See the possibilities

User Manual

GO-5000M-PMCL
GO-5000C-PMCL

5M CMOS Digital Progressive Scan Monochrome and Color Camera

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Notice

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Warranty

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

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that GO-5000M-PMCL and GO-5000C-PMCL comply with the following provisions applying to its standards.
EN 61000-6-3 (Generic emission standard part 1)
EN 61000-6-2 (Generic immunity standard part 1)

FCC

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

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

Warning

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

Supplement

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

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

重要注意事项

有毒，有害物质或元素名称及含量表

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

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

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

环保使用期限

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

数字「15」为期限15年。

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	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PPB)	多溴二苯醚 (PBDE)
螺丝固定座	×	○	○	○	○	○
光学滤色镜	×	○	×	○	○	○
连接插头	×	○	○	○	○	○
电路板	×	○	○	○	○	○
.....	.....	.....	.....	.....	.....	.....

○: 表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006规定的限量要求以下。
×: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006规定的限量要求。
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Before using this camera

EMVA 1288

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

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

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

1. General

The GO-5000M-PMCL and GO-5000C-PMCL are new small-in-size cameras providing both high resolution and a high frame rate with excellent image quality for machine vision applications. The GO-5000M-PMCL is a monochrome progressive scan COMS camera and the GO-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 107.2 frames per second for continuous scanning with 2560 x 2048 full pixel resolution in 1x8-1Y, 8-bit 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 8-tap, 4-tap, 3-tap or 2-tap output.

The GO-5000M-PMCL and GO-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 GO-5000M-PMCL and GO-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.

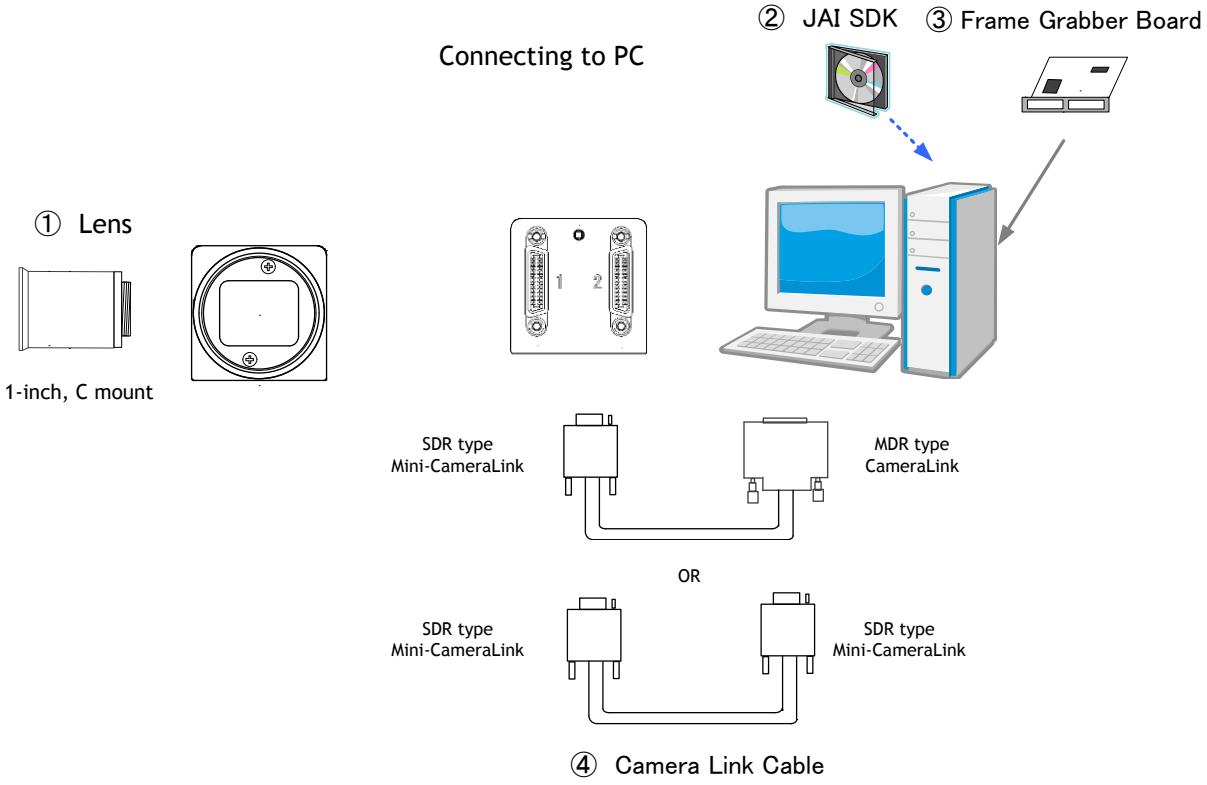
Tripod base	MP-43

3. Key features

- New small-in-size 1-inch CMOS 5-megapixel progressive scan camera
- Utilizes two Mini Camera Link interfaces to support Base, 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 (Dark compression is used, traditional measurement method)
- 8-bit, 10-bit or 12-bit output for monochrome and Bayer
- 107.2 frames/second with full resolution in continuous operation for 8-tap, 63.6 frames/second for 4-tap, 47.8 frames/second for 3-tap, and 31.9 fps for 2-tap readout
- Supports ROI (Region Of Interest) modes for faster frame rate
- 0dB to +24dB gain control for both GO-5000M-PMCL and GO-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 trigger mode for specific applications
- ALC control with combined function of AGC and Auto Shutter
- 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 (GO-5000C-PMCL only)
  Blemish compensation
  HDR (High Dynamic Range) function (GO-5000M-PMCL only)
- C-mount for lens mount
- Accepts power over Mini Camera Link
- Setup by Windows XP/Vista/7/8 via serial communication

4. Installation and preparation

Before starting operation, check to make sure that all equipment is appropriate and is connected in the right manner.



1. Lens used

The GO-5000-PMCL employs a 1-inch CMOS imager. It is necessary to select a 1-inch C mount lens if the full resolution of the camera is to be utilized. The imager used in the GO-5000-PMCL measures 16.392 mm diagonally, which is slightly larger than the standard 16 mm diagonal of the 1-inch format. Please consult with your lens provider to select a 1-inch lens able to cover 16.392 mm, otherwise the image captured may show vignetting.

It is possible to use C mount lenses with an optical format smaller than 1-inch, provided a less-than full-resolution ROI is going to be used. For example, a centered ROI of 1920 x 1080 pixels (HD format) will fit inside the image circle of most standard 2/3-inch C mount lenses. Likewise, a centered VGA ROI (640 x 480 pixels) can be accommodated by a standard 1/3-inch C mount lens.

The rear protrusion on any lens used must be less than 10 mm.

The focal length of lens used is estimated by the following formula.

Focal length = $WD/(1 + W/w)$

Here, WD: Working distance (the distance between lens and object)
W: Width of object
w: Width of sensor (the SP-5000-PMCL is 12.8 mm)

2. JAI SDK and Control Tool software

The GO-5000M-PMCL and GO-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. Third-party software can also be used with the camera provided it is compliant with the GenICam® standard. See section 10 for important notes regarding the use of third-party software.

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. A list of ASCII commands is shown at the end of this manual.

3. Frame grabber board

The GO-5000M-PMCL complies with "Power over Camera Link" which utilizes power supplied to the camera through the Camera Link cabling. Please be sure that the frame grabber board you are using also complies with this specification.

The GO-5000-PMCL employs output formats which comply with the GenICam® standard. They are 1X8-1Y (8-Tap output), 1X4–1Y (4-Tap output), 1X3–1Y (3-Tap output) and 1X2–1Y (2-Tap output). 1X8–1Y is available for 8-bit and 10-bit output, and 1X4-1Y and 1X2–1Y are available for 8-bit, 10-bit and 12-bit output. 1x3-1Y is only available for 8-bit output. Please check if the frame grabber used in the system complies with the mentioned formats.

The GO-5000-PMCL has two Camera Link connectors. Connector #1 is used for the Camera Link Base configuration, as well as in Medium and Full configurations. Power is supplied through this connector. Connector #2 is used for Medium and Full configurations.

4. Camera Link Cable

Please confirm that the Camera Link cable is securely connected to both the camera and the Camera Link interface board. A cable with a Mini-Camera Link connector (SDR) on one end is required to connect to the camera. A Standard Camera Link connector (MDR) or Mini (SDR) can be used on the other end of the cable, depending on the connector used in the Camera Link frame grabber board.
The length between the camera and frame grabber board is described in chapter 6.2.2.

5. 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.

6. Camera Default Settings

When the camera is connected to a PC and JAI SDK 2.0 is started up, an XML file which stores default settings of the camera is downloaded to the JAI_SDK camera control tool.

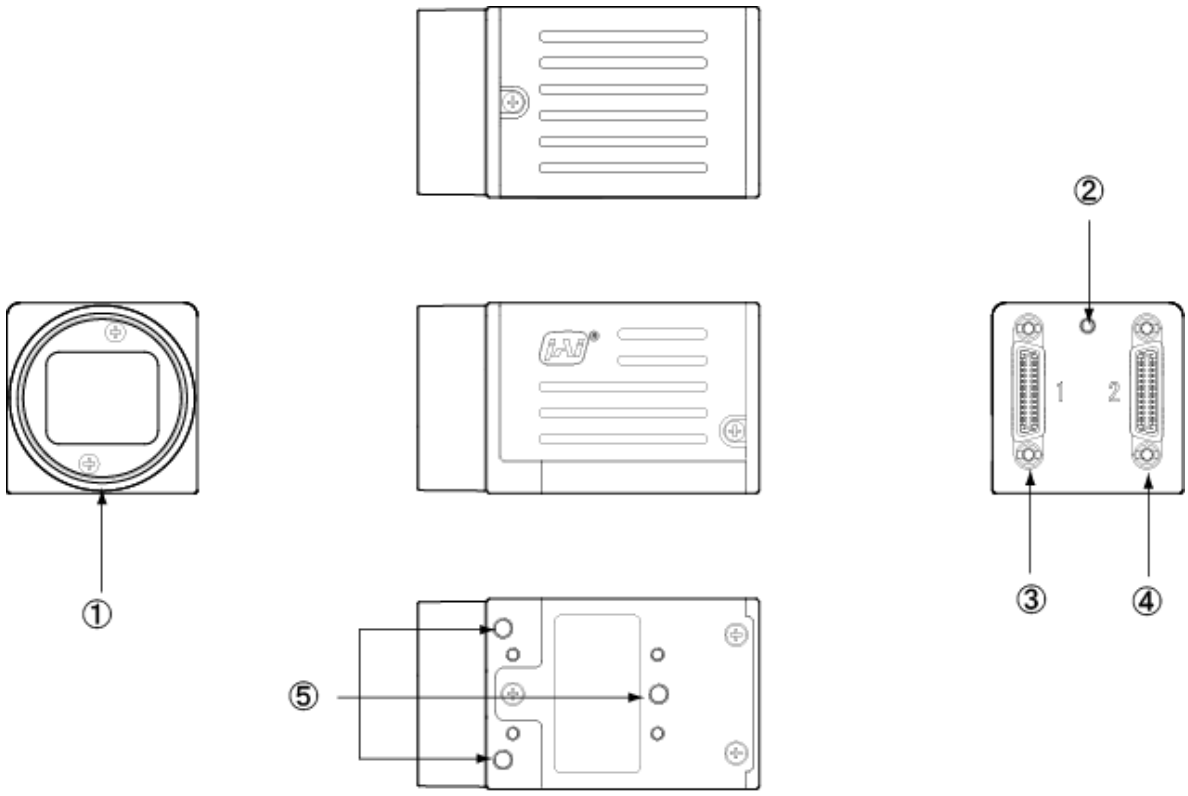
The default settings of the GO-5000-PMCL are as follows.

Table – 1 Default settings

Image Format	Bit allocation	8-bit
	Height	2048
	Device Tap Geometry	1x8_1Y
	Binning Horizontal	OFF
	Binning Vertical	OFF
Trigger Operation	Trigger Mode	OFF
	Trigger Source	CL_CC1_In
Exposure Control	Exposure Mode	OFF
Gain	Gain Auto	OFF
	Manual Gain all	0
	Manual Fine Gain all	0
	Analogue Base Gain	0dB

5. Parts locations and their functions

5.1 Parts locations and their functions



①	Lens mount	C-mount (Note *1)
②	LED	Indication for power and trigger input
③	Camera Link Connector 1	Digital video output (Base, Medium and Full config.) (Note *2)
④	Camera Link Connector 2	Digital video output (Medium and Full configuration) (Note *2)
⑤	Mounting holes	M3 depth 5 mm 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-43 (option). For MP-43, three M3x5 pan head screws must be used.

Fig. 1 Locations

5.2 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.

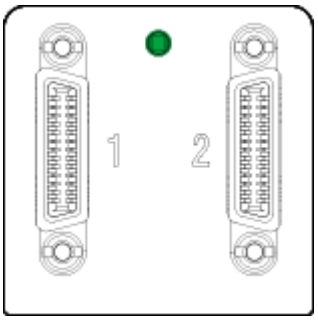


Fig. 2 Rear panel

6. Input and output

6.1 Connector and its pin configuration

6.1.1 Camera Link Connector

6.1.1.1 Figure

Type: 26-pin Mini Camera Link connector (Honda HDR-EC26FYTG2-SL+). The camera has two connectors. Power over Camera Link (PoCL) must be provided over Connector #1.

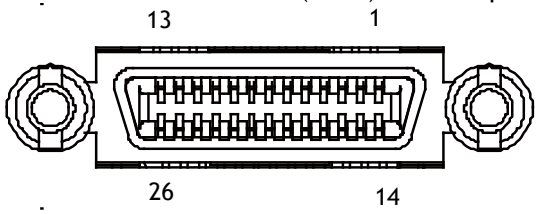


Fig.3 Camera Link connector

6.1.1.2 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)	Line2 Trigger input
10(+),23(-)	I	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	Connector #1 must be used for 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(-)		N.C	
8(-),21(+)	O	Z_OUT0	Data output
9(-),22(+)	O	Z_OUT1	
10(+),23(-)	O	Z_OUT2	
11,24	O	Z_Clk	Clock for CL
12,25	O	Z_OUT3	Data output
13,14		Shield	Power Return

6.2 Camera Link interface

6.2.1 Camera Link Interface

Table-3 Camera Link interface

GO-5000M/C-PMCL							
Port	Camera Link Configuration		Base	Base	Medium	Full	80bit
	Camera Link port/bit		2Tap / 12bit	3Tap/8bit	4Tap / 12bit	8 Tap / 8bit	8 Tap / 10bit
	GenICam Tap Geometry		1X2 - 1Y	1X3 - 1Y	1X4 - 1Y	1x8 - 1Y	1X8 - 1Y
Digital I/O-1	Port A0	TxIN 0	Tap1 D0	Tap 1 D0	Tap 1 D0	Tap 1 D0	Tap 1 D2
	Port A1	TxIN 1	Tap1 D1	Tap 1 D1	Tap 1 D1	Tap 1 D1	Tap 1 D3
	Port A2	TxIN 2	Tap1 D2	Tap 1 D2	Tap 1 D2	Tap 1 D2	Tap 1 D4
	Port A3	TxIN 3	Tap1 D3	Tap 1 D3	Tap 1 D3	Tap 1 D3	Tap 1 D5
	Port A4	TxIN 4	Tap1 D4	Tap 1 D4	Tap 1 D4	Tap 1 D4	Tap 1 D6
	Port A5	TxIN 6	Tap1 D5	Tap 1 D5	Tap 1 D5	Tap 1 D5	Tap 1 D7
	Port A6	TxIN 27	Tap1 D6	Tap 1 D6	Tap 1 D6	Tap 1 D6	Tap 1 D8
	Port A7	TxIN 5	Tap1 D7	Tap 1 D7	Tap 1 D7	Tap 1 D7	Tap 1 D9
	Port B0	TxIN 7	Tap1 D8	Tap 2 D0	Tap 1 D8	Tap 2 D0	Tap 2 D2
	Port B1	TxIN 8	Tap1 D9	Tap 2 D1	Tap 1 D9	Tap 2 D1	Tap 2 D3
	Port B2	TxIN 9	Tap1 D10	Tap 2 D2	Tap 1 D10	Tap 2 D2	Tap 2 D4
	Port B3	TxIN 12	Tap1 D11	Tap 2 D3	Tap 1 D11	Tap 2 D3	Tap 2 D5
	Port B4	TxIN 13	Tap2 D8	Tap 2 D4	Tap 2 D8	Tap 2 D4	Tap 2 D6
	Port B5	TxIN 14	Tap2 D9	Tap 2 D5	Tap 2 D9	Tap 2 D5	Tap 2 D7
	Port B6	TxIN 10	Tap2 D10	Tap 2 D6	Tap 2 D10	Tap 2 D6	Tap 2 D8
	Port B7	TxIN 11	Tap2 D11	Tap 2 D7	Tap 2 D11	Tap 2 D7	Tap 2 D9
	Port C0	TxIN 15	Tap2 D0	Tap 3 D0	Tap 2 D0	Tap 3 D0	Tap 3 D2
	Port C1	TxIN 18	Tap2 D1	Tap 3 D1	Tap 2 D1	Tap 3 D1	Tap 3 D3
	Port C2	TxIN 19	Tap2 D2	Tap 3 D2	Tap 2 D2	Tap 3 D2	Tap 3 D4
	Port C3	TxIN 20	Tap2 D3	Tap 3 D3	Tap 2 D3	Tap 3 D3	Tap 3 D5
	Port C4	TxIN 21	Tap2 D4	Tap 3 D4	Tap 2 D4	Tap 3 D4	Tap 3 D6
	Port C5	TxIN 22	Tap2 D5	Tap 3 D5	Tap 2 D5	Tap 3 D5	Tap 3 D7
	Port C6	TxIN 16	Tap2 D6	Tap 3 D6	Tap 2 D6	Tap 3 D6	Tap 3 D8
	Port C7	TxIN 17	Tap2 D7	Tap 3 D7	Tap 2 D7	Tap 3 D7	Tap 3 D9
	-	TxIN 24	LVAL	LVAL	LVAL	LVAL	LVAL
	-	TxIN 25	FVAL	FVAL	FVAL	FVAL	FVAL
	(Port I0)	TxIN 26	DVAL	DVAL	DVAL	DVAL	Tap 1 D0
	(Port I1)	TxIN 23	Exposure Active	Exposure Active	Exposure Active	Exposure Active	Tap 1 D1

GO-5000-PMCL							
Port	**Camera Link Configuration**		**Base**	**Base**	**Medium**	**Full**	**80bit**
	Camera Link port/bit		**2Tap / 12bit**	**3Tap/8bit**	**4Tap / 12bit**	**8 Tap / 8bit**	**8 Tap / 10bit**
	GenICam Tap Geometry		**1X2 - 1Y**	**1X3 - 1Y**	**1X4 - 1Y**	**1x8 - 1Y**	**1X8 - 1Y**
Digital I/O-2 (1/2)	Port D0	TxIN 0	–	–	Tap 4 D0	Tap 4 D0	Tap 4 D2
	Port D1	TxIN 1	–	–	Tap 4 D1	Tap 4 D1	Tap 4 D3
	Port D2	TxIN 2	–	–	Tap 4 D2	Tap 4 D2	Tap 4 D4
	Port D3	TxIN 3	–	–	Tap 4 D3	Tap 4 D3	Tap 4 D5
	Port D4	TxIN 4	–	–	Tap 4 D4	Tap 4 D4	Tap 4 D6
	Port D5	TxIN 6	–	–	Tap 4 D5	Tap 4 D5	Tap 4 D7
	Port D6	TxIN 27	–	–	Tap 4 D6	Tap 4 D6	Tap 4 D8
	Port D7	TxIN 5	–	–	Tap 4 D7	Tap 4 D7	Tap 4 D9
	Port E0	TxIN 7	–	–	Tap 3 D0	Tap 5 D0	Tap 5 D2
	Port E1	TxIN 8	–	–	Tap 3 D1	Tap 5 D1	Tap 5 D3
	Port E2	TxIN 9	–	–	Tap 3 D2	Tap 5 D2	Tap 5 D4
	Port E3	TxIN 12	–	–	Tap 3 D3	Tap 5 D3	Tap 5 D5
	Port E4	TxIN 13	–	–	Tap 3 D4	Tap 5 D4	Tap 5 D6
	Port E5	TxIN 14	–	–	Tap 3 D5	Tap 5 D5	Tap 5 D7
	Port E6	TxIN 10	–	–	Tap 3 D6	Tap 5 D6	Tap 5 D8
	Port E7	TxIN 11	–	–	Tap 3 D7	Tap 5 D7	Tap 5 D9
	Port F0	TxIN 15	–	–	Tap 3 D8	Tap6 D0	Tap 6 D2
	Port F1	TxIN 18	–	–	Tap 3 D9	Tap6 D1	Tap 6 D3
	Port F2	TxIN 19	–	–	Tap 3 D10	Tap6 D2	Tap 6 D4
	Port F3	TxIN 20	–	–	Tap 3 D11	Tap6 D3	Tap 6 D5
	Port F4	TxIN 21	–	–	Tap 4 D8	Tap6 D4	Tap 6 D6
	Port F5	TxIN 22	–	–	Tap 4 D9	Tap6 D5	Tap 6 D7
	Port F6	TxIN 16	–	–	Tap 4 D10	Tap6 D6	Tap 6 D8
	Port F7	TxIN 17	–	–	Tap 4 D11	Tap6 D7	Tap 6 D9
	-	TxIN 24	–	–	LVAL	LVAL	LVAL
	(Port I2)	TxIN 25	–	–	FVAL	FVAL	Tap 2 D0
	(Port I3)	TxIN 26	–	–	DVAL	DVAL	Tap 2 D1
	(Port I4)	TxIN 23	–	–	Exposure Active	Exposure Active	Tap 3 D0

GO-5000M/C-PMCL							
Port	Camera Link Configuration		Base	Base	Medium	Full	80bit
	Camera Link port/bit		2Tap / 12bit	3Tap/8bit	4Tap / 12bit	8 Tap / 8bit	8 Tap / 10bit
	GenICam Tap Geometry		1X2 - 1Y	1X3 - 1Y	1X4 - 1Y	1x8 - 1Y	1X8 - 1Y
Digital I/O-2 (2/2)	Port G0	TxIN 0	–	–	–	Tap 7 D0	Tap 7 D2
	Port G1	TxIN 1	–	–	–	Tap 7 D1	Tap 7 D3
	Port G2	TxIN 2	–	–	–	Tap 7 D2	Tap 7 D4
	Port G3	TxIN 3	–	–	–	Tap 7 D3	Tap 7 D5
	Port G4	TxIN 4	–	–	–	Tap 7 D4	Tap 7 D6
	Port G5	TxIN 6	–	–	–	Tap 7 D5	Tap 7 D7
	Port G6	TxIN 27	–	–	–	Tap 7 D6	Tap 7 D8
	Port G7	TxIN 5	–	–	–	Tap 7 D7	Tap 7 D9
	Port H0	TxIN 7	–	–	–	Tap 8 D0	Tap 8 D2
	Port H1	TxIN 8	–	–	–	Tap 8 D1	Tap 8 D3
	Port H2	TxIN 9	–	–	–	Tap 8 D2	Tap 8 D4
	Port H3	TxIN 12	–	–	–	Tap 8 D3	Tap 8 D5
	Port H4	TxIN 13	–	–	–	Tap 8 D4	Tap 8 D6
	Port H5	TxIN 14	–	–	–	Tap 8 D5	Tap 8 D7
	Port H6	TxIN 10	–	–	–	Tap 8 D6	Tap 8 D8
	Port H7	TxIN 11	–	–	–	Tap 8 D7	Tap 8 D9
	(Port I5)	TxIN 15	–	–	–		Tap 3 D1
	(Port I6)	TxIN 18	–	–	–		Tap 4 D0
	(Port I7)	TxIN 19	–	–	–		Tap 4 D1
	(Port K0)	TxIN 20	–	–	–		Tap 5 D0
	(Port K1)	TxIN 21	–	–	–		Tap 5 D1
	(Port K2)	TxIN 22	–	–	–		Tap 6 D0
	(Port K3)	TxIN 16	–	–	–		Tap 6 D1
	(Port K4)	TxIN 17	–	–	–		Tap 7 D0
	-	TxIN 24	–	–	–	LVAL	LVAL
	(Port K5)	TxIN 25	–	–	–	FVAL	Tap 7 D1
	(Port K6)	TxIN 26	–	–	–	DVAL	Tap 8 D0
	(Port K7)	TxIN 23	–	–	–	Exposure Active	Tap 8 D1

Note

1. In this table, not all tap geometry items are described. For instance, 1X4-1Y shows only 12-bit. In case of 10-bit, upper 2 bits (D10 and D11) are not used and in case of 8-bit, upper 4 bits (D8 through D11) are not used.
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.

