See the possibilities

User Manual

GO-5000M-USB
GO-5000C-USB

5M Digital Progressive Scan
Monochrome and Color Camera

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Warranty

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

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that GO-5000M-USB and GO-5000C-USB 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.

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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。
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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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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

Interface

The GO-5000-USB employs a USB 3.0 interface and is in the process of being certified for compliance with the USB3 Vision standard. USB3 Vision is a new standard interface for machine vision applications being developed and managed by the AIA (Automated Imaging Association). USB3 Vision uses USB 3.0 ports that will soon be standard on most PCs (with Windows 7 service pack and Windows 8 native support expected soon). Components from different manufacturers will easily communicate with each other.

USB3 Vision also supports the GenICam™ standard which is managed by the EMVA (European Machine Vision Association). The purpose of the GenICam standard is to provide a common program interface for various machine vision cameras. By using GenICam, cameras from different manufacturers can seamlessly connect in one platform.

The maximum transfer speed of USB 3.0 is specified at 5.0 Gbps, however effective bandwidth is reduced by a number of factors including pixel format conversions and the physical interface components used. The USB3 Vision standard specifies a bandwidth of 2.6 Gbps or greater. Maximum cable length for passive cables is five meters, but this can be made longer using active cables.

As for the USB connector, GO-5000-USB uses a Micro B connector which complies with USB 3.0. This connector has an additional 5-pin plug "stacked" on the side of a standard USB 2.0 Micro B connector. However, USB 2.0 cannot be used with the GO-5000-USB.

1. General

The GO-5000M-USB and GO-5000C-USB are members of JAI's Go Series, offering users small yet rugged cameras equipped with fundamental functions for machine vision. They are high performance cameras with high resolution and a fast frame rate suitable for a range of applications. The GO-5000M-USB is a monochrome progressive scan CMOS camera and the GO-5000C-USB is the equivalent Bayer mosaic progressive scan CMOS camera. Both are equipped with a CMOS sensor offering a 1-inch optical format, a resolution of 5.24 million pixels, and a 5:4 aspect ratio. They provide up to 61.9 frames per second for continuous scanning with 2560 x 2048 full pixel resolution for both monochrome and raw Bayer output.

8-bit, 10-bit or 12-bit output can be selected for both monochrome and raw Bayer formats. The new cameras feature a USB3 Vision interface. A full pixel readout or partial scan readout mode can be selected depending on applications.

The GO-5000M-USB and GO-5000C-USB 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, 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 Camera Control Tool for the GO-5000M-USB and GO-5000C-USB 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.

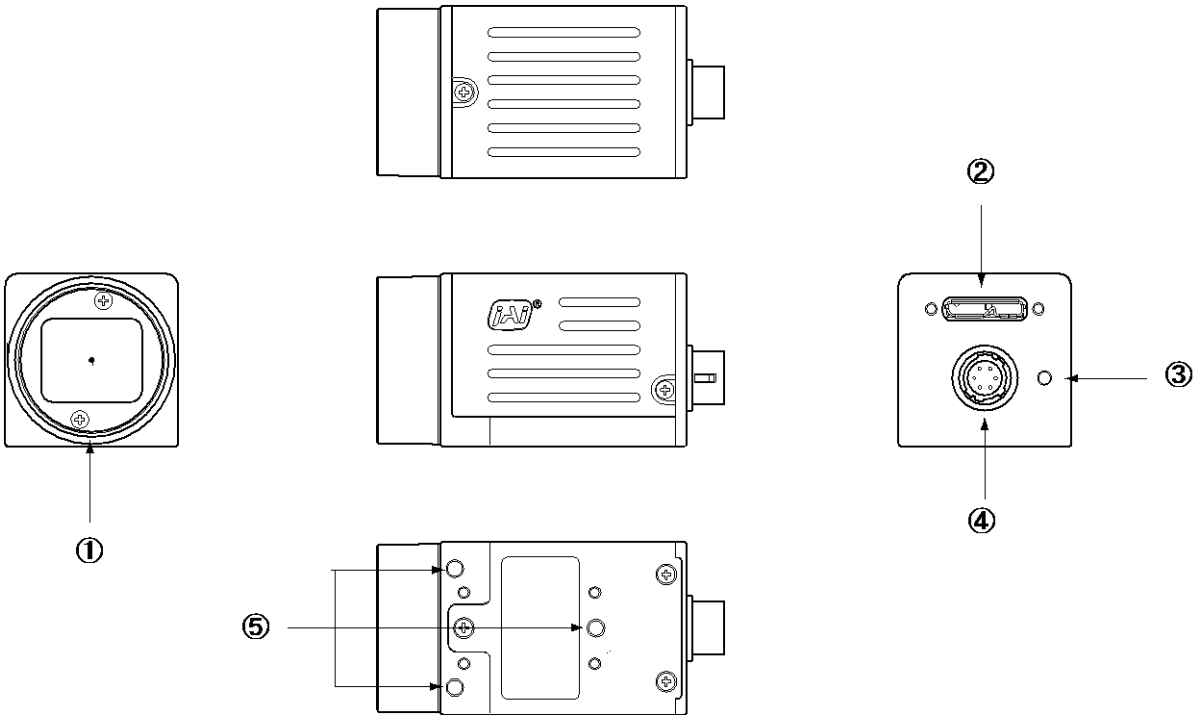
Tripod base	MP-43
Power supply unit	PD-12 series

3. Main features

- New Compact and Rugged housing Series, 1” progressive scan camera
- Intelligent body design for easy and flexible installation
- Utilizes new USB 3.0 interface
- Aspect ratio 5:4, 2560(H) x 2048(V) - 5.2 million effective pixels
- 5 µm square pixels
- S/N 55 dB for monochrome and 50 dB for color
- 8-bit, 10-bit or 12-bit output for monochrome and Bayer
- 61.9 frames/second with full resolution in continuous operation (8-bit)
- Various readout modes, including horizontal and vertical binning (GO-5000M-USB only) and ROI (Region Of Interest) for faster frame rates
- 0 dB to +24 dB gain control for both GO-5000M-USB and GO-5000C-USB
- 10 µs (1/100,000) to 8 seconds exposure control in 1 µs steps
- Auto exposure control
- Timed and trigger width exposure control
- RCT trigger mode for specific applications
- ALC control with combined function of AGC and auto exposure
- HDR (High Dynamic Range) function is available (GO-5000M-USB only)
- Various pre-processing circuits are provided
  Programmable LUT
  Gamma correction can be selected from 0.45, 0.6 and 1.0
  Shading correction
  Bayer white balance with manual or one-push auto (GO-5000C-USB only)
  Blemish compensation
- C-mount for lens mount
- Setup by Windows XP/Vista/7/8 via serial communication

4. Locations and functions

4.1 Locations and functions



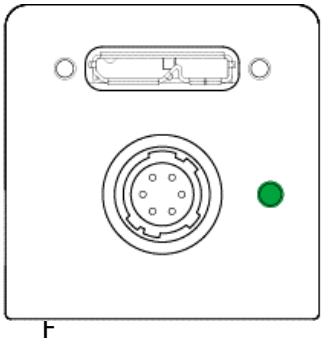
①	Lens mount	C-mount (Note *1)
②	USB 3.0 connector	Connector for interfacing via USB 3.0
③	LED	Indicator for power and trigger input
④	6-pin connector	DC and trigger input
⑤	Mounting holes	Holes for mounting tripod base or direct installation. Depth 3 mm (Note*2)

Note1: Rear protrusion on C-mount lens must be less than 10.0 mm.
Note2: The part number for the tripod adapter plate (with 1/4"-20 thread) is MP-43 (option). When the camera is mounted directly using mounting holes, the length of screws must be less than 3mm. If they are longer than 3mm, they may not fasten securely due to the 3mm hole depth.

Fig. 1 Locations

4.2 Rear panel

The rear panel mounted LED provides the following information:



POWER/TRIG

- 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.

ig. 2 Rear panel

5. Installation and preparation

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

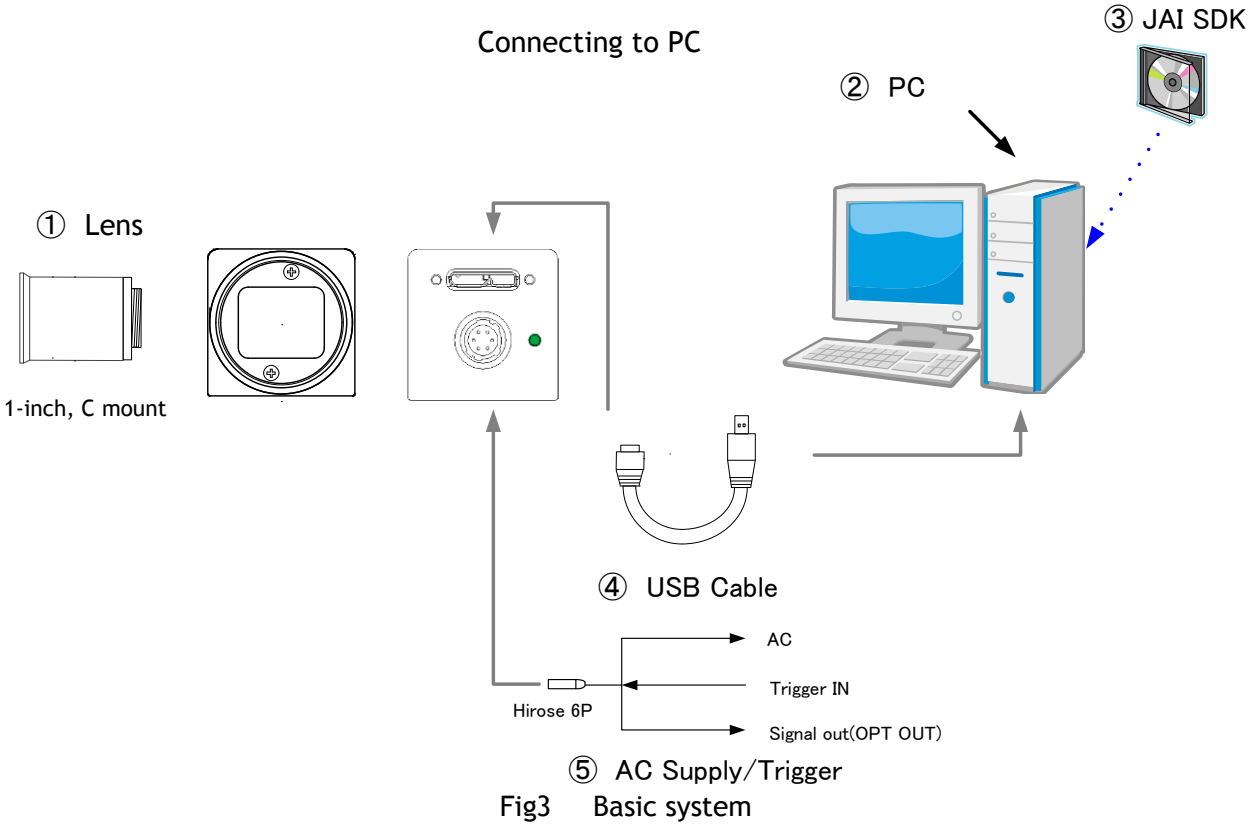


Fig3 Basic system

5.1 Lens used

The GO-5000-USB 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-USB 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 diagonally, 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 GO-5000-USB is 12.8 mm)

5.2 Computer to be used

It is necessary to use a PC equipped with a USB 3.0 interface. It is also recommended to use a PC equipped with slots of better than PC Express 2.0 x 8. Please note that the GO-5000-USB may not work properly depending on the chipset used in the PC.

5.3 JAI SDK and Control Tool software

The GO-5000M-USB and GO-5000C-USB 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.

5.4 Cables to be used

As for the USB connector, GO-5000-USB uses a Micro B connector which complies with USB 3.0. This connector has an additional 5-pin plug "stacked" on the side of a standard USB 2.0 Micro B connector. However, USB 2.0 cannot be used with the GO-5000-USB.

5.5 AC Adapter/Trigger

In the GO-5000-USB, the USB 3.0 interface is capable of supporting both data and power.
GO-5000-USB is also equipped with a 6-pin connector which can optionally be used to connect to a separate power supply, as well as providing an optical interface for external I/O such as a trigger pulse.

5.6 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-USB are as follows.

Table – 1 Default settings

Image Format	Bit allocation	8-bit
	Height	2048
	Binning Horizontal (Note)	OFF
	Binning Vertical (Note)	OFF
Trigger Operation	Trigger Mode	OFF
Exposure Control	Exposure Mode	OFF
Gain	Gain Auto	OFF
	Manual Gain all	0
	Manual Fine Gain all	0
	Analogue Base Gain	0dB

Note: GO-5000M- USB only.

6. Input and output

6.1 USB 3.0 Interface specifications

The GO-5000-USB employs a USB 3.0 interface for video and data transfer. USB 3.0 is an upgraded version of USB 2.0 widely used in the industry. Its transfer rate is 5 Gbps, which is 10 times faster than the 480 Mbps rate of USB 2.0. USB 3.0 employs a full-duplex system which executes both transmitting and receiving at the same time. USB 3.0 has downward compatibility to USB 2.0 but in the GO-5000-USB, USB 2.0 cannot be used because the performance is not guaranteed.
The connector used for USB 3.0 in the GO-5000-USB is a Micro B Type connector with a USB 3.0 form factor.

6.2 Connectors and pin assignment

6.2.1 Output connector for Digital Video Output (USB 3.0 Micro B connector)

Type : ZX3600-B-10p or equivalent

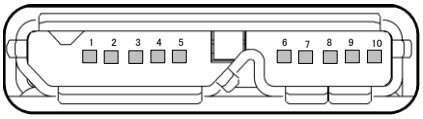


Fig.4 USB 3.0 Micro B Connector

Table – 2 USB 3.0 Pin assignment

No	I/O	Name	Note
1	I	Power(VBUS)	+5V
2	I/O	USB2.0 Differential pair(D-)	Differential pair
3	I/O	USB2.0 Differential pair(D+)	
4	I	USB OTG ID for identifying lines	Line identification ID
5		GND	
6	O	USB 3.0 Signal Transmission line (-)	Signal transmission line
7	O	USB 3.0 Signal Transmission line (+)	
8		GND	
9	I	USB 3.0 Signal Receiving line (-)	Signal Receiving line
10	I	USB 3.0 Signal Receiving line (+)	

6.2.2 Hirose 6-Pin connector

Type: HR-10A-7R-6PB(73) Hirose or equivalent

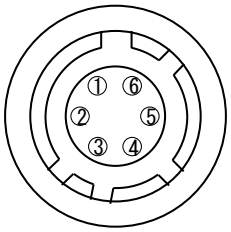


Fig.5 6-pin connector

Table - 3 Hirose 6P pin assignment

Pin no.	I/O	Signal	Remarks
1		DC in	+12V ～ +24V
2	I	Opto in1	Line 5
3	O	Opto out1	Line 1
4	O	Opto out2	Line 2
5		Opto Common	
6		GND	

6.3 Digital IN/OUT interface

In the GO-5000M-USB and GO-5000C-USB, the digital IN/OUT capability in the software control tool can assign the necessary signals needed for the system.

6.3.1 Line Selector

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

Table – 4 Line selector

Line Selector item	Description
Line 1 Opt 1 Out	Opt 1 output from #3 pin of DC In/Trigger 6-Pin on the rear
Line 2 Opt 2 Out	Opt 2 output from #4 pin of DC In/Trigger 6-Pin on the rear
NAND 0 In 1	First input at first NAND gate in GPIO
NAND 0 In 2	Second input at first NAND gate in GPIO
NAND 1 In 1	First input at second NAND gate in GPIO
NAND 1 In 2	Second input at second NAND gate in GPIO

Note: Select and connect the line source signal against the item selected in the line selector.

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 – 5 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
Acquisition Trigger Wait	Connect Acquisition Trigger Wait signal to line item selected in Line Selector
Acquisition Active	Connect Acquisition Active 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
PulseGenerator0 Out	Connect Pulse Generator 0 signal to line item selected in Line Selector
Line 5 Opt In	Connect Opt In 1 signal (line 5) to 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

6.3.3 Line Mode

Indicates the status of the interface, input or output.

6.3.4 Line Inverter

Sets the polarity of the selected input or output.

6.3.5 Line Status

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

6.3.6 Line Format

Controls the format of the line item selected in Line Selector.
(No Connect, TTL, LVDS, Opto Coupled)

Note: In the GO-5000-USB, TTL and LVDS are not available.

6.3.7 GPIO

This is a general interface for input and output and controls input and output for trigger signals or valid signals and pulse generator. By using this interface, you can control an external light source, make a delayed function to input a trigger signal or make a precise exposure control with PWC trigger.

