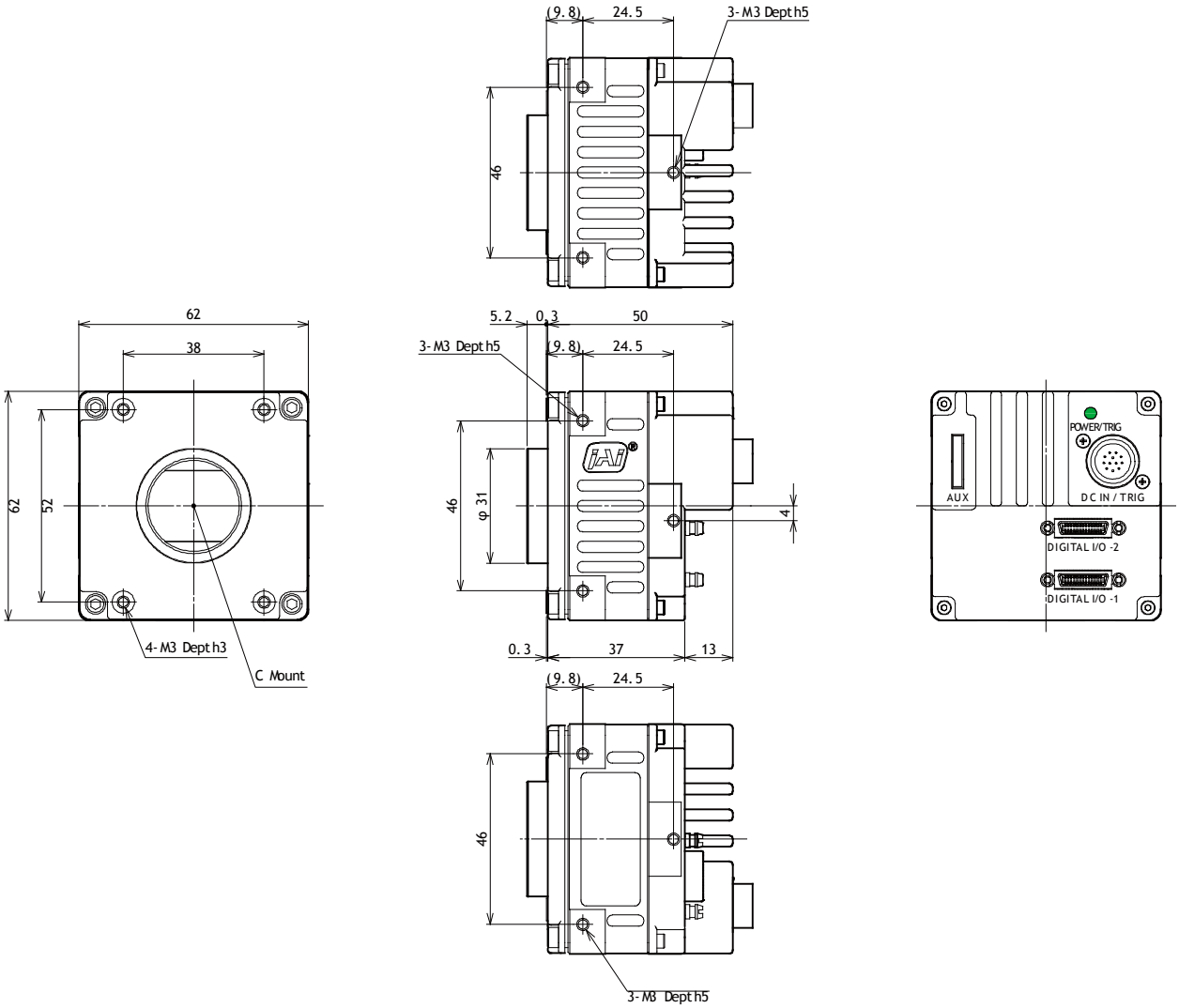
9.2 Camera Default settings

When the camera is connected to PC and start up JAI_SDK, camera setting data (XML file) is downloaded to the camera.

The following table shows default settings of basic functions.

Image Format	Bit allocation	8-bit
	Width	2560
	Height	2048
	Binning Horizontal	1(OFF)
	Binning Vertical	1(OFF)
Acquisition Control	Acquisition mode	Continuous
Trigger Selector		Frame Start
	Trigger Mode	OFF
	Trigger Activation	Rising Edge
	Trigger Source	Low
Trigger Overlap		OFF
Exposure Control	Exposure Mode	Timed
Gain	Gain	1
	Gain Auto	OFF
Gamma		1
Video Send Mode		Normal