6.2.2 Camera Link pixel clock frequency

In the GO-5000M-PMCL and GO-5000C-PMCL, the Camera Link pixel clock can be selected from 84.99 MHz, 72.85 MHz, 58.28 MHz, and 48.57 MHz. If the 48.57MHz clock is used, the transfer length through the camera link cable will be extended to 10m for all tap geometries. On the other hand, the frame rate will be reduced (see table). The default setting is 72.85 MHz.

Table – 4 Camera link pixel clock, cable length, and frame rates

Camera Link Pixel Clock	Maximum length	1X2-1Y	1X3-1Y	1X4-1Y	1X8-1Y	
		8/10/12bit	8bit	8/10/12bit	8bit	10bit
High (84.99MHz)	5m	31.9	47.8	63.6	-	-
Mid (72.85 MHz)	5m	27.4	41.0	54.7	-	-
High (72.85 MHz)	10m	-	-	-	107.2	-
Mid (58.28 MHz)	10m	-	-	-	-	84.9
Low (48.57 MHz)	10m	18.3	27.4	36.4	70.8	70.8

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

6.3 Digital IN/OUT interface

In the GO-5000M-PMCL and GO-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).

6.3.1 Line Selector

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

Table-5 Line selector

Line Selector item	Description
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

6.3.2 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-6 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
Pulse Generator 0 Out	Connect Pulse Generator 0 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

Note]
As for LVAL, some line items cannot be connected. Refer to "5.3.7.2 GPIO matrix table"

6.3.3 Line Mode

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

6.3.4 Line Inverter

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

6.3.5 Line Status

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

6.3.6 Line Format

Indicates the interface information of the input and output lines.

Not connected, TTL, LVDS or Opto-coupled
Note: In the GO-5000-PMCL, Opto-coupled interface is not available.

6.3.7 GPIO

GPIO is a general interface for input and output which 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.

6.3.7.1 Basic block diagram

The basic block diagram is as follows.

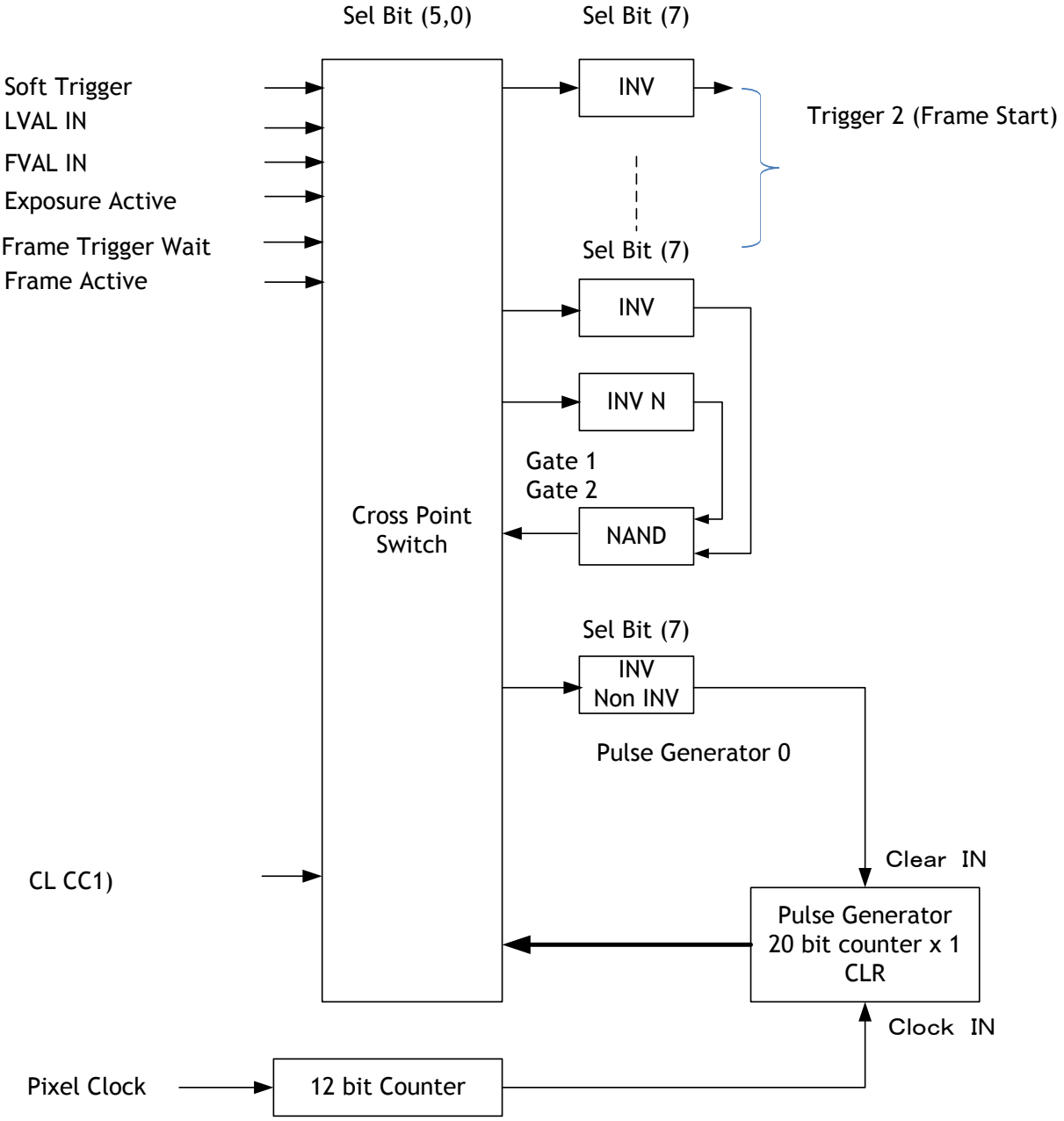


Fig.4 GPIO interface

6.3.7.2 Input and output matrix table

The relationship between input and output is as follows.

Table-7 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)	NAND 1 In 1	NAND 1 In 2	NAND 2 In 1	NAND 2 In 2	Pulse Generator 0
Low	○	○	○	○	○	○
High	○	○	○	○	○	○
Soft Trigger	○	×	×	×	×	×
Exposure Active	×	○	○	○	○	○
Frame Trigger Wait	×	○	○	○	○	○
Frame Active	×	○	○	○	○	○
FVAL	×	○	○	○	○	○
LVAL	×	×	×	×	×	○
Pulse Generator 0	○	○	○	○	○	×
CL CC1 in	○	○	○	○	○	○
NAND 0 Out	○	×	×	○	○	○
NAND 1 Out 1	○	○	○	×	×	○
	Trigger Source					Pulse Generator Clear Source

6.4 Pulse Generator

The GO-5000-PMCL has a frequency divider using the sensor clock as the basic clock and one pulse generator. In the Pulse Generator, various Clear settings are connected to GPIO.
The following shows the Pulse Generator default settings. In the GO-5000-PMCL, the sensor pixel clock is 36 MHz for 8-bit, 28.8MHZ for 10-bit and 24 MHZ for 12-bit.

Table - 8 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

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.

6.4.1 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.

6.4.2 Pulse Generator Selector

The GO-5000-PMCL has only one pulse generator. Therefore, it is fixed.

Table - 9 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.

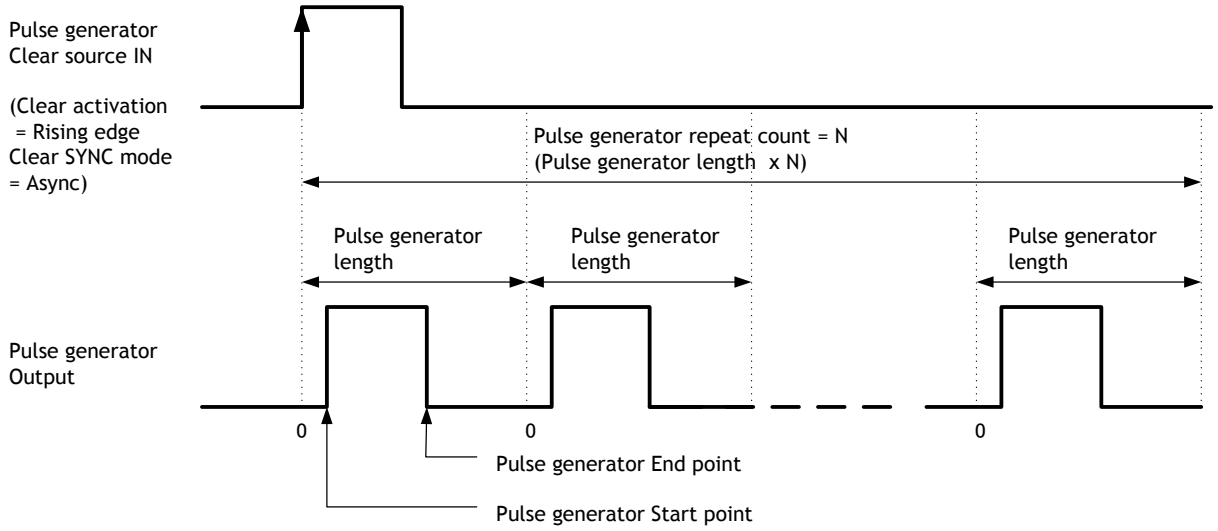


Fig.5 Pulse Generator pulse construction

6.4.3 Pulse Generator Length

Set the counter up value for the 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.

6.4.4 Pulse Generator Start Point

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

6.4.5 Pulse Generator End Point

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

6.4.6 Pulse Generator Repeat Count

Set the repeating number of the pulse for the 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 a free-running counter.

6.4.7 Pulse Generator Clear Activation

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

6.4.8 Pulse Generator Clear Sync Mode

Set the count clear method for the 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.

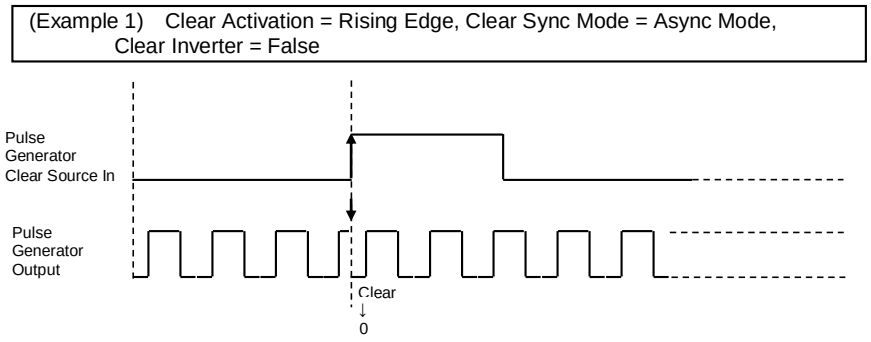


Fig.6 Counter clear in Async mode

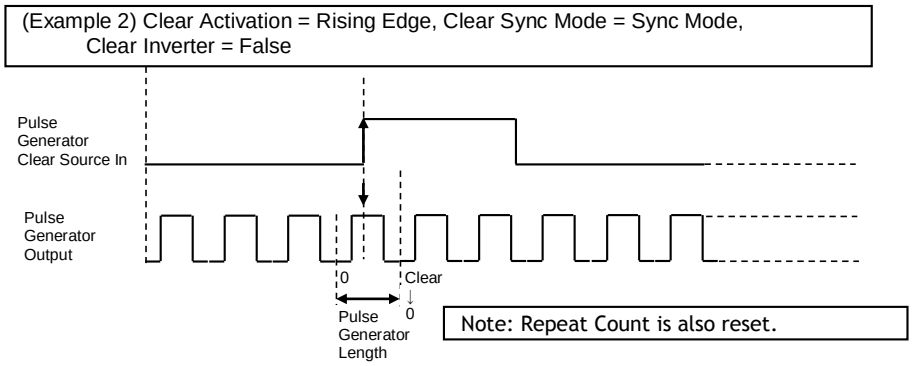


Fig.7 Counter clear in Sync mode

6.4.9 Pulse Generator Clear Source

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

Table - 10 Pulse generator clear source

Pulse Generator Clear Source item	Description
Low	Connect Low level signal to Clear Source for the pulse generator. **Default setting**
High	Connect High level signal to Clear Source for the pulse generator.
Frame Trigger Wait	Connect Frame Trigger Wait signal to Clear Source for the pulse generator.
Frame Active	Connect Frame Active signal to Clear Source for the pulse generator.
Exposure Active	Connect Exposure Active signal to Clear Source for the pulse generator.
FVAL	Connect FVAL signal to Clear Source for the pulse generator.
LVAL	Connect LVAL signal to Clear Source for the pulse generator.
CL CC1 In	Connect CL CC1 IN signal to Clear Source for the pulse generator.
Nand0 Out	Connect NAND 0 output signal to Clear Source for the pulse generator.
Nand1 Out	Connect NAND 1 output signal to Clear Source for the pulse generator.

6.4.10 Pulse Generator Inverter

Clear Source Signal can be have polarity inverted.

6.4.11 Pulse Generator Setting table

Table - 11 Pulse Generator setting parameters

Display Name	Value
Clock Pre-scaler	1 to 4096
Pulse Generator Clock (MHZ)	[Pixel Clock:36MHz/28.8MHz/24MHz]÷[Clock Pre-scaler]
Pulse Generator Selector	- Pulse Generator 0
- 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
	- CL_CC1_In
	- Nand0 Out
	- Nand1 Out
- 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.

7. Sensor layout, output format and timing

7.1 Sensor layout

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

7.1.1 Monochrome sensor

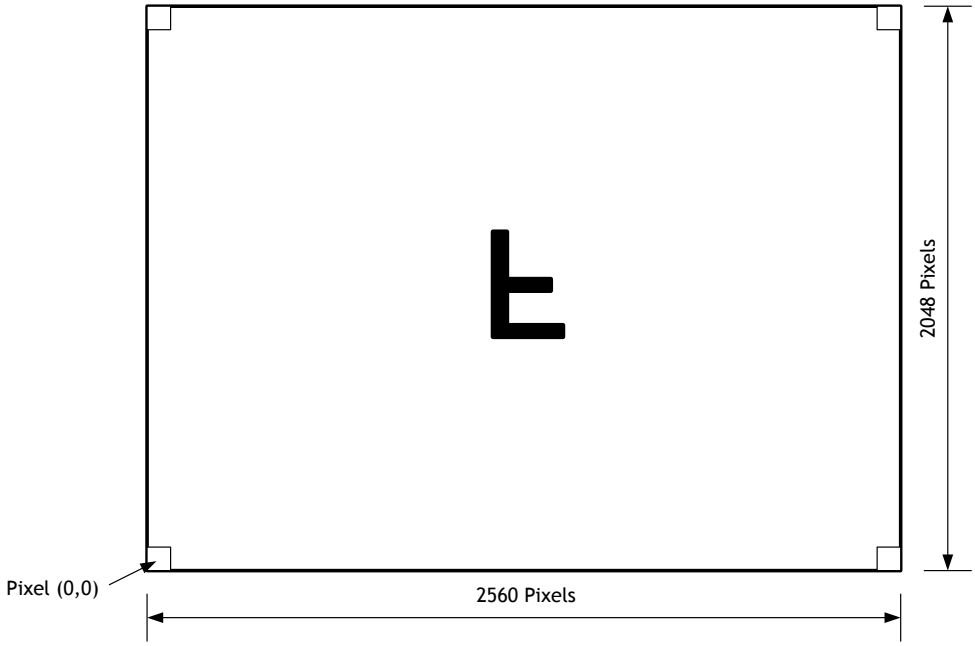


Fig. 8 Monochrome sensor layout

7.1.2 Bayer sensor

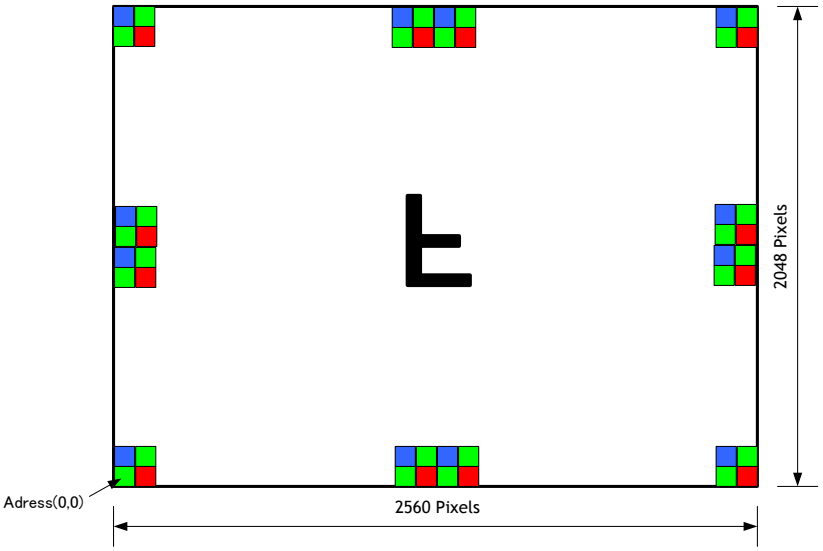


Fig. 9 Color sensor layout

7.2 Camera output format (Tap Geometry)

Table - 12 Output format

Camera output format	Bit assignment	Refer to drawing
1X2-1Y	8-bit, 10-bit, 12-bit	7.2.1
1X3-1Y	8-bit	7.2.2
1X4-1Y	8-bit, 10-bit, 12-bit	7.2.3
1X8-1Y	8-bit, 10-bit	7.2.4

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

7.2.1 1X2-1Y

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

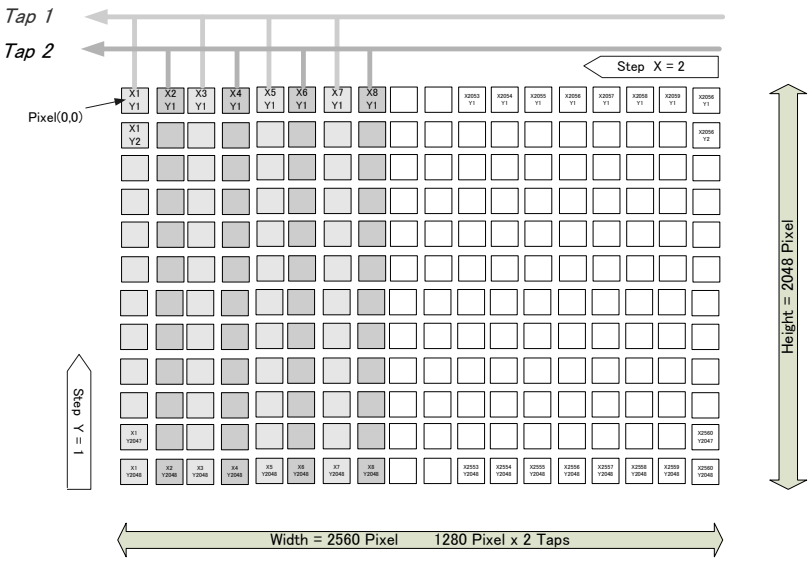
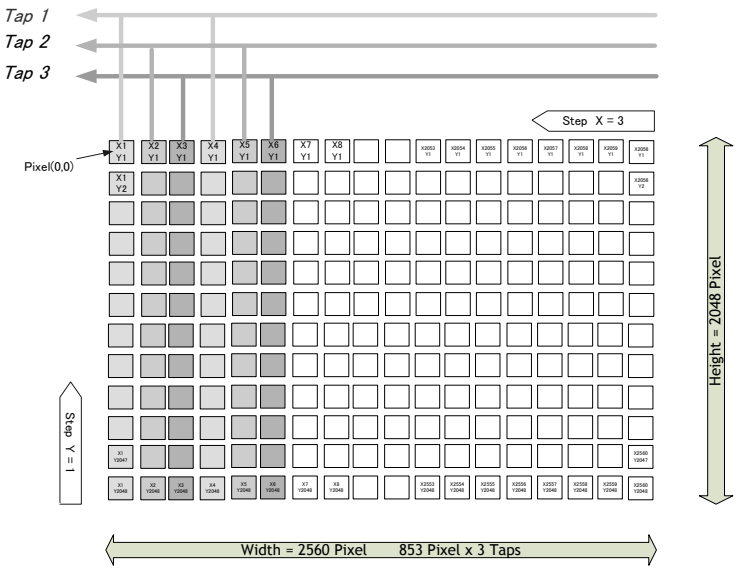


Fig.10 1X2-1Y output format

7.2.2 1X3-1Y

1X3-1Y is a 3-tap readout system specified in GenICam Tap Geometry.