6.3.7.1 Basic block diagram

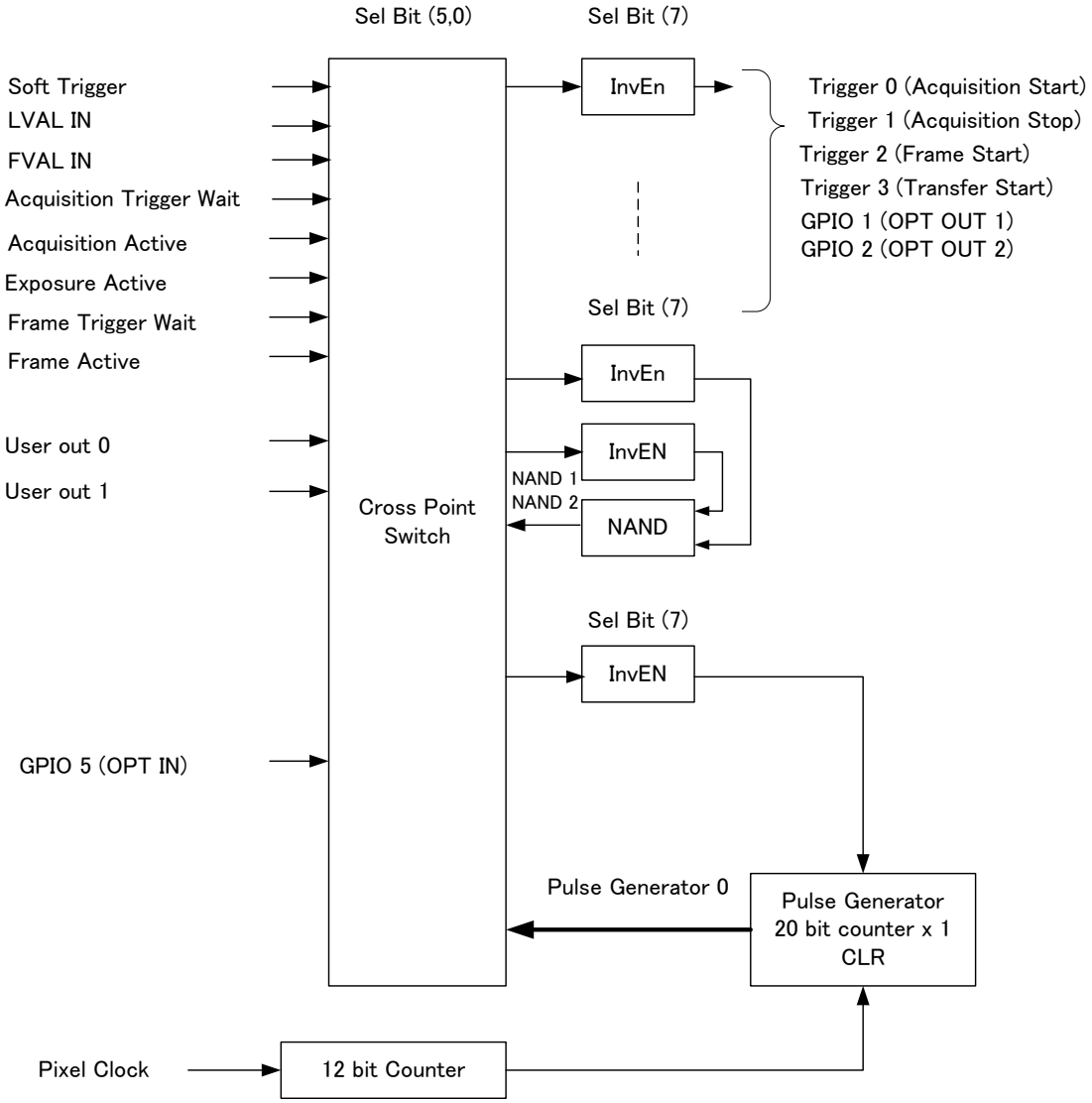


Fig. 6 GPIO

6.3.7.2 IN and OUT matrix table

The following table shows the input and output matrix table.

Table – 6 GPIO IN and OUT matrix table

Selector (Cross point switch output) / Source signal (Cross point switch input)	Trigger Selector				Line Selector						Pulse Generator Selector
	Acquisition Start	Acquisition Stop	Frame Start	Transfer Start	GPIO 1 - 12P OPT Out 1	GPIO 2 - 12P Opt Out 2	NAND 1 In 1	NAND 1 In 2	NAND 2 In 1	NAND 2 In 2	Pulse Generator 0
LOW	O	O	O	O	O	O	O	O	O	O	O
HIGH	O	O	O	O	O	O	O	O	O	O	O
GPIO 5 - 6P OPT 1 In	O	O	O	O	O	O	O	O	O	O	O
NAND 1 Out 1	O	O	O	O	O	O	×	×	O	O	O
NAND 2 Out 1	O	O	O	O	O	O	O	O	×	×	O
Pulse Generator 0	O	O	O	O	O	O	O	O	O	O	×
User Output 0	O	O	O	O	O	O	O	O	O	O	O
User Output 1	O	O	O	O	O	O	O	O	O	O	O
Software Trigger	O	O	O	O	×	×	×	×	×	×	O
FVAL	×	×	×	×	O	O	O	O	O	O	O
LVAL	×	×	×	×	×	×	×	×	×	×	O
Acqusition Active	×	×	×	×	O	O	O	O	O	O	O
Acquisition Trigger Wait	×	×	×	×	O	O	O	O	O	O	O
Exposure Active	×	×	×	×	O	O	O	O	O	O	O
Frame Trigger Wait	×	×	×	×	O	O	O	O	O	O	O
Frame Active	×	×	×	×	O	O	O	O	O	O	O
	Trigger Source				Line Source						Pulse Generator Clear Source

6.4 Optical Interface

The GO-5000-USB is equipped with opto-isolated inputs and outputs, providing galvanic separation between the camera's inputs/outputs and peripheral equipment.
In addition to galvanic separation, the opto-isolated inputs and outputs can cope with a wide range of voltages; the voltage range for inputs is +3.3V to +24V DC whereas outputs will handle +5V to +24V DC.
The following drawing is the concept of photo coupler

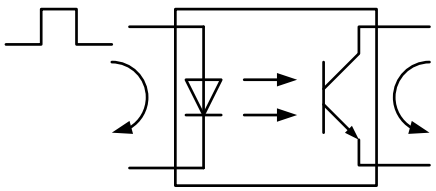


Fig.7 Photo coupler

6.4.1 Recommended External Input circuit diagram for customer

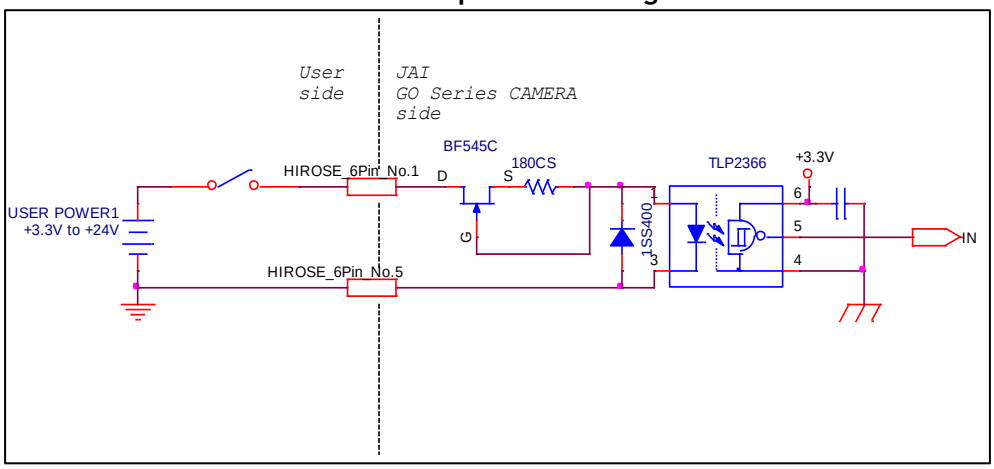


Fig.8 Example of external input circuit

6.4.2 Recommended External Output circuit diagram for customer

Standard circuit

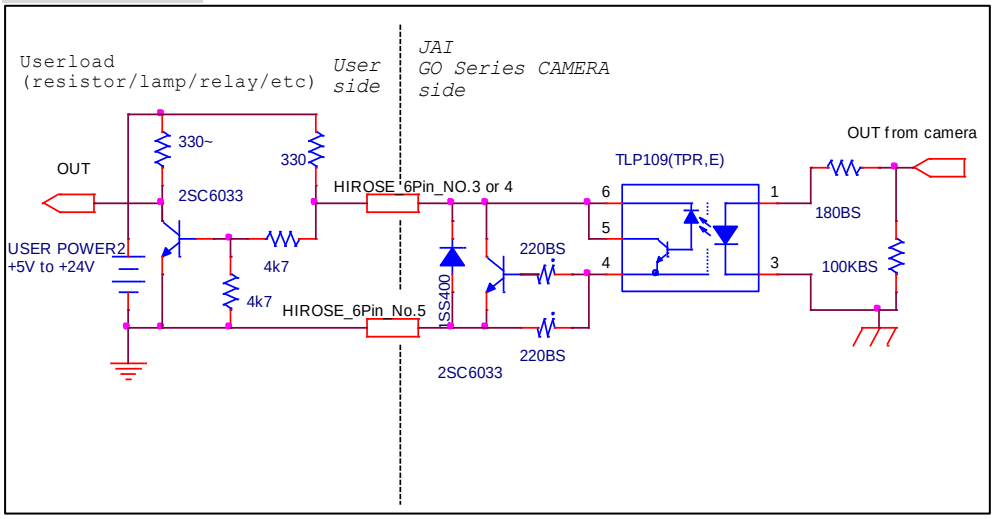


Fig.9 Example of external output circuit(Standard)

Simple circuit

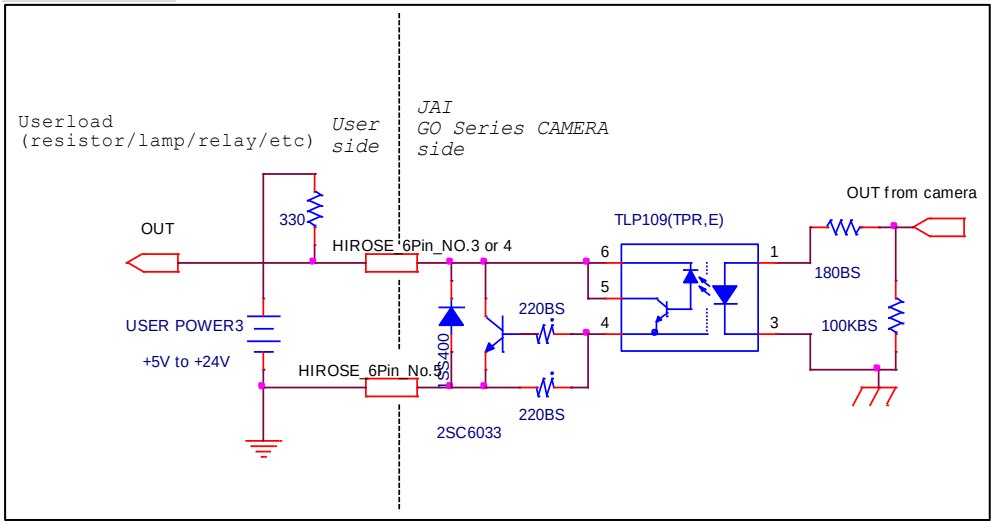


Fig.10 Example of external output circuit(Simple)

6.4.3 Characteristics of optical interface

The relationship of the input signal to the output signal through the optical interface is as follows.

Characteristics of user output circuit

R4= 330ΩPULL_UP	User Power (Vcc)			
	3.3v	5.0v	12v	24v
Time Delay Rise TDR (us)	0.78	0.82	1.8	2.65
Rise Time RT (us)	4.1	4.7	6.1	9.1
Time Delay Fall TDF (us)	0.26	0.48	0.56	0.78
Fall Time FT (us)	1.3	1.6	3.1	4.8

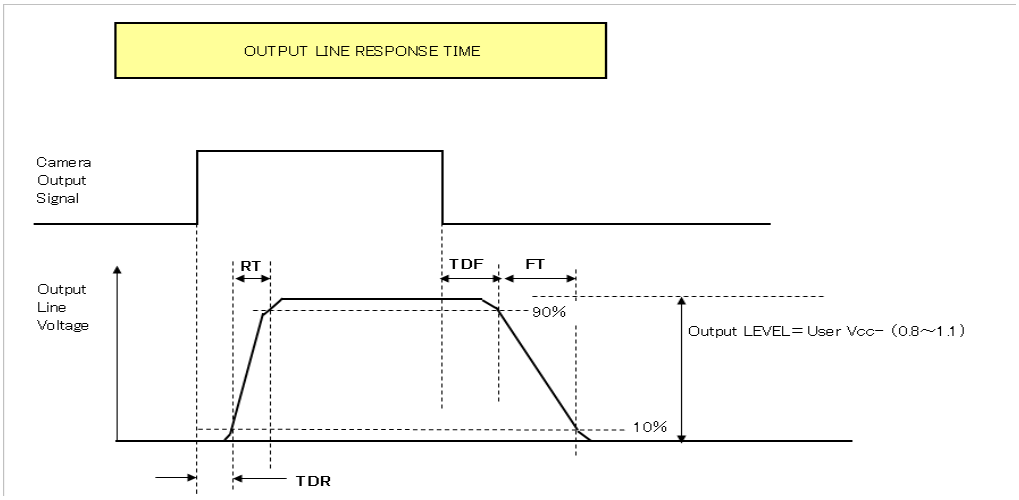


Fig.10 Optical interface characteristics

6.4.4 Opt In Filter Selector function

As for the surge protection of the optical input, the filter can be selected from 5 steps which are 10 µs (Typical), 100 µs, 500 µs, 1 ms and 10 ms. If the filter is set, a pulse with a shorter width than the filter setting value cannot be accepted.

6.5 Pulse Generator

The GO-5000-USB has a frequency divider using the pixel clock as the basic clock and a pulse generator. In each Pulse Generator, various Clear settings are connected to GPIO.
The following shows Pulse Generator default settings.

Table – 7 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 setting, 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.

6.5.1 Clock Pre-scaler

Clock pre-scaler (Divide Value) can set the dividing value of the frequency divider (12-bit length) and the pixel clock is used for this. A built-in pulse generator works by the same clock. In the GO-5000-USB, the pixel clock is 48 MHz.

6.5.2 Pulse Generator Selector

GO-5000-USB has one pulse generator.

Table – 8 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.

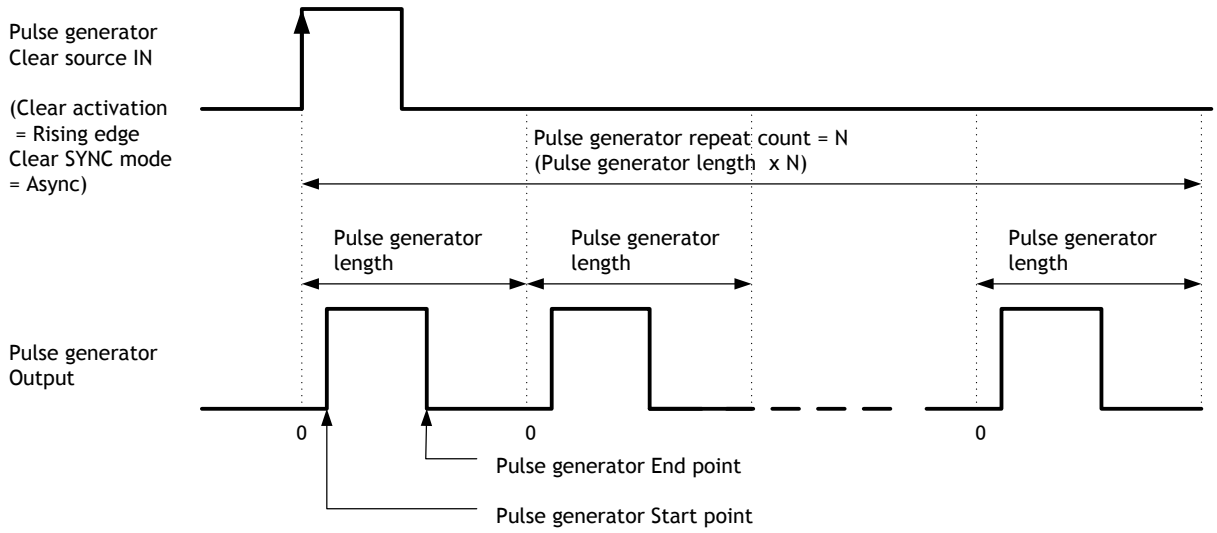


Fig.11 Pulse Generator pulse construction

6.5.3 Pulse Generator Length

Set the counter up value (number of clocks, refer to Table 14) for the selected pulse generator. If Repeat Count value is "0", and if Pulse Generator Clear signal is not input, the pulse generator generates the pulse repeatedly until reaching this counter up value.

