See the possibilities

User's Manual

CM-030GE-RH

1/3” Progressive Scan
Monochrome Remote Head Camera

Document Version: Ver.1.2
CM-030GE-RH_Ver.1.2_Feb2013

Notice

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

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

Warranty

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

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that CM-030GE-RH complies 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.

CM-030GE-RH

Supplement

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

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

重要注意事项

有毒，有害物质或元素名称及含量表

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

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PPB)	多溴二苯醚 (PBDE)
摄像头外壳	×	○	○	○	○	○
电缆线夹	×	○	○	○	○	○
螺丝固定座	×	○	○	○	○	○
.....	.....	.....	.....	.....	.....	.....

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

环保使用期限
电子信息产品中含有的有毒有害物质或元素在正常使用的条件下不会发生外泄或突变、电子信息产品用户使用该电子信息产品不会对环境造成严重污染或对基人身、财产造成严重损害的期限。
数字「15」为期限15年。

- Contents -

JAI GigE Vision® Camera operation manuals

To understand and operate this JAI GigE Vision® camera properly, JAI provides the following manuals.

User's manual (this booklet)	Describes functions and operation of the hardware
JAI SDK & Control Tool User Guide	Describes functions and operation of the Control Tool
JAI SDK Getting Started Guide	Describes the network interface

User's manual is available at **www.jai.com**
JAI SDK & Control Tool User Guide and JAI SDK Getting Started Guide are provided with the JAI SDK which is available at **www.jai.com**.

Introduction

GigE Vision is the new standard interface using Gigabit Ethernet for machine vision applications and it was mainly set up by AIA (Automated Imaging Association) members. GigE Vision is capable of transmitting large amounts of uncompressed image data through an inexpensive general purpose LAN cable for a long distance.

GigE Vision also supports the GenICam™ standard which is mainly set up 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 manufactures can seamlessly connect in one platform.

For details about the GigE Vision standard, please visit the AIA web site, www.machinvisiononline.org and for GenICam, the EMVA web site, www.genicam.org.

JAI GigE Vision cameras comply with both the GigE Vision standard and the GenICam standard.

Before using GigE Vision camera

All software products described in this manual pertain to the proper use of JAI GigE Vision cameras. Product names mentioned in this manual are used only for the explanation of operation. Registered trademarks or trademarks belong to their manufacturers.
To use the JAI SDK, it is necessary to accept the "Software license agreement" first.

This manual describes necessary equipment and the details of camera functions.

Equipment to be used
In order to set up the GigE Vision system, use the following equipment or equivalent.
It is necessary to use a PC and peripherals which comply with Gigabit Ethernet requirements.

1. Camera(s) which comply with GigE Vison and GenICam
2. Power supply for camera
3. Network cable (CAT5e or CAT6)
4. Computer
   CPU: Intel Core Duo 2 2.4GHz or more
   Memory: 2GB (recommended)
   Video card: PCI Express Bus x 16 connection
   VRAM : DDR2 with 256MB or more
   DVI : capable of display 2560 x 1600 pixels
5. Network adaptor (note 1)
6. Network HUB (if needed)
7. Trigger switch (If needed)
8. JAI SDK (Software Development Kit)

Note:
Pentium 4 type PC is not recommended due to dependency on chip set bus performance.

Note1: At the time of publishing this document these combinations have been verified:

NIC manufacturer	Model	PCI Bus	PCI-X Bus	PCI-Express Bus
Intel	PRO/1000MT (PWLA8490MT)	√ (33MHz)	√(100MHz)	–
Intel	PRO/1000GT (PWLA8391GT)	√ (33MHz)	√ (33MHz)	–
Intel	PRO/1000PT (EXPI9300PT)	–	–	√ (x1)
Intel	Gigabit CT Desktop adaptor (EXPI9301CT)	–	–	√ (x1)
Intel	PRO/1000PT Quad port (EXPI9404PT)	–	–	√ (x4)
Intel	PRO/1000PT Dual port (EXPI9402PT)	–	–	√ (x4)

The above NICs are verified under the following conditions.

- CPU:Intel Core 2 Duo, 2.4GHz
- 2 GB memory
- Windows XP, SP2(32 bit)
- Driver: Filter driver supplied with JAI SDK

Software installation

The JAI SDK & Control Tool for GigE Vision can be downloaded from the JAI web site at www.jai.com. The JAI SDK is available for Windows XP and Vista, 32bit and 64 bit.
As for the details of software installation, please refer to the "Getting Started Guide" supplied on the JAI SDK download page.

Camera Operation

1. General

The CM-030GE-RH is a 17mm diameter Remote Head camera with 330K pixels on a monochrome progressive scan CCD. This camera achieves a high speed frame rate of 120.491 frames per second. The camera head is small, so it is suitable for such machine vision applications as surface mounting, semiconductor inspection, surface inspection etc.

The 1/3" CCD with square pixels offers a superb image quality. The high-speed shutter function and asynchronous random trigger mode allow the camera to capture high quality images of fast moving objects.

The CM-030GE-RH complies with the GenICam standard and contains an internal XML-file that is used to describe the functions/features of the camera. For further information about the GigE Vision standard, please go to www.machinevisiononline.org and about GenICam, please go to www.emva.org.

As an application programming interface, JAI provides an SDK (Software Development Kit). This SDK includes the GigE Vision Filter Driver, JAI Control Tool, software documentation and code examples.