7.2.3 1X4-1Y

1X4-1Y is a 4-tap readout system specified in GenICam Tap Geometry.

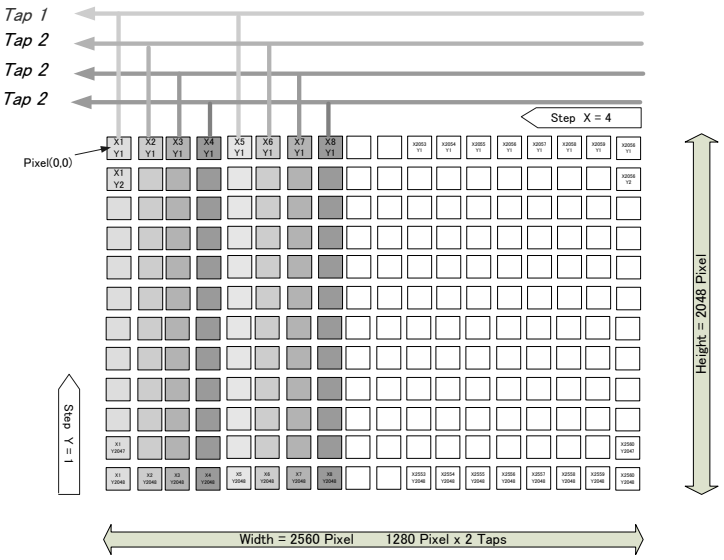


Fig. 11 1X4-1Y output format

7.2.4 1X8-1Y

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

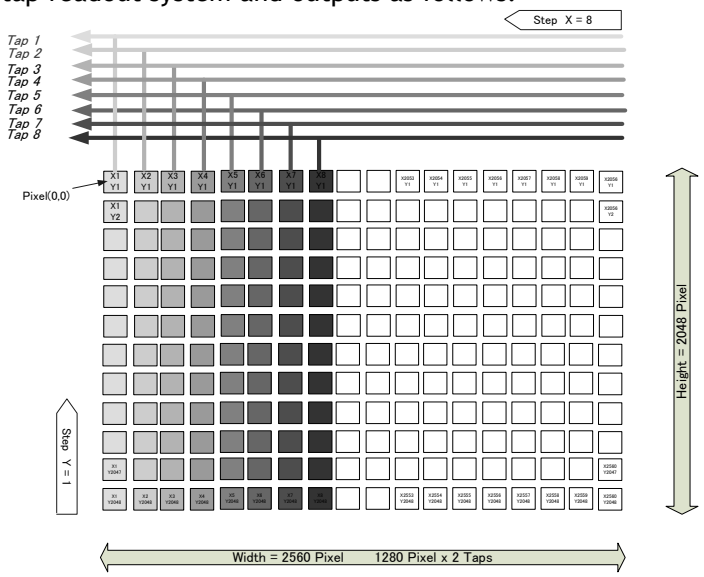


Fig. 12 1X8-1Y output format

7.3 Output timing and output image

7.3.1 Horizontal timing

The horizontal frequency is changed by setting the Tap Geometry. In the GO-5000M-PMCL, H-binning is available.

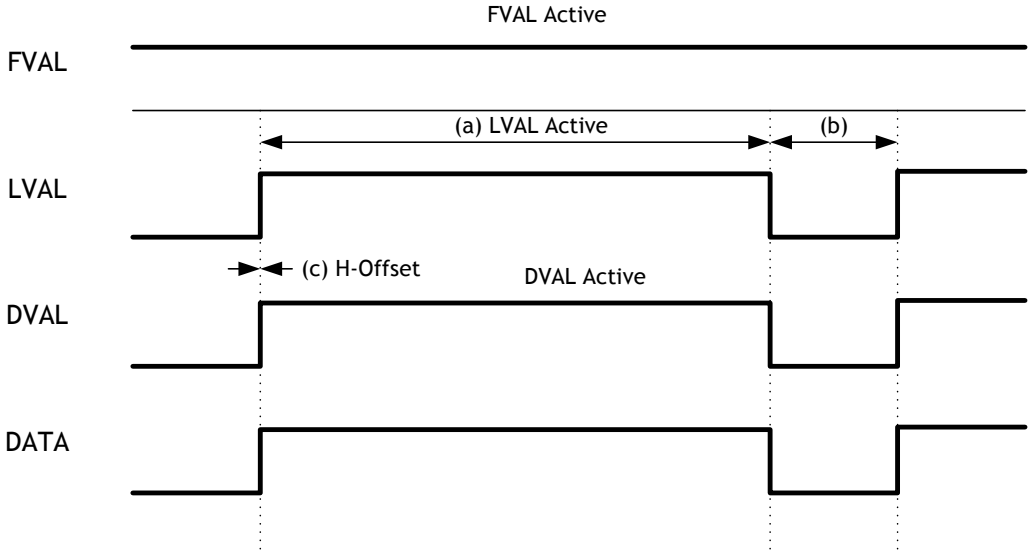


Fig. 13 Horizontal timing per 1 tap in Camera Link output

Table -13 Horizontal timing parameters in continuous trigger mode (1/2)

Camera Settings								(a)	(b)	(c)
Tap Geometry	Camera Link Pixel Clock	ROI				Bining		LVAL Active	LVAL Non Active	H Total
		Width	Offset X	Height	Offset Y	Horizontal	Vertical	(Unit: clock)	(Unit: clock)	(Unit: clock)
1X8 - 1Y 8-bit	72.85 MHz	2560	0	2048	0	Off	Off	320	10	330
		1280	0	2048	0	x2	Off	160	170	330
		640	0	2048	0	x4	Off	80	250	330
		2560	0	1024	0	Off	x2	320	10	330
		1280	0	1024	0	x2	x2	160	170	330
		640	0	1024	0	x4	x2	80	250	330
		2560	0	512	0	Off	Off	320	10	330
		1280	0	512	0	x2	x4	160	170	330
		640	0	512	0	x4	x4	80	250	330
	48.57 MHz	2560	0	2048	0	Off	Off	320	14	334
		1280	0	2048	0	x2	Off	160	170	330
		640	0	2048	0	x4	Off	80	250	330
		2560	0	1024	0	Off	x2	320	14	334
		1280	0	1024	0	x2	x2	160	170	330
		640	0	1024	0	x4	x2	80	250	330
		2560	0	512	0	Off	Off	320	14	334
		1280	0	512	0	x2	x4	160	170	330
		640	0	512	0	x4	x4	80	250	330

Camera Settings								(a)	(b)	(c)
Tap Geometry	Camera Link Pixel Clock	ROI				Bining		LVAL Active	LVAL Non Active	H Total
		Width	Offset X	Height	Offset Y	Horizontal	Vertical	(Unit: clock)	(Unit: clock)	(Unit: clock)
1X8 - 1Y 10-bit	58.28 MHz	2560	0	2048	0	Off	Off	320	14	334
		1280	0	2048	0	x2	Off	160	170	330
		640	0	2048	0	x4	Off	80	250	330
		2560	0	1024	0	Off	x2	320	14	334
		1280	0	1024	0	x2	x2	160	170	330
		640	0	1024	0	x4	x2	80	250	330
		2560	0	512	0	Off	Off	320	14	334
		1280	0	512	0	x2	x4	160	170	330
		640	0	512	0	x4	x4	80	250	330

Camera Settings								(a)	(b)	(c)
Tap Geometry	Camera Link Pixel Clock	ROI				Bining		LVAL Active	LVAL Non Active	H Total
		Width	Offset X	Height	Offset Y	Horizontal	Vertical	(Unit: clock)	(Unit: clock)	(Unit: clock)
1X4 - 1Y	84.99 MHZ	2560	0	2048	0	Off	Off	640	14	654
		1280	0	2048	0	x2	Off	320	253	573
		640	0	2048	0	x4	Off	160	413	573
		2560	0	1024	0	Off	x2	640	14	654
		1280	0	1024	0	x2	x2	320	253	573
		640	0	1024	0	x4	x2	160	413	573
		2560	0	512	0	Off	Off	640	14	654
		1280	0	512	0	x2	x4	320	253	573
		640	0	512	0	x4	x4	160	413	573
	72.85 MHz	2560	0	2048	0	Off	Off	640	12	652
		1280	0	2048	0	x2	Off	320	179	499
		640	0	2048	0	x4	Off	160	339	499
		2560	0	1024	0	Off	x2	640	12	652
		1280	0	1024	0	x2	x2	320	179	499
		640	0	1024	0	x4	x2	160	339	499
		2560	0	512	0	Off	Off	640	12	652
		1280	0	512	0	x2	x4	320	179	499
		640	0	512	0	x4	x4	160	339	499
	48.57 MHz	2560	0	2048	0	Off	Off	640	12	652
		1280	0	2048	0	x2	Off	320	173	493
		640	0	2048	0	x4	Off	160	333	493
		2560	0	1024	0	Off	x2	640	12	652
		1280	0	1024	0	x2	x2	320	173	493
		640	0	1024	0	x4	x2	160	333	493
		2560	0	512	0	Off	Off	640	12	652
		1280	0	512	0	x2	x4	320	173	493
		640	0	512	0	x4	x4	160	333	493

Camera Settings								(a)	(b)	(c)
Tap Geometry	Camera Link Pixel Clock	ROI				Bining		LVAL Active	LVAL Non Active	H Total
		Width	Offset X	Height	Offset Y	Horizontal	Vertical	(Unit: clock)	(Unit: clock)	(Unit: clock)
1X3 - 1Y	84.99 MHZ	2559	0	2048	0	Off	Off	853	12	865
		1278	0	2048	0	x2	Off	426	149	575
		639	0	2048	0	x4	Off	213	365	578
		2559	0	1024	0	Off	x2	853	12	865
		1280	0	1024	0	x2	x2	426	149	575
		639	0	1024	0	x4	x2	213	365	578
		2559	0	512	0	Off	Off	853	12	865
		1278	0	512	0	x2	x4	426	149	575
		639	0	512	0	x4	x4	213	365	578

Camera Settings								(a)	(b)	(c)
Tap Geometry	Camera Link Pixel Clock	ROI				Bining		LVAL Active	LVAL Non Active	H Total
		Width	Offset X	Height	Offset Y	Horizontal	Vertical	(Unit: clock)	(Unit: clock)	(Unit: clock)
1X2 - 1Y	84.99 MHz	2560	0	2048	0	Off	Off	1280	14	1294
		1280	0	2048	0	x2	Off	640	17	657
		640	0	2048	0	x4	Off	320	155	575
		2560	0	1024	0	Off	x2	1280	14	1294
		1280	0	1024	0	x2	x2	640	17	657
		640	0	1024	0	x4	x2	320	155	575
		2560	0	512	0	Off	Off	1280	14	1294
		1280	0	512	0	x2	x4	640	17	657
		640	0	512	0	x4	x4	320	155	575
	72.85 MHz	2560	0	2048	0	Off	Off	1280	14	1294
		1280	0	2048	0	x2	Off	640	13	653
		640	0	2048	0	x4	Off	320	173	493
		2560	0	1024	0	Off	x2	1280	14	1294
		1280	0	1024	0	x2	x2	640	13	653
		640	0	1024	0	x4	x2	320	173	493
		2560	0	512	0	Off	Off	1280	14	1294
		1280	0	512	0	x2	x4	640	13	653
		640	0	512	0	x4	x4	320	173	493
	48.57 MHz	2560	0	2048	0	Off	Off	1280	16	1296
		1280	0	2048	0	x2	Off	640	21	651
		640	0	2048	0	x4	Off	320	15	335
		2560	0	1024	0	Off	x2	1280	16	1296
		1280	0	1024	0	x2	x2	640	21	651
		640	0	1024	0	x4	x2	320	15	335
		2560	0	512	0	Off	Off	1280	16	1296
		1280	0	512	0	x2	x4	640	21	651
		640	0	512	0	x4	x4	320	15	335

Table – 14 Horizontal timing parameters in continuous trigger mode (2/2)

Note: A is Operation value and B is calculation value

Camera Settings								A: Operation value, B:Calculation value			
Tap Geometry	Camera Link Pixel Clock	ROI				Bining			1 line Total clock	Horizontal Frequency	Horizontal Period
		Width	Offset X	Height	Offset Y	Horizontal	Vertical		(Unit: clock)	(Unit: clock)	(Unit: clock)
1X8 - 1Y 8-bit	72.85 MHz	2560	0	2048	0	Off	Off	A	330	220.751	4.53
								B	330	220.779	4.529
		1280	0	2048	0	x2	Off	A	330	220.751	4.53
								B	330	220.779	4.529
		640	0	2048	0	x4	Off	A	330	220.751	4.53
								B	330	220.779	4.529
		2560	0	1024	0	Off	x2	A	330	220.751	4.53
								B	330	220.779	4.529
		1280	0	1024	0	x2	x2	A	330	220.751	4.53
								B	330	220.779	4.529
		640	0	1024	0	x4	x2	A	330	220.751	4.53
								B	330	220.779	4.529
		2560	0	512	0	Off	x4	A	330	220.751	4.53
								B	330	220.779	4.529
		1280	0	512	0	x2	x4	A	330	220.751	4.53
								B	330	220.779	4.529
		640	0	512	0	x4	x4	A	330	220.751	4.53
								B	330	220.779	4.529
	48.57 MHz	2560	0	2048	0	Off	Off	A	333.7	145.56	6.87
								B	334	145.423	6.876
		1280	0	2048	0	x2	Off	A	329.3	147.493	6.78
								B	330	147.186	6.794
		640	0	2048	0	x4	Off	A	329.3	147.493	6.78
								B	330	147.186	6.794
		2560	0	1024	0	Off	x2	A	333.7	145.56	6.87
								B	334	145.423	6.876
		1280	0	1024	0	x2	x2	A	329.3	147.493	6.78
								B	330	147.186	6.794
		640	0	1024	0	x4	x2	A	329.3	147.493	6.78
								B	330	147.186	6.794
		2560	0	512	0	Off	x4	A	333.7	145.56	6.87
								B	334	145.423	6.876
		1280	0	512	0	x2	x4	A	329.3	147.493	6.78
								B	330	147.186	6.794
		640	0	512	0	x4	x4	A	329.3	147.493	6.78
								B	330	147.186	6.794

Camera Settings								A: Operation value, B:Calculation value			
Tap Geometry	Camera Link Pixel Clock	ROI				Bining			1 line Total clock	Horizontal Frequency	Horizontal Period
		Width	Offset X	Height	Offset Y	Horizontal	Vertical		(Unit: clock)	(Unit: clock)	(Unit: clock)
1X-8 - 1Y 10bit	58.28 MHz	2560	0	2048	0	Off	Off	A	333.4	174.825	5.72
								B	334	174.508	5.73
		1280	0	2048	0	x2	Off	A	329.9	176.687	5.66
								B	330	176.623	5.662
		640	0	2048	0	x4	Off	A	329.9	176.687	5.66
								B	330	176.623	5.662
		2560	0	1024	0	Off	x2	A	333.4	174.825	5.72
								B	334	174.508	5.73
		1280	0	1024	0	x2	x2	A	329.9	176.687	5.66
								B	330	176.623	5.662
		640	0	1024	0	x4	x2	A	329.9	176.687	5.66
								B	330	176.623	5.662
		2560	0	512	0	Off	x4	A	333.4	174.825	5.72
								B	334	174.508	5.73
		1280	0	512	0	x2	x4	A	329.9	176.687	5.66
								B	330	176.623	5.662
		640	0	512	0	x4	x4	A	329.9	176.687	5.66
								B	330	176.623	5.662
	48.57 MHz	2560	0	2048	0	Off	Off	A	333.7	145.56	6.87
								B	334	145.423	6.876
		1280	0	2048	0	x2	Off	A	329.3	147.493	6.78
								B	330	147.186	6.794
		640	0	2048	0	x4	Off	A	329.3	147.493	6.78
								B	330	147.186	6.794
		2560	0	1024	0	Off	x2	A	333.7	145.56	6.87
								B	334	145.423	6.876
		1280	0	1024	0	x2	x2	A	329.3	147.493	6.78
								B	330	147.186	6.794
		640	0	1024	0	x4	x2	A	329.3	147.493	6.78
								B	330	147.186	6.794
		2560	0	512	0	Off	x4	A	333.7	145.56	6.87
								B	334	145.423	6.876
		1280	0	512	0	x2	x4	A	329.3	147.493	6.78
								B	330	147.186	6.794
		640	0	512	0	x4	x4	A	329.3	147.493	6.78
								B	330	147.186	6.794

Camera Settings								A: Operation value, B:Calculation value			
Tap Geometry	Camera Link Pixel Clock	ROI				Bining			1 line Total clock	Horizontal Frequency	Horizontal Period
		Width	Offset X	Height	Offset Y	Horizontal	Vertical		(Unit: clock)	(Unit: clock)	(Unit: clock)
1X4 -1Y	84.99 MHz	2560	0	2048	0	Off	Off	A	653.6	130.039	7.69
								B	654	129.969	7.694
		1280	0	2048	0	x2	Off	A	572.9	148.368	6.74
								B	573	148.342	6.741
		640	0	2048	0	x4	Off	A	572.9	148.368	6.74
								B	573	148.342	6.741
		2560	0	1024	0	Off	x2	A	653.6	130.039	7.69
								B	654	129.969	7.694
		1280	0	1024	0	x2	x2	A	572.9	148.368	6.74
								B	573	148.342	6.741
		640	0	1024	0	x4	x2	A	572.9	148.368	6.74
								B	573	148.342	6.741
		2560	0	512	0	Off	x4	A	653.6	130.039	7.69
								B	654	129.969	7.694
		1280	0	512	0	x2	x4	A	572.9	148.368	6.74
								B	573	148.342	6.741
		640	0	512	0	x4	x4	A	572.9	148.368	6.74
								B	573	148.342	6.741
	72.85 MHz	2560	0	2048	0	Off	Off	A	651.3	111.857	8.94
								B	652	111.916	8.935
		1280	0	2048	0	x2	Off	A	498.3	146.199	6.84
								B	499	146.006	6.849
		640	0	2048	0	x4	Off	A	492.5	147.929	6.76
								B	493	147.059	6.767
		2560	0	1024	0	Off	x2	A	651.3	111.857	8.94
								B	652	111.916	8.935
		1280	0	1024	0	x2	x2	A	498.3	146.199	6.84
								B	499	146.006	6.849
		640	0	1024	0	x4	x2	A	492.5	147.929	6.76
								B	493	147.059	6.767
		2560	0	512	0	Off	x4	A	651.3	111.857	8.94
								B	652	111.916	8.935
		1280	0	512	0	x2	x4	A	498.3	146.199	6.84
								B	499	146.006	6.849
		640	0	512	0	x4	x4	A	492.5	147.929	6.76
								B	493	147.059	6.767
	48.57 MHz	2560	0	2048	0	Off	Off	A	651.3	74.571	13.41
								B	652	75.421	13.259
		1280	0	2048	0	x2	Off	A	334.2	154.349	6.88
								B	335	144.989	6.897
		640	0	2048	0	x4	Off	A	329.3	147.493	6.78
								B	330	147.186	6.794
		2560	0	1024	0	Off	x2	A	651.3	74.571	13.41
								B	652	75.421	13.259
		1280	0	1024	0	x2	x2	A	334.2	154.349	6.88
								B	335	144.989	6.897
		640	0	1024	0	x4	x2	A	651.3	74.571	13.41
								B	652	75.421	13.259
		2560	0	512	0	Off	x4	A	334.2	154.349	6.88
								B	335	144.989	6.897
		1280	0	512	0	x2	x4	A	651.3	74.571	13.41
								B	652	75.421	13.259
		640	0	512	0	x4	x4	A	334.2	154.349	6.88
								B	335	144.989	6.897

Camera Settings									A: Operation value, B:Calculation value			
Tap Geometry	Camera Link Pixel Clock	ROI				Bining			1 line Total clock	Horizontal Frequency	Horizontal Period
		Width	Offset X	Height	Offset Y	Horizontal	Vertical		(Unit: clock)	(Unit: clock)	(Unit: clock)
1X3 - 1Y	84.99 MHz	2560	0	2048	0	Off	Off	A	864.4	98.328	10.17
								B	865	98.266	10.176
		1280	0	2048	0	x2	Off	A	578	147.059	6.8
								B	578	147.059	6.8
		640	0	2048	0	x4	Off	A	578	147.059	6.8
								B	578	147.059	6.8
		2560	0	1024	0	Off	x2	A	864.4	98.328	10.17
								B	865	98.266	10.176
		1280	0	1024	0	x2	x2	A	578	147.059	6.8
								B	578	147.059	6.8
		640	0	1024	0	x4	x2	A	578	147.059	6.8
								B	578	147.059	6.8
		2560	0	512	0	Off	x4	A	864.4	98.328	10.17
								B	865	98.266	10.176
		1280	0	512	0	x2	x4	A	578	147.059	6.8
								B	578	147.059	6.8
		640	0	512	0	x4	x4	A	578	147.059	6.8
								B	578	147.059	6.8

Camera Settings								A: Operation value, B:Calculation value			
Tap Geometry	Camera Link Pixel Clock	ROI				Bining			1 line Total clock	Horizontal Frequency	Horizontal Period
		Width	Offset X	Height	Offset Y	Horizontal	Vertical		(Unit: clock)	(Unit: clock)	(Unit: clock)
1X2 - 1Y	84.99 MHz	2560	0	2048	0	Off	Off	A	1293.7	65.703	15.22
								B	1294	65.668	15.224
		1280	0	2048	0	x2	Off	A	656.2	129.534	7.72
								B	657	129.376	7.729
		640	0	2048	0	x4	Off	A	574.6	147.929	6.76
								B	575	147.826	6.765
		2560	0	1024	0	Off	x2	A	1293.7	65.703	15.22
								B	1294	65.668	15.224
		1280	0	1024	0	x2	x2	A	656.2	129.534	7.72
								B	657	129.376	7.729
		640	0	1024	0	x4	x2	A	574.6	147.929	6.76
								B	575	147.826	6.765
		2560	0	512	0	Off	x4	A	1293.7	65.703	15.22
								B	1294	65.668	15.224
		1280	0	512	0	x2	x4	A	656.2	129.534	7.72
								B	657	129.376	7.729
		640	0	512	0	x4	x4	A	574.6	147.929	6.76
								B	575	147.826	6.765
	72.85 MHz	2560	0	2048	0	Off	Off	A	1293.2	56.338	17.75
								B	1294	56.304	17.761
		1280	0	2048	0	x2	Off	A	652.8	111.607	8.96
								B	653	111.573	8.963
		640	0	2048	0	x4	Off	A	492.5	147.929	6.76
								B	493	147.783	6.767
		2560	0	1024	0	Off	x2	A	1293.2	56.338	17.75
								B	1294	56.304	17.761
		1280	0	1024	0	x2	x2	A	652.8	111.607	8.96
								B	653	111.573	8.963
		640	0	1024	0	x4	x2	A	492.5	147.929	6.76
								B	493	147.783	6.767
		2560	0	512	0	Off	x4	A	1293.2	56.338	17.75
								B	1294	56.304	17.761
		1280	0	512	0	x2	x4	A	652.8	111.607	8.96
								B	653	111.573	8.963
		640	0	512	0	x4	x4	A	492.5	147.929	6.76
								B	493	147.783	6.767
	48.57 MHz	2560	0	2048	0	Off	Off	A	1294.9	37.509	26.66
								B	1296	37.478	26.682
		1280	0	2048	0	x2	Off	A	650.9	74.627	13.4
								B	651	74.61	13.403
		640	0	2048	0	x4	Off	A	334.2	145.349	6.88
								B	335	144.989	6.897
		2560	0	1024	0	Off	x2	A	1294.9	37.509	26.66
								B	1296	37.478	26.682
		1280	0	1024	0	x2	x2	A	650.9	74.627	13.4
								B	651	74.61	13.403
		640	0	1024	0	x4	x2	A	334.2	145.349	6.88
								B	335	144.989	6.897
		2560	0	512	0	Off	x4	A	1294.9	37.509	26.66
								B	1296	37.478	26.682
		1280	0	512	0	x2	x4	A	650.9	74.627	13.4
								B	651	74.61	13.403
		640	0	512	0	x4	x4	A	334.2	145.349	6.88
								B	335	144.989	6.897

7.3.2 Vertical timing

Figure 17 shows the vertical timing of Camera Link output during continuous trigger operation. However, with 1X8-1Y 10-bit geometry, which is 80-bit configuration, 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. H-Binning and V-Binning functions are available in both the GO-5000M-PMCL and GO-5000C-PMCL.