6.5.4 Pulse Generator Start Point

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

6.5.5 Pulse Generator End Point

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

6.5.6 Pulse Generator Repeat Count

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

6.5.7 Pulse Generator Clear Activation

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

6.5.8 Pulse Generator Clear Sync Mode

Set the clear count method for the selected pulse generator. In the 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 the 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.

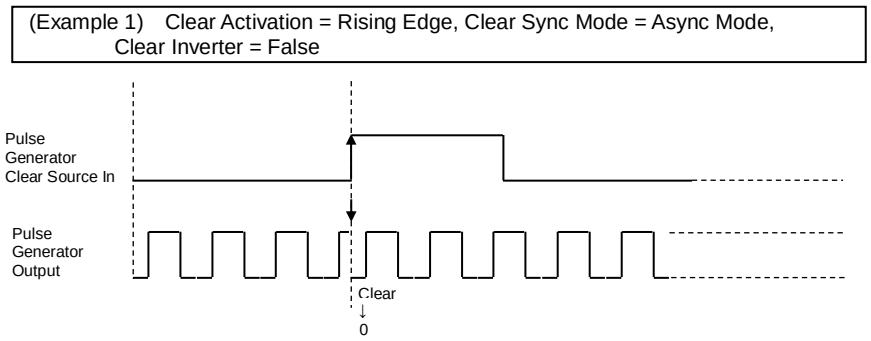


Fig.12 Counter clear in Async mode

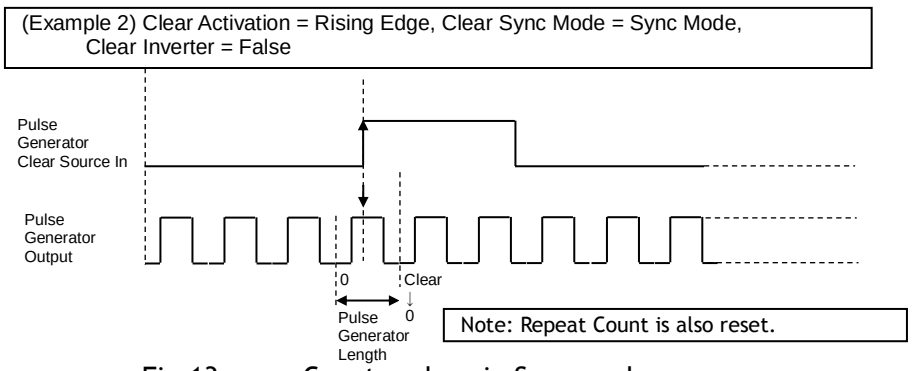


Fig.13 Counter clear in Sync mode

6.5.9 Pulse Generator Clear Source

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

Table – 9 Pulse generator clear source

Pulse Generator Clear Source item	Description
Low	Connect Low level signal to Clear Source for the selected pulse generator. **Default setting**
High	Connect High level signal to Clear Source for the selected pulse generator.
Acquisition Trigger Wait	Connect Acquisition Trigger Wait signal to Clear Source for the selected pulse generator.
Acquisition Active	Connect Acquisition Active signal to Clear Source for the selected pulse generator.
Frame Trigger Wait	Connect Frame Trigger Wait signal to Clear Source for the selected pulse generator.
Frame Active	Connect Frame Active signal to Clear Source for the selected pulse generator.
Exposure Active	Connect Exposure Active signal to Clear Source for the selected pulse generator.
FVAL	Connect FVAL signal to Clear Source for the selected pulse generator.
LVAL	Connect LVAL signal to Clear Source for the selected pulse generator.
User Output 0	Connect User Output 0 output to Clear Source for the selected pulse generator.
User Output 1	Connect User Output 1 output to Clear Source for the selected pulse generator.
Line 5 OPT in	Connect Opt In signal to Clear Source for the selected pulse generator.
NAND 0 Out	Connect NAND 0 output signal to Clear Source for the selected pulse generator.
NAND 1 Out	Connect NAND 1 output signal to Clear Source for the selected pulse generator.

6.5.10 Pulse Generator Inverter

Clear Source Signal can have polarity inverted.

6.5.11 Pulse Generator Setting Parameters

Table – 10 Pulse Generator setting parameters

Display Name	Value
Clock Pre-scaler	1 to 4096
Pulse Generator Clock (MHz)	[Pixel Generator Tick Frequency: 48MHz]÷[Clock Pre-scaler]
Pulse Generator Selector	- Pulse Generator 0
	- Pulse Generator 1
- 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
	- Acquisition Trigger Wait
	- Acquisition Active
	- Frame Trigger Wait
	- Frame Active
	- Exposure Active
	- Fval
	- Lval
	- User output 0
	- User output 1
	- OPT 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.

7. Sensor layout, output format and timing

7.1 Sensor layout

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

7.1.1 Monochrome sensor

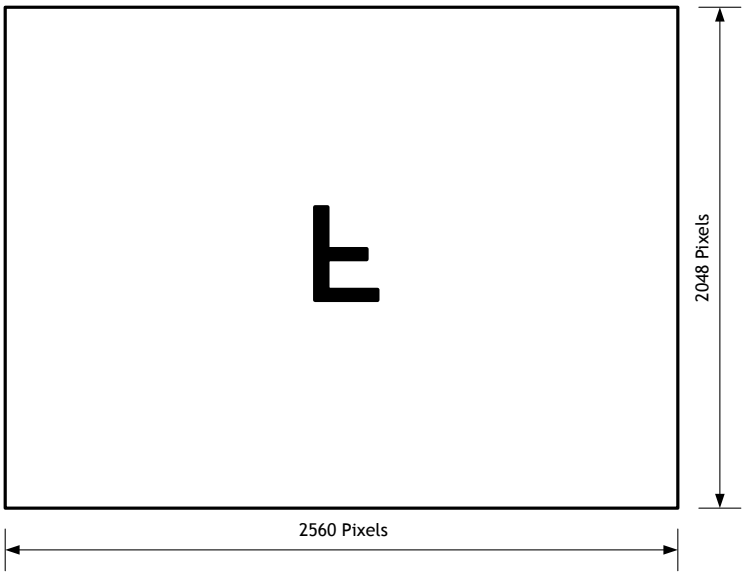


Fig.14 Monochrome sensor layout

7.1.2 Bayer color sensor

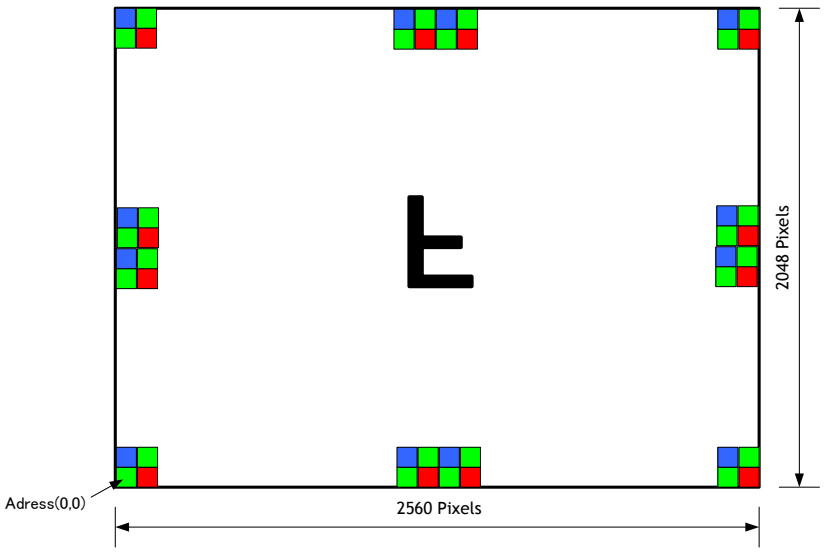


Fig.15 Bayer color sensor layout

7.2. Camera output format

The following table shows the relationship between camera output and sensor readout system.

Camera output format	Sensor readout system	Reference figure
1X-1Y	1-tap readout	7.2.1

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

7.2.1 1X-1Y

1X-1Y is defined in GenICam SFNC Ver.1.5.1 for 1-tap readout and the readout system is the following.

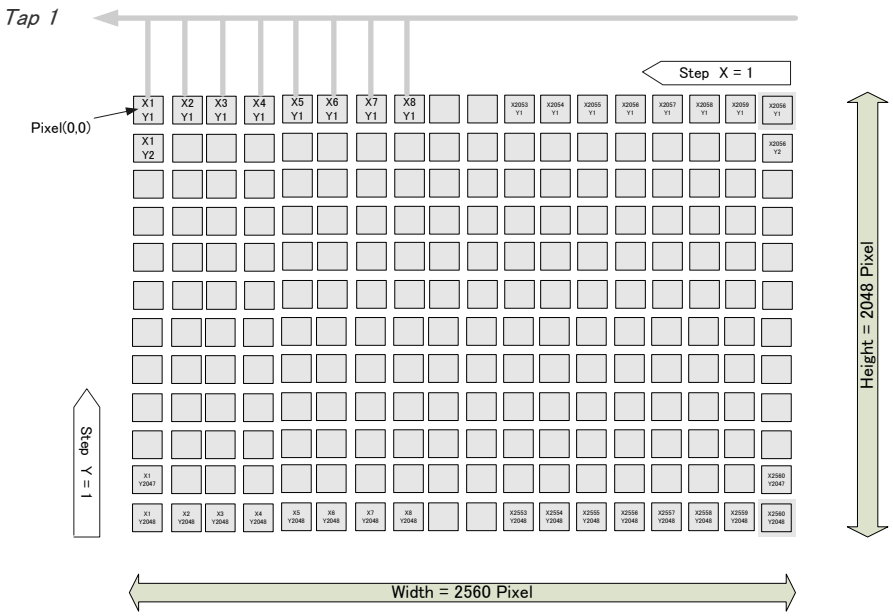


Fig.16 1X – 1Y readout

7.3 Pixel Format

7.3.1 Pixel Format

Model	Supported Pixel Formats
GO-5000M-USB	Mono8, Mono10, Mono12, Mono10_Packed, Mono12_Packed
GO-5000C-USB	BayGR8, BayGR10, BayGR12 ,BayerGR10_Packed, BayerGR12_Packed

7.3.2 GO-5000M-USB Pixel Type

7.3.2.1 GVSP_PIX_MONO8 8-bit output

Y0								Y1								Y2							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

7.3.2.2 GVSP_PIX_MONO10_Packed 10-bit output

Y0								Y0		Y1						Y1				Y2								Y2				Y3							
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9

7.3.2.3 GVSP_PIX_MONO10 16-bit output

Y0								Y0								Y1								Y1							
0	1	2	3	4	5	6	7	8	9	X	X	X	X	X	X	0	1	2	3	4	5	6	7	8	9	X	X	X	X	X	X

7.3.2.4 GVSP_PIX_MONO12Packed 12-bit output

Y0								Y0				Y1				Y1								
0	1	2	3	4	5	6	7	8	9	10	11	0	1	2	3	4	5	6	7	8	9	10	11

7.3.2.5 GVSP_PIX_MONO12 16-bit output

Y0								Y0								Y1								Y1							
0	1	2	3	4	5	6	7	8	9	10	11	X	X	X	X	0	1	2	3	4	5	6	7	8	9	10	11	X	X	X	X

7.3.3 GO-5000C-USB Pixel Type

7.3.3.1 GVSP_PIX_BAYGR8 8-bit output

odd Line

G0								R1								G2							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

Even Line

B0								G1								B2							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

7.3.3.2 GVSP_PIX_BAYGR10_Packed 10-bit output

Odd Line

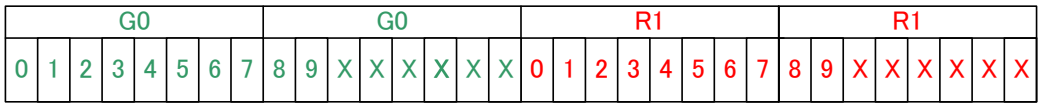
G0								G0		R1						R1				G2								G2				R3							
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9

Even Line

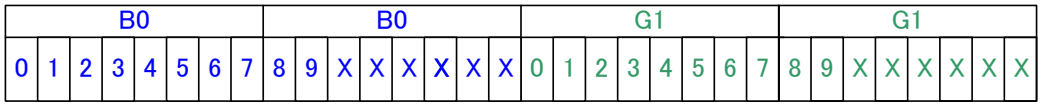
B0								B0		G1						G1				B2								B2				G3							
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9

7.3.3.3 GVSP_PIX_BAYERGR10 16-bit output

Odd Line

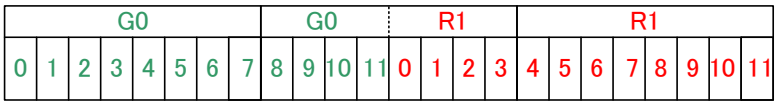


Even Line

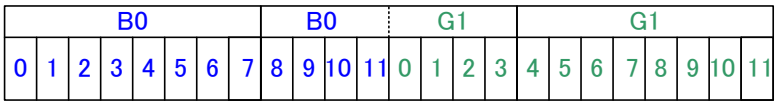


7.3.3.4 GVSP_PIX_BAYGR12_Packed 12-bit output

Odd Line

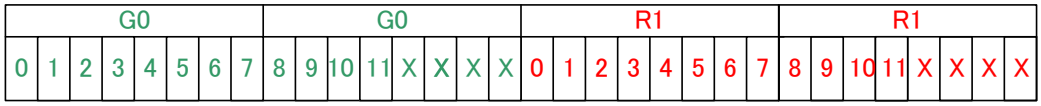


Even Line

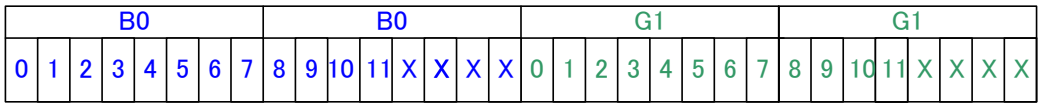


7.3.3.5 GVSP_PIX_BAYERGR12 16-bit output

Odd Line



Even Line



7.3.4 PixelSize

Table - 11 Pixel size

Bit per Pixel	Pixel Format	
	GO-5000M-USB	GO-5000C-USB
Bpp8	Mono8	BayerGR8
Bpp10	Mono10_Packed	BayerGR10_Packed
Bpp12	Mono12_Packed	BayerGR12_Packed
Bpp16	Mono10, Mono12	BayerGR10, BayerGR12

7.4 Output timing

7.4.1 Horizontal timing

The horizontal timing of the GO-5000-USB is described below. Although the GO-5000M-USB has a horizontal binning function, its horizontal frequency does not change if it is ON. So, the frame rate is not increased.

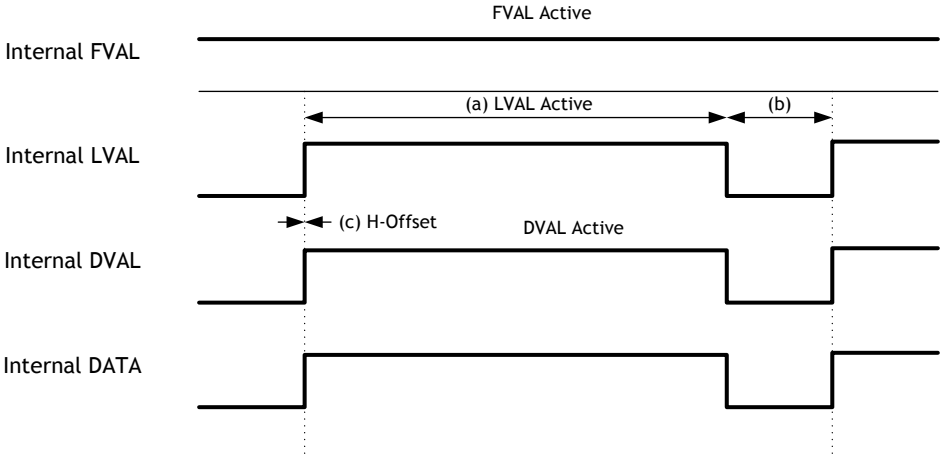


Fig.17 Horizontal Timing (Vertical timing OFF)

Table - 12 Timming parameters in Continuous Trigger Mode

		Horizontal Frequency[	C		A		B	
			H-Offset		LVAL Active		LVAL Non-active	
H Binning (Note 1)	Pixel Type	kHz	Interval (us)	clk	Interval (us)	clk	clk	Freme Rate (fps)
H1	8Bit	145.455	6.875	330	6.84	328	2	61.895
	10Bit Packed	145.455	6.875	330	6.84	328	2	49.508
	12Bit Packed	145.455	6.875	330	6.84	328	2	41.358
	10Bit	145.455	6.875	330	6.84	328	2	30.902
	12Bit	145.455	6.875	330	6.84	328	2	30.895
H2	8Bit	145.455	6.875	330	3.50	168	162	61.895
	10Bit Packed	145.455	6.875	330	3.50	168	162	49.508
	12Bit Packed	145.455	6.875	330	3.50	168	162	41.357
	10Bit	145.455	6.875	330	3.50	168	162	30.902
	12Bit	145.455	6.875	330	3.50	168	162	30.895
H4	8Bit	145.455	6.875	330	1.84	88	242	61.895
	10Bit Packed	145.455	6.875	330	1.84	88	242	49.508
	12Bit Packed	145.455	6.875	330	1.84	88	242	41.346
	10Bit	145.455	6.875	330	1.84	88	242	30.902
	12Bit	145.455	6.875	330	1.84	88	242	30.902

(Note1) GO-5000M-USB only

7.4.2 Vertical timing

The vertical timing of the GO-5000-USB is described below.