2. Camera nomenclature

The standard camera composition consists of:

Camera body	x 1
Sensor Protection cap	x 1

The camera is available in the following versions:

CM-030GE-RH

Where **C** stands for "Compact" family, **M** stands for "Monochrome", **30** represents the resolution "330K pixels", and **GE** for GigE Vision interface

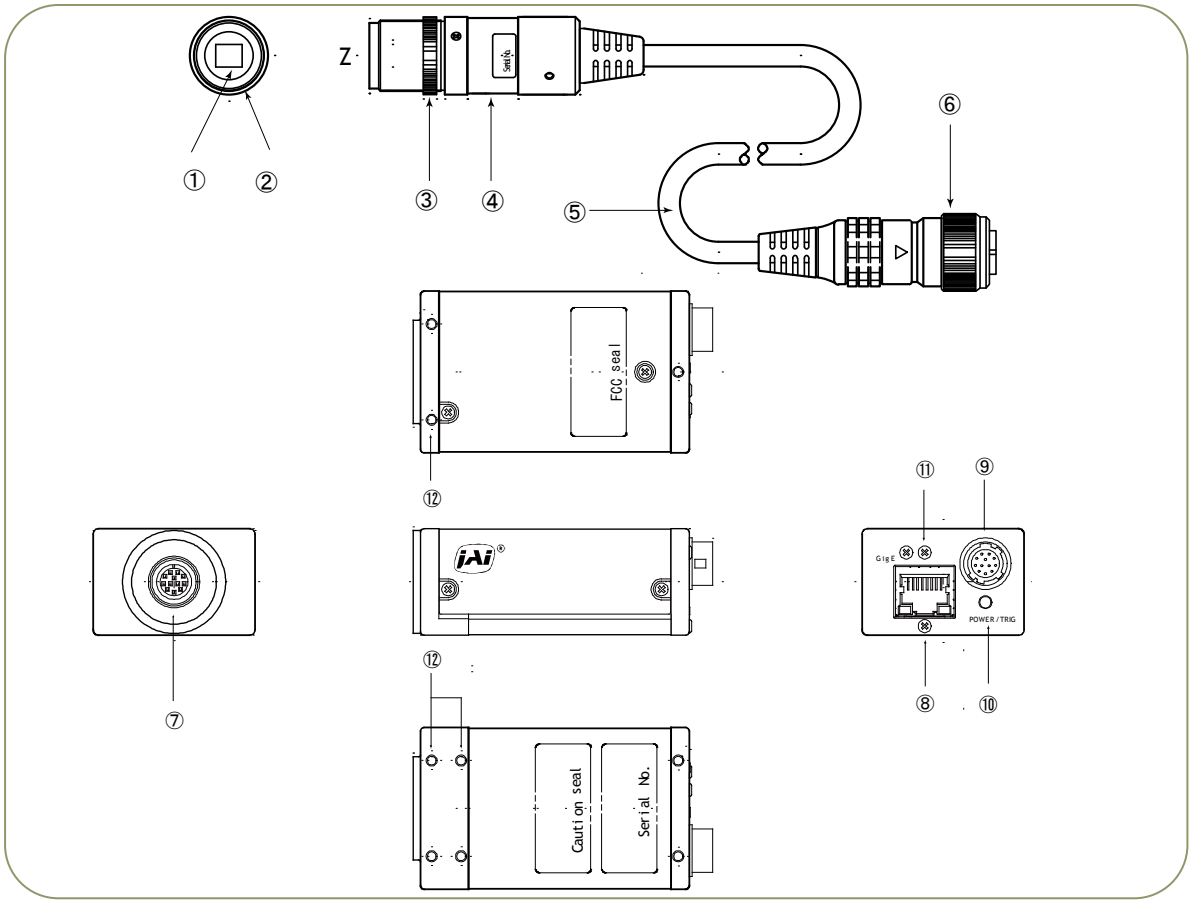
Options:	OP735	Lens f=7.5mm, F=1.6
	OP715	Lens f=15mm, F=2.0
	OP724	Lens f=24mm, F=3.1
	PD-12U series	AC power adapter

3. Main Features

- ϕ 17mm Remote head system with 1/3 inch progressive CCD
- GigE Vision and GenICam compliant
- High frame rate of 120 fps in Continuous mode, full resolution
- 659 (h) x 494 (v) active pixels
- 7.4 µm square pixels
- 120 frames/second with external trigger and full resolution
- Up to 504 frames/second with partial scan of 1/8
- 193 frames/second with vertical binning
- Shutter speed from 32.48µs to 2 sec. using Pulse Width Control
- Programmable exposure from 32.48µs to 8.299 ms by 1 LVAL (16.24µs) increments
- Pre-select, Pulse Width and RCT trigger modes
- LVAL-synchronous/-asynchronous operation (auto-detect)
- 10 or 8-bit output
- Comprehensive software tools and SDK for Windows XP/Vista (32 bit "x86" and 64 bit "x64" JAI SDK Ver. 1.2.1 and after)