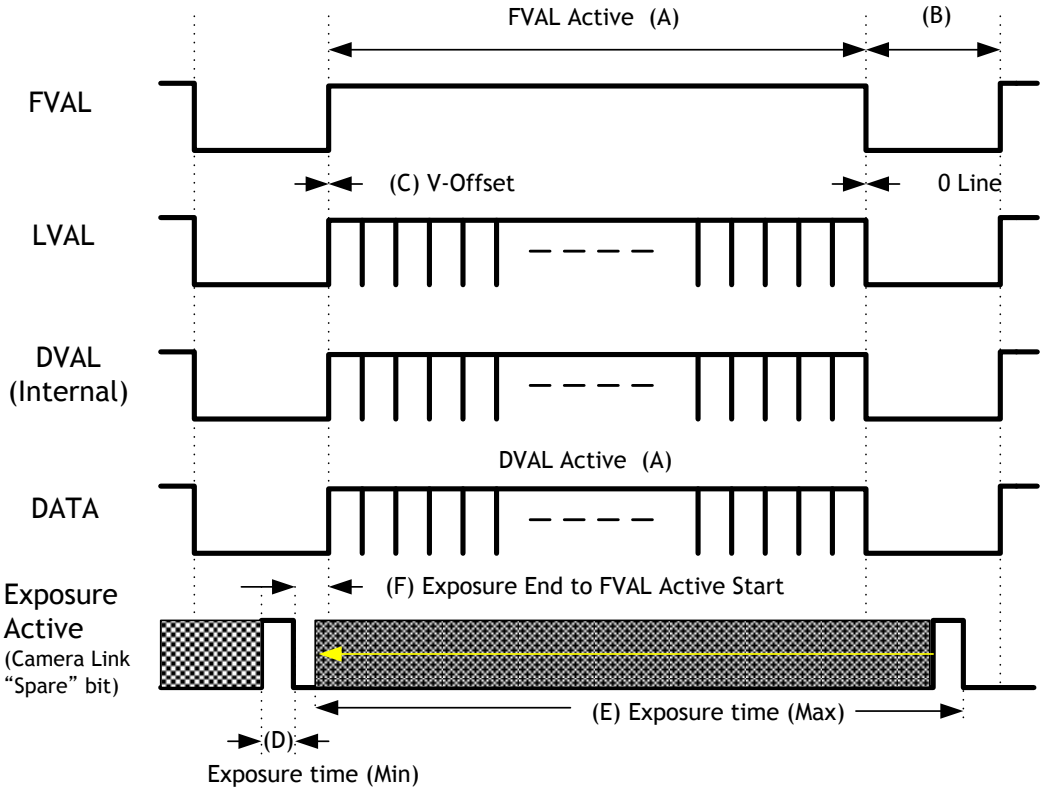


Fig. 14 Vertical timing

Table - 15 Vertical format (in Continuous trigger mode) (1/2)

Camera Settings									(A)	(B)	(C)	(D)
Tap Geometry	Pixel Clock	Frame Period (Typ)	ROI				Binning		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:µs)
1X8 - 1Y 8-bit	72.85 MHz	9328 us	2560	0	2048	0	Off	Off	2048	10	0	10
			2560	0	1024	0	Off	x2	1024	10		
			2560	0	512	0	Off	x4	512	10		
			1280	0	2048	0	x2	Off	2048	10		
			1280	0	1024	0	x2	x2	1024	10		
			1280	0	512	0	x2	x4	512	10		
			512	0	2048	0	x4	Off	2048	10		
			512	0	1024	0	x4	x2	1024	10		
			512	0	512	0	x4	x4	512	10		
	48.57 MHz	14117 us	2560	0	2048	0	Off	Off	2048	14	0	10
			2560	0	1024	0	Off	x2	1024	14		
			2560	0	512	0	Off	x4	512	14		
			1280	0	2048	0	x2	Off	2048	14		
			1280	0	1024	0	x2	x2	1024	14		
			1280	0	512	0	x2	x4	512	14		
			512	0	2048	0	x4	Off	2048	14		
			512	0	1024	0	x4	x2	1024	14		
			512	0	512	0	x4	x4	512	14		

Camera Settings									(A)	(B)	(C)	(D)
Tap Geometry	Pixel Clock	Frame Period (Typ)	ROI				Binning		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:µs)
1X8 - 1Y 10-bit	58.28 MHz	11765 us	2560	0	2048	0	Off	Off	2048	14	0	10
			2560	0	1024	0	Off	x2	1024	14		
			2560	0	512	0	Off	x4	512	14		
			1280	0	2048	0	x2	Off	2048	14		
			1280	0	1024	0	x2	x2	1024	14		
			1280	0	512	0	x2	x4	512	14		
			512	0	2048	0	x4	Off	2048	14		
			512	0	1024	0	x4	x2	1024	14		
			512	0	512	0	x4	x4	512	14		

Camera Settings									(A)	(B)	(C)	(D)
Tap Geometry	Pixel Clock	Frame Period (Typ)	ROI				Binning		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:µs)
1X4 - 1Y	84.99 MHz	15719 us	2560	0	2048	0	Off	Off	2048	14	0	10
			2560	0	1024	0	Off	x2	1024	14		
			2560	0	512	0	Off	x4	512	14		
			1280	0	2048	0	x2	Off	2048	14		
			1280	0	1024	0	x2	x2	1024	14		
			1280	0	512	0	x2	x4	512	14		
			512	0	2048	0	x4	Off	2048	14		
			512	0	1024	0	x4	x2	1024	14		
			512	0	512	0	x4	x4	512	14		
	72.85 MHz	18268 us	2560	0	2048	0	Off	Off	2048	12	0	10
			2560	0	1024	0	Off	x2	1024	12		
			2560	0	512	0	Off	x4	512	12		
			1280	0	2048	0	x2	Off	2048	12		
			1280	0	1024	0	x2	x2	1024	12		
			1280	0	512	0	x2	x4	512	12		
			512	0	2048	0	x4	Off	2048	12		
			512	0	1024	0	x4	x2	1024	12		
			512	0	512	0	x4	x4	512	12		
	48.57 MHz	27778 us	2560	0	2048	0	Off	Off	2048	12	0	10
			2560	0	1024	0	Off	x2	1024	12		
			2560	0	512	0	Off	x4	512	12		
			1280	0	2048	0	x2	Off	2048	12		
			1280	0	1024	0	x2	x2	1024	12		
			1280	0	512	0	x2	x4	512	12		
			512	0	2048	0	x4	Off	2048	12		
			512	0	1024	0	x4	x2	1024	12		
			512	0	512	0	x4	x4	512	12		

Camera Settings									(A)	(B)	(C)	(D)
Tap Geometry	Pixel Clock	Frame Period (Typ)	ROI				Binning		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:µs)
1X3 - 1Y 8-bit	84.99 MHz	20796 us	2559	0	2048	0	Off	Off	2048	14	0	10
			2559	0	1024	0	Off	x2	1024	14		
			2559	0	512	0	Off	x4	512	14		
			1278	0	2048	0	x2	Off	2048	14		
			1278	0	1024	0	x2	x2	1024	14		
			1278	0	512	0	x2	x4	512	14		
			510	0	2048	0	x4	Off	2048	14		
			510	0	1024	0	x4	x2	1024	14		
			510	0	512	0	x4	x4	512	14		

Camera Settings									(A)	(B)	(C)	(D)
Tap Geometry	Pixel Clock	Frame Period (Typ)	ROI				Binning		FVAL & DVAL Active (Unit:line)	FVAL Non Active (Unit:line)	V-Offset (Unit:line)	Exposure Time (min) (Unit:µs)
			Width	Offset X	Height	Offset Y	Horizontal	Vertical				
1X2 - 1Y	84.99 MHz	31268 us	2560	0	2048	0	Off	Off	2048	14	0	10
			2560	0	1024	0	Off	x2	1024	14		
			2560	0	512	0	Off	x4	512	14		
			1280	0	2048	0	x2	Off	2048	14		
			1280	0	1024	0	x2	x2	1024	14		
			1280	0	512	0	x2	x4	512	14		
			512	0	2048	0	x4	Off	2048	14		
			512	0	1024	0	x4	x2	1024	14		
			512	0	512	0	x4	x4	512	14		
	72.85 MHz	36366 us	2560	0	2048	0	Off	Off	2048	14	0	10
			2560	0	1024	0	Off	x2	1024	14		
			2560	0	512	0	Off	x4	512	14		
			1280	0	2048	0	x2	Off	2048	14		
			1280	0	1024	0	x2	x2	1024	14		
			1280	0	512	0	x2	x4	512	14		
			512	0	2048	0	x4	Off	2048	14		
			512	0	1024	0	x4	x2	1024	14		
			512	0	512	0	x4	x4	512	14		
	48.57 MHz	55126 us	2560	0	2048	0	Off	Off	2048	16	0	10
			2560	0	1024	0	Off	x2	1024	16		
			2560	0	512	0	Off	x4	512	16		
			1280	0	2048	0	x2	Off	2048	16		
			1280	0	1024	0	x2	x2	1024	16		
			1280	0	512	0	x2	x4	512	16		
			512	0	2048	0	x4	Off	2048	16		
			512	0	1024	0	x4	x2	1024	16		
			512	0	512	0	x4	x4	512	16		

Table - 15 Vertical format (in Continuous trigger mode) (2/2)

Camera Settings										(E)	(F)
Tap Geometry	Pixel Clock	Frame Period (Typ)	ROI				Binning		Frame Period (min) (Unit:us)	Exposure Time (max) (Unit:us)	Expsoure End to FVAL Active Start (Unit:us)
			Width	Offset X	Height	Offset Y	Horizontal	Vertical			
1X8 - 1Y 8-bit	72.85 MHz	9328 us	2560	0	2048	0	Off	Off	9328	9222	29.6
			2560	0	1024	0	Off	x2	4709	4657	
			2560	0	512	0	Off	x4	2397	2317	
			1280	0	2048	0	x2	Off	9272	9228	
			1280	0	1024	0	x2	x2	4681	4628	
			1280	0	512	0	x2	x4	2383	2302	
			512	0	2048	0	x4	Off	9272	9280	
			512	0	1024	0	x4	x2	4681	4628	
			512	0	512	0	x4	x4	2383	2302	
	48.57 MHz	14117 us	2560	0	2048	0	Off	Off	14117	14184	40.4
			2560	0	1024	0	Off	x2	7127	7102	
			2560	0	512	0	Off	x4	3627	3560	
			1280	0	2048	0	x2	Off	13947	14012	
			1280	0	1024	0	x2	x2	7041	7015	
			1280	0	512	0	x2	x4	3584	3516	
			512	0	2048	0	x4	Off	13947	14012	
			512	0	1024	0	x4	x2	7041	7015	
			512	0	512	0	x4	x4	3584	3516	

Camera Settings											(E)	(F)
Tap Geometry	Pixel Clock	Frame Period (Typ)	ROI				Binning		Frame Period (min) (Unit:us)	Exposure Time (max) (Unit:us)	Expsoure End to FVAL Active Start (Unit:us)
			Width	Offset X	Height	Offset Y	Horizontal	Vertical			
1X8 - 1Y 10-bit	58.28 MHz	11765 us	2560	0	2048	0	Off	Off	11765	11803	35.2
			2560	0	1024	0	Off	x2	5938	5900	
			2560	0	512	0	Off	x4	3023	2949	
			1280	0	2048	0	x2	Off	11622	11659	
			1280	0	1024	0	x2	x2	5867	5828	
			1280	0	512	0	x2	x4	2986	2913	
			512	0	2048	0	x4	Off	11622	11659	
			512	0	1024	0	x4	x2	5867	5828	
			512	0	512	0	x4	x4	2986	2913	

Camera Settings											(E)	(F)
Tap Geometry	Pixel Clock	Frame Period (Typ)	ROI				Binning		Frame Period (min) (Unit:us)	Exposure Time (max) (Unit:us)	Expsoure End to FVAL Active Start (Unit:us)
			Width	Offset X	Height	Offset Y	Horizontal	Vertical			
1X4 - 1Y	84.99 MHz	15719 us	2560	0	2048	0	Off	Off	15719	15804	41.6
			2560	0	1024	0	Off	x2	7927	7911	
			2560	0	512	0	Off	x4	4028	3964	
			1280	0	2048	0	x2	Off	13934	13998	
			1280	0	1024	0	x2	x2	7027	7001	
			1280	0	512	0	x2	x4	3570	3502	
			512	0	2048	0	x4	Off	13934	13998	
			512	0	1024	0	x4	x2	7027	7001	
			512	0	512	0	x4	x4	3570	3502	
	72.85 MHz	18268 us	2560	0	2048	0	Off	Off	18268	18384	43.2
			2560	0	1024	0	Off	x2	9213	9211	
			2560	0	512	0	Off	x4	4681	4624	
			1280	0	2048	0	x2	Off	13934	13998	
			1280	0	1024	0	x2	x2	7027	7001	
			1280	0	512	0	x2	x4	3570	3502	
			512	0	2048	0	x4	Off	13934	13998	
			512	0	1024	0	x4	x2	7027	7001	
			512	0	512	0	x4	x4	3570	3502	
	48.57 MHz	27444 us	2560	0	2048	0	Off	Off	27444	27672	52.4
			2560	0	1024	0	Off	x2	13841	13891	
			2560	0	512	0	Off	x4	7033	7000	
			1280	0	2048	0	x2	Off	14019	14084	
			1280	0	1024	0	x2	x2	7070	7044	
			1280	0	512	0	x2	x4	3592	3524	
			512	0	2048	0	x4	Off	13934	13998	
			512	0	1024	0	x4	x2	7027	7001	
			512	0	512	0	x4	x4	3608	3502	

Camera Settings											(E)	(F)
Tap Geometry	Pixel Clock	Frame Period (Typ)	ROI				Binning		Frame Period (min) (Unit:us)	Exposure Time (max) (Unit:us)	Expsoure End to FVAL Active Start (Unit:us)
			Width	Offset X	Height	Offset Y	Horizontal	Vertical			
1X3 - 1Y 8-bit	84.99 MHz	20796 us	2559	0	2048	0	Off	Off	20881	20944	46
			2559	0	1024	0	Off	x2	10521	10491	
			2559	0	512	0	Off	x4	5336	5264	
			1278	0	2048	0	x2	Off	13920	13985	
			1278	0	1024	0	x2	x2	7013	6987	
			1278	0	512	0	x2	x4	3557	3489	
			510	0	2048	0	x4	Off	13920	13985	
			510	0	1024	0	x4	x2	7013	6987	
			510	0	512	0	x4	x4	3557	3489	

Camera Settings											(E)	(F)
Tap Geometry	Pixel Clock	Frame Period (Typ)	ROI				Binning		Frame Period (min) (Unit:us)	Exposure Time (max) (Unit:us)	Expsoure End to FVAL Active Start (Unit:us)
			Width	Offset X	Height	Offset Y	Horizontal	Vertical			
1X2 - 1Y	84.99 MHz	31268 us	2560	0	2048	0	Off	Off	31268	31542	58
			2560	0	1024	0	Off	x2	15770	15841	
			2560	0	512	0	Off	x4	8013	7990	
			1280	0	2048	0	x2	Off	15889	15976	
			1280	0	1024	0	x2	x2	8013	7998	
			1280	0	512	0	x2	x4	4071	4008	
			512	0	2048	0	x4	Off	13934	13998	
			512	0	1024	0	x4	x2	7027	7001	
			512	0	512	0	x4	x4	3570	3502	
	72.85 MHz	36366 us	2560	0	2048	0	Off	Off	36366	36702	70
			2560	0	1024	0	Off	x2	18341	18441	
			2560	0	512	0	Off	x4	9319	9310	
			1280	0	2048	0	x2	Off	18438	18556	
			1280	0	1024	0	x2	x2	9299	9298	
			1280	0	512	0	x2	x4	4725	4668	
			512	0	2048	0	x4	Off	13934	13998	
			512	0	1024	0	x4	x2	7027	7001	
			512	0	512	0	x4	x4	3570	3502	
	48.57 MHz	55126 us	2560	0	2048	0	Off	Off	54464	55020	82.8
			2560	0	1024	0	Off	x2	27469	27671	
			2560	0	512	0	Off	x4	13958	13996	
			1280	0	2048	0	x2	Off	27614	27844	
			1280	0	1024	0	x2	x2	13926	13978	
			1280	0	512	0	x2	x4	7077	7044	
			512	0	2048	0	x4	Off	14189	14256	
			512	0	1024	0	x4	x2	7156	7131	
			512	0	512	0	x4	x4	3635	3568	

7.3.3 ROI (Region Of Interest) setting

In the GO-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 GO-5000M-PMCL, the minimum width is “2” to “8” depending on the tap geometry and minimum height is “1”. In the GO-5000C-PMCL, the minimum width is the same as GO-5000-PMCL but minimum height is “2”.

Setting example (1)
Binning Horizontal = 1
Binning Vertical = 1

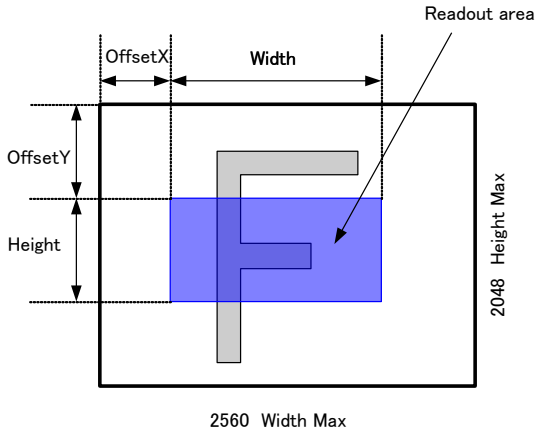


Fig. 15 Setting example (No binning)

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

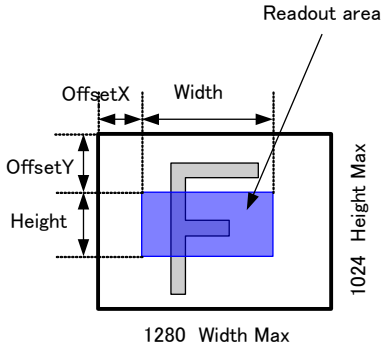


Fig.16 Setting example (Binning)

7.4 Digital output bit allocation

Table -16 Output level

CMOS out		Offset -100@12-bit	Setup +133@12-bit	Digital Out		
				8-bit	10-bit	12-bit
Black	100	0LSB	133LSB	8LSB	32LSB	128LSB
100%	3527	3427LSB	3560LSB	222LSB	890LSB	3560LSB
Full (115%)	4062	3962LSB	4095LSB	255LSB	1023LSB	4095LSB

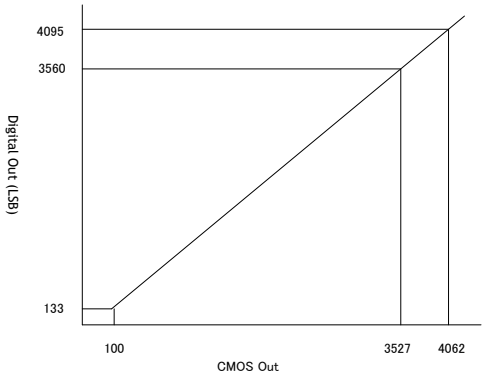


Fig. 17 Bit allocation (12-bit)

8. Operating modes

8.1. Acquisition control (change the frame rate)

8.1.1 Acquisition control

With Trigger OFF (free running mode – see section 7.2.1), the default frame rate of the camera is based on the specified ROI. The smaller the ROI, the faster the default frame rate. However, it is possible to specify a free-running frame rate (i.e., no trigger needed) that is slower than the default rate. This can be useful when a longer exposure time is needed for a specific ROI.