10. External appearance and dimensions



Dimensions tolerance: ±0.3mm Unit: mm

Fig. 40 Appearance and Dimensions

11. Specifications

11.1. Camera spectral response

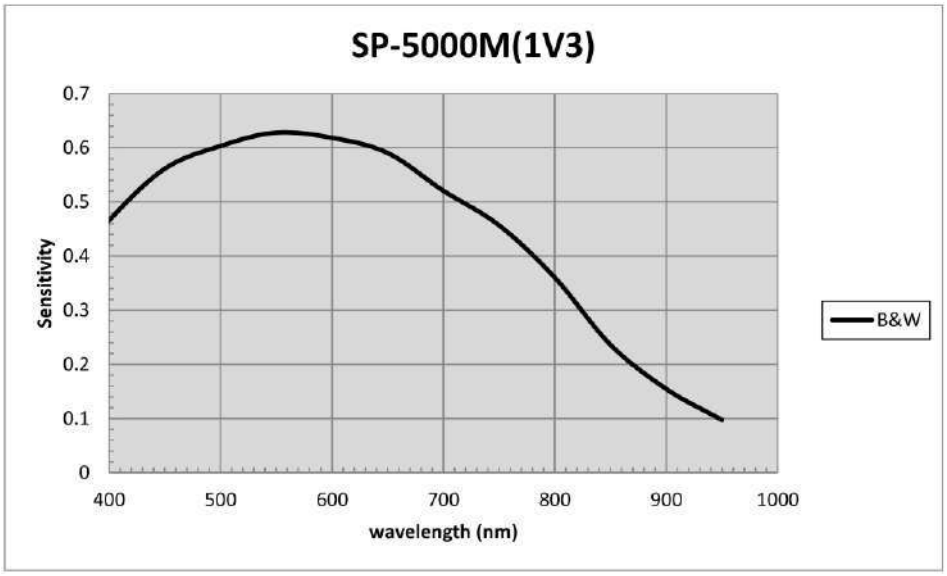


Fig.41 SP-5000M-PMCL Spectral response

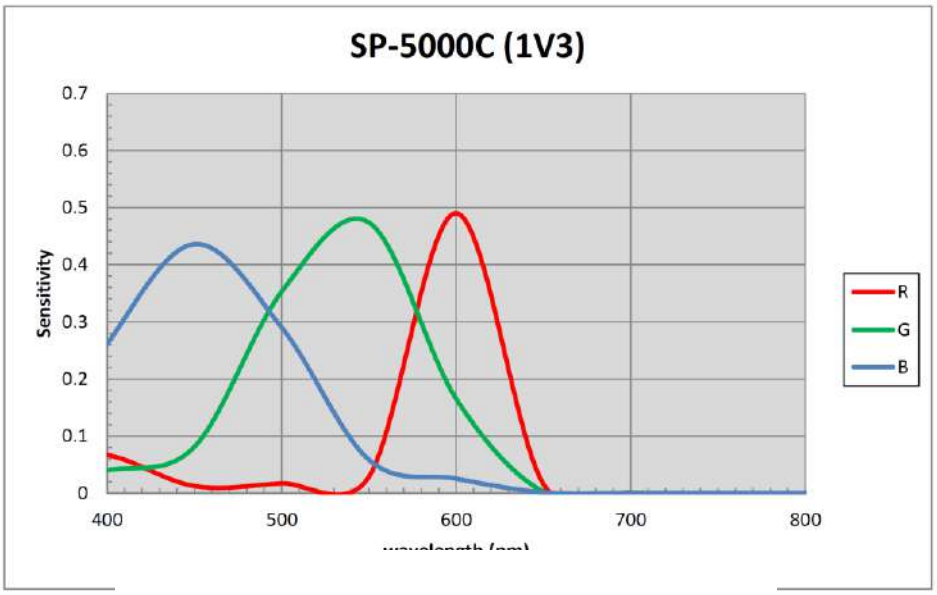


Fig.42 SP-5000C-PMCL Spectral response

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) μm	
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		137 fps (Max.) to 0.125s (Min.) 8-bit	137 fps (Max.) to 0.125s (Min.) 8-bit
	Binning	H1/V2	268 fps (Max.) ～0.125s (Min.) 1X10-1Y	–
		H2/V1	137 fps(Max.) ～0.125s (Min.) 1X10-1Y	–
		H2/V2	268 fps (Max.) ～0.125s (Min.) 1X10-1Y	–
EMVA 1288 Parameters Absolute sensitivity Maximum SNR			At 10-bit output 23.50 p (λ = 525 nm) 41.48 dB	At 10-bit output 36.08 p (λ = 525 nm) 38.00 dB
SN ratio (Traditional)			55dB (Typical) (0dB gain, Black))	50dB (Typical) (0dB gain, Green Pixel Black)
Image Output Format Digital	Full image		2560 (h) x 2048 (v)	2560 (h) x 2048 (v)
	ROI	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	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
		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) 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	
	Trigger Width		10 μs (Min)(Note1) ～ ∞ (Max)	
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			AGC, Auto Shutter, and Auto Iris can be combined and automatically controlled	
Gamma			0.45 ～ 1.0 (8 steps are available)	
LUT			OFF: γ=1.0, ON=256 points can be set	
Shading compensation			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)			-10°C to +50°C / 20% – 80% (non-condensing)	
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) The external trigger width requires the setting value + 45μs.
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.

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	DEFAULT	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	DEFAULT	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	CBDRT	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	DEFAULT	Description
DeviceFirmware Version	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	DEFAULT	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	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:GreyHorizontal RampMoving 4: Horizontal Colorbar* 5: Vertical Colorbar* 6: Moving Colorbar* (* Bayer model only)	0	6	0	TPN=[Param.]<CR><LF> TPN?<CR><LF>

2.4.5 Acquisition Control

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFAULT	Description
FrameStartTrigMode	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>
FrameStartTrigSource	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>
FrameStartTrigActivation	I Enumeration	R/W	TA	0: RisingEdge 1: FallingEdge 2: LevelHigh 3: LevelLow	0	3	0	TA=[Param.]<CR><LF> TA?<CR><LF>
FrameStartTrigOver 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	8000000	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	MIN	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	ND0INV1	False/True	0	1	0	ND0INV1=[Param.]<CR><LF> ND0INV1?<CR><LF>
LineInverter_Nand0In2	I Boolean	R/W	ND0INV2	False/True	0	1	0	ND0INV2=[Param.]<CR><LF> ND0INV2?<CR><LF>
LineInverter_Nand1In1	I Boolean	R/W	ND1INV1	False/True	0	1	0	ND1INV1=[Param.]<CR><LF> ND0INV1?<CR><LF>
LineInverter_Nand1In2	I Boolean	R/W	ND1INV2	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>
LineSource_Nand1In2	I Enumeration	R/W	ND1IN2	Same as for Line1	0	17	0	ND1IN2=[Param.]<CR><LF> ND1IN2?<CR><LF>