4. Locations and Functions

4.1. Locations and functions



①	CCD sensor	1/3 inch CCD sensor
②	Lens mount	Excluding mount M15.5 x 0.5
③	Lock ring	Is used to fix the focus position
④	Camera head	ϕ 17mm Camera Head
⑤	Camera cable	2m
⑥	12-pin connector	Connecting with CCU
⑦	12-pin receptacle	Connecting with Camera Head
⑧	RJ-45 connector	Gigabit Ethernet connector with threaded holes for thumbscrews
⑨	HIROSE 12P connector	Indication for power and trigger input
⑩	LED	Indication for power and trigger input
⑪	Holes for RJ45 thumbscrews	When an RJ-45 connector with thumbscrews is used, remove the two screws located above and below RJ-45 (Note*1)
⑫	CCU mounting holes	M3 depth 3.5mm for tripod mount plate(Note*2)

*1) Note: When a RJ-45 cable with thumbscrews is connected to the camera, please do not excessively tighten screws by using a screw driver. The RJ-45 receptacle on the camera might get damaged. For security, the strength to tighten screws is less than 0.147 Newton meter (Nm). Tightening by hand is sufficient in order to achieve this.

*2) Note: The depth of holes is 3.5mm. When the tripod adapter plate MP-40 or MP-41 is used, use the attached screws. If installing the camera directly, please do not use screws longer than 3.5mm.

Fig. 1. Locations (version)

4.2. Rear panel indicator

The rear panel mounted LED provides the following information:

- Amber : Power connected - initiating
- Steady green : Camera is operating in Continuous mode
- Flashing green : The camera is receiving external trigger

Ethernet connector indicates,

- Steady green : 1000 Base-T has been connected
- Flashing green : 100 Base-TX has been connected (Note)
- Flashing amber : Network active in communication

Note: When 10BASE-T is connected, the green is also flashing.
However, the video is not streamed through Ethernet.

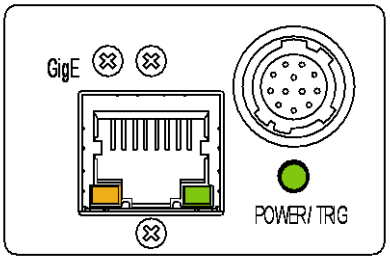


Fig.2 Rear Panel

5. Pin Assignment

5.1. 12-pin Multi-connector (DC-in/GPIO/Iris Video)

Type: HR10A-10R-12PB (Hirose) male.
(Seen from rear of camera)

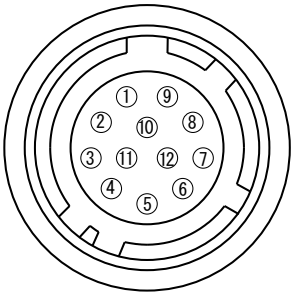
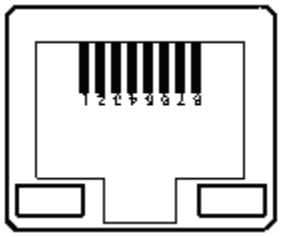


Fig. 3. 12-pin connector.

Pin no.	Signal	Remarks
1	GND	
2	DC input	+12V to +24V
3	Opt IN 2 (-)	GPIO IN / OUT
4	Opt IN 2 (+)	
5	Opt IN 1 (-)	
6	Opt IN 1 (+)	
7	Opt Out 1 (-)	
8	Opt Out 1 (+)	
9	Opt Out 2 (-)	
10	Opt Out 2 (+)	
11	DC input	+12V to +24V
12	GND	

5.2. Digital Output Connector for Gigabit Ethernet



Type: RJ-45
HFJ11-1G02E-L21RL or equivalent

The CM-030GE-RH camera also accepts industrial RJ-45 connectors with thumbscrews. This assures that the connector does not come undone in tough industrial environments.
Please contact the nearest JAI distributor for details on recommended industrial RJ-45 connectors.

Fig. 4. Gigabit Ethernet connector

The digital output signals follow the Gigabit Ethernet interface using RJ-45 conforming connector. The following is pin assignment for Gigabit Ethernet connector.