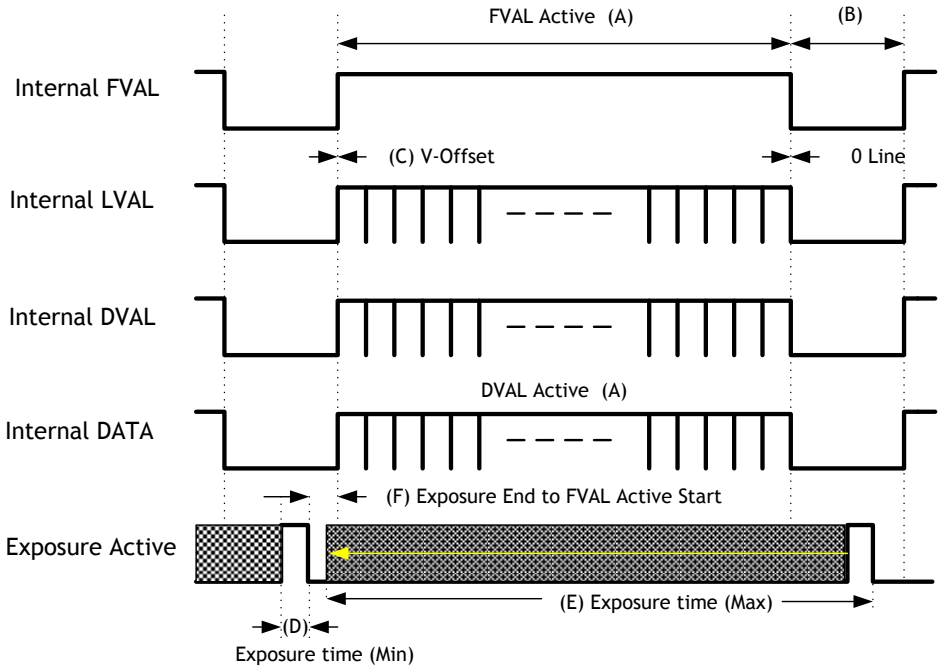


Fig.18 Vertical Timing (Vertical binning OFF)

Table - 13 Timming parameters in Continuous Trigger Mode

				A	B	C
		Frame Rate	1Line Total clock	FVAL & DVAL Active	FVAL Non-active	V -Offset
V-Binning (Note 1)	Pixel Type	Interval (fps)	L	L	L	L
V1, H1	8Bit	61.895	2350	2048	302	0
	10Bit Packed	49.508	2938	2048	890	0
	12Bit Packed	41.358	3517	2048	1469	0
	10Bit	30.902	4707	2048	2659	0
	12Bit	30.902	4707	2048	2659	0
V1, H2	8Bit	61.895	2350	2048	302	0
	10Bit Packed	49.508	2938	2048	890	0
	12Bit Packed	41.358	3517	2048	1469	0
	10Bit	30.902	4707	2048	2659	0
	12Bit	30.895	4708	2048	2660	0
V1, H4	8Bit	61.895	2350	2048	302	0
	10Bit Packed	49.508	2938	2048	890	0
	12Bit Packed	41.358	3517	2048	1469	0
	10Bit	30.902	4707	2048	2659	0
	12Bit	30.895	4708	2048	2660	0
V2, H1	8Bit	123.58	1177	1024	153	0
	10Bit Packed	99.219	1466	1024	442	0
	12Bit Packed	82.598	1761	1024	737	0
	10Bit	16.184	2354	1024	1330	0
	12Bit	16.184	2354	1024	1330	0

(Note1) GO-5000M-USB only

				A	B	C
		Frame Rate	1Line Total clock	FVAL & DVAL Active	FVAL Non-active	V -Offset
V-Binning (Note 1)	Pixel Type	Interval (fps)	L	L	L	L
V2, H2	8Bit	123.58	1177	1024	153	0
	10Bit Packed	99.219	1466	1024	442	0
	12Bit Packed	82.598	1761	1024	737	0
	10Bit	16.184	8988	1024	7964	0
	12Bit	16.184	8988	1024	7964	0
V2, H4	8Bit	123.58	1177	1024	153	0
	10Bit Packed	99.219	1466	1024	442	0
	12Bit Packed	82.598	1761	1024	737	0
	10Bit	61.791	2354	1024	1330	0
	12Bit	61.791	2354	1024	1330	0
V4, H1	8Bit	245.7	592	512	80	0
	10Bit Packed	198.71	732	512	220	0
	12Bit Packed	165.235	880	512	368	0
	10Bit	123.37	1179	512	667	0
	12Bit	123.37	1179	512	667	0
V4, H2	8Bit	123.58	1177	512	665	0
	10Bit Packed	99.219	1466	512	954	0
	12Bit Packed	82.598	1761	512	1249	0
	10Bit	61.791	2354	512	1842	0
	12Bit	61.791	2354	512	1842	0
V4, H4	8Bit	245.76	592	512	80	0
	10Bit Packed	198.71	732	512	220	0
	12Bit Packed	165.29	880	512	368	0
	10Bit	123.48	1178	512	666	0
	12Bit	123.48	1178	512	666	0

(Note1) GO-5000M-USB only

7.4.3 ROI (Region Of Interest) setting

In the GO-5000-USB, 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-5000-USB, the minimum width is “16” and minimum height for GO-5000M-USB is “1” and for GO-5000C-USB is “2”.

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

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

* GO-5000M-USB only

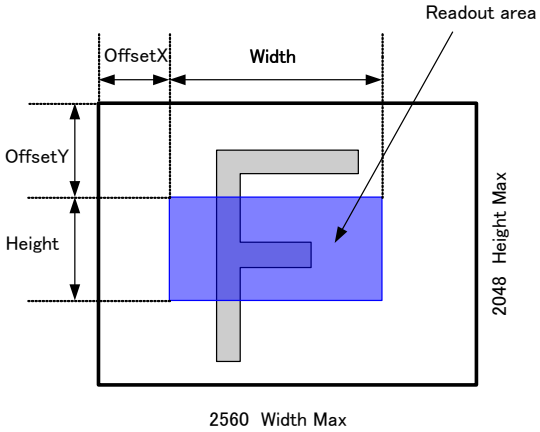


Fig.19 Setting example (No binning)

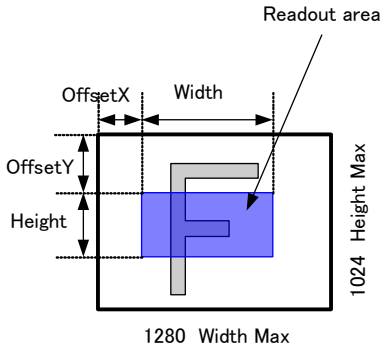
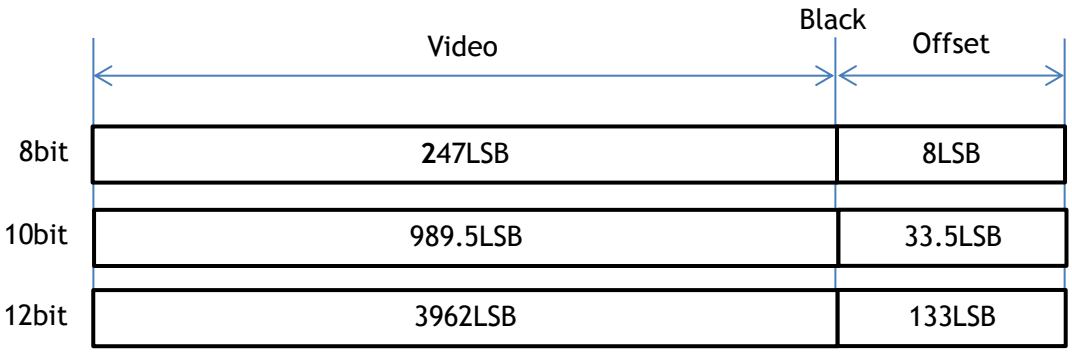


Fig.20 Setting example (Binning)

7.5 Digital output Bit allocation

The following drawing shows Bit allocation of Digital output.



Note: Above figures are the average value of 100 x 100 pixels in the center.

Fig.21 Bit allocation (12-bit)

8. Operating modes

8.1. Acquisition control

Acquisition control contains the following commands.

Table-14 Acquisition control command

Command	Parameter	Description
Acquisition Mode	Single Frame	One frame can be output by AcqusitionStart command
	Multi Frame	The number of frames which is specified in Acquistion Frame Count, are output by AcquisitionStart command
	Continuous	Images are continuously output by AcquisitionStart command until AcqusitionStop command is input.
Acquisition Start	No(EXE command)	Start Acquisition
Acquisition Stop	No(EXE command)	Stop Acquisition
Acquisition Frame Count	1～255	Set the number of frames to be used in Multi Frame mode.
Acquisition Frame Rate	0.125 to Maximum FrameRate	Set the frame rate in fps value
Acquisition Frame Rate Raw	8 sec to Minimum FramePeriod	Set the frame rate in Frame period (μs)

8.1.1 Acquisition Mode

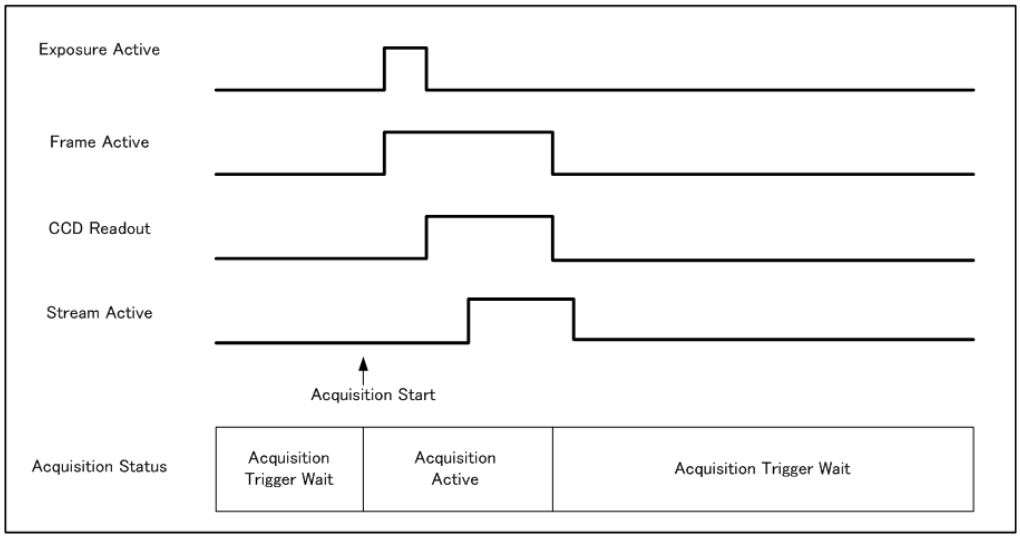
In the GO-5000-USB, the following three acquisition modes are available.

Single frame : One frame can be output by AcqusitionStart command
Multi frames : The number of frames which is specified in Acquistion Frame Count, are output by AcquisitionStart command
Continuous : Images are continuously output by AcquisitionStart command until AcqusitionStop command is input.

8.1.1.1 Single Frame operation

In single frame mode, executing the AcquisitionStart command causes one frame to be captured. After one frame is captured, this operation is automatically stopped.
In order to restart the capture, it is necessary to input the AcquisitionStart command again. BlockID is not reset until AcquisitionStop is input and is incremented when the AcquisitionStart command is called.

◆ Normal single frame operation
1) AcquisitionStart command is input
2) AcquisitionActive becomes “TRUE” (accepts capture)
3) 1 frame is output
4) AcquisitionActive becomes “FALSE” (stop capturing)



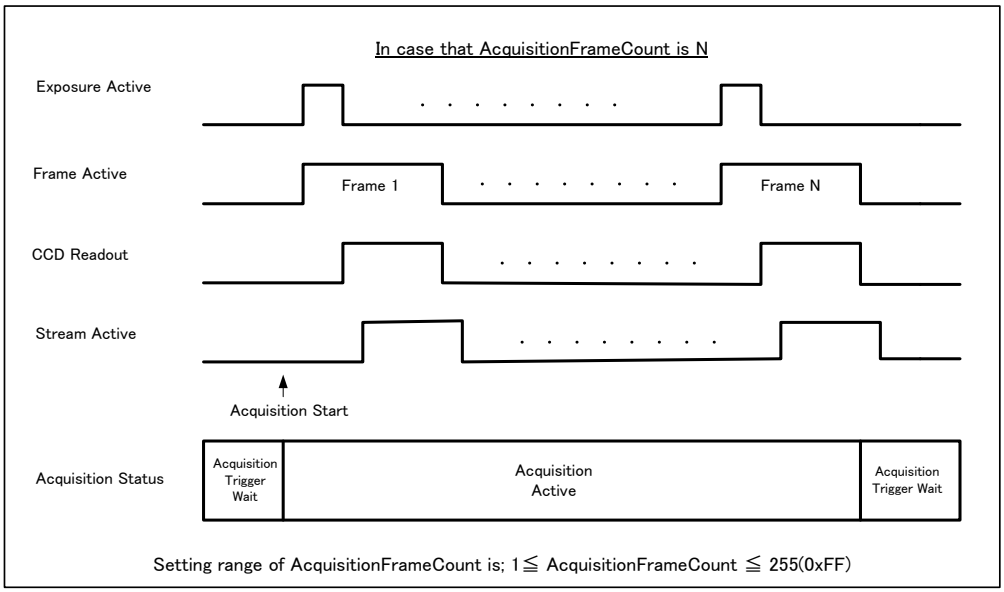
◆ Forcing acquisition to stop
While AcquisitionActive is “TRUE”, if AcquisitionStop or AcquisitionAbort is initiated, AcquisitionActive becomes “FALSE” (stop capturing).
However, if AcqusitionStop command is initiated during image output period, AcqusitionActive becomes “FALSE” (stop capturing) after image output is completed.

Associated commands : Acqusition Start, Acqusition Stop

8.1.1.2 Multi Frame operation

In this mode, the AcquisitionStart command captures the number of frames which are specified by AcquisitionFrameCount.

◆ Normal multi-frame operation
1) AcquisitionStart command is input
2) AcquisitionTriggerWait becomes effective
3) AcquisitionActive becomes “TRUE” (accepts capture)
4) Output N frames as specified by AcquisitionFrameCount
5) AcquisitionActive becomes “FALSE”. Then the output stops. (See the following diagram)



◆ Forcing acquisition to stop
While AcquisitionActive is “TRUE”, if AcquisitionStop or AcquisitionAbort is initiated, AcquisitionActive becomes “FALSE” (stop capturing).
Once the operation is set to “FALSE”, the internal FrameCount is reset.
However, if AcqusitionStop command is initiated during image output period, AcqusitionActive becomes “FALSE” (stop capturing) after image output is completed.
Once, AcqusitionActive becomes “FALSE”, the internal count is reset.

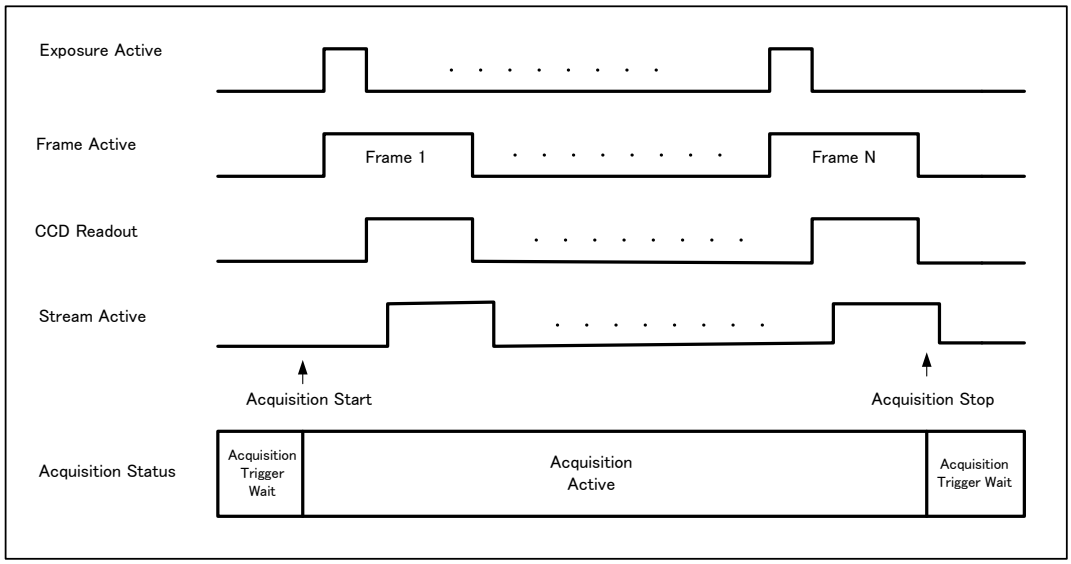
Associated commands: Acqusition Start, Acqusition Frame Count, Acquisition Stop

8.1.1.3 Continuous

In this mode, when the AcquisitionStart command is set, the image is continuously output at the current frame rate. This is the default setting for the GO-5000M-USB and GO-5000C-USB.