2.4.7 Analogue Control

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFAULT	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	37876 (*1)	0	PGR=[Param.]<CR><LF> PGR?<CR><LF> (Bayer model only)
GainRawDigitalBlueAll	I Integer	R/W	PGB	min～0～max	-4533	37876 (*1)	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)
AnalogBaseGainSelector (*1)	I Enumeration	R/W	ABGS	0: All 1: Red 2: Green 3 : Blue	0	3	0	ABGS=[Param.]<CR><LF> ABGS?<CR><LF> (Bayer model only)
AnalogBaseGainAll (*1)	I Enumeration	R/W	ABG	0: 0dB 1: 6dB 2: 12dB	0	2	0	ABG=[Param.]<CR><LF> ABG?<CR><LF>
AnalogBaseGainRed (*1)	I Enumeration	R/W	ABGR	0: 0dB 1: 6dB 2: 12dB	0	2	0	ABGR=[Param.]<CR><LF> ABGR?<CR><LF> (Bayer model only)
AnalogBaseGainGreen (*1)	I Enumeration	R/W	ABGG	0: 0dB 1: 6dB 2: 12dB	0	2	0	ABGG=[Param.]<CR><LF> ABGG?<CR><LF> (Bayer model only)
AnalogBaseGainBlue (*1)	I Enumeration	R/W	ABGB	0: 0dB 1: 6dB 2: 12dB	0	2	0	ABGB=[Param.]<CR><LF> ABGB?<CR><LF> (Bayer model only)

Note: *1) is effective on DeviceVersion 0.3.0.0 and after

2.4.8 LUT Control

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFAULT	Description
LUTValueRed	I Integer	R/W	LUTR	Param 1: LUT index Param 2:LUTdata (Min～Max) (Bayer model only)	0	4095	γ 1	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		
Dark Compression	I Enumeration	R/O	SBS	0: Dark Compression 1: Linear	0	1	1	SBS=[Param.]<CR><LF>

2.4.9 Transport Layer Control

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFAULT	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	DEFAULT	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	DEFAULT	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>
RequestShadingDetectResult	I Enumeration	R/O	SDRS	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	SDRS?<CR><LF>
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>
SequenceModeFrame Count0	I Integer	R/W	SQF1	Min～Max	1	255	1	SQF1=[Param.]<CR><LF> SQI1?<CR><LF>
SequenceModeFrame Count1	I Integer	R/W	SQF2	Min～Max	1	255	1	SQF2=[Param.]<CR><LF> SQI2?<CR><LF>
SequenceNodeFrame Count2	I Integer	R/W	SQF3	Min～Max	1	255	1	SQF3=[Param.]<CR><LF> SQI3?<CR><LF>
SequenceModeFrame Count3	I Integer	R/W	SQF4	Min～Max	1	255	1	SQF4=[Param.]<CR><LF> SQI4?<CR><LF>
SequenceModeFrame Count4	I Integer	R/W	SQF5	Min～Max	1	255	1	SQF5=[Param.]<CR><LF> SQI5?<CR><LF>

SequenceModeFrame Count5	I Integer	R/W	SQF6	Min～Max	1	255	1	SQF6=[Param.]<CR><LF> SQI6?<CR><LF>
SequenceModeFrame Count6	I Integer	R/W	SQF7	Min～Max	1	255	1	SQF7=[Param.]<CR><LF> SQI7?<CR><LF>
SequenceModeFrame Count7	I Integer	R/W	SQF8	Min～Max	1	255	1	SQF8=[Param.]<CR><LF> SQI8?<CR><LF>
SequenceModeFrame Count8	I Integer	R/W	SQF9	Min～Max	1	255	1	SQF9=[Param.]<CR><LF> SQI9?<CR><LF>
SequenceModeFrame Count9	I Integer	R/W	SQF10	Min～Max	1	255	1	SQF10=[Param.]<CR><LF> SQI10?<CR><LF>
SequenceModeNext Index0	I Enumeration	R/W	SQNI1	0: Index0 1: Index1 2: Index2 3: Index3 4: Index4 5: Index5 6: Index6 7: Index7 8: Index8 9: Index9	0	9	0	SQNI1=[Param.]<CR><LF> SQNI1?<CR><LF>
SequenceModeNext Index1	I Enumeration	R/W	SQNI2	Same as the above	0	9	0	SQNI2=[Param.]<CR><LF> SQNI2?<CR><LF>
SequenceModeNext Index2	I Enumeration	R/W	SQNI3	Same as the above	0	9	0	SQNI3=[Param.]<CR><LF> SQNI3?<CR><LF>
SequenceModeNext Index3	I Enumeration	R/W	SQNI4	Same as the above	0	9	0	SQNI4=[Param.]<CR><LF> SQNI4?<CR><LF>
SequenceModeNext Index4	I Enumeration	R/W	SQNI5	Same as the above	0	9	0	SQNI5=[Param.]<CR><LF> SQNI5?<CR><LF>
SequenceModeNext Index5	I Enumeration	R/W	SQNI6	Same as the above	0	9	0	SQNI6=[Param.]<CR><LF> SQNI6?<CR><LF>
SequenceModeNext Index6	I Enumeration	R/W	SQNI7	Same as the above	0	9	0	SQNI7=[Param.]<CR><LF> SQNI7?<CR><LF>
SequenceModeNext Index7	I Enumeration	R/W	SQNI8	Same as the above	0	9	0	SQNI8=[Param.]<CR><LF> SQNI8?<CR><LF>
SequenceModeNext Index8	I Enumeration	R/W	SQNI9	Same as the above	0	9	0	SQNI9=[Param.]<CR><LF> SQNI9?<CR><LF>
SequenceModeNext Index9	I Enumeration	R/W	SQNI10	Same as the above	0	9	0	SQNI10=[Param.]<CR><LF> SQNI10?<CR><LF>
SequenceMode Width0)*1)	I Integer	R/W	SQW1	Min～Max	16	2560	2560	SQW1=[Param.]<CR><LF> SQW1?<CR><LF>
SequenceMode Width 1 (*1)	I Integer	R/W	SQW2	Min～Max	16	2560	2560	SQW2=[Param.]<CR><LF> SQW2?<CR><LF>
SequenceMode Width 2 (*1)	I Integer	R/W	SQW3	Min～Max	16	2560	2560	SQW3=[Param.]<CR><LF> SQW3?<CR><LF>