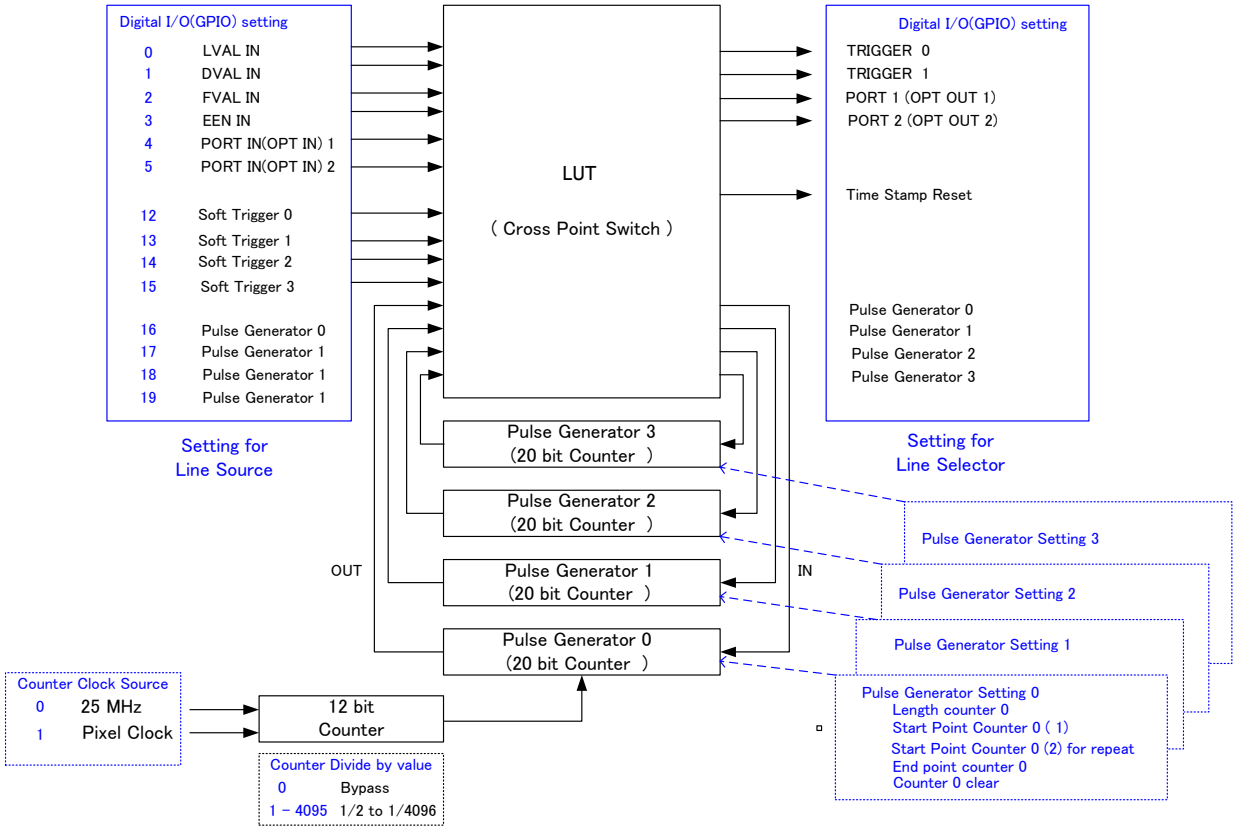
Pin No	In/Out	Name
1	In/Out	MX1+ (DA+)
2	In/Out	MX1- (DA-)
3	In/Out	MX2+ (DB+)
4	In/Out	MX3+ (DC+)
5	In/Out	MX3- (DC-)
6	In/Out	MX2- (DB-)
7	In/Out	MX4+ (DD+)
8	In/Out	MX4- (DD-)

6. GPIO (General purpose inputs and outputs)

In chapter 6, there are some examples of settings. the values shown in these examples may need to be adjusted to fit the pixel clock specifications of this particular model.

6.1. Overview

All input and output signals pass through the GPIO (General Purpose Input and Output) module. The GPIO module consists of a Look-Up Table (LUT – Cross-Point Switch), 4 Pulse Generators and a 12-bit counter. In the LUT, the relationship between inputs, counters and outputs is governed by internal register set-up.



On the above block diagram, Trigger 0 is used for Exposure and Trigger 1 is used for Delayed Readout. The Time Stamp Reset can reset the time stamp in compliance with the GigE Vision standard. This is used for having the same time stamp in the case of using multiple cameras.

The blocks shown in the above diagram have the following functionality:

6.1.1 LUT (Look Up Table)

The LUT works as a cross-point switch, which allows connecting inputs and outputs freely. The signals LVAL_IN, DVAL_IN, FVAL_IN and EEN_IN all originate from the camera timing circuit.
Trigger 0 is connected to the camera's timing circuit and is used for initiating triggered exposure. Trigger 1 is used for Delayed Readout mode. The Time Stamp Reset signal is used reset the camera's time stamp function, also making it possible to reset and synchronize the time stamp of multiple cameras.

6.1.2 12-bit Counter

A 25 MHz clock or the camera pixel clock (58 MHz) can be used as a source. The counter has a "Divide by N", where N has the range 1 through 4096, allowing a wide range of clock frequencies to be programmed. Setting Value 0 is bypass, setting value 1 is 1/2 dividing and setting value 4095 is 1/4096 dividing.

6.1.3 Pulse Generators (0 to 3)

Each pulse generator consists of a 20-bit counter. The behavior of these signals is defined by their pulse width, start point, end point and number of repetitions.
The pulse generator signals can be set in either triggered or periodic mode.
In triggered mode, the pulse is triggered by the rising edge/falling edge/high level or low level of the input signal.
In periodic mode, the trigger continuously generates a signal that is based on the configured pulse width, starting point and end point.

6.2. Opto-isolated Inputs/Outputs

The control interface of the C3 GigE Vision camera series has 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 below figure shows the functional principle (opto-coupler) of the opto-isolated inputs/outputs.