Modification of the frame rate is done by entering a value in the AcquisitionFrameRate control corresponding to the frame frequency (Hz). Allowed values range from the shortest frame rate to 0.125 Hz (fps), 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.

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 (fps) = 8 seconds

8.1.2 Calculation of the frame rate

The frame rate depends on the tap geometry and is calculated in the following formula.

Frame Rate[fps] = 1 / Frame Period[us] x 10e-6

Frame Period[us] = Ceil {Line Period[us] x (Height + V.Blank[Line]) x 0.988}
Note: 0.988 is compensation coefficient.

V.Blank depends on Tap Geometry, CL Clock Frequency and Bit Allocation. Refer to the following table.

Tap Geometry	CL Clock Frequency	Bit Allocation	V.Black (dec)
1x2-1Y	High	8/10/12	16
	Mid	8/10/12	16
	Low	8/10/12	16
1x3-1Y	High	8	14
1x4-1Y	High	8/10/12	16
	Mid	8/10/12	16
	Low	8/10/12	16
1x8-1Y	High	8	18
	Mid	10	18
	Low	8/10	18

Line Period[us] = T_{Row} x 16 / InRate [MHz]

T_{Row} = Ceil (HTotal x InRate [MHZ] / (OutRate [MHz] x 16)
Note: If T_{ROW} calculation result is less 164, T_{ROW} is fixed to 164.

The value of InRate and OutRate depend on Tap geometry, CL Clock Frequency, and Bit Allocation. Refer to the following table.

Tap Geometry	Tap	CL Clock Frequency	Bit Allocation	OutRate(MHz)	InRate(MHz)
1x2-1Y	2	High	8/10/12	169.9999	384
	2	Mid	8/10/12	145.7142	
	2	Low	8/10/12	97.1428	
1x3-1Y	3	High	8	254.99985	
1x4-1Y	4	High	8/10/12	339.9998	
	4	Mid	8/10/12	291.4284	
	4	Low	8/10/12	194.2856	
1x8-1Y	8	High	8	582.8568	577.6
	8	Mid	10	466.28544	460.8
	8	Low	8/10	388.5712	577.6

Calculation of OutRate
OutRate = CL Clock [MHz] x Tap

Calculation of InRate (Using internal clock)
If [1X2_1Y/1X3_1Y/1X4_1Y/1X8-1Y(Low)] is used,
InRate = 48MHz x 8 = 384

If [1X8_1Y(Mid)] is used,
InRate = 57.6 MHz x 8 = 460.8

If [1X8_1Y(High)] is used,
InRate = 72.2 MHz x 8 = 577.6

HTotal = (Pixel x Width / 2560 + H.Blank) x Tap
Pixel = Floor (2560/Tap)

The value of H.Blank depends on Tap geometry, CL Clock Frequency, and Bit Allocation. Refer to the following table.

Tap Geometry	CL Clock Frequency	Bit Allocation	H.Blank (dec)
1x2-1Y	High	8/10/12	20
	Mid	8/10/12	18
	Low	8/10/12	16
1x3-1Y	High	8	15
1x4-1Y	High	8/10/12	12
	Mid	8/10/12	12
	Low	8/10/12	12
1x8-1Y	High	8	12
	Mid	10	14
	Low	8/10	14

Width: Width of the image transferred through Camera Link interface (pixels)
The value of Width is restricted by the multiple number of 64 (pixels)
Height: Height of the image transferred through Camera Link interface (pixels)

8.2. Exposure setting

This section describes how to set the exposure settings.

8.2.1 Exposure Mode

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

Table – 17 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

Table - 18 Trigger option

Trigger Option setting	Exposure operation
OFF	Timed (EPS) mode
RCT	RCT mode

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

Table20. The combination of Exposure Mode, Trigger Option and Trigger Mode

Exposure Mode	Trigger Option	Trigger Mode (Frame Start)	Operation
OFF	N/A	N/A	Free-running operation Exposure control by Exposure Time is not possible
Timed	OFF	OFF	Free-running operation Exposure control by Exposure Time is not possible
		ON	Timed (EPS) Operation Exposure can be controlled by Exposure Time
	RCT	Forced to ON	RCT 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

8.2.2 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 – noise may make image unusable after 1 second)

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 GO-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.

8.2.3 ExposureAuto

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

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 can be set
ASC Max:	The maximum value for the exposure time to be controlled can be set
ASC 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
ALC Channel Area:	This can Enable or Disable the area selected by ALC Custom Area Selector

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.18 ALC Area Type

8.3. Trigger control

The following 5 types of Trigger Control are available by the combination of Trigger Selector, Trigger Mode, Exposure Mode and Trigger Option.

Table - 19 Trigger control

Camera Settings				JAI Custom Trigger Mode Name	Description
Trigger Selector	Trigger Mode	Exposure Mode	Trigger Option		
Frame Start	Off	Off	Off	Continuous Trigger	Free-running operation with the maximum exposure time per the frame rate
	Off	Timed	Off	Continuous Trigger	Free-running operation with a user-set exposure time.
	On	Timed	Off	EPS Trigger	Externally triggered operation with a user-set exposure time
	On	Timed	RCT	RCT Trigger	Externally triggered operation for RCT
	On	Trigger Width	Off	PWC Trigger	Externally triggered operation with a pulse width exposure time

8.3.1 Trigger Selector

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

Table - 20 Trigger selector

Trigger Selector Item	Description
Frame Start	Frame Start Trigger

8.3.2 Trigger Mode

Select either free-running operation or external trigger operation.

OFF: Free-running operation
ON: External trigger operation

8.3.3 Trigger Source

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

Table – 21 Trigger Source

Trigger Source item	Description
Low	Connect LOW level signal to the selected trigger operation **Default setting**
High	Connect HIGH level signal to the selected trigger operation
Soft Trigger	Connect Soft Trigger signal to the selected trigger operation Trigger can be input manually by the execution of the software trigger Trigger software is available on each trigger source.
PulseGenerator0 Out	Connect Pulse generator 0 signal to the selected trigger operation
Line 2 – CC1	Connect Trigger In signal through CC1 in Camera Link Interface to the selected trigger operation
NAND 0 Out	Connect NAND 0 OUT signal to the selected trigger operation
NAND 1 Out	Connect NAND 1 OUT signal to the selected trigger operation

8.3.4 TriggerActivation

This command can select how to activate the trigger.

Rising edge: At the rising edge of the pulse, the trigger is activated.
Falling edge: At the falling edge of the pulse, the trigger is activated.
Level High: During the high level of trigger, the accumulation is activated
Level Low: During the low level of trigger, the accumulation is activated

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

Table - 22 Trigger Activation

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

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

This is used for applications which do not require triggering.

Table - 23 Minimum interval (1X8-1Y, 8-bit, CL Clock =72.85MHz)

Trigger Mode	Readout Mode	Time (Min. trigger period)
Timed Exposure Mode Trigger Mode OFF (Note 1)	Full	9435us
	AOI Center 2/3	6281us
	AOI Center 1/2	4740us
	AOI Center 1/4	2393us
	AOI Center 1/8	1219us
	V Binning ON (Full) (Note2)	4740us

Note 1 : Readout setting in Trigger Overlap is not available
Note 2: GO-5000M-PMCL only

8.5. 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.

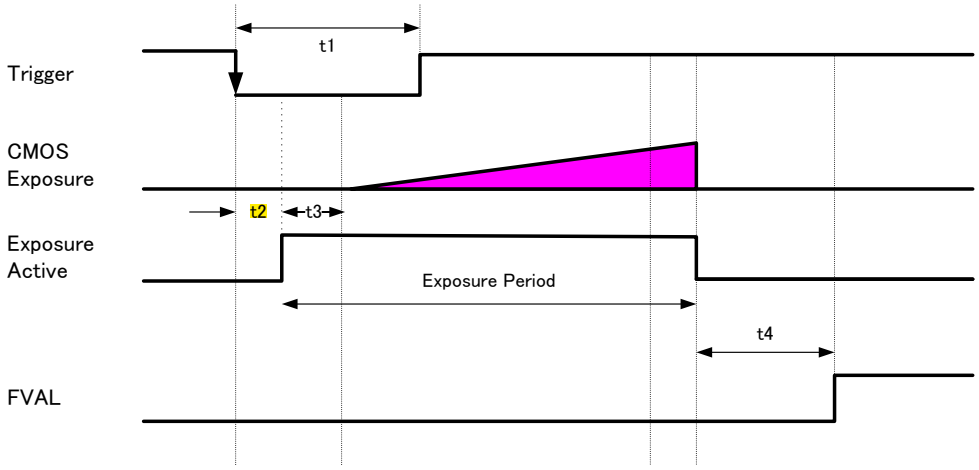
Primary settings to use this mode
Acquisition Mode = Single frame, Multi-frame or Continuous
Trigger Mode = ON
Exposure Mode = Timed

Table - 24 Trigger minimum interval (Trigger Overlap = Readout)
(1X8-1Y, 8-bit, CL Clock=72.85 MHz)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
Timed Exposure Mode Trigger Mode ON	Full	9435 us + 8.01 µs
	AOI Center 2/3	6281 us + 8.01 µs
	AOI Center 1/2	4740 us + 8.01 µs
	AOI Center 1/4	2393 us + 8.01 µs
	AOI Center 1/8	1219 us + 8.01 µs
	V Binning ON (Full) (Note 1)	4740 us + 8.01 µs

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

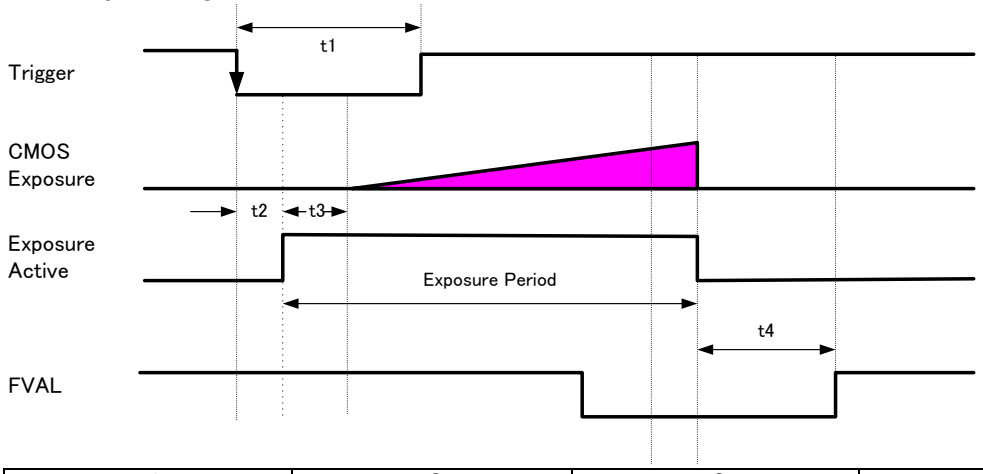
8.5.1 If Overlap setting is OFF



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

Fig. 19 Overlap OFF

8.5.2 If Overlap setting is Readout



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

Fig. 20 Overlap Readout

8.6 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.

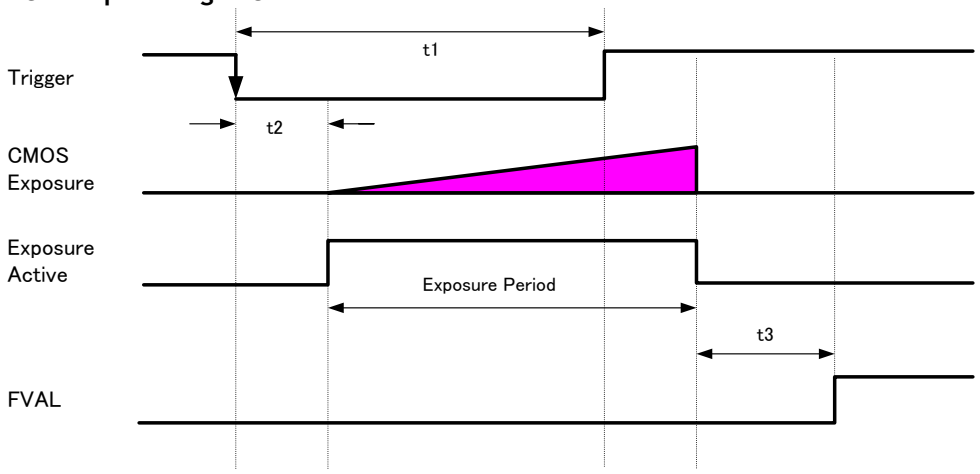
Primary settings to use this mode
Trigger Mode = ON
Exposure Mode = Trigger Width

Table - 25 Minimum trigger interval (Trigger Overlap = Readout)
(1X8-1Y, 8-bit, CL Clock=72.85 MHz)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
Trigger Width Exposure Mode	Full	9435 us + 8.01 µs
	AOI Center 2/3	6281 us + 8.01 µs
	AOI Center 1/2	4740 us + 8.01 µs
	AOI Center 1/4	2393 us + 8.01 µs
	AOI Center 1/8	1219 us + 8.01 µs
	V Binning ON (Full) (Note1)	4740 us + 8.01 µs

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

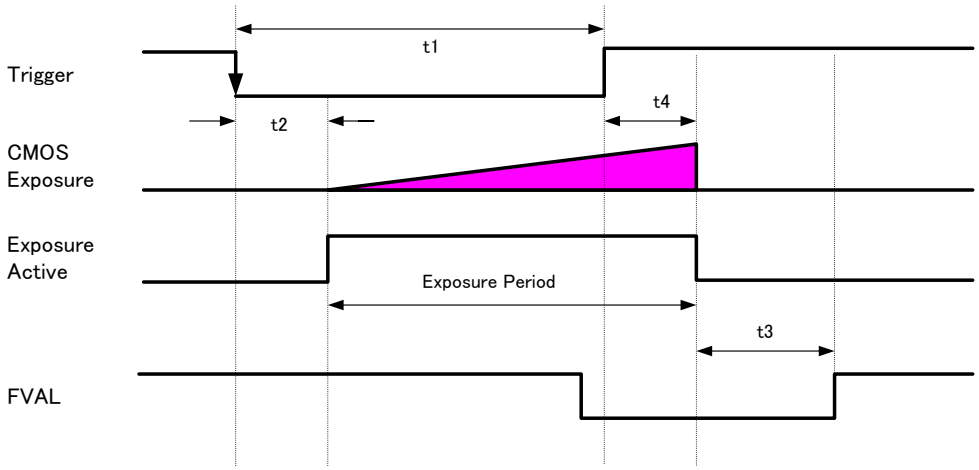
8.6.1 If Overlap setting is OFF



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

Fig. 21 Overlap = OFF

8.6.2 If Overlap setting is Readout



t1	t2	t3	t4
2L (Min.)	208 clocks	7L to 8L	1L

Fig. 22 Overlap: Readout

8.7. RCT mode

Until the trigger is input, the camera operates continuously and can use auto-gain, if necessary, to control the exposure setting. During this time, FVAL and LVAL are output but DVAL is not output. When the trigger is input, the fast dump is activated to read out the electronic charge very quickly, after which the accumulation and the readout are performed. When the accumulated signal against the trigger is read out, FVAL, LVAL and DVAL are output too.

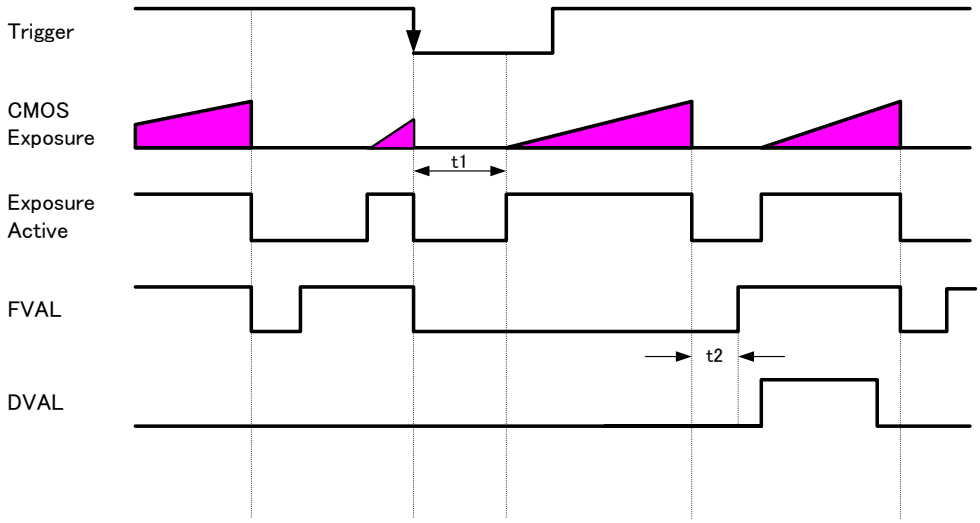
Primary settings to use this mode

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

Table – 26 Minimum trigger interval (1X8-1Y)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
Reset Continuous Trigger Mode (Note2)	Full	9435 us + Exposure time + 1.562 ms
	AOI Center 2/3	6281 us + Exposure time + 1.562 ms
	AOI Center 1/2	4740 us+ Exposure time + 1.562 ms
	AOI Center 1/4	2393 us + Exposure time + 1.562 ms
	AOI Center 1/8	1219 us + Exposure time + 1.562 ms
	V Binning ON (Full) (Note1)	4740 us + Exposure time + 1.562 ms

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



t1	t2
28L	9L ～10L

F

Fig.23 RCT mode timing

8.9 Sequence ROI Trigger 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, Video Send Mode must be switched from “Normal” to either “Trigger Sequence” or “Command Sequence” (see below).

8.9.1 Video send mode

Sequence Mode has two operating modes and it is set in the Video Send Mode selector.

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

8.9.2 Sequence mode

Basic setting to use this function
Trigger Mode: ON
Exposure mode : Timed
Video Send Mode: Trigger Sequence or Command Sequence

Table – 27 Minimum trigger interval (1x8-1Y)

Trigger Mode	Readout Mode	Time (Min. Trigger Period)
PIV mode	Full	9435 us + Exposure time + 8.01μs
	ROI Center 2/3	6281 us + Exposure time + 8.01μs
	ROI Center 1/2	4740 us + Exposure time + 8.01μs
	ROI Center 1/4	2393 us + Exposure time + 8.01μs
	ROI Center 1/8	1219 us + Exposure time + 8.01μs
	V Binning ON (Full) (Note 1)	4740 us + Exposure time + 8.01μs

Note 1: GO-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.

8.9.3 Trigger Sequence mode timing

The following drawing shows the sequence mode timing concept.

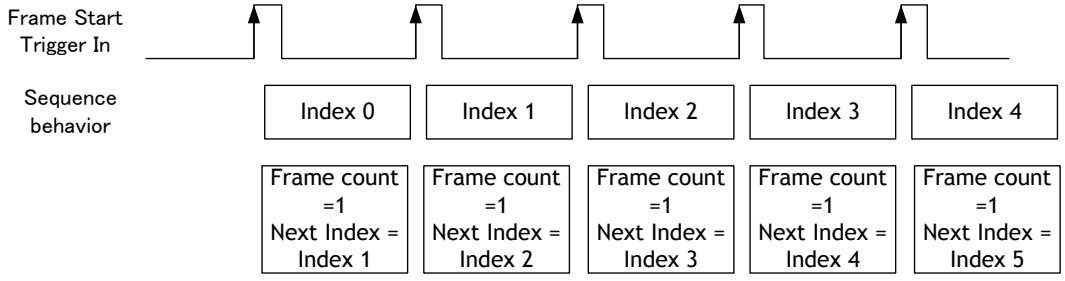


Fig. 24 Behavior of Sequence trigger

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 1 and after Index 1 is activated, the next index can be processed.

Table 28. 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 1	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 1
- Index 2	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 1
- Index 3	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 1
- Index 4	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 1
- Index 5	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 1
- Index 6	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 1
- Index 7	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 1
- Index 8	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 1
- Index 9	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 1
-Index 10	2560	2048	0	0	100	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 1

8.9.4 Sequence ROI setting parameters

Setting parameters for Sequence ROI are as follows.

(1) Sequence ROI Index Selector
In Sequence ROI Index Selector, Index 1 to 10 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 2 to 2560 pixels (1X2-1Y), 4 to 2560 pixels (1X4-1Y and 8 to 2560 pixels (1X8-1Y).
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 (Monochrome) and 2 to 2048 lines (Color).
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. Refer to the specifications table for the details.
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. Refer to the specifications table for the details.
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.
GO-5000C-PMCL: Gain (ALL), Red, and Blue can be set.
GO-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 index1 to 10 can be set. In the sequence operation, if LUT mode is selected OFF or LUT Table, the dark compression function is forced to be OFF.

(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 1 in the table. Frame Count is also re-initialized.