1) AcquisitionStart command is input
2) AcquisitionTriggerWait becomes effective
3) AcquisitionActive becomes “TRUE”
4) Images begin outputting continuously
5) AcquisitionStop command is sent
6) AcquisitionActive becomes “FALSE”. At this moment, the output stops.

However, if AcqusitionStop command is initiated during image output period, AcqusitionActive becomes “FALSE” (stop capturing) after image output is completed.



Associated commands : Acqusition Start, Acqusition Stop

8.1.2 AcquisitionStart

This is the command to start Acquisition.

8.1.3 AcquisitionStop

This is the command to stop Acquisition.

8.1.4 Acquisition frame rate

With Trigger OFF, 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. Allowed values range from 3846 Hz to 0.125 Hz for GO-5000-USB. However, if the value entered is less than the time required for the default frame rate of the specified format, the setting is ignored and the default frame rate is used. For example, the minimum frame period for the smallest possible ROI (1 line) requires 3846 Hz (fps), so any entry more than 3846 Hz (fps) will always be ignored.

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

For the above setting, Acquisition Frame Rate is used and its unit is Hz (fps).
Acquisition Frame Rate range: 3846 Hz (fps) to 0.125 Hz (fps)

8.1.5 Calculation of the maximum frame rate

Maximum frame rate(fps) = 1 / (Roundup[*3]([Line Period] x [Height[*2]] + [V Blank Value]) / 1000000)

Where
[Line Period] = [Trow] / 24
[Trow] = Rounddown[*1](24000000 / ((A x (2048 / [Height[*2]])) x ([Height[*2]] + 32)))
If the result is less than 165, it is calculated as fixed value 165.
[V Blank Value] = Roundup[*3]([Line Period] x 32) + B

The following table shows figures for A and B in the different pixel format.

Pixel Format	Binning Vertical[*4]	A	B	Max. Frame Rate(fps)[*5]
8bit	1(off)	61.9	33	61.9
	2(on)			123.6
	4(on)			245.7
10/12bit	1(off)	30.9	31	30.9
	2(on)			61.8
	4(on)			123.4
10bit Packed	1(off)	49.5	0	49.5
	2(on)			99.2
	4(on)			198.7
12bit Packed	1(off)	41.3	0	41.3
	2(on)			82.6
	4(on)			165.2

The following table shows Height figure range in the binning mode.

	Height [*2]	
	Mono	Color
Binning OFF 1	1 ～ 2048	2 ～ 2048
Binning ON 2	1 ～ 1024	-
Binning ON 4	1 ～ 512	-

*1 Rounddown after the decimal point
*2 Refer to the Height value on the above table. In the binning Vertical, the maximum value is changed.
*3 Roundup after the decimal point
*4 ON is only for GO-5000M-USB
*5 Maximum frane rate at the full image size

If the width is changed, the frame rate is not changed.

8.2. Exposure settings

This section describes how to set the exposure settings.

8.2.1 Exposure Mode

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

Table -15 Exposure mode

Exposure Mode setting	Exposure operation
OFF	No exposure control (free-running operation)
Timed	Exposure operates 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 – 16 Trigger option

Trigger Option setting	Exposure operation
OFF	Timed (EPS) mode
RCT	RCT mode, Refer to Chapter 8.7 for the details

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

Table – 17 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	ON	RCT Operation Exposure can be controlled by Exposure Time
Trigger Width	N/A	ON	Exposure is controlled by the pulse width of the external trigger

8.2.2 Exposure Time

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)

8.2.3 Exposure Auto

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

Continuous: Exposure continues to be adjusted automatically

In this mode, the following settings are available.
ALC Speed: Rate of adjustment can be set (Common with GainAuto)
Exposure Auto Max: The maximum value for the exposure time can be set.
Exposure Auto Min: The minimum value for the exposure time can be set.
ALC Reference: The reference level of the exposure control can be Set (Common with GainAuto)
ALC Area Selector : The portion of the image used for controlling exposure can be set (Common with GainAuto)

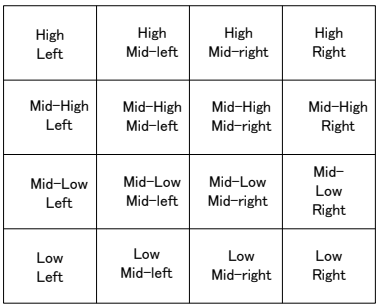


Fig.22 ALC Area Selector

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 – 18 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-USB, the following trigger operation can be selected as the trigger.

Table – 19 Trigger selector

Trigger Selector Item	Description
Acquisition Start	Set to start Acquisition or not
Acquisition End	Set to end Acquisition or not
Frame Start	Set to start Frame control or not
Acquisition Transfer Start	Set to start the stream or not

Each trigger selection has its own settings. Therefore, it is necessary to set up the following items on each selected trigger.

Trigger Mode
Trigger Source
Trigger Activation

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

The following signals can be used as the trigger source signal.

Table – 20 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
User Output 0	Connect User Output 0 signal to the selected trigger operation
User Output 1	Connect User Output 1 signal to the selected trigger operation
Line 5 - OPT IN	Connect OPTO IN 1 signal 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 Trigger activation

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

Table – 21 Trigger Activation

Camera Settings				Trigger Activation Setting			
Trigger Selector	Trigger Mode	Exposure Mode	Trigger Option	Rising Edge	Falling Edge	Level High	Level Low
Frame Start	On	Timed	Off	○	○	×	×
	On	Timed	RCT	○	○	×	×
	On	Trigger Width	Off	×	×	○	○

Note: When Trigger Width mode is used, the level High or level Low must be used.

8.3.5 Trigger Overlap

In the GO-5000-USB, the trigger overlap function is fixed to Read Out.

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

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

This is used for applications which do not require triggering.

Primary settings to use this mode

Trigger Mode: Off

Minimum interval of the frame

Read out mode	Minimum trigger interval
Full	16.155 ms
ROI 1/2 (Height=1024)	8.092 ms
ROI 1/4 (Height=512)	4.07 ms
1/2V Binning (Note 1)	8.092 ms

(Note1) GO-5000M-USB only

8.5. Timed mode

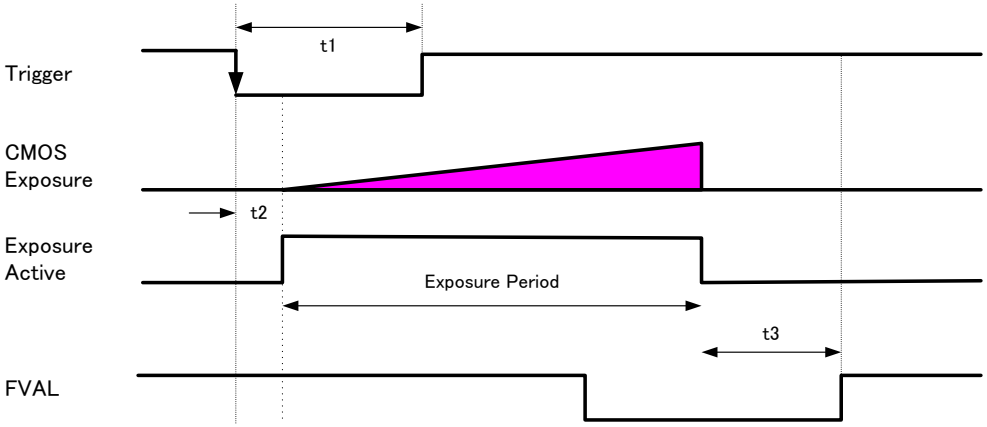
This mode allows a single image frame to be captured with a preset exposure time by using the external trigger. Additional settings determine if the trigger pulse can be accepted during the exposure period.

Primary settings to use this mode
Exposure Mode: Timed
Trigger Mode: ON
Trigger Option: OFF
Optical Filter Selector: 10 µs

Minimum interval of the trigger

Read out mode	Minimum trigger interval
Full	16.155 ms
ROI 1/2 (Height=1024)	8.09 ms
ROI 1/4 (Height=512)	4.077 ms
1/2V Binning (Note 1)	8.09 ms

(Note1) GO-5000M-USB only



t1	t2	t3
10 µs (Min)	36 µs	5L ～6L

Note 1: The trigger is input through 6P optical input. Accordingly, the timing will be changed if the optical filter is set to the other figures.
Note 2: Other timings are internal operating timing of the camera.

Fig.23 Timed

8.6. Trigger width mode

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.

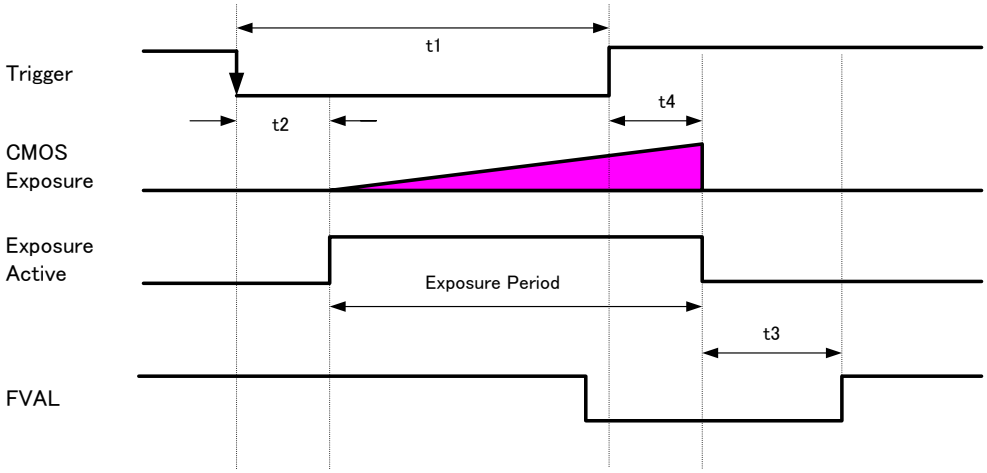
Note: As the exposure time is shortened against an input trigger width, the input trigger width should be "the necessary exposure time plus 5 µs".

Primary settings to use this mode
Exposure Mode: Trigger Width
Trigger Mode: ON
Trigger Option: OFF
Optical Filter Selector: 10 µs

Minimum interval of the trigger

Read out mode	Minimum trigger interval
Full	16.155 ms
ROI 1/2 (Height=1024)	8.09 ms
ROI 1/4 (Height=512)	4.077 ms
1/2V Binning (Note 1)	8.09 ms

(Note1) GO-5000M-USB only



t1	t2	t3	t4
10 µs (Min)	36 µs	5L ～6L	32 µs

Note 1: The trigger is input through 6P optical input. Accordingly, the timing will be changed if the optical filter is set to the other figures.
Note 2: Other timings are internal operating timing of the camera.

Fig.24 Pulse width

8.7. RCT mode

8.7.1 RCT mode together with ALC function

RCT mode can use ALC control to ensure that the proper exposure is set when the trigger pulse is input. In the following drawing, the steps to achieve this combination are explained.

① The exposure control is the same as in continuous mode.
② When the trigger signal is input, the charge that has already been accumulated during the current exposure period is read out very quickly and a new exposure period starts. The exposure continues as in continuous mode.
③ All video level data from every exposure is transferred to ALC control.
④ The video output sent to the GigE interface is only the signal after the trigger is input.

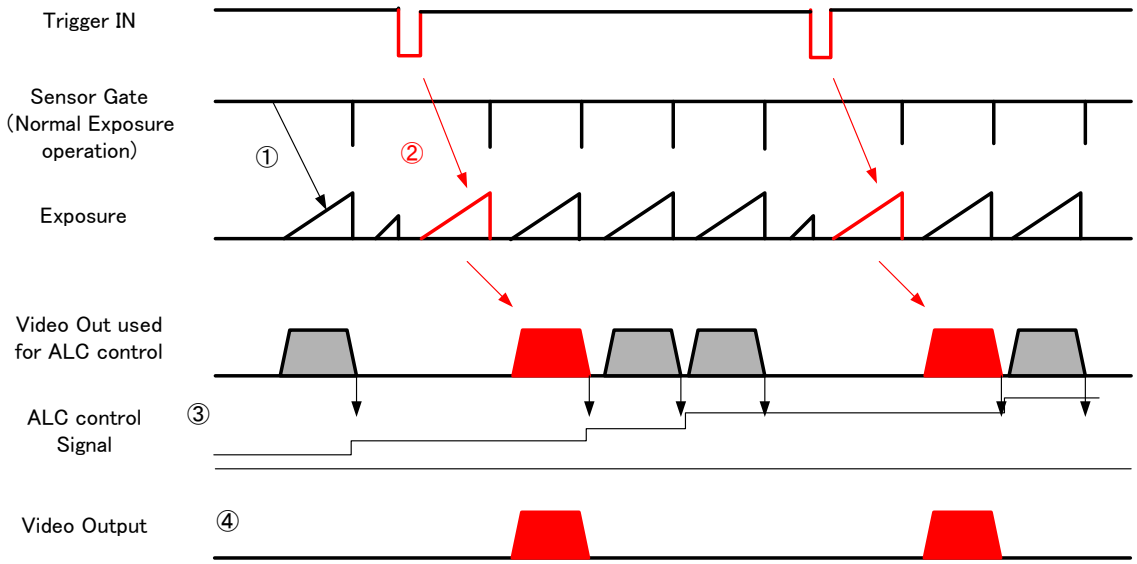


Fig.25 RCT mode timing for ALC operation (Example)

8.7.2 RCT mode timing after the trigger is input

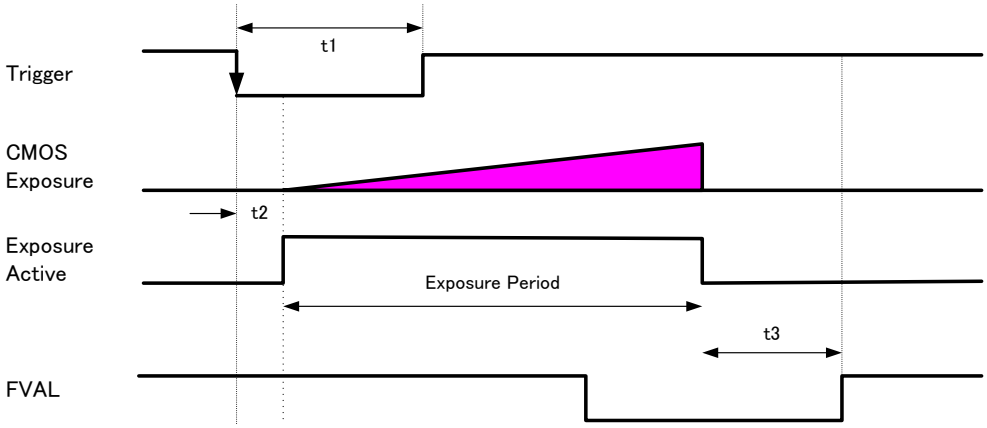
Primary settings to use this mode

Exposure Mode: Timed
Trigger Mode: ON
Trigger Option: RCT
Optical Filter Selector: 10μs
If ALC control is used together with RCT mode, then
Exposure auto: Continuous
Gain Auto: Continuous

Minimum interval of the trigger

Read out mode	Minimum trigger interval
Full	16.447 ms
ROI 1/2 (Height=1024)	8.375 ms
ROI 1/4 (Height=512)	4.35 ms
1/2V Binning (Note 1)	8.375 ms

(Note1) GO-5000M-USB only



t1	t2	t3
10 µs (Min)	102µs	5L ～6L

Note 1: The trigger is input through 6P Optical input. Accordingly, the timing will be changed if the optical filter is set to the other figures.
Note 2: Other timings are internal operating timing of a camera.

Fig.26 RCT mode timing

8.8 Video Send Mode

The GO-5000-USB has a Video Send Mode and it includes the following operations.