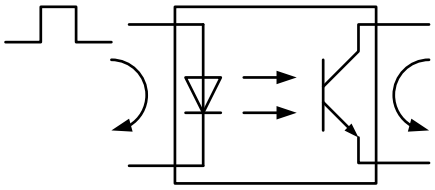


Fig.5. Opto-coupler

6.2.1 Recommended External Input circuit diagram for customer

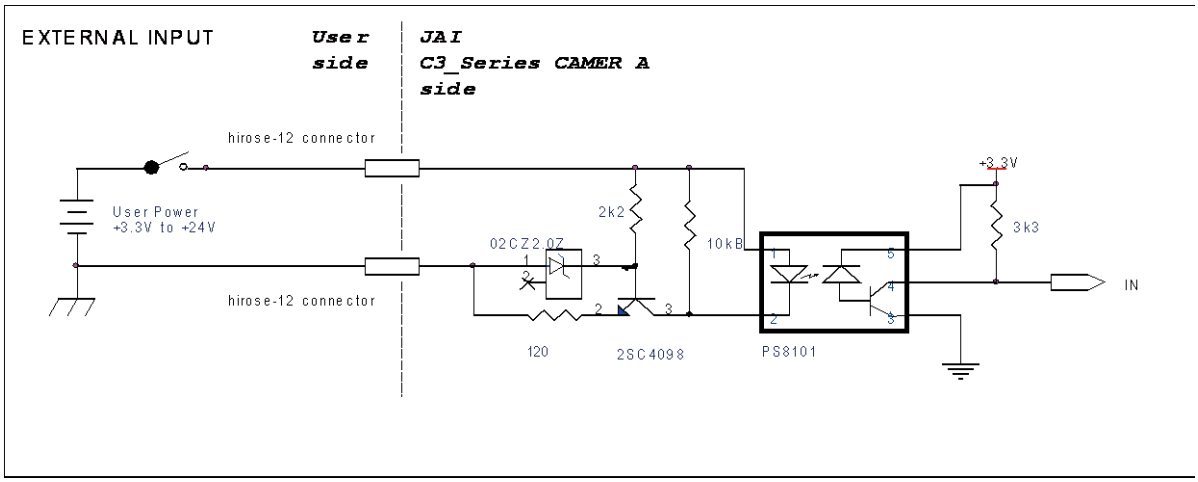


Fig.6 External Input Circuit, OPT IN 1 and 2

6.2.2 Recommended External Output circuit diagram for customer

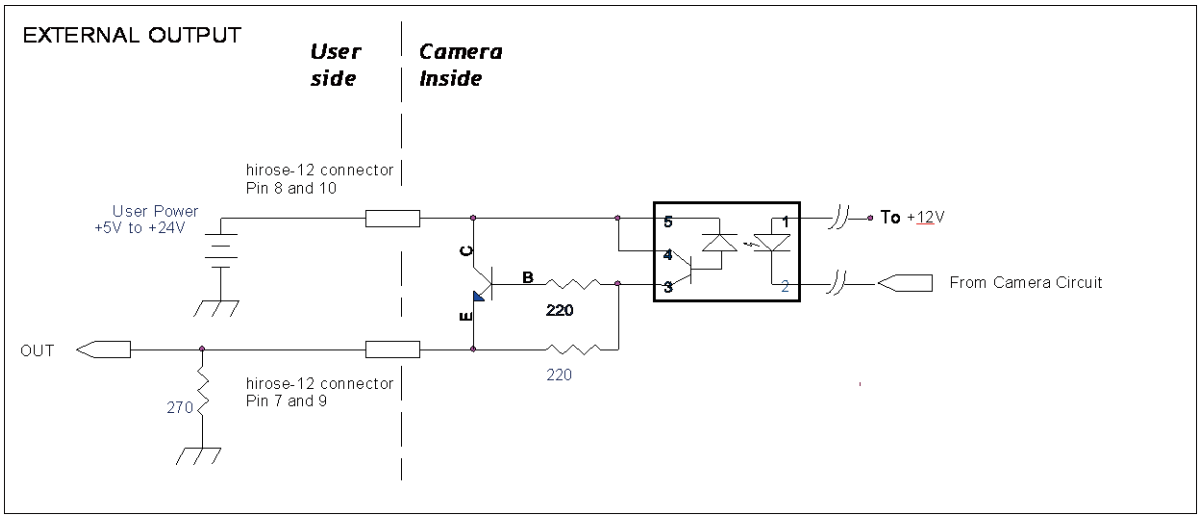
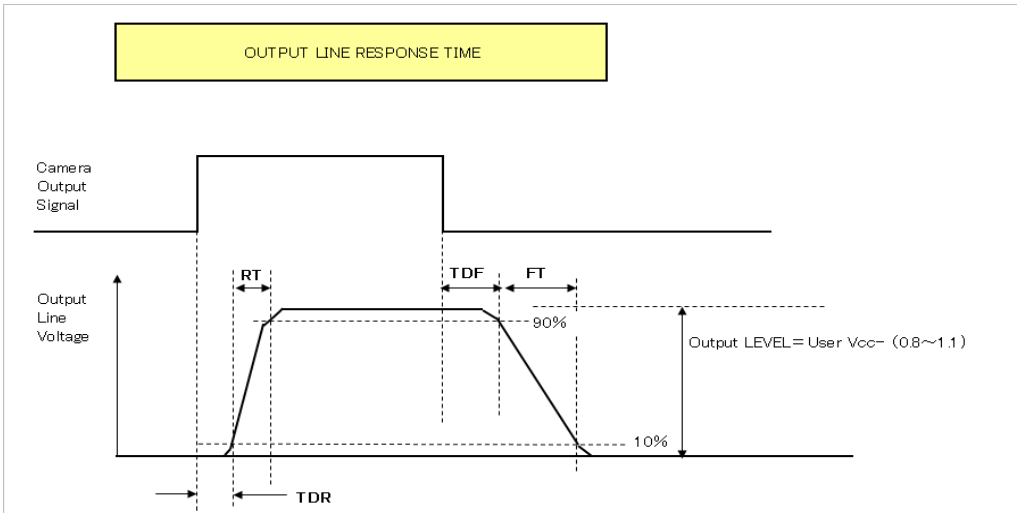


Fig.7. External Output Circuit, OPT OUT 1 and 2

6.2.3 Optical Interface Specifications

The relation of the input signal and the output signal through optical interface is as follows.