SequenceMode Width 3 (*1)	I Integer	R/W	SQW4	Min～Max	16	2560	2560	SQW4=[Param.]<CR><LF> SQW4?<CR><LF>
SequenceMode Width 4 (*1)	I Integer	R/W	SQW5	Min～Max	16	2560	2560	SQW5=[Param.]<CR><LF> SQW5?<CR><LF>
SequenceMode Width 5 (*1)	I Integer	R/W	SQW6	Min～Max	16	2560	2560	SQW6=[Param.]<CR><LF> SQW6?<CR><LF>
SequenceMode Width 6 (*1)	I Integer	R/W	SQW7	Min～Max	16	2560	2560	SQW7=[Param.]<CR><LF> SQW7?<CR><LF>
SequenceMode Width 7 (*1)	I Integer	R/W	SQW8	Min～Max	16	2560	2560	SQW8=[Param.]<CR><LF> SQW8?<CR><LF>
SequenceMode Width 8 (*1)	I Integer	R/W	SQW9	Min～Max	16	2560	2560	SQW9=[Param.]<CR><LF> SQW9?<CR><LF>
SequenceMode Width 9 (*1)	I Integer	R/W	SQW10	Min～Max	16	2560	2560	SQW10=[Param.]<CR><LF> SQW10?<CR><LF>
SequenceMode OffsetX0 (*1)	I Integer	R/W	SQOX1	Min～Max	0	2544	0	SQOX1=[Param.]<CR><LF> SQOX1?<CR><LF>
SequenceMode OffsetX1 (*1)	I Integer	R/W	SQOX2	Min～Max	0	2544	0	SQOX2=[Param.]<CR><LF> SQOX2?<CR><LF>
SequenceMode OffsetX2 (*1)	I Integer	R/W	SQOX3	Min～Max	0	2544	0	SQOX3=[Param.]<CR><LF> SQOX3?<CR><LF>
SequenceMode OffsetX3 (*1)	I Integer	R/W	SQOX4	Min～Max	0	2544	0	SQOX4=[Param.]<CR><LF> SQOX4?<CR><LF>
SequenceMode OffsetX4 (*1)	I Integer	R/W	SQOX5	Min～Max	0	2544	0	SQOX5=[Param.]<CR><LF> SQOX5?<CR><LF>
SequenceMode OffsetX5 (*1)	I Integer	R/W	SQOX6	Min～Max	0	2544	0	SQOX6=[Param.]<CR><LF> SQOX6?<CR><LF>
SequenceMode OffsetX6 (*1)	I Integer	R/W	SQOX7	Min～Max	0	2544	0	SQOX7=[Param.]<CR><LF> SQOX7?<CR><LF>
SequenceMode OffsetX7 (*1)	I Integer	R/W	SQOX8	Min～Max	0	2544	0	SQOX8=[Param.]<CR><LF> SQOX8?<CR><LF>
SequenceMode OffsetX8 (*1)	I Integer	R/W	SQOX9	Min～Max	0	2544	0	SQOX9=[Param.]<CR><LF> SQOX9?<CR><LF>
SequenceMode OffsetX9 (*1)	I Integer	R/W	SQOX10	Min～Max	0	2544	0	SQOX10=[Param.]<CR><LF> SQOX10?<CR><LF>
SequenceMode Height0	I Integer	R/W	SQH1	Min～Max	1(Mono) 2(Bayer)	2048	2048	SQH1=[Param.]<CR><LF> SQH1?<CR><LF>
SequenceMode Height1	I Integer	R/W	SQH2	Min～Max	1(Mono) 2(Bayer)	2048	2048	SQH2=[Param.]<CR><LF> SQH2?<CR><LF>

SequenceMode Height2	I Integer	R/W	SQH3	Min～Max	1(Mono) 2(Bayer)	2048	2048	SQH3=[Param.]<CR><LF> SQH3?<CR><LF>
SequenceMode Height3	I Integer	R/W	SQH4	Min～Max	1(Mono) 2(Bayer)	2048	2048	SQH4=[Param.]<CR><LF> SQH4?<CR><LF>
SequenceMode Height4	I Integer	R/W	SQH5	Min～Max	1(Mono) 2(Bayer)	2048	2048	SQH5=[Param.]<CR><LF> SQH5?<CR><LF>
SequenceMode Height5	I Integer	R/W	SQH6	Min～Max	1(Mono) 2(Bayer)	2048	2048	SQH6=[Param.]<CR><LF> SQH6?<CR><LF>
SequenceMode Height6	I Integer	R/W	SQH7	Min～Max	1(Mono) 2(Bayer)	2048	2048	SQH7=[Param.]<CR><LF> SQH7?<CR><LF>
SequenceMode Height7	I Integer	R/W	SQH8	Min～Max	1(Mono) 2(Bayer)	2048	2048	SQH8=[Param.]<CR><LF> SQH8?<CR><LF>
SequenceMode Height8	I Integer	R/W	SQH9	Min～Max	1(Mono) 2(Bayer)	2048	2048	SQH9=[Param.]<CR><LF> SQH9?<CR><LF>
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 (Baye r)	0	SQOY7=[Param.]<CR><LF> SQOY7?<CR><LF>
SequenceMode OffsetY7	I Integer	R/W	SQOY8	Min～Max	0	2047 (Mno) 2046 (Baye r)	0	SQOY8=[Param.]<CR><LF> SQOY8?<CR><LF>
SequenceMode OffsetY8	I Integer	R/W	SQOY9	Min～Max	0	2047 (Mno) 2046 (Baye r)	0	SQOY9=[Param.]<CR><LF> SQOY9?<CR><LF>
SequenceMode OffsetY9	I Integer	R/W	SQOY10	Min～Max	0	2047 (Mno) 2046 (Baye r)	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>
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)
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)