Table-22 Video send mode

Mode selected	Index selection method
Normal	Normal operation
Multi ROI	Up to 5 ROI images can be set up. Each image is output independently.
Trigger Sequence	Up to 10 indexes can be set for ROI, Exposure Time and Gain. Select the index by using the Frame Start trigger signal.
Command Sequence	Up to 10 indexes can be set for ROI, Exposure time and Gain. Select the index number to assign directly by using the Command Sequence Index command.
Delayed Readout	Up to 7 frames can be stored (8-bit). Each image can be output by Acquisition Transfer Start trigger timing.

8.8.1 Sequence ROI Trigger

This mode allows the user to define a preset sequence of up to 10 images, each with its own ROI, exposure time and gain values. This mode has two operation modes.

Mode selected	Index selection method
Trigger Sequence	Select the index by using the Frame Start trigger signal. (The setting index can be determined by the Next Index setting.)
Command Sequence	Select the index number to assign directly by using the Command Sequence Index command.

Primary settings to use this mode

Exposure Mode: Timed
Trigger Mode: ON
Video Send Mode: Trigger Sequence or Command Sequence

Minimum interval of the trigger

Read out mode	Minimum trigger interval
Full	16.155 ms + Exposure time
ROI 1/2 (Height=1024)	8.09 ms + Exposure time
ROI 1/4 (Height=512)	4.077 ms + Exposure time
1/2V Binning (Note 1)	8.09 ms + Exposure time

(Note1) GO-5000M-USB only

8.8.1.1 Trigger Sequence mode basic timing

In this mode, as each trigger input is received, the image data associated with the next index within the preset sequence is output. In the trigger sequence mode, it is not possible to input the trigger while the current index is executing.
The sequence index table always starts at Index 1 and changes to next index which is preset in the Next Index setting after the current index is completed.
.

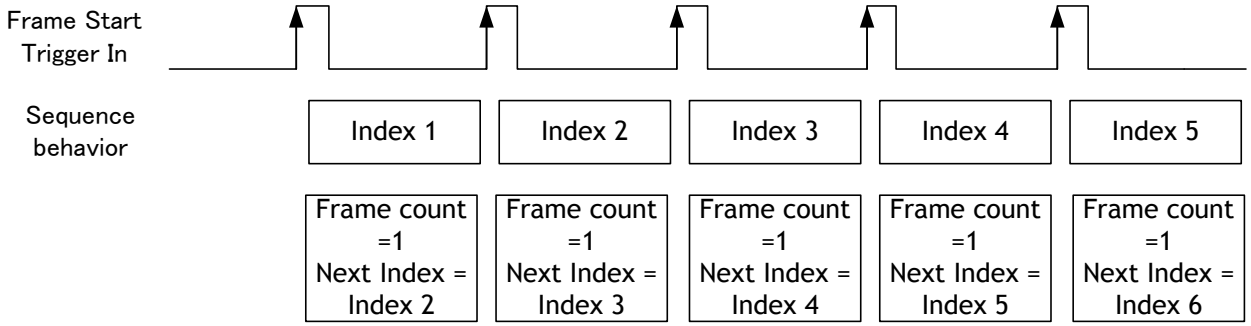


Fig. 27 Behavior of Sequence trigger

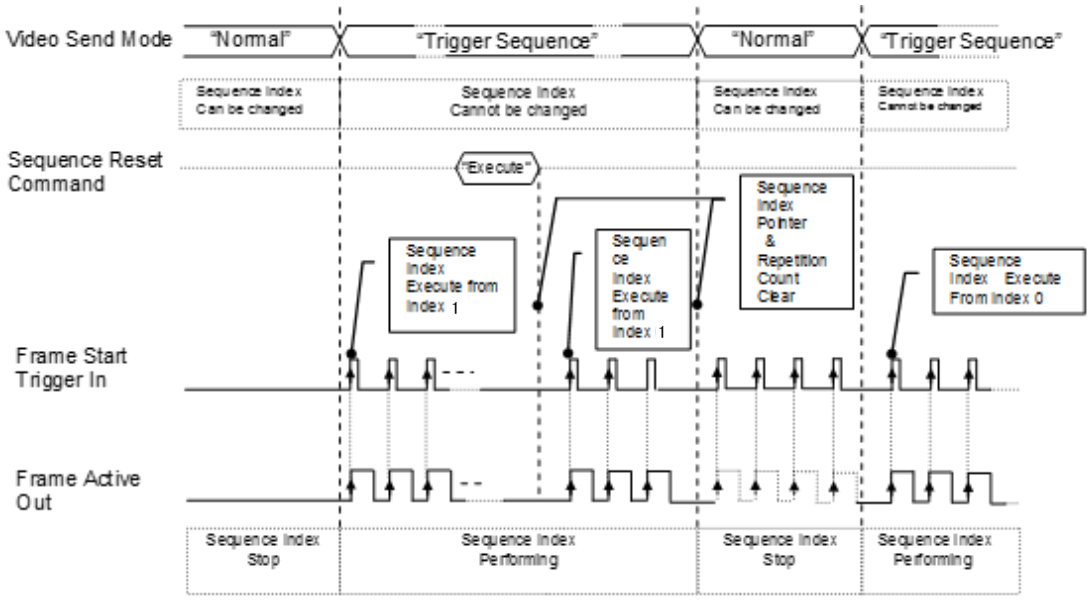


Fig. 28 Behavior if Video Send Mode is set to Trigger Sequence

8.8.1.2 Sequence index table (Default)

The following table shows the default settings.

Table – 23 Sequence Index table (Default)

Sequence ROI Index	Sequence ROI													
	Width	Height	Offset		Gain Selector			Exposure Time	Black Level	Binning (Note 1)		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

(Note1) GO-5000M-USB only

8.8.1.3 Descriptions of index table parameters

Table-24 Sequence mode command

Command	Parameter	Description
Sequence ROI Index	Index 1～10	Select an index to be set
Sequence ROI Frame Count	1～255	<Set to each Index> Set fame number for display per a frame
Sequence ROI Next Index	Index 1～10 Off	<Set to each Index> <Used for Trigger Sequence Mode> Set the index to be active at the next

		Off: Stop a sequence operation at the current index.
Sequence ROI Width	16～2560 (Note 1)	<Set to each Index> Set the width value
Sequence ROI Height	1～2048 (Note 1, Note3) 2～2048 (Note 2)	<Set to each Index> Set the height value
Sequence ROI Offset X	0～2560 (Note 1)- [Sequence ROI Width]	<Set to each Index> Set the offset value.
Sequence ROI Offset Y	0～2048(Note1) - [Sequence ROI Height]	<Set to each Index> Set the offset Y.
Sequence ROI Gain All	100～1600	<Set to each index> Set the gain value.
Sequence ROI Gain Red*2	-4533～37876	<Set to each Index> Set the Gain Red value.
Sequence ROI Gain Blue*2	-4533～37876	<Set to each Index> Set the Gain Blue value.
Sequence ROI Exposure Time	10～8000000	<Set to each Index> Set the exposure time value.
Sequence ROI Black Level	-256～255	<Set to each index> Set the black level value.
Sequence ROI LUT enable	0 (Disable) 1 (Enable)	<Set to each Index> Set the disable or enable of LUT. If it is set to enable, the function is selected in the Sequence LUT mode.
Sequence ROI H Binning*3	1, 2, 4 (3 is disable)	<Set to each Index> Set the H Binning value.
Sequence ROI V Binning*3	1, 2, 4 (3 is disable)	<Set to each Index> Set the V Binning value.
Sequence Repetition	1～255	<For Trigger Sequence Mode> Set the repeat number of the sequence.
Command Sequence Index	Index 1～10	<For Command Sequence Mode> Set the performed index.
Current Sequence Index	Index 1～10	<READ only> Refer to the current Sequence Index.
Sequence LUT Mode	Gamma LUT	Set the function if Sequence ROI LUT is set to enable. Set the value on Gamma or LUT control.
Reset Sequence Index	No (EXE command)	Reset the Sequence Index to 0. At the same time, the Frame Count is also initialized.

Note 1: If the binning mode is used, the maximum value is changed.
Note 2: Only Bayer model
Note 3: Only Monochrome model

8.9 Multi ROI function

In the GO-5000-USB, the width and height of 5 separate ROIs within the full image area can be set as required. Each image can be overlapped. The location of each ROI can also be set as required. Each Multi ROI data is output as an independent frame.

The multi ROI mode is enabled if [Video Sending Mode] is set to “Multi ROI”.

Table-25 Multi ROI Index table default values

Multi ROI Index Selector	Multi ROI			
	Width	Height	Offset	
			X	Y
- Index 1	2560	2048	0	0
- Index 2	2560	2048	0	0
- Index 3	2560	2048	0	0
- Index 4	2560	2048	0	0
- Index 5	2560	2048	0	0

8.9.1 Multi ROI setting parameters

Table-26 Multi ROI command

Command	Parameter	Description
Multi ROI Index	Index 1～5	Select the index to be configured.
Multi ROI Width	16～2560 (Note 1)	<Set to each Index> Set the width value.
Multi ROI Height	1～2048 (Note 1, Note2) 2～2048 (Note 3)	<Set to each Index> Set the Height value.
Multi ROI Offset X	0～2560(Note 1) - [Sequence ROI Width]	<Set to each Index> Set the Offset X value.
Multi ROI Offset Y	0～2048 (Note 1) - [Sequence ROI Height]	<Set to each Index> Set the Offset Y value.
Multi ROI Index Max	1～5	Set the number of index to be used.

Note 1: If the binning mode is used, the maximum values are adjusted accordingly.
Note 2: Only for GO-5000M-USB
Note 3: Only for GO-5000C-USB

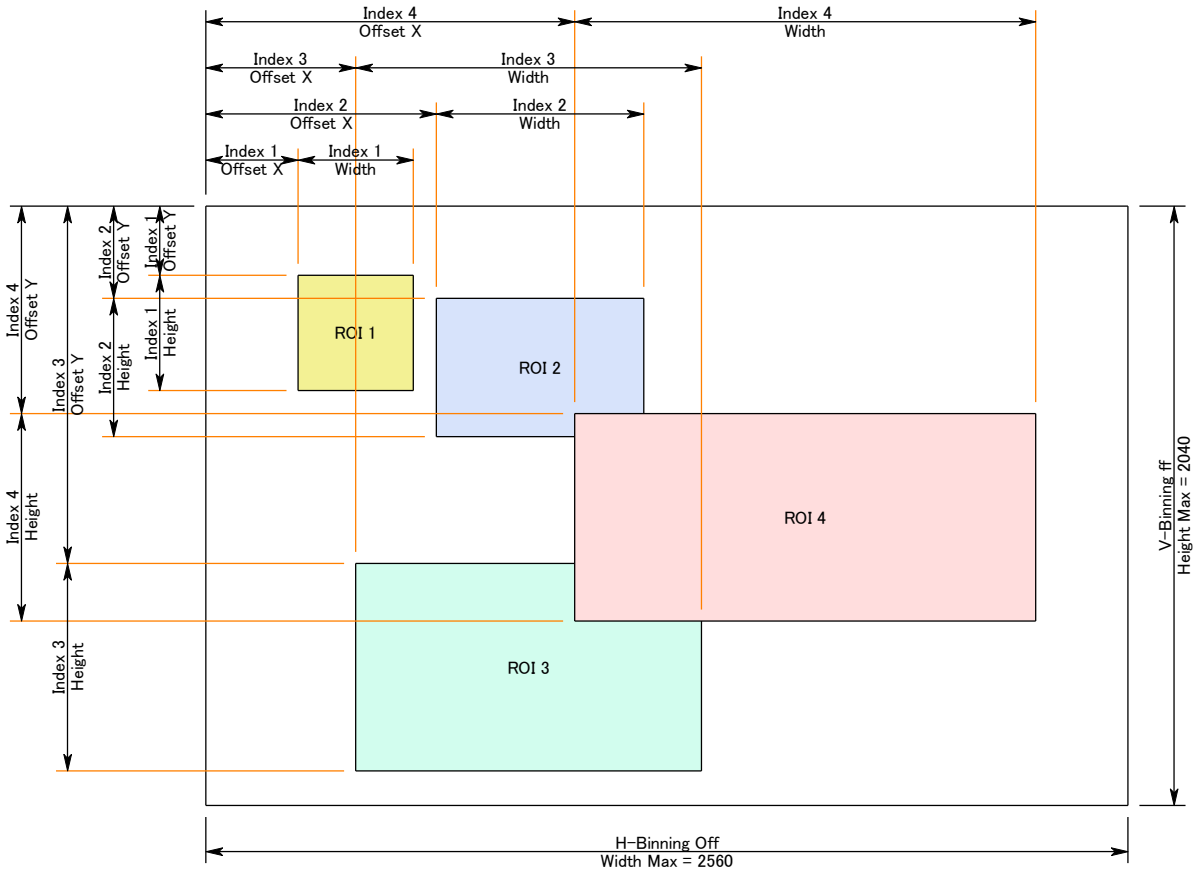


Fig.29 Multi ROI setting example

8.10 Delayed Readout function

The images captured by Frame Start trigger can be stored inside the camera and readout by Acquisition Transfer Start trigger. Up to 7 frames can be stored.

Table-27 Delayed readout command

Command	Setting	Description
Trigger Selector	Acquisition Transfer Start	Select the Trigger Selector at Acquisition Transfer Start to operate this function.
Trigger Mode	On	Refer to Chapter 8.3
Trigger Source	Select the source to be used	
Trigger Activation	Select the polarity of the source to be used.	

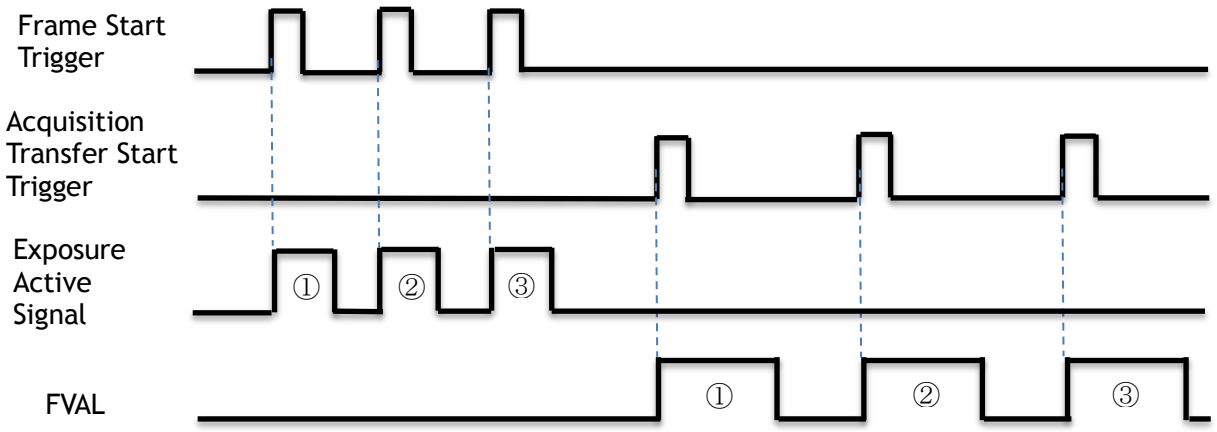


Fig. 30 Operating timing (Example)

8.11. Operation and function matrix

Table – 28 Operation and function matrix

Exposure Operation	Trigger mode	Trigger Option	V-Binning (Note1)	H-Binning (Note1)	Exposure Time	ROI	AWB (Note2)	Auto Gain	Auto Exposure	Video Send Mode		HDR (Note1)
										Multi ROI	Sequence	
OFF	OFF	OFF	1	1	×	○	○	○	×	○	×	×
			2 / 4	2 / 4	×	○	×	○	×	○	×	×
Timed	OFF	OFF	1	1	○	○	×	○	○	○	×	○
			2 / 4	2 / 4	○	○	×	○	○	○	×	○
Timed (EPS)	ON	OFF	1	1	○	○	○	○	○	○	○	○
			2 / 4	2 / 4	○	○	×	○	○	○	○	○
Trigger Width	ON	OFF	1	1	×	○	○	○	×	○	×	×
			2 / 4	2 / 4	×	○	×	○	×	○	×	×
Timed (RCT)	ON	RCT	1	1	○	○	○	○	○	○	×	×
			2 / 4	2 / 4	×	×	×	×	×	×	×	×

Note 1. Only GO-5000M-USB
Note 2: Only GO-5000C-USB

9. Other functions

9.1 Black level control

This function adjusts the setup level.

Reference level	33.5LSB (Average of 100 x 100)
Video level adjusting range	0～approx. 100 LSB
Adjusting level	-256 to 255 (Default: 0)
Resolution of adjust	1STEP=0.25LSB

Note: the above figures are for 10-bit.

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9.1.1 Black Level Selector

The following factors can be set.