Conditions for Input	
Input Line Voltage Range	+3.3v ~ +24V
Input Current	6mA ~ 30mA
Minimum Input Pulse Width to Turn ON	0.5us
Output Specifications	
Output Load(Maximum Current)	100mA
Minimum Output Pulse Width	20us
Time Delay Rise TDR	0.5us ~ 0.7us
Rise Time RT	1.2us ~ 3.0us
Time Delay Fall TDF	1.5us ~ 3.0us
Fall Time FT	4.0us ~ 7.0us

Fig.8. Optical Interface Performance

6.3. Inputs and outputs table

		Output Port								
		Trigger 0	Trigger 1	OPT OUT1	OPT OUT2	Time Stamp Reset	Pulse Gen. 0	Pulse Gen. 1	Pulse Gen. 2	Pulse Gen. 3
Input Port	LVAL IN	×	×	×	×	×	○	○	○	○
	DVAL IN	×	×	×	×	×	○	○	○	○
	FVAL IN	×	×	×	×	×	○	○	○	○
	EEN IN	×	×	○	○	×	○	○	○	○
	OPT IN 1	○	○	○	○	○	○	○	○	○
	OPT IN 2	○	○	○	○	○	○	○	○	○
	Soft Trigger 0	○	○	○	○	○	○	○	○	○
	Soft Trigger 1	○	○	○	○	○	○	○	○	○
	Soft Trigger 2	○	○	○	○	○	○	○	○	○
	Soft Trigger 3	○	○	○	○	○	○	○	○	○
	Pulse Gen. 0	○	○	○	○	○	×	○	○	○
	Pulse Gen. 1	○	○	○	○	○	○	×	○	○
	Pulse Gen. 2	○	○	○	○	○	○	○	×	○
	Pulse Gen. 3	○	○	○	○	○	○	○	○	×

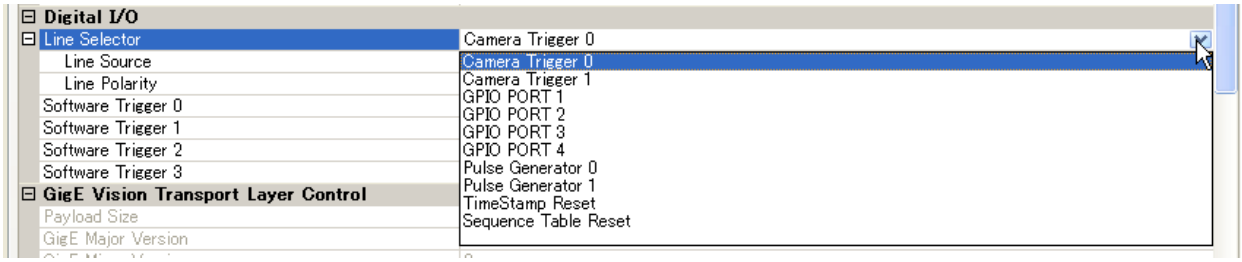
LEGEND: 0 = valid combination / x = Not valid (do not use this combination)

6.4. Configuring the GPIO module (register settings)

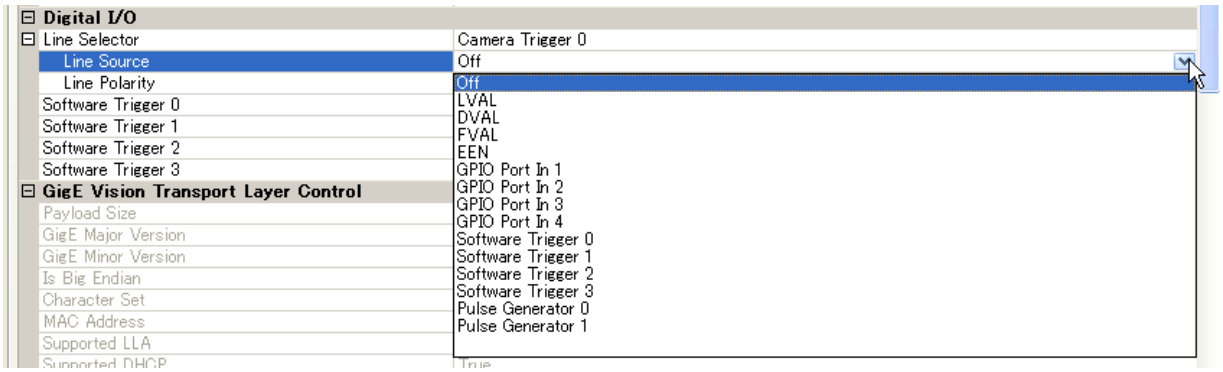
6.4.1 Input/Output Signal Selector

GPIO is used to determine which signal is assigned which terminal. For the details, please refer to Register Map, Digital I/O, Acquisition and Trigger Control and Pulse Generator.