SequenceModeHbinning9	Enumeration	R/W	SQHB10	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB10=[Param.]<CR><LF> SQHB10?<CR><LF> (Mono model only)
SequenceModeVbinning0	Enumeration	R/W	SQVB1	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB1=[Param.]<CR><LF> SQVB1?<CR><LF> (Mono model only)
SequenceModeVbinning1	Enumeration	R/W	SQVB2	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB2=[Param.]<CR><LF> SQVB2?<CR><LF> (Mono model only)
SequenceModeVbinning2	Enumeration	R/W	SQVB3	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB3=[Param.]<CR><LF> SQVB3?<CR><LF> (Mono model only)
SequenceModeVbinning3	Enumeration	R/W	SQVB4	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB4=[Param.]<CR><LF> SQVB4?<CR><LF> (Mono model only)
SequenceModeVbinning4	Enumeration	R/W	SQVB5	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB5=[Param.]<CR><LF> SQVB5?<CR><LF> (Mono model only)
SequenceModeVbinning5	Enumeration	R/W	SQVB6	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB6=[Param.]<CR><LF> SQVB6?<CR><LF> (Mono model only)
SequenceModeVbinning6	Enumeration	R/W	SQVB7	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB7=[Param.]<CR><LF> SQVB7?<CR><LF> (Mono model only)
SequenceModeVbinning7	Enumeration	R/W	SQVB8	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB8=[Param.]<CR><LF> SQVB8?<CR><LF> (Mono model only)
SequenceModeVbinning8	Enumeration	R/W	SQVB9	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB9=[Param.]<CR><LF> SQVB9?<CR><LF> (Mono model only)
SequenceModeVbinning9	Enumeration	R/W	SQVB10	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB10=[Param.]<CR><LF> SQVB10?<CR><LF> (Mono model only)
SequenceModeLutEnable0	Enumeration	R/W	SQLUT1	Off/On	0	1	0	SQLUT1=[Param.]<CR><LF> SQLUT1?<CR><LF>
SequenceModeLutEnable1	Enumeration	R/W	SQLUT2	Off/On	0	1	0	SQLUT2=[Param.]<CR><LF> SQLUT2?<CR><LF>
SequenceModeLutEnable2	Enumeration	R/W	SQLUT3	Off/On	0	1	0	SQLUT3=[Param.]<CR><LF> SQLUT3?<CR><LF>
SequenceModeLutEnable3	Enumeration	R/W	SQLUT4	Off/On	0	1	0	SQLUT4=[Param.]<CR><LF> SQLUT4?<CR><LF>
SequenceModeLutEnable4	Enumeration	R/W	SQLUT5	Off/On	0	1	0	SQLUT5=[Param.]<CR><LF> SQLUT5?<CR><LF>
SequenceModeLutEnable5	Enumeration	R/W	SQLUT6	Off/On	0	1	0	SQLUT6=[Param.]<CR><LF> SQLUT6?<CR><LF>

SequenceModeLutEnable6	I Enumeration	R/W	SQLUT7	Off/On	0	1	0	SQLUT7=[Param.]<CR><LF> SQLUT7?<CR><LF>
SequenceModeLutEnable7	I Enumeration	R/W	SQLUT8	Off/On	0	1	0	SQLUT8=[Param.]<CR><LF> SQLUT8?<CR><LF>
SequenceModeLutEnable8	I Enumeration	R/W	SQLUT9	Off/On	0	1	0	SQLUT9=[Param.]<CR><LF> SQLUT9?<CR><LF>
SequenceModeLutEnable9	I Enumeration	R/W	SQLUT10	Off/On	0	1	0	SQLUT10=[Param.]<CR><LF> SQLUT10?<CR><LF>
SequenceModeBlackLevel0	I Integer	R/W	SQBL1	Min～Max	-256	255	0	SQBL1=[Param.]<CR><LF> SQBL1?<CR><LF>
SequenceModeBlackLevel1	I Integer	R/W	SQBL2	Min～Max	-256	255	0	SQBL2=[Param.]<CR><LF> SQBL2?<CR><LF>
SequenceModeBlackLevel2	I Integer	R/W	SQBL3	Min～Max	-256	255	0	SQBL3=[Param.]<CR><LF> SQBL3?<CR><LF>
SequenceModeBlackLevel3	I Integer	R/W	SQBL4	Min～Max	-256	255	0	SQBL4=[Param.]<CR><LF> SQBL4?<CR><LF>
SequenceModeBlackLevel4	I Integer	R/W	SQBL5	Min～Max	-256	255	0	SQBL5=[Param.]<CR><LF> SQBL5?<CR><LF>
SequenceModeBlackLevel5	I Integer	R/W	SQBL6	Min～Max	-256	255	0	SQBL6=[Param.]<CR><LF> SQBL6?<CR><LF>
SequenceModeBlackLevel6	I Integer	R/W	SQBL7	Min～Max	-256	255	0	SQBL7=[Param.]<CR><LF> SQBL7?<CR><LF>
SequenceModeBlackLevel7	I Integer	R/W	SQBL8	Min～Max	-256	255	0	SQBL8=[Param.]<CR><LF> SQBL8?<CR><LF>
SequenceModeBlackLevel8	I Integer	R/W	SQBL9	Min～Max	-256	255	0	SQBL9=[Param.]<CR><LF> SQBL9?<CR><LF>
SequenceModeBlackLevel9	I Integer	R/W	SQBL10	Min～Max	-256	255	0	SQBL10=[Param.]<CR><LF> SQBL10?<CR><LF>
SequenceModeGainRed0	I Integer	R/W	SQPGR1	Min～Max	-4533	17713	0	SQPGR1=[Param.]<CR><LF> SQPGR1?<CR><LF> (Bayer model only)
SequenceModeGainRed1	I Integer	R/W	SQPGR2	Min～Max	-4533	17713	0	SQPGR2=[Param.]<CR><LF> SQPGR2?<CR><LF> (Bayer model only)
SequenceModeGainRed2	I Integer	R/W	SQPGR3	Min～Max	-4533	17713	0	SQPGR3=[Param.]<CR><LF> SQPGR3?<CR><LF> (Bayer model only)
SequenceModeGainRed3	I Integer	R/W	SQPGR4	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.]<C R><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)
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)

SequenceModeGainBlue8	I Integer	R/W	SQPGB9	Min～Max	-4533	17713	0	SQPGB9=[Param.]<CR><LF> SQPGB9?<CR><LF> (Bayer model only)
SequenceModeGainBlue9	I Integer	R/W	SQPGB10	Min～Max	-4533	17713	0	SQPGB10=[Param.]<CR><LF> SQPGB10?<CR><LF> (Bayer model only)
CommnadSequence Index	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	CSQI=[Param.]<CR><LF> CSQI?<CR><LF>
CurrentSequence Index	I Enumeration	R/O	SQIDX	Same as CommadSequenceIndex	0	9	0	SQIDX?<CR><LF>
SequenceReset	I Enumeration	W/O	SQRST	0	0	0	0	SQRST=[Param.]<CR><LF>
SequenceLutMode	I Enumeration	R/W	SQLUT	0: Gamma 1: LUT	0	1	0	SQLUT=[Param.]<CR><LF> SQLUT?<CR><LF>
MultiRoiIndexMax	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>
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>