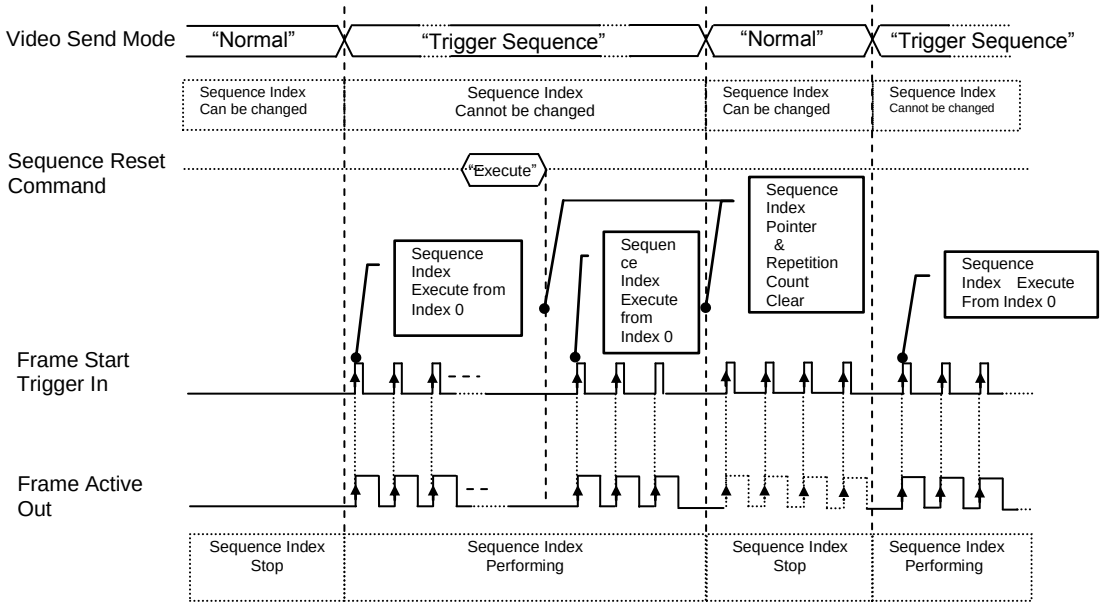


Fig. 25 Trigger Sequence timing

8.10 Multi ROI function

This function divides one frame image into a maximum of 5 images vertically and reads out all areas in one frame. In this function, width is the same for all 5 images.

Multi ROI setting
Video Send Mode: Set to Multi ROI

Table 29 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

8.10.1 Multi ROI setting parameters

(1) Multi ROI Index Max : Setting value = 1 ～ 5
Maximum 5 ROI settings are possible in a frame. Set Index 0 through 4 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 0 to index 4 is the object in this calculation.

(3) Multi ROI Index Selector :

Index 0 to 4 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 5.
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 5.

(5) Multi ROI Height :

Height can be set for each ROI area of Multi ROI Index 1 to 5.
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 5.
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 5 should be less than Height Max.

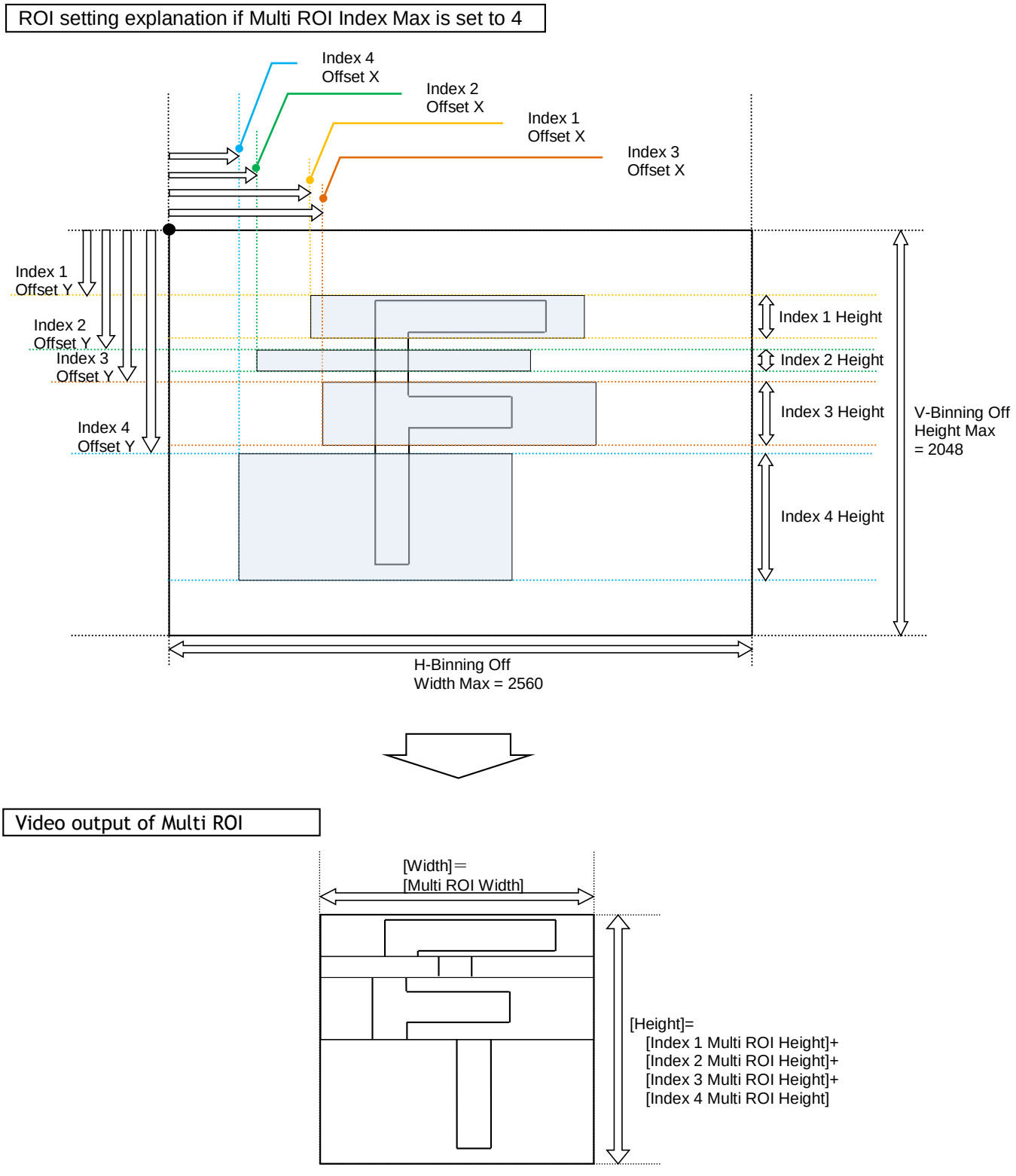


Fig. 26 Multi ROI settings and output image

Note: In this mode, the frame grabber board must set its horizontal pixel number to Multi ROI Width and its vertical pixels to Multi ROI Max and the sum of Multi ROI Height.

8.11. Operation and function matrix

Table - 30 Operation and function matrix

Exposure operation	Trigger Mode	Trigger Option	Binning Vertical	Binning Horizontal	Exposure Time	ROI	Auto White Balance (Note1)	Auto Gain	Auto Exposure	Over lap	Vide Send Mode	
											Multi ROI	Sequence ROI
OFF	OFF	OFF	1	1	×	○	○	○	×	×	○	×
			2	2	×	○	×	○	×	×	○	×
Timed	OFF	OFF	1	1	○	○	○	○	○	×	○	×
			2	2	○	○	×	○	○	×	○	×
Timed	ON	OFF	1	1	○	○	○	○	○	○	○	○
			2	2	○	○	×	○	○	○	○	○
Trigger Width	ON	OFF	1	1	×	○	○	○	×	○	○	×
			2	2	×	○	×	○	×	○	○	×
RCT	ON	RCT	1	1	○	○	○	○	○	×	○	×
			2	2	×	×	×	×	×	×	×	×

(Note1) GO-5000C-PMCL only

9. Other functions

9.1 Black level control

This function adjusts the setup level.
Variable range: -256 to 255 LSB (at 10-bit output)

9.1.1 Black Level Selector

The following items can be adjusted.

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

9.1.2 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

9.2 Gain control

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

Note: If the gain up function is used, it is recommended to use the analog base gain as the master gain setting. For instance, if +12dB gain up is required, the analog base gain is set at +12dB and no digital gain is added. This is because the signal-to-noise is better on analog gain performance. Additionally, the analog base gain is effective in order to minimize breaks in the histogram at higher gain settings. Please note that the analog base gain has less accuracy due to its variability. Also note that the AGC function only works with digital gain.

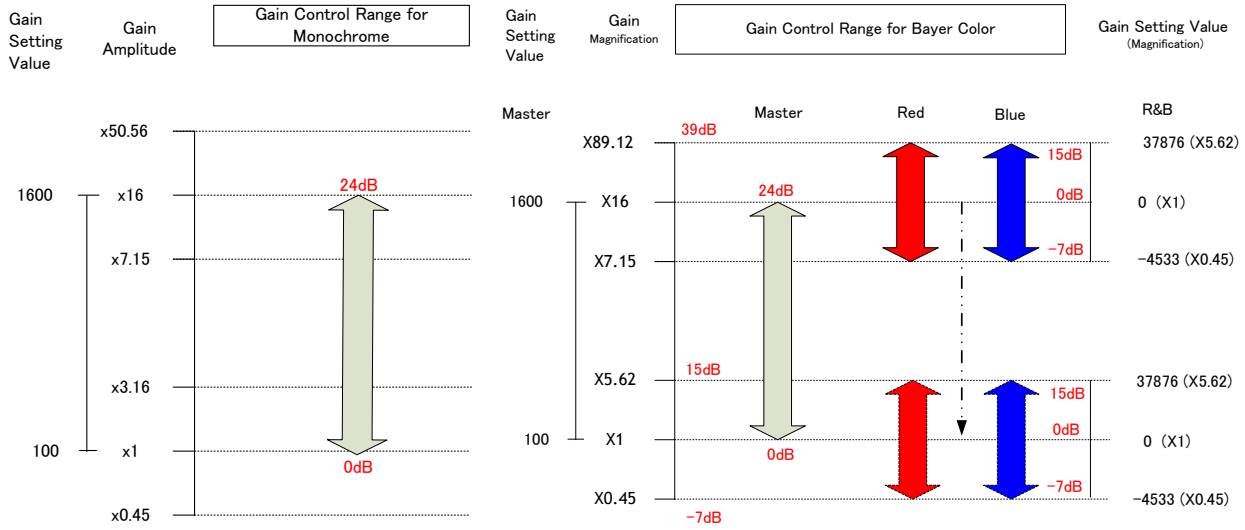


Fig.27 Gain control

9.2.1 Gain Selector

The following parameters can be set.

Monochrome: Digital All
Color: Digital All/Digital Red/ Digital Blue

9.2.2 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: -0.4467 ～ 5.6235 (-7dB ～+15dB)
Digital Blue: 0.4467 ～ 5.6235 (-7dB ～+15dB)

9.2.3 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

Gain calculation formula

$$\text{Gain value} = \frac{(8192 + \text{Setting Value})}{8192}$$

Exp.1 If Setting value is -4533, Gain value = $\frac{(8192-4533)}{8192} = 0.4467\ (-7dB)$

9.2.4 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)

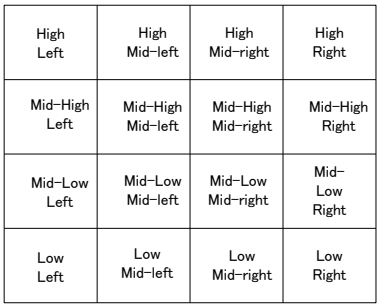


Fig.28 ALC channel area

9.2.4 Balance white auto

This is to adjust the white balance by controlling R and B gain level.

OFF: Auto white balance is disabled. Manually adjusted.
Once: The white balance is controlled at one time when it is activated.
Continuous: The white balance is continuously adjusted.
Preset 4600K: R and B gain is preset so that the color temperature is 4600K.
Preset 5600K: R and B gain is preset so that the color temperature is 5600K.
Preset 6500K: R and B gain is preset so that the color temperature is 6500K.

9.3. LUT

This function can be used to convert the input to the desired output characteristics. The Lookup Table (LUT) has 32 points for setup in the monochrome model (GO-5000M-PMCL) and 16 points for setup in the color model (GO-5000C-PMCL). The output level is created by applying gain to the input level to achieve the specified output level.

9.3.1 LUT Mode

Can be set to OFF, gamma (see section 9.4), or Lookup Table. If Lookup Table is selected, the dark compression is forced to be OFF.

9.3.2 LUT Index

This represents the “starting” or “input” pixel value to be modified by the Lookup Table. The GO-5000M-PMCL has a 32-point Lookup Table and GO-5000C-PMCL has a 16-point table. Thus, in the GO-5000M-PMCL, an index value of 0 represents a full black pixel and a value of 31 represents a full white pixel. For the GO-5000C-PMCL, the corresponding index values range from 0 to 15. The index point values are automatically scaled to fit the internal pixel format of the camera. This is common for all output configurations.

9.3.3 LUT Value

This is the “adjusted” or “output” pixel value for a given LUT index. It has range of 0 to 4095 (12-bits) and is automatically scaled to the bit depth of the current output mode (8-bit, 10-bit, or 12-bit).
Note: Linear interpolation is used to calculate LUT values between index points. In the color model, the LUT function works the same regardless of the color of the pixel.

9.4 Gamma

This command is used set gamma. Gamma 0.45, 0.6 and 1.0 (OFF) can be selected. The gamma value is an approximate value.

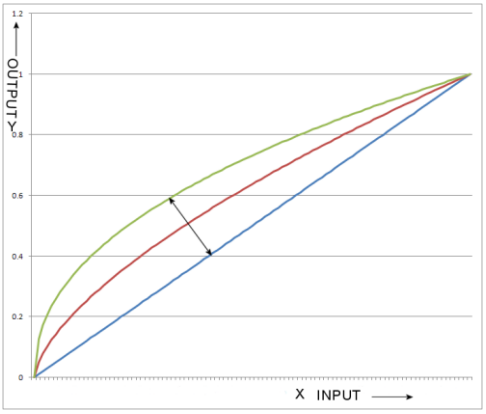


Fig.30 Gamma correction

9.4.1 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.

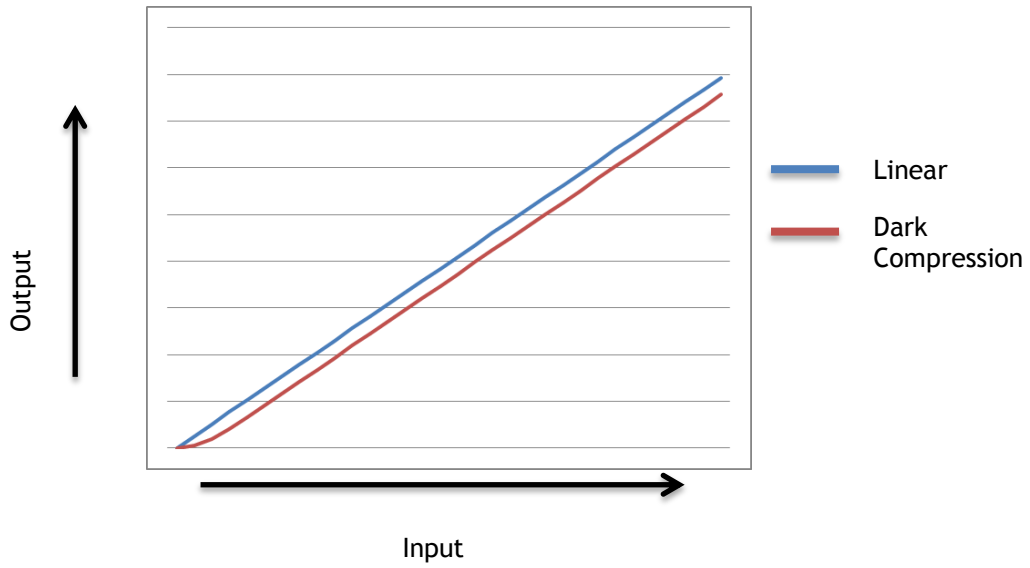


Fig.48 Characteristics

9.5 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.

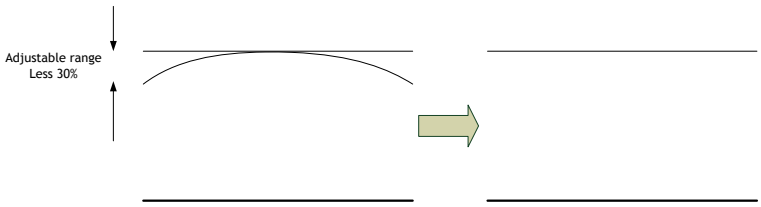


Fig.31 Concept drawing of flat shading correction

Color shading correction (For GO-5000C-PMCL only):
In this case, R channel and B channel are adjusted to match with G channel characteristics. The block grid for compensation is 20 (H) x 16(V) and each block contains 128 x 128 pixels. The complementary process is applied to produce the compensation data with less error.

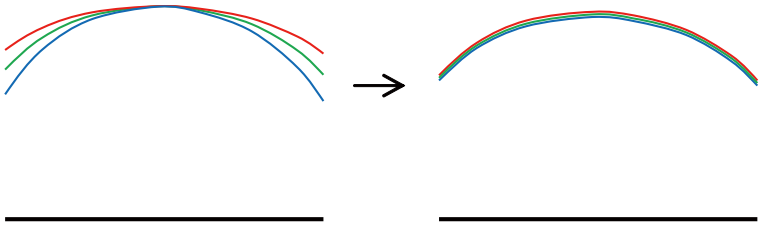


Fig. 32 Concept drawing of color shading correction

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)

9.6 Blemish compensation

The GO-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 the pixel in the left adjacent column and, in the case of the GO-5000C-PMCL, the defective pixels can be compensated by averaging the data from the same Bayer color pixel in left adjacent column. The number of pixels that can be compensated is up to 512 pixels.
GO-5000-PMCL has automatic blemish detection function. After setting the threshold, and then the blemish compensation is executed, blemishes are automatically detected and stored in the memory inside the camera. If the blemish compensation is set to ON, the stored data is loaded. The customer can adjust white blemishes but not black blemishes.

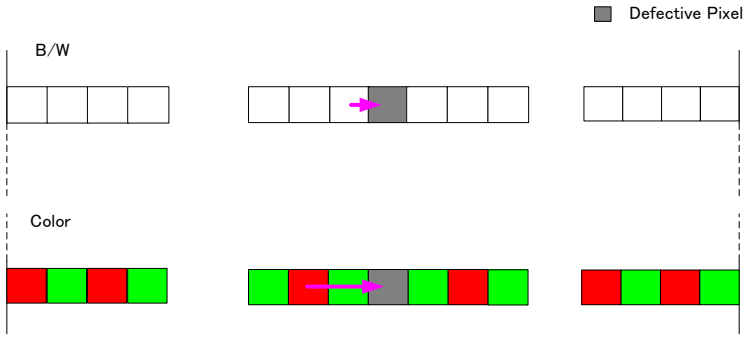


Fig. 33 Blemish compensation

9.7 ALC

In the GO-5000-PMCL, auto gain and auto exposure 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 remaining function will work independently.

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

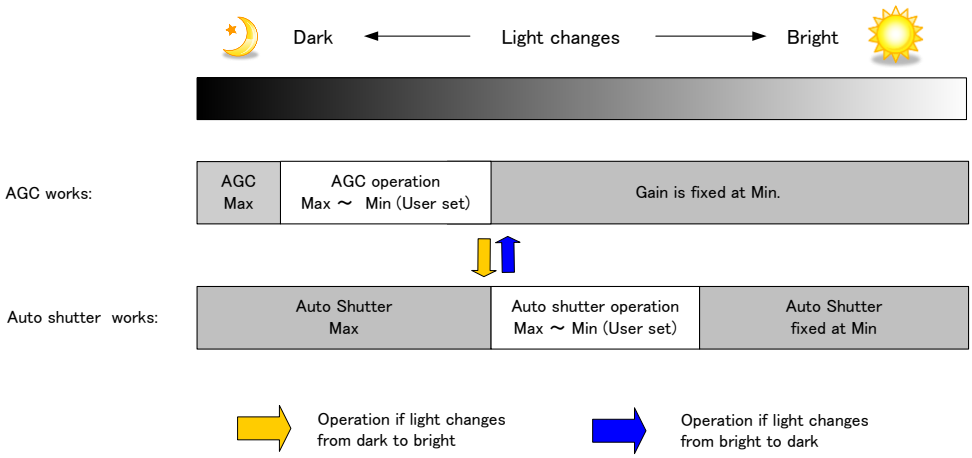


Fig.34 ALC function concept

9.8 HDR (High Dynamic Range) (GO-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.

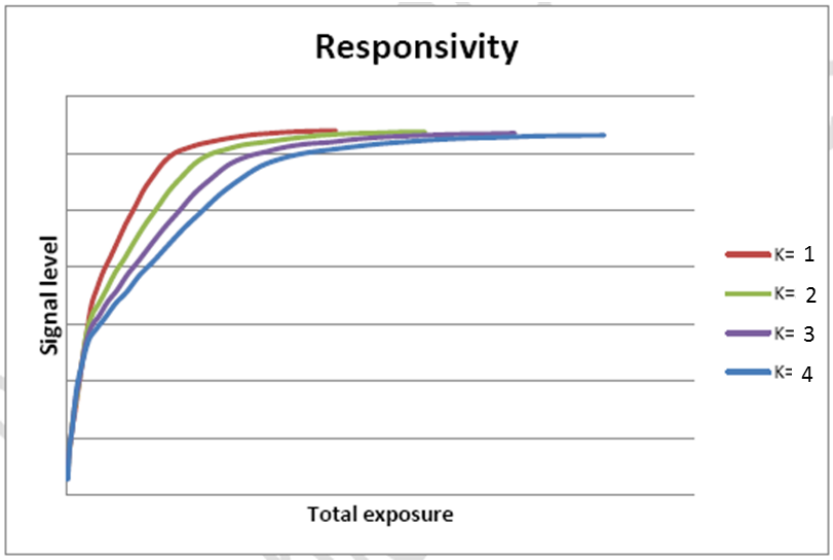


Fig. 35 HDR characteristics

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

10. Camera Settings

In the GO-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.