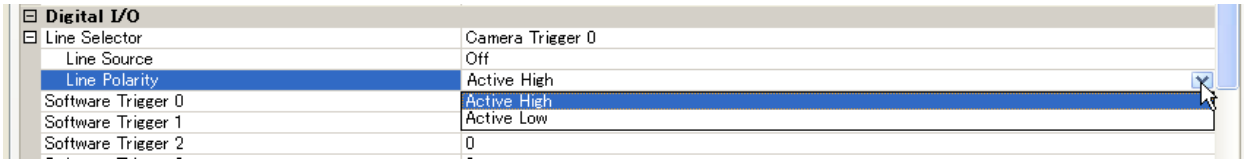
Line Selector



Line Source



Line Polarity

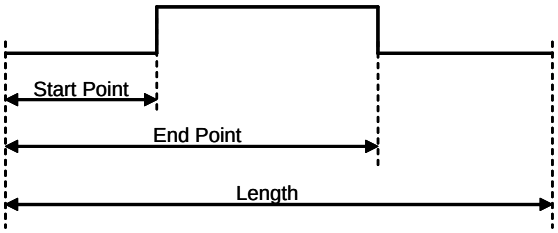


6.4.2 12-bit counter

Address	Internal Name	GenIcam Name	Access	Size	Value (Range)
0xB000	Counter Clock Choice	ClockSource	R/W	4	0x00: 25MHz 0x01: Pixel Clock
0xB004	Counter Dividing Value	ClockPreScaler	R/W	4	0x000: Bypass 0x001: 1/2 Dividing 0x002: 1/3 Dividing | 0xFFF: 1/4096 Dividing

6.4.3 Pulse generators (20-bit x 4)

There are 4 pulse generators (designated 0 through 3) that can be used to create various timing scenarios by programming start point, endpoint, length and repeats.



The following example shows the FVAL input to a pulse generator. The pulse generator creates the pulse using FVAL and the pulse is output through GPIO PORT 1.

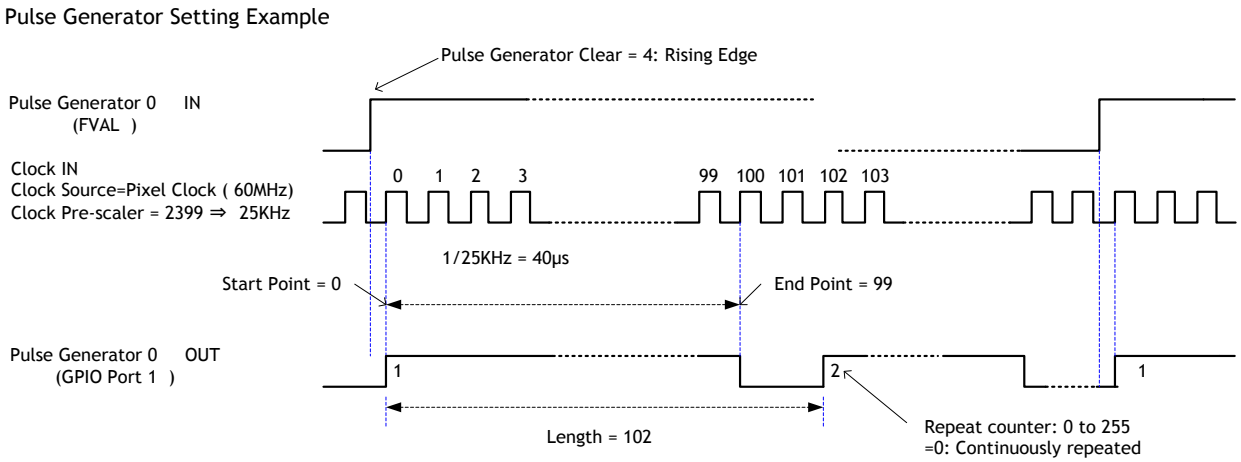


Fig 9. Pulse generator setting example

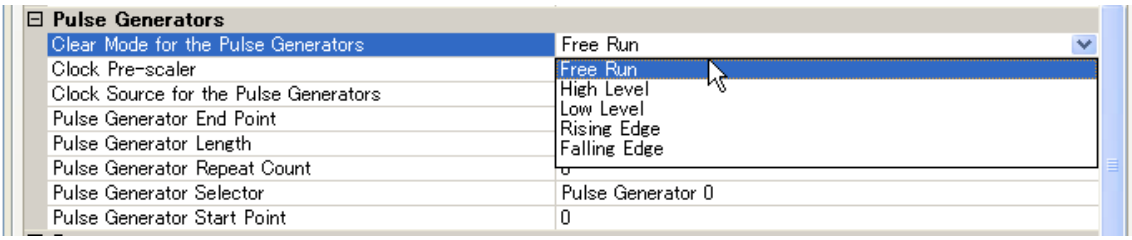
The created pulse rises up at the start point and falls down at the end point, as shown above. Accordingly, the High duration is (End point – Start point) clocks x (1/Pulse gen. frequency).

In the above example, the original oscillation uses pixel clock (60 MHz) and the pixel clock is divided by 2400. A pulse frequency of the generator is 25 KHz (60000000/2400). As the start point is 0 and the end point is 99, a pulse having 100 x 1/25000 = 4ms width is created.

If the High duration needs to be delayed against an incoming trigger, the start point should be set at “N”. The delay value is N x (1/ 25000). In the above example, the N is “0” which is no delay.

The length, in this case, is 102 clocks.

These settings can be achieved by using the JAI Control tool which is part of the JAI SDK.



6.5. GPIO programming examples

6.5.1 GPIO Plus PWC shutter

Example: 10µs unit pulse width exposure control (PWC).
Pixel clock is 58MHz. 580 clocks (680-100) equals 10µs.