MultiRoiOffsetX 2	I Integer	R/W	MROX2	Min～Max	0	5118	0	MROX2=[Param.]<CR><LF> MROX2?<CR><LF>
MultiRoiOffsetX 3	I Integer	R/W	MROX3	Min～Max	0	5118	0	MROX3=[Param.]<CR><LF> MROX3?<CR><LF>
MultiRoiOffsetX 4	I Integer	R/W	MROX4	Min～Max	0	5118	0	MROX4=[Param.]<CR><LF> MROX4?<CR><LF>
MultiRoiOffsetX 5	I Integer	R/W	MROX5	Min～Max	0	5118	0	MROX5=[Param.]<CR><LF> MROX5?<CR><LF>
MultiRoiOffsetX 6	I Integer	R/W	MROX6	Min～Max	0	5118	0	MROX6=[Param.]<CR><LF> MROX6?<CR><LF>
MultiRoiOffsetX 7	I Integer	R/W	MROX7	Min～Max	0	5118	0	MROX7=[Param.]<CR><LF> MROX7?<CR><LF>
MultiRoiOffsetX 8	I Integer	R/W	MROX8	Min～Max	0	5118	0	MROX8=[Param.]<CR><LF> MROX8?<CR><LF>
MultiRoiOffsetY 1	I Integer	R/W	MROY1	Min～Max	0	3839	0	MROY1=[Param.]<CR><LF> MROY1?<CR><LF>
MultiRoiOffsetY 2	I Integer	R/W	MROY2	Min～Max	0	3839	0	MROY2=[Param.]<CR><LF> MROY2?<CR><LF>
MultiRoiOffsetY 3	I Integer	R/W	MROY3	Min～Max	0	3839	0	MROY3=[Param.]<CR><LF> MROY3?<CR><LF>
MultiRoiOffsetY 4	I Integer	R/W	MROY4	Min～Max	0	3839	0	MROY4=[Param.]<CR><LF> MROY4?<CR><LF>
MultiRoiOffsetY 5	I Integer	R/W	MROY5	Min～Max	0	3839	0	MROY5=[Param.]<CR><LF> MROY5?<CR><LF>
MultiRoiOffsetY 6	I Integer	R/W	MROY6	Min～Max	0	3839	0	MROY6=[Param.]<CR><LF> MROY6?<CR><LF>
MultiRoiOffsetY 7	I Integer	R/W	MROY7	Min～Max	0	3839	0	MROY7=[Param.]<CR><LF> MROY7?<CR><LF>
MultiRoiOffsetY 8	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.
RequestExposureAuto Result	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>
RequestGainAuto Result	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>
AutoIrisLensControl SignalOutput	I Enumeration	R/W	AIC	0: Off 1: On	0	1	0	AIC=[Param.]<CR><LF> AIC?<CR><LF>
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>
ALCChannelArea LowRight	I Enumeration	R/W	ALCLR	0: Off / 1: On	0	1	1	ALC**=[Param.]<CR><LF> ALC**?<CR><LF>
ALCChannelArea LowMidRight	I Enumeration	R/W	ALCLMR	0: Off / 1: On	0	1	1	
ALCChannelArea LowMidLeft	I Enumeration	R/W	ALCLML	0: Off / 1: On	0	1	1	
ALCChannelArea LowLeft	IEnumeration	R/W	ALCLL	0: Off / 1: On	0	1	1	

ALCChannelArea MidLowRight	I Enumeration	R/W	ALCMLR	0: Off / 1: On	0	1	1	
ALCChannelArea MidLowMidRight	I Enumeration	R/W	ALCMLMR	0: Off / 1: On	0	1	1	
ALCChannelArea MidLowMidLeft	I Enumeration	R/W	ALCMLML	0: Off / 1: On	0	1	1	
ALCChannelArea MidLowLeft	I Enumeration	R/W	ALCMLL	0: Off / 1: On	0	1	1	
ALCChannelArea MidHighRight	I Enumeration	R/W	ALCMHR	0: Off / 1: On	0	1	1	
ALCChannelArea MidHighMidRight	I Enumeration	R/W	ALCMHMR	0: Off / 1: On	0	1	1	
ALCChannelArea MidHighMidLeft	I Enumeration	R/W	ALCMHML	0: Off / 1: On	0	1	1	
ALCChannelArea MidHighLeft	I Enumeration	R/W	ALCMHL	0: Off / 1: On	0	1	1	
ALCChannelArea HighRight	I Enumeration	R/W	ALCHR	0: Off / 1: On	0	1	1	
ALCChannelArea HighMidRight	I Enumeration	R/W	ALCHMR	0: Off / 1: On	0	1	1	
ALCChannelArea HighMidLeft	I Enumeration	R/W	ALCHML	0: Off / 1: On	0	1	1	
ALCChannelArea HighLeft	I Enumeration	R/W	ALCHL	0: Off / 1: On	0	1	1	
AWBChannelAreaAll	I Enumeration	R/W	AWBA	0: Off / 1: On	0	1	0	AWBA=[Param.]<CR><LF> AWBA?<CR><LF>
AWBChannelArea LowRight	I Enumeration	R/W	AWBLR	0: Off / 1: On	0	1	1	AWB**=[Param.]<CR><LF> AWB**?<CR><LF> (Bayer model only)
AWBChannelArea LowMidRight	I Enumeration	R/W	AWBLMR	0: Off / 1: On	0	1	1	
AWBChannelArea LowMidLeft	I Enumeration	R/W	AWBLML	0: Off / 1: On	0	1	1	
AWBChannelArea LowLeft	I Enumeration	R/W	AWBLL	0: Off / 1: On	0	1	1	
AWBChannelArea MidLowRight	I Enumeration	R/W	AWBMLR	0: Off / 1: On	0	1	1	
AWBChannelArea MidLowMidRight	I Enumeration	R/W	AWBMLMR	0: Off / 1: On	0	1	1	
AWBChannelArea	I Enumera	R/W	AWBMLML	0: Off / 1: On	0	1	1	