GO-5000M-USB: DigitalAll

GO-5000C-USB: DigitalAll/DigitalRed/ DigitalBlue

9.1.2 Black Level

The black level can be set in the following range.

GO-5000M-USB: DigitalAll : -256～ +255

GO-5000C-USB: DigitalAll : -256～ +255

DigitalRed/DigitalBlue : -512～ +511

9.2 Gain control

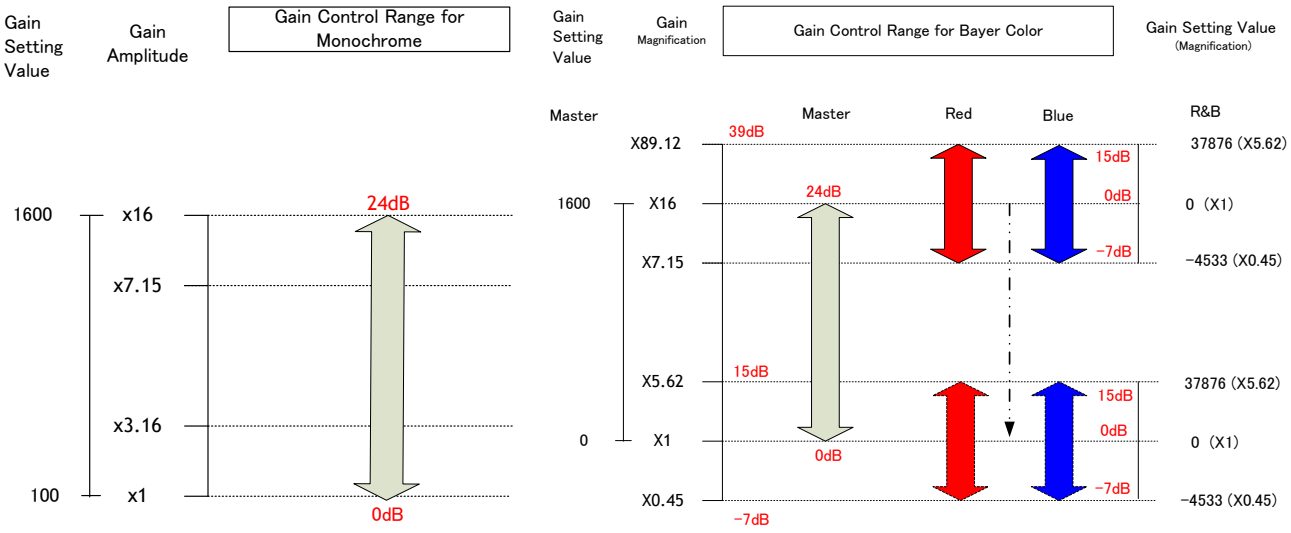
In the GO-5000-USB, the gain control uses Analog Base Gain and Digital Gain.
Analog Base Gain can be set at 0dB, +6dB or +12dB for both GO-5000M-USB and GO-5000C-USB. The digital gain is used for the master gain setting.

For setting the gain,

1. Set analog base 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 x0.01/step which is 0.05dB to 0.08dB, depending on the setting value.
3. In the GO-5000C-USB, blue and red digital gain can be set from x0.45 to x5.62 against the Master gain setting and its resolution is x0.01/step.
4. In the GO-5000C-USB, analog base gain can be applied to R, G and B channel respectively in order to cover a wider range of color temperatures.

Note1: If the gain up function is used, it is recommended to use the analog base gain as the master gain setting. For instance, if +12dB gain up is required, the analog base gain is set at +12dB and no digital gain is added. This is because the signal-to-noise performance is better with analog gain applied. However, the AGC function works only with digital gain.
Additionally, the analog base gain is effective in order to minimize any breaks in the histogram at higher gain settings. Please note that the analog base gain has less accuracy due to its variability.

The master gain control uses Digital Gain. All digital gain can be set by x0.01/step. If the digital gain is set too high, breaks (missing counts) in the histogram may occur.



The above drawing shows the relationship between gain setting value (command), gain amplitude, and dB indication. For example, the gain amplitude “x 5.62” equals 15dB.

Fig.31 Gain control

9.2.1 Gain Selector

The following parameters can be set.

GO-5000M-USB: DigitalAll
GO-5000C-USB: DigitalAll/Digital Red All/Digital Blue All

9.2.2 Gain

This is the reference value upon which gain adjustments are based. The operational adjustment is done in Gain Raw.

GO-5000M-USB: DigitalAll : 1～16 (0dB to +24dB)
GO-5000C-USB: DigitalAll : 1～16 (0dB to +24dB)
Digital Red All : 0.447～5.62 (0dB to +15dB)
Digital Blue All : 0.447～5.62 (0dB to +15dB)

9.2.3 Gain Raw

The gain raw can be adjusted in the following range.

GO-5000M-USB: DigitalAll : 100～1600
GO-5000C-USB: DigitalAll : 100～1600
Digital Red All/Digital Blue All : -4533～37876

9.2.4 Gain Auto

This function automatically controls the gain level.
This is controlled by the command JAI ALC Reference.

There are three modes.

OFF: Adjust manually.
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 ExposureAuto).
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 ExposureAuto)
ALC Area Selector: The portion of the image used for auto gain control can be set (Common with ExposureAuto)
ALC Area Enable: This command can make selected area(s) disabled or enabled. If ALC Area Selector selects ALC Area Enable ALL, and it is set to True, all areas are enabled and in this case, preset areas are all disabled.

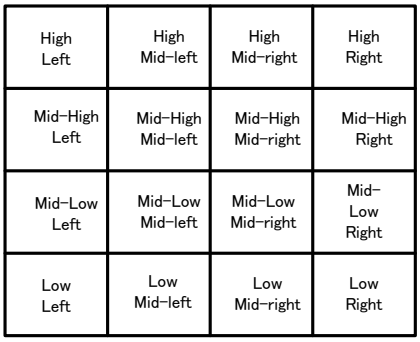


Fig.32 ALC Channel Area

9.2.5 Balance White Auto

This is a function to achieve auto white balance by using R and B gain.
There are three methods which can be selected.

OFF: Manual operation
Once: The auto white balance is executed one time when this command is set.
Continuous: The auto white balance is continuously executed.
AWB Channel Area: AWB reference areas can be selected from 16 (4x4) choices.

Note: The figure for AWB Channel Area is the same as Fig.31.

9.3. LUT

This function can be used to convert the input to the desired output characteristics.
The Look-Up Table (LUT) has 32 points (Monochrome) or 16 points (Bayer color) for setup. The output level can be created by multiplying the gain data by the input level.

9.3.1 LUT Mode

Can be set to OFF, gamma (see section 9.4), or Lookup Table.

9.3.2 LUT selector

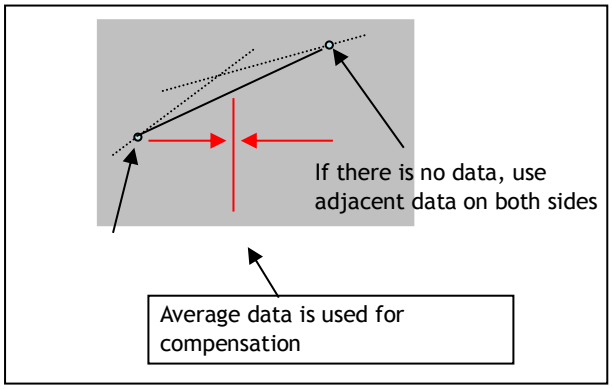
In the GO-5000C-USB, the selection of R, G or B is displayed. Select one to adjust. In the GO-5000M-USB, this is not displayed.

9.3.3 LUT Index

This represents the “starting” or “input” pixel value to be modified by the Lookup Table. The GO-5000M-USB has a 32-point Lookup Table, meaning the index points are treated with 0 representing a full black pixel and 31 representing a full white pixel. In the GO-5000C-USB, a Look up Table is 16 points instead of 32 points. The index points are automatically scaled to fit the internal pixel format of the camera. This is common for all output configurations.

9.3.4 LUT value

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



Output Data = Video IN x LUT data

Fig. 33 LUT value

9.4. Gamma

This command is used to set gamma between gamma 0.45, gamma 0.6 and gamma 1.0 (OFF) in 3 steps.
The gamma value is an approximate value.

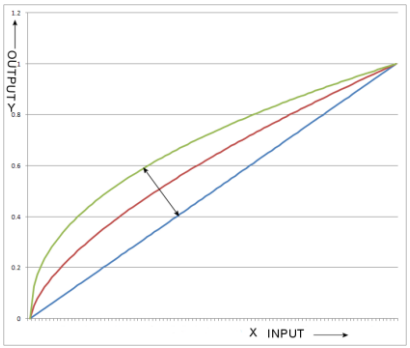


Fig. 34 Gamma compensation

9.4.1 Linear and Dark Compression

GO-5000-USB has a dark compression circuit to improve the signal-to-noise ratio in the dark portion of the image. This function is OFF as factory default setting and can be ON according to applications.

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.

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. Users can store up to 3 shading compensation data in memory.

9.5.1 Shading Correction mode

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. Compensation is performed using a block grid of 20 blocks (H) x 16 blocks (V). Each block contains 128 x 128 pixels. The complementary process is applied to produce the compensation data with less error.

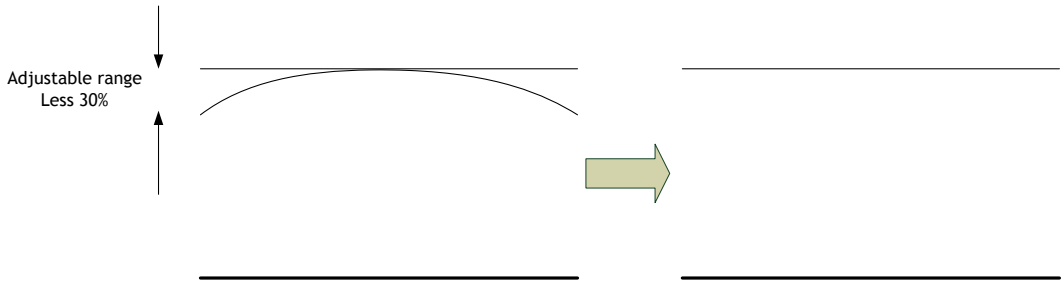
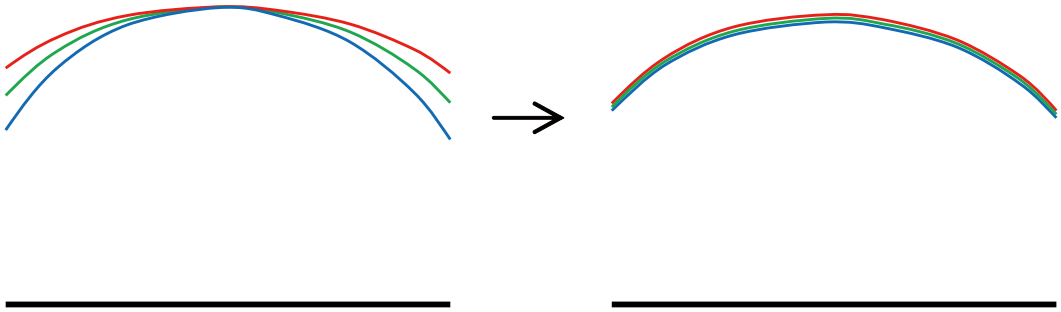


Fig. 35 Flat shading correction concept drawing

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



Before adjustment After adjustment

Fig.36 Color shading correction concept drawing

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)

9.5.2 Shading Mode

Shading mode	Description
Off	Shading correction is OFF.
User 1	The correction data in user area 1 is stored or loaded to the camera
User 2	The correction data in user area 2 is stored or loaded to the camera
User 3	The correction data in user area 3 is stored or loaded to the camera

9.5.3 Perform Shading Calibration

This is a .exe command to execute a shading correction. The correction data after executing the shading correction is automatically stored in the used user area.

9.6. Blemish compensation

The GO-5000M-USB and GO-5000C-USB have 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 adjacent pixel in left column and, in the case of the GO-5000C-USB, the defective pixel can be compensated by the same Bayer color pixel in left adjacent column. Please refer to the following drawing. As for white blemishes, the automatic detection function is available and after its execution, the data is stored in memory. The customer can use the data by setting the blemish compensation ON. For black blemishes, only compensation that has been done in the factory is available. The number of pixels that can be compensated by the user is up to 256 pixels.

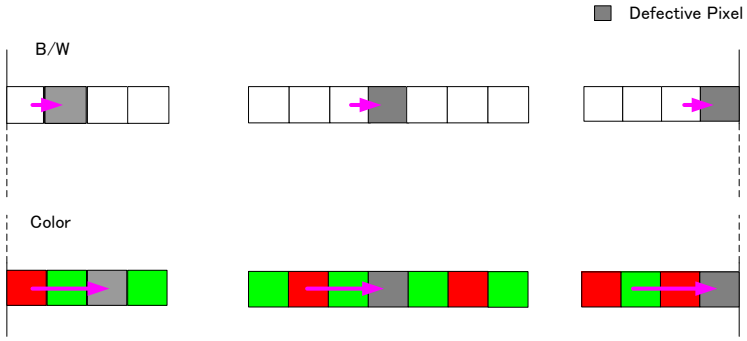


Fig.37 Blemish compensation

Note: If defective pixels are found consecutively in the horizontal direction, the blemish compensation circuit does not work.

9.7 ALC

In the GO-5000-USB, 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

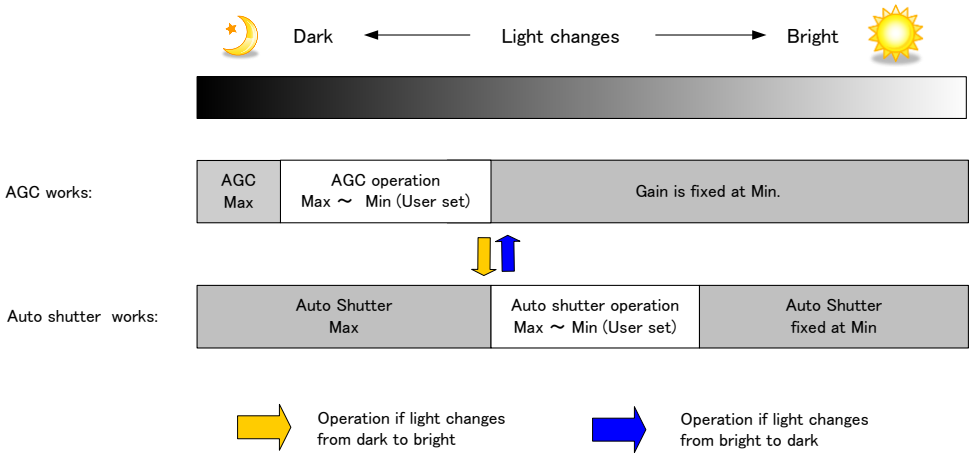


Fig.38 ALC function concept

ALC Reference will determine the target video level for AGC and Auto Shutter. For instance, if ALC Reference is set to 100% video level, AGC and Auto Shutter will function to maintain 100% video level.
■ Please note that ALC function is available only in continuous mode, as well as RCT mode.

9.8 HDR (High Dynamic Range) (GO-5000M-USB only)

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

Notes:

1. If the exposure mode is OFF and the HDR** mode is set to ON, the exposure mode is automatically changed to Timed.
2. If horizontal binning** and/or vertical binning** are set to ON, the HDR** mode cannot be set. In this case, the HDR** mode must be set first before H-Binning** and/or V-Binning** are set.
3. In this mode, exposure overlapped behavior is not available and the frame rate is slower than the normal operation.
4. The exposure time value is fixed at the value when HDR** Mode is activated. When the exposure time is changed, HDR** Mode should be off. Once the exposure time is changed, the HDR** Mode can be set to ON again.
5. In this mode, Exposure Auto function is disabled.