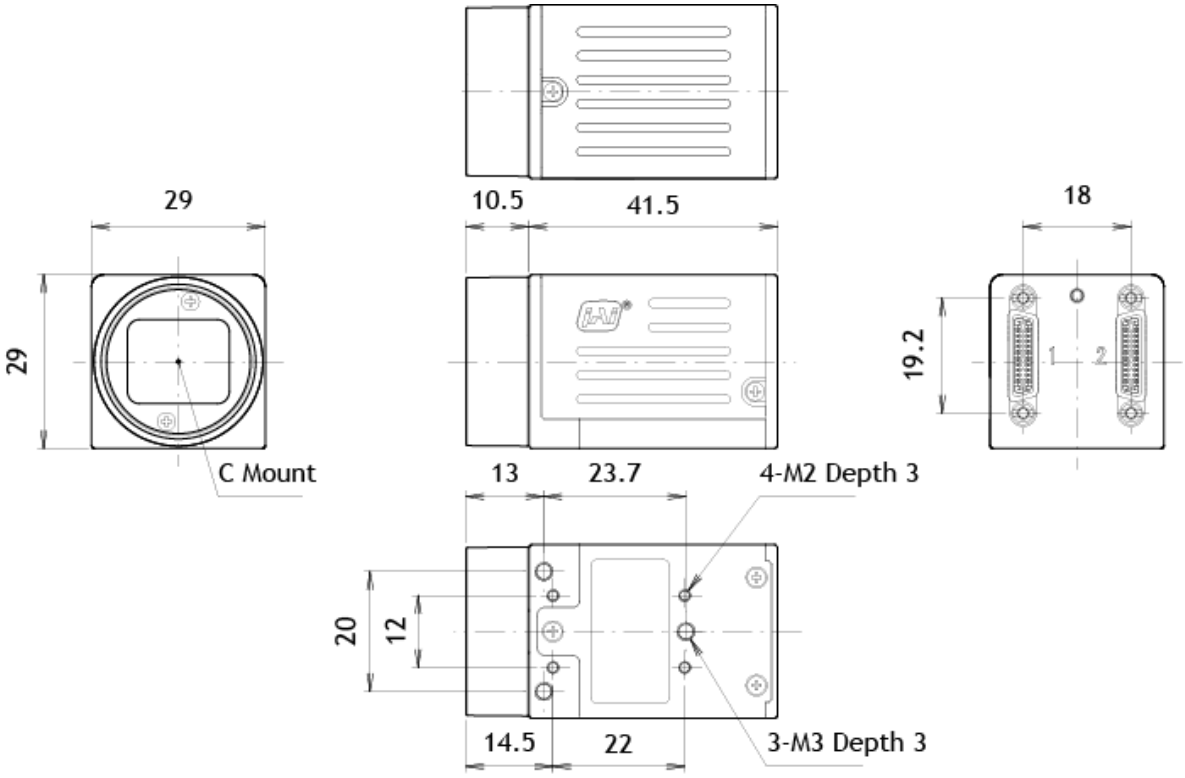
If you need to use the Short ASCII communication protocol and associated control tool, please contact your local JAI representative.

Specific notes regarding Control Tool use:

1. For GO-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.

11. External appearance and dimensions



Dimensions tolerance: ±0.3mm Unit: mm

Fig. 36 Appearance and Dimensions

12. Specifications

12.1. Camera spectral response

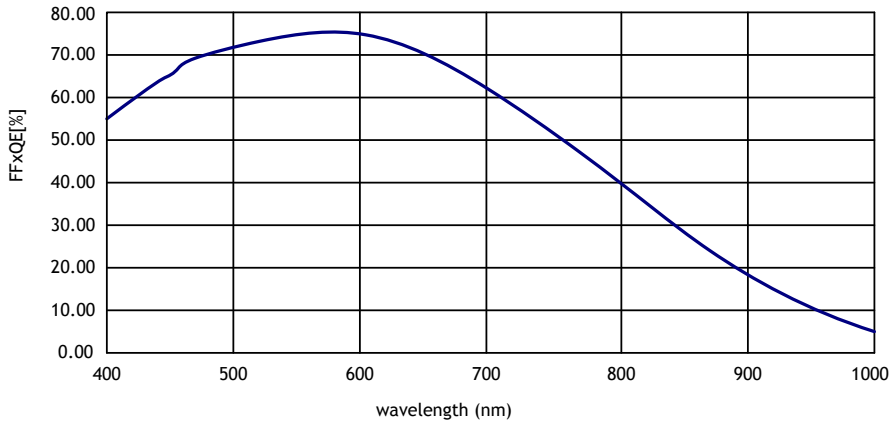


Fig.37 GO-5000M-PMCL Spectral response

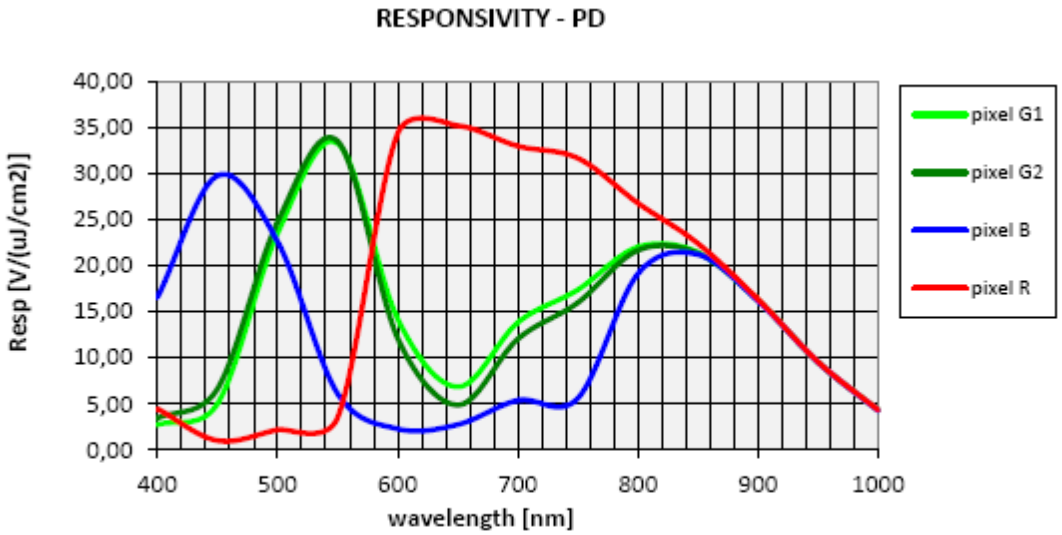


Fig.38 GO-5000C-PMCL Spectral response
(Note: full sensor response. IR-cut filter not shown)

12.2. Specification table

Table – 31 Specification table

Specifications			GO-5000M-PMCL	GO-5000C-PMCL
Scanning system			Progressive scan	
Synchronization			Internal	
Interface			CameraLink Specifications (V.2.0 RC2), Conforming with PoCL specifications	
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)	
Sensor Pixel clock			8-bit: 36MHz, 10-bit: 28.8MHz, 12-bit: 24MHz	
Camera Link clock			48.57 MHz/8 Pixels (Camera Link Clock = Low) 58.28 MHz/8 Pixels (Camera Link Clock = Mid, only for X8-1Y-10bit) 72.85 MHz/8 Pixels (Camera Link Clock = Mid, High for 1X8-1Y-8bit) 84.99 MHz/8 Pixels (Camera Link Clock = High)	
Acquisition Frame Rate			Maximum frame rate shown. Minimum is 0.125fps in all instances.	
1X2-1Y 8/10/ 12-bit CL clock: HIGH	H1, V1		31.9fps	31.9fps
	Binning	H1, V2	63.4fps	–
		H1, V4	124.7fps	–
		H2, V1	62.9fps	–
		H2, V2	124.7fps	–
		H2, V4	245.6fps	–
		H4, V1	124.7fps	–
		H4, V2	245.6fps	–
		H4, V4	280.1fps	–
1X3-1Y 8-bit CL clock: HIGH	H1, V1		47.8fps	47.8fps
	Binning	H1, V2	95.0fps	–
		H1, V4	187.4fps	–
		H2, V1	71.8fps	–
		H2, V2	142.5fps	–
		H2, V4	281.1fps	–
		H4, V1	71.8fps	–
		H4, V2	142.5fps	–
		H4, V4	281.1fps	–
1X4-1Y 8/10/ 12-bit CL clock: HIGH	H1, V1		63.6fps	63.6fps
	Binning	H1, V2	126.1fps	–
		H1, V4	248.2fps	–
		H2, V1	71.7fps	–
		H2, V2	142.3fps	–
		H2, V4	280.1fps	–
		H4, V1	71.7fps	–
		H4, V2	142.3fps	–
		H4, V4	280.1fps	–
1x8-1Y 8-bit CL Clock: HIGH	H1, V1		107.2fps	107.2fps
	Binning	H1, V2	212.3fps	–
		H1, V4	417.1fps	–
		H2, V1	107.1fps	–
		H2, V2	213.6fps	–
		H2, V4	417.0fps	–

		H4, V1	107.8fps	–
		H4, V2	213.6fps	–
		H4, V4	419.6fps	–
1x8-1Y 10-bit CL Clock: MID	H1, V1		84.9fps	84.9fps
	Binning	H1, V2	168.4fps	–
		H1, V4	330.7fps	–
		H2, V1	86.0fps	–
		H2, V2	170.4fps	–
		H2, V4	334.8fps	–
		H4, V1	86.0fps	–
		H4, V2	170.4fps	–
		H4, V4	334.8fps	–
EMVA 1288 Parameters Absolute sensitivity Maximum SNR			At 10-bit output 20.17 p (λ = 525 nm) 41.3 dB	At 10-bit output 51.25 p (λ = 525 nm) 38.12 dB
SN ratio (Traditional)			Dark Compression:55dB (Typical) Linear:49dB (Typical) (0dB gain, Black))	Dark Compression:53dB (Typical) Linear: 44dB (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	2 ～2560 pixels, 2 pixels/step(1X2-1Y) 3 ～2559 pixels, 3 pixels/step(1X3-1Y) 4 ～2560 pixels, 4 pixels/step(1X4-1Y) 8 ～2560 pixels, 8 pixels/step(1X8-1Y)	2 ～2560 pixels, 2 pixels/step(1X2-1Y) 3 ～2559 pixels, 3 pixels/step(1X3-1Y) 4 ～2560 pixels, 4 pixels/step(1X4-1Y) 8 ～2560 pixels, 8 pixels/step(1X8-1Y)
		OFFSET X	0 ～2558 pixels, 2 pixels/step(1X2-1Y) 0 ～2556 pixels, 3 pixels/step(1X3-1Y) 0 ～2556 pixels, 4 pixels/step(1X4-1Y) 0 ～2552 pixels, 8 pixels/step(1X8-1Y)	0 ～2558 pixels, 2 pixels/step(1X2-1Y) 0 ～2556 pixels, 3 pixels/step(1X3-1Y) 0 ～2556 pixels, 4 pixels/step(1X4-1Y) 0 ～2552 pixels, 8 pixels/step(1X8-1Y)
	H Binning	H1	2560 pixels	2560 pixels
		H2	1280 pixels The frame rate is not changed.	–
		H4	640 pixels The frame rate is not changed.	
	V Binning	V1	2048 lines	2048 lines
		V2	1024 lines	–
		V4	512 lines	
	Pixel Format		Mono8,Mono10,Mono12	BayerGR8, BayerGR10, BayerGR12
Acquisition Mode			Continuous	
Trigger selector			Frame Start	
Trigger mode			Continuous, Timed (EPS), Trigger Width,	
Trigger option			JAI_RCT with ALC	
Trigger overlap			OFF, Readout	
Trigger input signal			Line2 (Camera link CC1), Pulse Generator 0, Soft Trigger, NAND0 (out), NAND1 (out)	
Exposure Mode	Timed		Auto Exposure OFF: 10 μs (Min) ～ 8 sec. (Max)(Note1), Step: 1μs Auto Exposure Continuous: 100 μs (Min) ～ 8 sec. (Max)(Note1), Step: 1μs	
	Trigger Width		10 μs (Min) ～ ∞ (Max)(Note1)	

Auto exposure		OFF / Continuous	
Exposure Auto response speed		1 ～8	
Digital I/O		Line Selector (Camera Link): EEN out/CC1 in	
Black level adjust	Reference	33.5LSB 10-bit (Average of 100*100)	
	Adj. range	-256 ～+255LSB 10-bit	
	Resolution	1 STEP = 0.25LSB	
Analog Base Gain		x1 (0dB), x2 (+6dB), x4 (+12dB)	x1 (0dB), x2 (+6dB), x4 (+12dB) R,G,B can be adjustable individually
Gain Adjust	Manual adj. range	0dB ～+24dB, 1%/step (Note2)	0dB ～+24dB、1%/step (Note2)
	WB gain	—	R / B : -7dB to +15dB, 1%/ step
	WB area	—	4 x 4
	WB range	—	3000K ～ 9000K
	White balance	—	OFF, Once, Continuous, Preset 4600K/5600K/6500K
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 and Auto Shutter can be combined and automatically controlled	
Gamma		γ=0.45, 0.6, 1.0 (3 steps are available)	
LUT		OFF: γ=1.0, ON=32 points can be set	
Shading compensation(Note1)		Flat field Block based (20 x 16 blocks))	Flat field, Color shading Block based (20 x 16 blocks)
HDR Mode		Level 1, 2, 3 and 4 based on the exposure time setting	—
Power supply	Power input	DC+12V ± 1V (Complies with PoCL Standards)	
	Current	250mA (12V input, full image)	
	Power Consumption	3.0W (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)
Performance Guaranteed Operating temperature / Humidity		-5°C to +45°C / 20% – 80% (non-condensing)	
Storage Temp. / Humidity		-25°C to +60°C / 20% - 80 % (non-condensing)	
Regulation		CE (EN61000-6-2 and EN61000-6-3), FCC part 15 class B, RoHS, WEEE	
Housing Dimensions		29 x 29 x 52 mm (W x H x D) (including lens mount)	
Weight		46 g	

Note 1) Performance guarantee is up to 1 second.
Note 2) Gaps in histogram may occur if more than +12dB of gain is applied.
Note 3) Approximately 5 minutes pre-heating is required to achieve these specifications.
Note 4) 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 Bootstrap 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)	2(1X 2-1y) 4(1X 4-1Y) 8(1X 8-1Y)	2560	2560	WTC=[Param.]<CR><LF> WTC?<CR><LF>
Width	I Integer	R/W	WTC	Min ~ (Max - OffsetX)	(1X3-1Y)	2559	2559	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: BayerGR8 1: BayerGR10 2: BayerGR12	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	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
AcquisitionFrameRate	I Float	R/W	-	Min～Max[fps]	0.125	Firm will set	83.6	**TI**=[Param.]<CR><LF> TI?<CR><LF>
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 13: CL_CC1_In 14: Nand0 15: Nand1	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 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_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 13: CL_CC1_In 14: Nand0 15: Nand1	0	17	0	LS0=[Param.]<CR><LF> LS0?<CR><LF> For 12pin 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>
AnalogBaseColorGainAll	I Integer	R/W	ABALL	0:0dB, 1:6dB, 2:12dB	0	2	0	ABALL=[Param.]<CR><LF> ABALL?<CR><LF>
AnalogBaseColorGainR	I Integer	R/W	ABR	0:0dB, 1:6dB, 2:12dB	0	2	0	ABR=[Param.]<CR><LF> ABR?<CR><LF>
AnalogBaseColorGainG	I Integer	R/W	ABG	0:0dB, 1:6dB, 2:12dB	0	2	0	ABG=[Param.]<CR><LF> ABG?<CR><LF>
AnalogBaseColorGainB	I Integer	R/W	ABB	0:0dB, 1:6dB, 2:12dB	0	2	0	ABB=[Param.]<CR><LF> ABB?<CR><LF>
GainAuto	I Enumeration	R/W	AGC	0: Off 1: Continuous	0	1	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>

2.4.8 LUT Control

Name	Interface	Access	Short ASCII	Values	MIN	MAX	DEFAULT	Description
LUTValueGreen (Mono)	I Integer	R/W	LUTG	Param 1: LUT index Param 2:LUTdata (Min～Max)	0	32	γ =1 Equivalent	LUT*=[Param1],[Param2]<CR><LF> LUT*?[Param1]<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 7: Geometry_1X3_1Y	1	7	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
AcquisitionFramePeriod	I Integer	R/W	AR	Min～Max[us]	1	325786	11961	AR=[Param.]<CR><LF> AR?<CR><LF> Maximum value is calcurated depending on Height and Offset Y settings
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>
BlemishWhiteDetectThreshold	I Integer	R/W	BMTHW	0	0	100	10	BMTHW=[Param.]<CR><LF> BMTHW?<CR><LF>
BlemishWhiteDetectPositionX	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>
BlemishWhiteDetectPositionY	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>
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>
SequenceModeIndex	I Enumeration	R/W	SQI	0: Index0 1: Index1 2: Index2 3: Index3 4: Index4 5: Index5 6: Index6 7: Index7 8: Index8 9: Index9	0	9	0	SQI=[Param.]<CR><LF> SQI?<CR><LF>
SequenceModeFrameCount0	I Integer	R/W	SQF1	Min～Max	1	255	1	SQF1=[Param.]<CR><LF> SQI1?<CR><LF>
SequenceModeFrameCount1	I Integer	R/W	SQF2	Min～Max	1	255	1	SQF2=[Param.]<CR><LF> SQI2?<CR><LF>
SequenceNodeFrameCount2	I Integer	R/W	SQF3	Min～Max	1	255	1	SQF3=[Param.]<CR><LF> SQI3?<CR><LF>
SequenceMod	I Integer	R/W	SQF4	Min～Max	1	255	1	SQF4=[Param.]<CR>

eFrame Count3								<LF> SQI4?<CR><LF>
SequenceMode eFrame Count4	I Integer	R/W	SQF5	Min～Max	1	255	1	SQF5=[Param.]<CR> <LF> SQI5?<CR><LF>
SequenceMode eFrame Count5	I Integer	R/W	SQF6	Min～Max	1	255	1	SQF6=[Param.]<CR> <LF> SQI6?<CR><LF>
SequenceMode eFrame Count6	I Integer	R/W	SQF7	Min～Max	1	255	1	SQF7=[Param.]<CR> <LF> SQI7?<CR><LF>
SequenceMode eFrame Count7	I Integer	R/W	SQF8	Min～Max	1	255	1	SQF8=[Param.]<CR> <LF> SQI8?<CR><LF>
SequenceMode eFrame Count8	I Integer	R/W	SQF9	Min～Max	1	255	1	SQF9=[Param.]<CR> <LF> SQI9?<CR><LF>
SequenceMode eFrame Count9	I Integer	R/W	SQF10	Min～Max	1	255	1	SQF10=[Param.]<CR ><LF> SQI10?<CR><LF>
SequenceMode eNext Index0	I Enumeration	R/W	SQNI1	Same as SequenceRoiIndex	0	9	0	SQNI1=[Param.]<CR ><LF> SQNI1?<CR><LF>
SequenceMode eNext Index1	I Enumeration	R/W	SQNI2	Same as SequenceRoiIndex	0	9	0	SQNI2=[Param.]<CR ><LF> SQNI2?<CR><LF>
SequenceMode eNext Index2	I Enumeration	R/W	SQNI3	Same as SequenceRoiIndex	0	9	0	SQNI3=[Param.]<CR ><LF> SQNI3?<CR><LF>
SequenceMode eNext Index3	I Enumeration	R/W	SQNI4	Same as SequenceRoiIndex	0	9	0	SQNI4=[Param.]<CR ><LF> SQNI4?<CR><LF>
SequenceMode eNext Index4	I Enumeration	R/W	SQNI5	Same as SequenceRoiIndex	0	9	0	SQNI5=[Param.]<CR ><LF> SQNI5?<CR><LF>
SequenceMode eNext Index5	I Enumeration	R/W	SQNI6	Same as SequenceRoiIndex	0	9	0	SQNI6=[Param.]<CR ><LF> SQNI6?<CR><LF>
SequenceMode eNext Index6	I Enumeration	R/W	SQNI7	Same as SequenceRoiIndex	0	9	0	SQNI7=[Param.]<CR ><LF> SQNI7?<CR><LF>
SequenceMode eNext Index7	I Enumeration	R/W	SQNI8	Same as SequenceRoiIndex	0	9	0	SQNI8=[Param.]<CR ><LF> SQNI8?<CR><LF>
SequenceMode eNext Index8	I Enumeration	R/W	SQNI9	Same as SequenceRoiIndex	0	9	0	SQNI9=[Param.]<CR ><LF> SQNI9?<CR><LF>
SequenceMode eNext Index9	I Enumeration	R/W	SQNI10	Same as SequenceRoiIndex	0	9	0	SQNI10=[Param.]<CR><LF> SQNI10?<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 (Mono) 2046 (Bayer)	0	SQOY1=[Param.]<CR><LF> SQOY1?<CR><LF>
SequenceMode OffsetY1	I Integer	R/W	SQOY2	Min～Max	0	2047 (Mono) 2046 (Bayer)	0	SQOY2=[Param.]<CR><LF> SQOY2?<CR><LF>
SequenceMode OffsetY2	I Integer	R/W	SQOY3	Min～Max	0	2047 (Mono) 2046 (Baye	0	SQOY3=[Param.]<CR><LF> SQOY3?<CR><LF>

						r)		
SequenceMode OffsetY3	I Integer	R/W	SQOY4	Min～Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY4=[Param.]<CR><LF> SQOY4?<CR><LF>
SequenceMode OffsetY4	I Integer	R/W	SQOY5	Min～Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY5=[Param.]<CR><LF> SQOY5?<CR><LF>
SequenceMode OffsetY5	I Integer	R/W	SQOY6	Min～Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY6=[Param.]<CR><LF> SQOY6?<CR><LF>
SequenceMode OffsetY6	I Integer	R/W	SQOY7	Min～Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY7=[Param.]<CR><LF> SQOY7?<CR><LF>
SequenceMode OffsetY7	I Integer	R/W	SQOY8	Min～Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY8=[Param.]<CR><LF> SQOY8?<CR><LF>
SequenceMode OffsetY8	I Integer	R/W	SQOY9	Min～Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY9=[Param.]<CR><LF> SQOY9?<CR><LF>
SequenceMode OffsetY9	I Integer	R/W	SQOY10	Min～Max	0	2047 (Mno) 2046 (Bayer)	0	SQOY10=[Param.]<CR><LF> SQOY10?<CR><LF>
SequenceModeGain0	I Integer	R/W	SQGA1	Min～Max	100	1600	0	SQGA1=[Param.]<CR><LF> SQGA1?<CR><LF>
SequenceModeGain1	I Integer	R/W	SQGA2	Min～Max	100	1600	0	SQGA2=[Param.]<CR><LF> SQGA2?<CR><LF>
SequenceModeGain2	I Integer	R/W	SQGA3	Min～Max	100	1600	0	SQGA3=[Param.]<CR><LF> SQGA3?<CR><LF>
SequenceModeGain3	I Integer	R/W	SQGA4	Min～Max	100	1600	0	SQGA4=[Param.]<CR><LF>