MidLowMidLeft	tion							
AWBChannelArea MidLowLeft	I Enumeration	R/W	AWBMLL	0: Off / 1: On	0	1	1	
AWBChannelArea MidHighRight	I Enumeration	R/W	AWBMHR	0: Off / 1: On	0	1	1	
AWBChannelArea MidHighMidRight	I Enumeration	R/W	AWBMHMR	0: Off / 1: On	0	1	1	
AWBChannelArea MidHighMidLeft	I Enumeration	R/W	AWBMHML	0: Off / 1: On	0	1	1	
AWBChannelArea MidHighLeft	I Enumeration	R/W	AWBMHL	0: Off / 1: On	0	1	1	
AWBChannelArea HighRight	I Enumeration	R/W	AWBHR	0: Off / 1: On	0	1	1	
AWBChannelArea HighMidRight	I Enumeration	R/W	AWBHMR	0: Off / 1: On	0	1	1	
AWBChannelArea HighMidLeft	I Enumeration	R/W	AWBHML	0: Off / 1: On	0	1	1	
AWBChannelArea HighLeft	I Enumeration	R/W	AWBHL	0: Off / 1: On	0	1	1	
RequestBalance White AutoResult	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)
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 (2, 5)	I Enumeration	R/W	PLS	0=LM16JC5MM 1= LM35JC5MM 2= CINEGON1.9/10 3= CINEGON1.8/4.8 4= SCHNEIDER COMPACT IRIS 5= MG3518KC 6= OTHERS				PLS=[Param.]<CR><LF> PLS?<CR><LF>
PIrisStepMax (5)	I Integer	R/O	PIS	Indicate P-IRIS control step maximum value	0	255	128	PIS?<CR><LF> Different depending on PirisLensSelect value
PIrisPosition (5)	I Integer	R/W	PIP	Min～Max	0	255	128	PIP=[Param.]<CR><LF> PIP?<CR><LF> Maximum value is PIrisStepMax

PirisAutoMin (5)	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 (5)	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 (5)	I Enumeration	R/O	PCV	Same as above.	0	11	0	PCV?<CR><LF>
PirisAutoStepMin (*2, 5)	I Integer	R/W	PLSI	Min～Max	0	200	0	PLSI=[Param.]<CR><LF> PLSI?<CR><LF>
PirisAutoStepMax (*2, 5)	I Integer	R/W	PLSA	Min～Max	0	200	60	PLSA=[Param.]<CR><LF> PLSA?<CR><LF>
PirisPositionLimit (*2, 5)	I Integer	R/W	PLSL	Min～Max	0	200	74	PLSL=[Param.]<CR><LF> PLSL?<CR><LF>
AlcStatus (*2)	I Enumeration	R/O	ALCST	0=Off 1=AIC 2=ASC 3=AGC	0	3	0	ALCST?<CR><LF>
AcquisitionFrameRatePeriod	I Integer	R/W	ART	Min～Max	10	8000000	8333	ART=[Param.]<CR><LF> ART?<CR><LF> Maximum value is calculated depending on Height and Offset Y settings
GammaSelector	I Integer	R/W	GMA	0(γ=1) ～ 8(γ=0.45) ～ 15(γ=TBD)	0	15	8	GMA=[Param.]<CR><LF> GMA?<CR><LF>
Temperature	I Integer	R/O	TMP0	value	—	—	—	TMP0?<CR><LF> (Value÷128) = Temperature[℃]
GpioPulseGenDivide Value	I Integer	R/W	PGDEV	Min～Max	1	4096	1	PGDEV=[Param.]<CR><LF> PGDEV?<CR><LF>
GpioPulseGenLength0	I Integer	R/W	PGL0	Min～Max	1	1048575	1	PGL0=[Param.]<CR><LF> PGL0?<CR><LF>
GpioPulseGenLength1	I Integer	R/W	PGL1	Min～Max	1	1048575	1	PGL1=[Param.]<CR><LF> PGL1?<CR><LF>

GpioPulseGenLength2	I Integer	R/W	PGL2	Min～Max	1	1048575	1	PGL2=[Param.]<CR><LF> PGL2?<CR><LF>
GpioPulseGenLength3	I Integer	R/W	PGL3	Min～Max	1	1048575	1	PGL3=[Param.]<CR><LF> PGL3?<CR><LF>
GpioPulseGenStart Point0	I Integer	R/W	PGST0	Min～Max	0	1048574	0	PGST0=[Param.]<CR><LF> PGST0?<CR><LF>
GpioPulseGenStart Point1	I Integer	R/W	PGST1	Min～Max	0	1048574	0	PGST1=[Param.]<CR><LF> PGST1?<CR><LF>
GpioPulseGenStart Point2	I Integer	R/W	PGST2	Min～Max	0	1048574	0	PGST2=[Param.]<CR><LF> PGST2?<CR><LF>
GpioPulseGenStart Point3	I Integer	R/W	PGST3	Min～Max	0	1048574	0	PGST3=[Param.]<CR><LF> PGST3?<CR><LF>
GpioPulseGenEnd Point0	I Integer	R/W	PGEN0	Min～Max	1	1048575	1	PGEN0=[Param.]<CR><LF> PGEN0?<CR><LF>
GpioPulseGenEnd Point1	I Integer	R/W	PGEN1	Min～Max	1	1048575	1	PGEN1=[Param.]<CR><LF> PGEN1?<CR><LF>
GpioPulseGenEnd Point2	I Integer	R/W	PGEN2	Min～Max	1	1048575	1	PGEN2=[Param.]<CR><LF> PGEN2?<CR><LF>
GpioPulseGenEnd Point3	I Integer	R/W	PGEN3	Min～Max	1	1048575	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>
GpioPulseGenClear 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>
GpioPulseGenClear Mode1	I Enumeration	R/W	PGCM1	Same as above.	0	4	0	PGCM1=[Param.]<CR><LF> PGCM1?<CR><LF>
GpioPulseGenClear Mode2	I Enumeration	R/W	PGCM2	Same as above.	0	4	0	PGCM2=[Param.]<CR><LF> PGCM2?<CR><LF>
GpioPulseGenClear Mode3	I Enumeration	R/W	PGCM3	Same as above.	0	4	0	PGCM3=[Param.]<CR><LF> PGCM3?<CR><LF>
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>