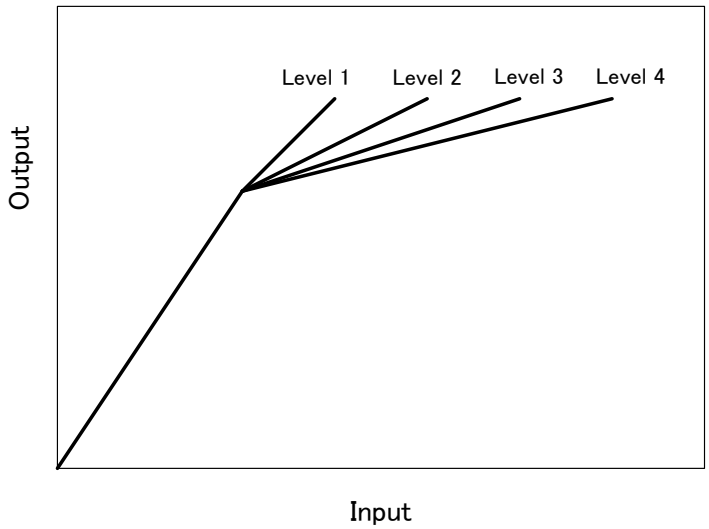


Fig.39 HDR characteristics

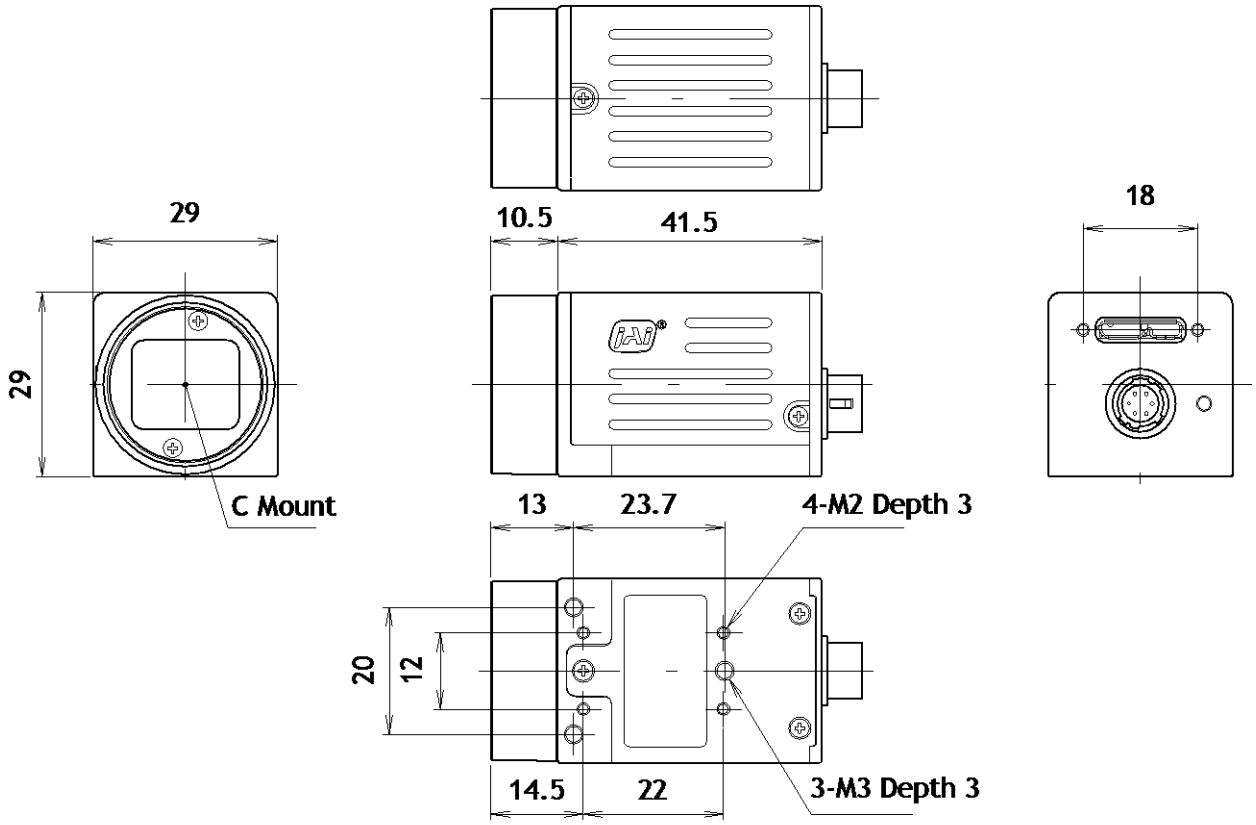
Knee Slope	Dynamic Range [%]
1	(200)
2	(400)
3	(800)
4	(1600)

10. Camera setting

10.1 Camera Control Tool

In the GO-5000M-USB and GO-5000C-USB, 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.

11. External appearance and dimensions



Dimensions tolerance: ± 0.3mm
Unit: mm

Fig.40 Outside dimensions

12. Specifications

12.1 Spectral response

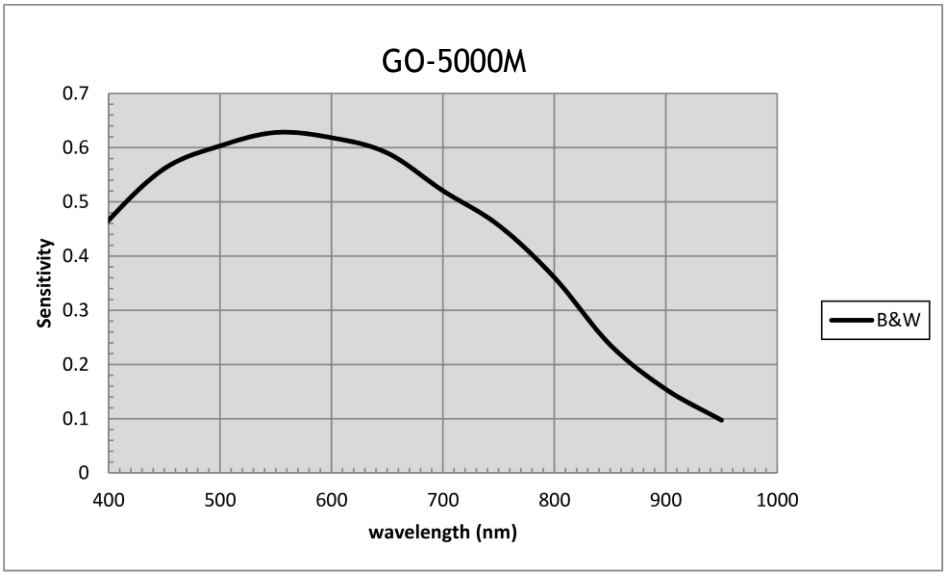


Fig.41 Spectral response (GO-5000M-USB)

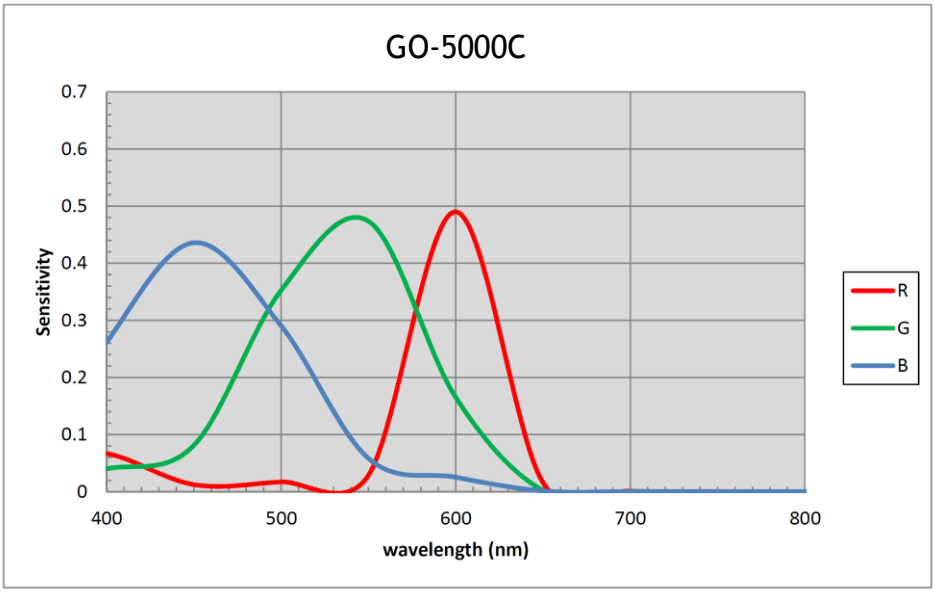


Fig.42 Spectral response (GO-5000C-USB)

Note: With IR-cut filter

12.2 Specifications table

Specifications				GO-5000M-USB	GO-5000C-USB
Scanning system				Progressive scan, 1-tap	
Synchronization				Internal	
Interface				Complies with USB3 Vision (Specification v1.0 RC4.12)	
Image sensor				1-inch Monochrome CMOS	1-inch Bayer color CMOS
Aspect Ratio				5:4	
Image size(Effective Image)				12.8 (h) x 10.24 (v) mm, 16.39 mm diagonal	
Pixel size				5 (h) x 5 (v) μm	
Effective Image output Pixels				2560 (h) x 2048 (v)	2560 (h) x 2048 (v)
Pixel Clock				48 MHz	
Maximum Acquisition Frame Rate per Pixel Format (minimum is 0.125 fps for all formats)	8-bit	H1, V1		61.9 fps (Max)	61.9 fps (Max)
		Binning	H1, V2	123.6 fps (Max)	–
			H1, V4	245.7 fps (Max)	–
			H2, V1	61.9 fps (Max)	–
			H2, V2	123.6 fps (Max)	–
			H2, V4	245.7 fps (Max)	–
			H4, V1	61.9 fps (Max)	–
			H4, V2	123.6 fps (Max)	–
			H4, V4	245.7 fps (Max)	–
	10bit Packed	H1, V1		49.5 fps (Max)	49.5 fps (Max)
		Binning	H1, V2	99.2 fps (Max)	–
			H1, V4	198.7 fps (Max)	–
			H2, V1	49.5 fps (Max)	–
			H2, V2	99.2 fps (Max)	–
			H2, V4	198.7 fps (Max)	–
			H4, V1	49.5 fps (Max)	–
			H4, V2	99.2 fps (Max)	–
			H4, V4	198.7 fps (Max)	–
	12-bit Packed	H1, V1		41.3 fps (Max)	41.3 fps (Max)
		Binning	H1, V2	82.6 fps (Max)	–
			H1, V4	165.2 fps (Max)	–
			H2, V1	41.3 fps (Max)	–
			H2, V2	82.6 fps (Max)	–
			H2, V4	165.2 fps (Max)	–
			H4, V1	41.3 fps (Max)	–
			H4, V2	82.6 fps (Max)	–
			H4, V4	165.2 fps (Max)	–
	10bit/ 12bit	H1, V1		30.9 fps (Max)	30.9 fps (Max)
		Binning	H1, V2	61.8 fps (Max)	–
			H1, V4	123.4 fps (Max)	–
			H2, V1	30.9 fps (Max)	–
			H2, V2	61.8 fps (Max)	–
			H2, V4	123.4 fps (Max)	–
			H4, V1	30.9 fps (Max)	–
			H4, V2	61.8 fps (Max)	–
			H4, V4	123.4 fps (Max)	–

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 method)					55 dB (Typical): Dark Compression 49dB (Typical): Linear (0dB gain, Black)	50 dB (Typical): Dark Compression 44d B(Typical): Linear (0dB gain, Green Black)
Image Output format Digital	Full pixels				2560 (h) x 2048 (v)	Bayer 2560 (h) x 2048 (v)
	ROI	Width			16 ～2560, 16 pixels/step	16 ～2560, 16 pixels/step
		OFFSET X			0 ～2544, 16 pixels/step	0 ～2544, 16 pixels/step
		Height			1 ～2048 lines,1 line/step	2 ～2048 lines,2 line/step
		OFFSET Y			0 ～2047 lines, 1 line/step	0 ～2046 lines, 2 line/step
	Binning	H		1	2560 (H)	2560 (H)
				2	1280 (H)	–
				4	640 (H)	–
		V		1	2048 (V)	2048 (V)
				2	1024 (V)	–
				4	512 (V)	–
	Bit assignment				Mono8, Mono10, Mono12 Mono10Packed, Mono12Packed	BayerGR, BayerGR10, BayerGR12 BayerGR10Packed, BayerGR12Packed
Acquisition mode					Continuous / Single Frame / Multi Frame (1 ～255)	
Trigger Selector	Acquisition				Acquisition Start/ Acquisition Stop	
	Exposure				Frame Start	
	Transfer				Acqusition Frame Transfer	
Trigger option					OFF / RCT (with ALC function)	
Trigger Overlap					Fixed to Readout	
Trigger Input Signal					Line 5 (Opt In), Software, PG 0, NAND Out 0/1, User out 0/1	
Opto In Filter					5 steps: 10μs (Typ), 100μs, 500μs, 1ms, 5ms, 10ms	
Exposure mode					OFF, Continuous, Timed (EPS), Trigger Width	
Exposure Mode	Timed				Exposure Auto: OFF 10 μs (Min.)～ 8 second (Max.Note1), Variable unit: 1 μs Exposure Auto: Continuous 10 μs (Min.)～ 8 second (Max.Note1), Variable unit: 1 μs	
	Trigger Width				10 μs (Min.) ～ ∞ (Max. Note1)	
Exposure Auto					OFF / Continuous	
Auto Exposure Response Speed					1 ～ 8	
Video send Mode					Normal ROI, Multi ROI, Trigger Sequence, Command Sequence, Delayed readout	
Digital I/O					Line Selector (6P): GPIO IN / GPIO OUT	
Black Level Adjust.	Ref. level				33.5LSB 10-bit (Average value of 100*100)	
	Video Level adj. range				0 ～ approx. 100LSB	
	Adj. range				-256 ～ +255LSB 10-bit	
	Resolution				1 STEP = 0.25LSB	
Analog Base Gain (For manual only)					0dB, 6dB, 12dB	0dB, 6dB, 12dB (R/G/B individual setting)
Gain Control	Manual Adj. range				-0dB ～+24dB (Note2) 1 step=x0.01 (0.005dB to 0.08dB) Varies by setting value	-0dB ～+24dB (Note2) 1 step=x0.01 (0.005dB to 0.08dB) Varies by setting value

	WB Gain		—	R / B : -7dB to +15dB, 1 step = 0.01dB
	WB Area		—	4 x 4
	WB Range		—	3000K ～ 9000K
	White Balance		—	OFF, Continuous, Once
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)	
	Numbers		256 pixels (for user adjustment)	
ALC			AGC and auto exposure can be combined and automatically controlled	
Gamma			0.45, 0.6 and 1.0 (OFF) (3 steps are available)	
LUT			32 points (for monochrome) and 16 points (for color) can be set	
HDR			4 settings, Level 1, 2, 3 and 4	—
Dark compression			Dark Compression (ON) / Linear (OFF)	
Shading Compensation			Flat Field Block Comp. (20 x 16 locks) Block size: 128 x 128 pixels	Flat Field, Color shading Block comp. (20 x 16 blocks) Block size: 128 x 128 pixels
Power	6-Pin Connector	Input range	DC+12V to +24V ± 10% (At the input terminal)	
		Current	240mA (At 12V input, Full pixels)	
		Power	2.8W (At 12V input, Full pixels)	
	USB Bus Power	Input range	DC 5V ± 10%	
		Current	720mA (At 5V input, Full pixels)	
		Power	3.6W (At 5V input, Full pixels)	
Lens mount			C mount Rear protrusion of the lens is less than 10 mm	
Flange back			17.526 mm, Tolerance: 0 to -0.05 mm	
Optical filter			Protection glass: Not provided	IR cut filter (Half value is 670 nm)
Operating temperature/Humidity Performance guaranteed			-5°C to +45°C / 20 – 80% (non-condensing)	
Storage Temp. / Humidity			-25°C to +60°C/20% to 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) (excluding protrusion)	
Weight			46 g	

Note1): Usable performance will be up to 1 second.
Note2): Histogram integrity is guaranteed with up to +12dB gain applied.
Note3): Approximately 5 minutes pre-heating is required to achieve these specifications.
Note4): The above specifications are subject to change without notice.

Appendix

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.

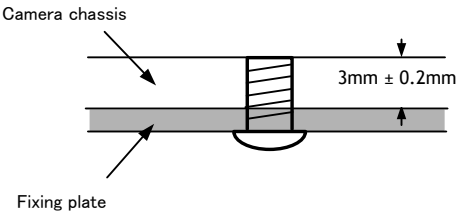
Patterned Noise
When the sensor captures a dark object at high temperature or is used for long time integration, fixed pattern noise may appear on the video monitor screen.

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.

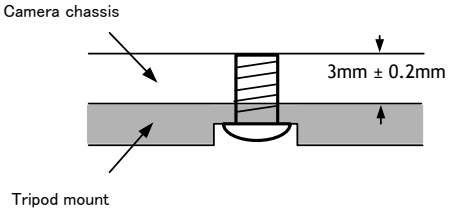
4. Caution when mounting the camera

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.



Mounting the camera to fixing plate

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



Attaching the tripod mount

5. Exportation

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

6. References

1. This manual can and datasheet for GO-5000M-USB / GO-5000C-USB can be downloaded from www.jai.com
2. Camera control software can be downloaded from www.jai.com

Manual change history

Date	Revision	Changes
Sept 2014	Preliminary	New Release
Nov. 2014	Ver. 1.0	Release
Dec. 2014	Ver. 1.1	Review the frame rate calculation

User's Record

Camera type: **GO-5000M-USB / GO-5000C-USB**

Revision: **……..**

Serial No. **……..**

Firmware version. **……..**

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

User's Mode Settings.

User's Modifications.

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