								SQGA4?<CR><LF>
SequenceModeGain4	I Integer	R/W	SQGA5	Min～Max	100	1600	0	SQGA5=[Param.]<CR><LF> SQGA5?<CR><LF>
SequenceModeGain5	I Integer	R/W	SQGA6	Min～Max	100	1600	0	SQGA6=[Param.]<CR><LF> SQGA6?<CR><LF>
SequenceModeGain6	I Integer	R/W	SQGA7	Min～Max	100	1600	0	SQGA7=[Param.]<CR><LF> SQGA7?<CR><LF>
SequenceModeGain7	I Integer	R/W	SQGA8	Min～Max	100	1600	0	SQGA8=[Param.]<CR><LF> SQGA8?<CR><LF>
SequenceModeGain8	I Integer	R/W	SQGA9	Min～Max	100	1600	0	SQGA9=[Param.]<CR><LF> SQGA9?<CR><LF>
SequenceModeGain9	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>
SequenceMod	I Integer	R/W	SQPE9	Min～Max	10	8000	1800	SQPE9=[Param.]<CR

e ExposureTime 8						000	0	><LF> SQPE9?<CR><LF>
SequenceMod e ExposureTime 9	I Integer	R/W	SQPE1 0	Min～Max	10	8000 000	1800 0	SQPE10=[Param.]<C R><LF> SQPE10?<CR><LF>
SequenceMod e Hbinning0	I Enumer ation	R/W	SQHB1	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB1=[Param.]<CR ><LF> SQHB1?<CR><LF> (Mono model only)
SequenceMod e Hbinning1	I Enumer ation	R/W	SQHB2	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB2=[Param.]<CR ><LF> SQHB2?<CR><LF> (Mono model only)
SequenceMod e Hbinning2	I Enumer ation	R/W	SQHB3	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB3=[Param.]<CR ><LF> SQHB3?<CR><LF> (Mono model only)
SequenceMod e Hbinning3	I Enumer ation	R/W	SQHB4	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB4=[Param.]<CR ><LF> SQHB4?<CR><LF> (Mono model only)
SequenceMod e Hbinning4	I Enumer ation	R/W	SQHB5	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB5=[Param.]<CR ><LF> SQHB5?<CR><LF> (Mono model only)
SequenceMod e Hbinning5	I Enumer ation	R/W	SQHB6	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB6=[Param.]<CR ><LF> SQHB6?<CR><LF> (Mono model only)
SequenceMod e Hbinning6	I Enumer ation	R/W	SQHB7	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB7=[Param.]<CR ><LF> SQHB7?<CR><LF> (Mono model only)
SequenceMod e Hbinning7	I Enumer ation	R/W	SQHB8	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB8=[Param.]<CR ><LF> SQHB8?<CR><LF> (Mono model only)
SequenceMod e Hbinning8	I Enumer ation	R/W	SQHB9	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB9=[Param.]<CR ><LF> SQHB9?<CR><LF> (Mono model only)
SequenceMod e Hbinning9	I Enumer ation	R/W	SQHB1 0	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQHB10=[Param.]<C R><LF> SQHB10?<CR><LF> (Mono model only)
SequenceMod e Vbinning0	I Enumer ation	R/W	SQVB1	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB1=[Param.]<CR ><LF> SQVB1?<CR><LF> (Mono model only)
SequenceMod	I	R/W	SQVB2	1: Hbinning = OFF	1	2	1	SQVB2=[Param.]<CR

e Vbinning1	Enumeration			2: Hbinning = ON				><LF> SQVB2?<CR><LF> (Mono model only)
SequenceMode Vbinning2	I Enumeration	R/W	SQVB3	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB3=[Param.]<CR ><LF> SQVB3?<CR><LF> (Mono model only)
SequenceMode Vbinning3	I Enumeration	R/W	SQVB4	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB4=[Param.]<CR ><LF> SQVB4?<CR><LF> (Mono model only)
SequenceMode Vbinning4	I Enumeration	R/W	SQVB5	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB5=[Param.]<CR ><LF> SQVB5?<CR><LF> (Mono model only)
SequenceMode Vbinning5	I Enumeration	R/W	SQVB6	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB6=[Param.]<CR ><LF> SQVB6?<CR><LF> (Mono model only)
SequenceMode Vbinning6	I Enumeration	R/W	SQVB7	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB7=[Param.]<CR ><LF> SQVB7?<CR><LF> (Mono model only)
SequenceMode Vbinning7	I Enumeration	R/W	SQVB8	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB8=[Param.]<CR ><LF> SQVB8?<CR><LF> (Mono model only)
SequenceMode Vbinning8	I Enumeration	R/W	SQVB9	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB9=[Param.]<CR ><LF> SQVB9?<CR><LF> (Mono model only)
SequenceMode Vbinning9	I Enumeration	R/W	SQVB10	1: Hbinning = OFF 2: Hbinning = ON	1	2	1	SQVB10=[Param.]<CR><LF> SQVB10?<CR><LF> (Mono model only)
SequenceMode LutEnable0	I Enumeration	R/W	SQLUT1	Off/On	0	1	0	SQLUT1=[Param.]<CR><LF> SQLUT1?<CR><LF>
SequenceMode LutEnable1	I Enumeration	R/W	SQLUT2	Off/On	0	1	0	SQLUT2=[Param.]<CR><LF> SQLUT2?<CR><LF>
SequenceMode LutEnable2	I Enumeration	R/W	SQLUT3	Off/On	0	1	0	SQLUT3=[Param.]<CR><LF> SQLUT3?<CR><LF>
SequenceMode LutEnable3	I Enumeration	R/W	SQLUT4	Off/On	0	1	0	SQLUT4=[Param.]<CR><LF> SQLUT4?<CR><LF>
SequenceMode LutEnable4	I Enumeration	R/W	SQLUT5	Off/On	0	1	0	SQLUT5=[Param.]<CR><LF> SQLUT5?<CR><LF>
SequenceMode LutEnable5	I Enumeration	R/W	SQLUT6	Off/On	0	1	0	SQLUT6=[Param.]<CR><LF> SQLUT6?<CR><LF>
SequenceMode	I Enumer	R/W	SQLUT7	Off/On	0	1	0	SQLUT7=[Param.]<CR><LF>

LutEnable6	ation							SQLUT7?<CR><LF>
SequenceMode LutEnable7	I Enumeration	R/W	SQLUT8	Off/On	0	1	0	SQLUT8=[Param.]<CR><LF> SQLUT8?<CR><LF>
SequenceMode LutEnable8	I Enumeration	R/W	SQLUT9	Off/On	0	1	0	SQLUT9=[Param.]<CR><LF> SQLUT9?<CR><LF>
SequenceMode LutEnable9	I Enumeration	R/W	SQLUT10	Off/On	0	1	0	SQLUT10=[Param.]<CR><LF> SQLUT10?<CR><LF>
SequenceMode BlackLevel0	I Integer	R/W	SQBL1	Min～Max	-256	255	0	SQBL1=[Param.]<CR><LF> SQBL1?<CR><LF>
SequenceMode BlackLevel1	I Integer	R/W	SQBL2	Min～Max	-256	255	0	SQBL2=[Param.]<CR><LF> SQBL2?<CR><LF>
SequenceMode BlackLevel2	I Integer	R/W	SQBL3	Min～Max	-256	255	0	SQBL3=[Param.]<CR><LF> SQBL3?<CR><LF>
SequenceMode BlackLevel3	I Integer	R/W	SQBL4	Min～Max	-256	255	0	SQBL4=[Param.]<CR><LF> SQBL4?<CR><LF>
SequenceMode BlackLevel4	I Integer	R/W	SQBL5	Min～Max	-256	255	0	SQBL5=[Param.]<CR><LF> SQBL5?<CR><LF>
SequenceMode BlackLevel5	I Integer	R/W	SQBL6	Min～Max	-256	255	0	SQBL6=[Param.]<CR><LF> SQBL6?<CR><LF>
SequenceMode BlackLevel6	I Integer	R/W	SQBL7	Min～Max	-256	255	0	SQBL7=[Param.]<CR><LF> SQBL7?<CR><LF>
SequenceMode BlackLevel7	I Integer	R/W	SQBL8	Min～Max	-256	255	0	SQBL8=[Param.]<CR><LF> SQBL8?<CR><LF>
SequenceMode BlackLevel8	I Integer	R/W	SQBL9	Min～Max	-256	255	0	SQBL9=[Param.]<CR><LF> SQBL9?<CR><LF>
SequenceMode BlackLevel9	I Integer	R/W	SQBL10	Min～Max	-256	255	0	SQBL10=[Param.]<CR><LF> SQBL10?<CR><LF>
SequenceMode GainRed0	I Integer	R/W	SQPGR1	Min～Max	-4533	17713	0	SQPGR1=[Param.]<CR><LF> SQPGR1?<CR><LF> (Bayer model only)
SequenceMode GainRed1	I Integer	R/W	SQPGR2	Min～Max	-4533	17713	0	SQPGR2=[Param.]<CR><LF> SQPGR2?<CR><LF> (Bayer model only)
SequenceMode GainRed2	I Integer	R/W	SQPGR3	Min～Max	-4533	17713	0	SQPGR3=[Param.]<CR><LF> SQPGR3?<CR><LF> (Bayer model only)
SequenceMod	I Integer	R/W	SQPG	Min～Max	-4533	1771	0	SQPGR4=[Param.]<C

e GainRed3			R4			3		R><LF> SQPGR4?<CR><LF> (Bayer model only)
SequenceMode GainRed4	I Integer	R/W	SQPGR5	Min～Max	-4533	17713	0	SQPGR5=[Param.]<CR><LF> SQPGR5?<CR><LF> (Bayer model only)
SequenceMode GainRed5	I Integer	R/W	SQPGR6	Min～Max	-4533	17713	0	SQPGR6=[Param.]<CR><LF> SQPGR6?<CR><LF> (Bayer model only)
SequenceMode GainRed6	I Integer	R/W	SQPGR7	Min～Max	-4533	17713	0	SQPGR7=[Param.]<CR><LF> SQPGR7?<CR><LF> (Bayer model only)
SequenceMode GainRed7	I Integer	R/W	SQPGR8	Min～Max	-4533	17713	0	SQPGR8=[Param.]<CR><LF> SQPGR8?<CR><LF> (Bayer model only)
SequenceMode GainRed8	I Integer	R/W	SQPGR9	Min～Max	-4533	17713	0	SQPGR9=[Param.]<CR><LF> SQPGR9?<CR><LF> (Bayer model only)
SequenceMode GainRed9	I Integer	R/W	SQPGR10	Min～Max	-4533	17713	0	SQPGR10=[Param.]<CR><LF> SQPGR10?<CR><LF> (Bayer model only)
SequenceMode GainBlue0	I Integer	R/W	SQPGB1	Min～Max	-4533	17713	0	SQPGB1=[Param.]<CR><LF> SQPGB1?<CR><LF> (Bayer model only)
SequenceMode GainBlue1	I Integer	R/W	SQPGB2	Min～Max	-4533	17713	0	SQPGB2=[Param.]<CR><LF> SQPGB2?<CR><LF> (Bayer model only)
SequenceMode GainBlue2	I Integer	R/W	SQPGB3	Min～Max	-4533	17713	0	SQPGB3=[Param.]<CR><LF> SQPGB3?<CR><LF> (Bayer model only)
SequenceMode GainBlue3	I Integer	R/W	SQPGB4	Min～Max	-4533	17713	0	SQPGB4=[Param.]<CR><LF> SQPGB4?<CR><LF> (Bayer model only)
SequenceMode GainBlue4	I Integer	R/W	SQPGB5	Min～Max	-4533	17713	0	SQPGB5=[Param.]<CR><LF> SQPGB5?<CR><LF> (Bayer model only)
SequenceMode GainBlue5	I Integer	R/W	SQPGB6	Min～Max	-4533	17713	0	SQPGB6=[Param.]<CR><LF> SQPGB6?<CR><LF> (Bayer model only)
SequenceMode GainBlue6	I Integer	R/W	SQPGB7	Min～Max	-4533	17713	0	SQPGB7=[Param.]<CR><LF> SQPGB7?<CR><LF>

								(Bayer model only)
SequenceMode GainBlue7	I Integer	R/W	SQPGB8	Min～Max	-4533	17713	0	SQPGB8=[Param.]<CR><LF> SQPGB8?<CR><LF> (Bayer model only)
SequenceMode GainBlue8	I Integer	R/W	SQPGB9	Min～Max	-4533	17713	0	SQPGB9=[Param.]<CR><LF> SQPGB9?<CR><LF> (Bayer model only)
SequenceMode GainBlue9	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	Same as SequenceModeIndex	0	9	0	CSQI=[Param.]<CR><LF> CSQI?<CR><LF>
CurrentSequence Index	I Enumeration	R/O	SQIDX	Same as SequenceModeIndex	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>
MultiRoiIndex Max	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	2560	8	MRW=[Param.]<CR><LF> MRW?<CR><LF>
MultiRoiHeight1	I Integer	R/W	MRH1	Min～Max	0	2048	1	MRH1=[Param.]<CR><LF> MRH1?<CR><LF>
MultiRoiHeight2	I Integer	R/W	MRH2	Min～Max	0	2048	1	MRH2=[Param.]<CR><LF> MRH2?<CR><LF>
MultiRoiHeight3	I Integer	R/W	MRH3	Min～Max	0	2048	1	MRH3=[Param.]<CR><LF> MRH3?<CR><LF>
MultiRoiHeight4	I Integer	R/W	MRH4	Min～Max	0	2048	1	MRH4=[Param.]<CR><LF> MRH4?<CR><LF>
MultiRoiHeight5	I Integer	R/W	MRH5	Min～Max	0	2048	1	MRH5=[Param.]<CR><LF> MRH5?<CR><LF>
MultiRoiOffsetX1	I Integer	R/W	MROX1	Min～Max	0	5118	0	MROX1=[Param.]<CR><LF> MROX1?<CR><LF>
MultiRoiOffsetX2	I Integer	R/W	MROX2	Min～Max	0	5118	0	MROX2=[Param.]<CR><LF> MROX2?<CR><LF>
MultiRoiOffset	I Integer	R/W	MROX	Min～Max	0	5118	0	MROX3=[Param.]<C

X3			3					R><LF> MROX3?<CR><LF>
MultiRoiOffsetX4	I Integer	R/W	MROX4	Min～Max	0	5118	0	MROX4=[Param.]<CR><LF> MROX4?<CR><LF>
MultiRoiOffsetX5	I Integer	R/W	MROX5	Min～Max	0	5118	0	MROX5=[Param.]<CR><LF> MROX5?<CR><LF>
MultiRoiOffsetY1	I Integer	R/W	MROY1	Min～Max	0	3839	0	MROY1=[Param.]<CR><LF> MROY1?<CR><LF>
MultiRoiOffsetY2	I Integer	R/W	MROY2	Min～Max	0	3839	0	MROY2=[Param.]<CR><LF> MROY2?<CR><LF>
MultiRoiOffsetY3	I Integer	R/W	MROY3	Min～Max	0	3839	0	MROY3=[Param.]<CR><LF> MROY3?<CR><LF>
MultiRoiOffsetY4	I Integer	R/W	MROY4	Min～Max	0	3839	0	MROY4=[Param.]<CR><LF> MROY4?<CR><LF>
MultiRoiOffsetY5	I Integer	R/W	MROY5	Min～Max	0	3839	0	MROY5=[Param.]<CR><LF> MROY5?<CR><LF>
LUTMode	I Enumeration	R/W	LUTC	0: Off 1: Gamma 2: LUT	0	2	0	LUTC=[Param.]<CR><LF> LUTC?<CR><LF>
AlcSpeed	I Integer	R/W	ALCS	Min～Max	1	8	4	ALCS=[Param.]<CR><LF> ALCS?<CR><LF> for AGC and ASC
ExposureAutoMax	I Integer	R/W	ASCEA	Min～Max[us]	101	8000000	18000	ASCEA=[Param.]<CR><LF> ASCEA?<CR><LF> Maximum value is varied depending on frame rate.
ExposureAutoMin	I Integer	R/W	ASCEI	Min～Max	100	7999999	100	ASCEI=[Param.]<CR><LF> ASCEI?<CR><LF> Maximum value is varied depending on frame rate.
RequestExposureAutoResult	I Enumeration	R/O	ASRS	0=Complete. 1=Too Bright. 2=Too dark. 3=Timeout Error. 4=Busy. 5=Limit. 6= Trig is not set as Normal.	0	6	0	ASRS?<CR><LF>
TriggerOption	I Enumeration	R/W	TRGOP	0: Off 1: RCT 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>
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	I Enumeration	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	I Enumer	R/W	ALCMHML	0: Off / 1: On	0	1	1	

MidHighMidLeft	ation							
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	
AcquisitionFrameRateLine	I Integer	R/W	AR	Min～Max	1	325786	774	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=0.45) 1(γ=0.6) 2(γ=1)	0	2	0	GMA=[Param.]<CR><LF> GMA?<CR><LF>
Temperature	I Integer	R/O	TMP0	value	—	—	—	TMP0?<CR><LF> (Value÷128) = Temperature[℃]
GpioPulseGen Divide Value	I Integer	R/W	PGDEV	Min～Max	1	4096	1	PGDEV=[Param.]<CR><LF> PGDEV?<CR><LF>
GpioPulseGen Length0	I Integer	R/W	PGL0	Min～Max	1	1048575	1	PGL0=[Param.]<CR><LF> PGL0?<CR><LF>
GpioPulseGen Start Point0	I Integer	R/W	PGST0	Min～Max	0	1048574	0	PGST0=[Param.]<CR><LF> PGST0?<CR><LF>
GpioPulseGen End Point0	I Integer	R/W	PGEN0	Min～Max	1	1048575	1	PGEN0=[Param.]<CR><LF> PGEN0?<CR><LF>
GpioPulseGen Repeat Count0	I Integer	R/W	PGRPT0	Min～Max	0	255	0	PGRPT0=[Param.]<CR><LF> PGRPT0?<CR><LF>
GpioPulseGen Clear 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>
GpioPulseGen Sync Mode0	I Enumeration	R/W	PGSM0	0: Async Mode 1: Sync Mode	0	1	0	PGSM0=[Param.]<CR><LF> PGSM0?<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 14:CL CC1 in 15:nand0 16:nand1	0	18	0	PGIN0=[Param.]<CR><LF> PGIN0?<CR><LF>
GpioPulseGenInvert0	I Enumeration	R/W	PGINV0	0:Non-Inv 1:Inv	0	1	0	PGIN0=[Param.]<CR><LF> PGIN0?<CR><LF>
GpioNand0InputSource1	I Enumeration	R/W	ND0IN1	0: Low 1: High 2: FrameTriggerWait 3: FramActive 4: ExposureActive 5: Fval 6: PulseGenerator0 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 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>

LUTSequenceG	I Enumeration	R/W	LUTSG	Min～Max	0	4095	0	LUTSG=[Param.]<CR><LF> LUTSG?<CR><LF>
BlemishNum	I Integer	R/O	BNUM	Min～Max	0	512	0	BNUM?<CR><LF>
VideoProcessBypass	I Enumeration	R/W	VPB	0: Off / 1: On	0	1	0	VPB=[Param.]<CR><LF> VPB?<CR><LF>

Appendix 2

1. Precautions

Personnel not trained in dealing with similar electronic devices should not service this camera.
The camera contains components sensitive to electrostatic discharge. The handling of these devices should follow the requirements of electrostatic sensitive components.
Do not attempt to disassemble this camera.
Do not expose this camera to rain or moisture.
Do not face this camera towards the sun, extreme bright light or light reflecting objects.
When this camera is not in use, put the supplied lens cap on the lens mount.
Handle this camera with the maximum care.
Operate this camera only from the type of power source indicated on the camera.
Power off the camera during any modification such as changes of jumper and switch setting.

2. Typical Sensor Characteristics

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

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

Blemishes
All cameras are shipped without visible image sensor blemishes.
Over time some pixel defects can occur. This does not have a practical effect on the operation of the camera. These will show up as white spots (blemishes).
Exposure to cosmic rays can cause blemishes to appear on the image sensor. Please take care to avoid exposure to cosmic rays during transportation and storage. It is recommended using sea shipment instead of air flight in order to limit the influence of cosmic rays on the camera. Pixel defects/blemishes also may emerge due to prolonged operation at elevated ambient temperature, due to high gain setting, or during long time exposure. It is therefore recommended to operate the camera within its specifications.

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

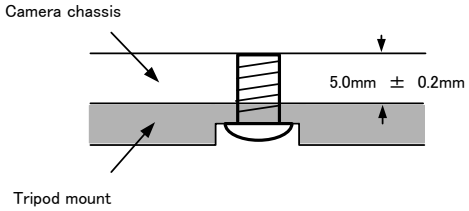
3. Caution when mounting a lens on the camera

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

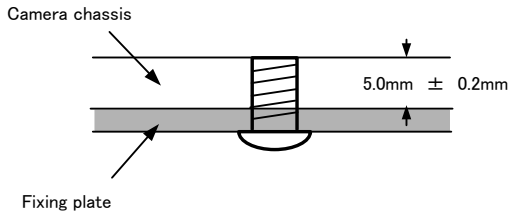
4. Caution when mounting the camera

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

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



Attaching the tripod mount



Mounting the camera to fixing plate

5. Exportation

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

6. References

1. This manual and a datasheet for GO-5000M-PMCL / GO-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
May 2014	Preliminary	New Release
June 2014	Ver.1.0	Release
July 2014	Ver.1.1	Review EMA1288 parameters
August 2014	Ver.1.2	Review Frame Rate in 6.2.2 and 12.2, Review Frame Rate and Frame Period in 7.3.2 and review the calculation formula in 8.1.2

User's Record

Camera type: **GO-5000M-PMCL / GO-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*

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