GpioNand0InputSource1	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	ND0N1=[Param.]<CR><LF> ND0IN1?<CR><LF>
GpioNand1InputSource1	I Enumeration	R/W	ND1IN1	Same as above.	0	11	0	ND1N1=[Param.]<CR><LF> ND1IN1?<CR><LF>
GpioNand0InputSource2	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	ND0N2=[Param.]<CR><LF> ND0IN2?<CR><LF>
GpioNand1InputSource2	I Enumeration	R/W	ND1IN2	Same as above.	0	11	0	ND1N2=[Param.]<CR><LF> ND1IN2?<CR><LF>
GpioNand0InputInvert1	I Enumeration	R/W	ND0INV1	0: Non-Inv 1: Inv	0	1	0	ND0INV1=[Param.]<CR><LF> ND0INV1?<CR><LF>
GpioNand1InputInvert1	I Enumeration	R/W	ND1INV1	Same as above.	0	1	0	ND1INV1=[Param.]<CR><LF> ND1INV1?<CR><LF>
GpioNand0InputInvert2	I Enumeration	R/W	ND0INV2	0: Non-Inv 1: Inv	0	1	0	ND0INV2=[Param.]<CR><LF> ND0INV2?<CR><LF>
GpioNand1InputInvert2	I Enumeration	R/W	ND1INV2	Same as above.	0	1	0	ND1INV2=[Param.]<CR><LF> ND1INV2?<CR><LF>
MotorLensIris (5)	I Enumeration	R/W	MLI	0: Stop 1: Open 2: Close	0	2	0	MLI=[Param.]<CR><LF> MLI?<CR><LF>
MotorLensZoom (5)	I Enumeration	R/W	MLZ	0: Stop 1: Wide 2: Tele	0	2	0	MLZ=[Param.]<CR><LF> MLZ?<CR><LF>
MotorLensFocus (5)	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>

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>
HighDynamicRange Mode	I Enumeration	R/W	HES	0: Off / 1: On	0	1	0	HES=[Param.]<CR><LF> HES?<CR><LF>
HighDynamicRange Slope	I Enumeration	R/W	HKS	0: 70dB 1: 80dB 2: 90dB 3: 100dB	0	3	0	HKS=[Param.]<CR><LF> HKS?<CR><LF>
DarkCompression (*1)	I Enumeration	R/W	SBS	0: DarkCompression 1: Linear	0	1	1	SBS=[Param.]<CR><LF> SBS?<CR><LF>
SensorPwcOffset (*1)(*3)	I Enumeration	R/W	SPO	0: Off 1: On	0	1	0	SPO=[Param.]<CR><LF> SPO?<CR><LF>
BinningGainControl (*1)(*4)	I Enumeration	R/W	BINN	0: Disable 1: Enable	0	1	0	BINN=[Param.]<CR><LF> BINN?<CR><LF> (Mono model only)

Note: *1) is effective on DeviceVersion 0.3.0.0 and after
*2) is effective on DeviceVersion 0.4.0.2 and after
*3) is the offset for timing adjustment (Default: 0)
*4) is the adjustment gain (Default:0)
*5) is not supported on cameras with hardware revision K (mono model) / J (color model) or later.

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.

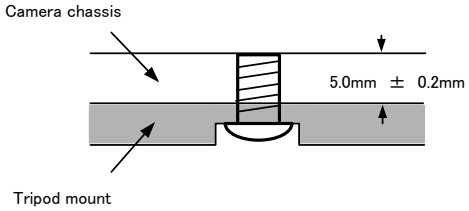
3. Caution when mounting a lens on the camera

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.

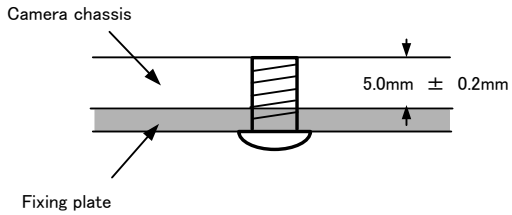
4. Caution when mounting the camera

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
2. Camera control software can be downloaded from www.jai.com

Manual change history

Date	Revision	Changes
Sept. 2013	Ver.1.0	New release
Oct. 2013	Ver.1.1	Add EMVA1288 spec. for SP-5000C-PMCL
Oct. 2013	Ver.1.2	Correct the top view of Bayer sensor
Feb. 2014	Ver. 1.3	Correct parameters on AcqusitionFrameRatePeriod in chapter 2.4.11, Add caution for command setting
Mar. 2014	Ver.1.4	Correct the pin assignment of P-iris
June 2014	Ver. 1.5	Revised totally
Sept. 2014	Ver.1.6	Revise Spectral Response
Oct. 2014	Ver.1.7	Revise B/W spectral response with wider wave length range, Add Dark Compensation to protocol
Feb. 2015	Ver. 1.8	12-bit specifications added, Correct Black level adjusting range
Mar. 2015	Ver. 1.9	Correct the value of itf in PIV, add note for changing gain.
April 2015	Ver. 2.0	Update the protocol list
Nov 2018	Ver. 2.1	Add KC.
Jan 2021	Ver. 2.2	China RoHS
May 2023	Ver. 2.3	Added notes that lens control is not supported on cameras with hardware revision K (mono model) / J (color model) or later.

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.

User's Mode Settings.

User's Modifications.

Europe, Middle East & Africa	*Asia Pacific*	*Americas*
Phone +45 4457 8888 *Fax +45 4491 3252*	*Phone +81 45 440 0154* *Fax +81 45 440 0166*	*Phone (toll-free) +1 800 445 5444* *Phone +1 408 383 0300*

Visit our web site at www.jai.com

See the possibilities