	Address	Register	Value
	0xA040	Trigger Mode	2 = PWC (Pulse Width Control)
①	0xB090	Pulse Generator 0 Selector	4 =OPT IN 1
②	0xB000	Clock Choice	1 = Pixel Clock (58MHz)
	0xB004	Counter Dividing Value	0 = Pass through
	0xB008	Length Counter 0	1000 Clocks
	0xB00C	Start point Counter 0	100 Clocks
	0xB010	Repeat Count 0	1
	0xB014	End point Counter 0	680 Clocks
	0xB018	Counter Clear 0	4 = Rising Edge Clear
③	0xB060	CAMERA TRIGGER Selector	16 = pulse generator 0

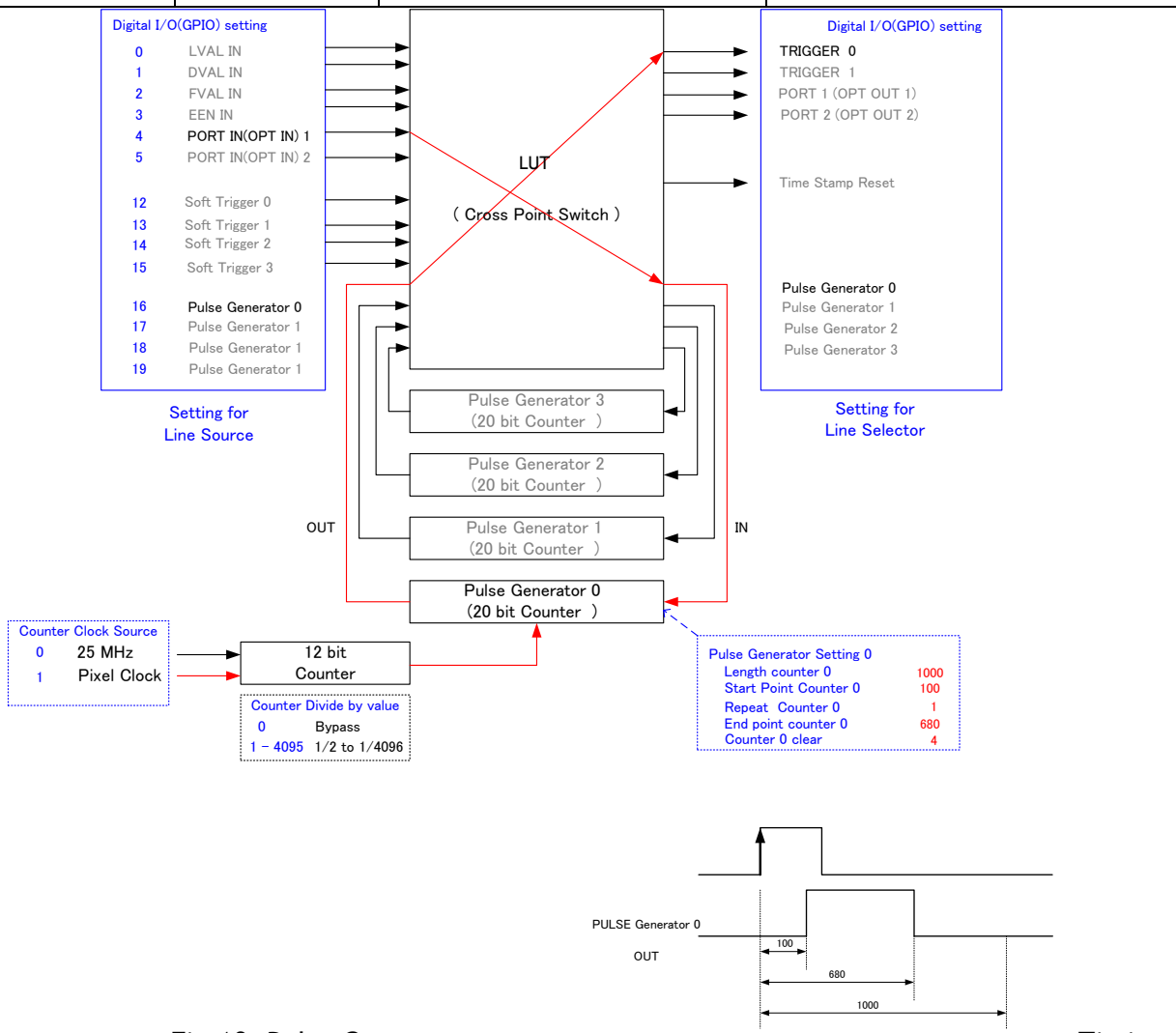


Fig.10. Pulse Generator Timing Example 1

6.5.2 Internal Trigger Generator

Create a trigger signal and trigger the camera

	Address	Register	Value
	0xA040	Trigger Mode	1 = EPS
①	0xB000	Clock Choice	1 = Pixel Clock
	0xB004	Counter Dividing Value	1829= 1/1830 dev(Line Rate)
	0xB008	Length Counter 0	1000 Clocks
	0xB00C	Start point Counter 0	100 Clocks
	0xB010	Repeat Count 0	0 = Free Run
	0xB014	End point Counter 0	500 Clocks
	0xB018	Counter Clear 0	0 = No Clear
②	0xB060	CAMERA TRIGGER Selector	11 = pulse generator 0

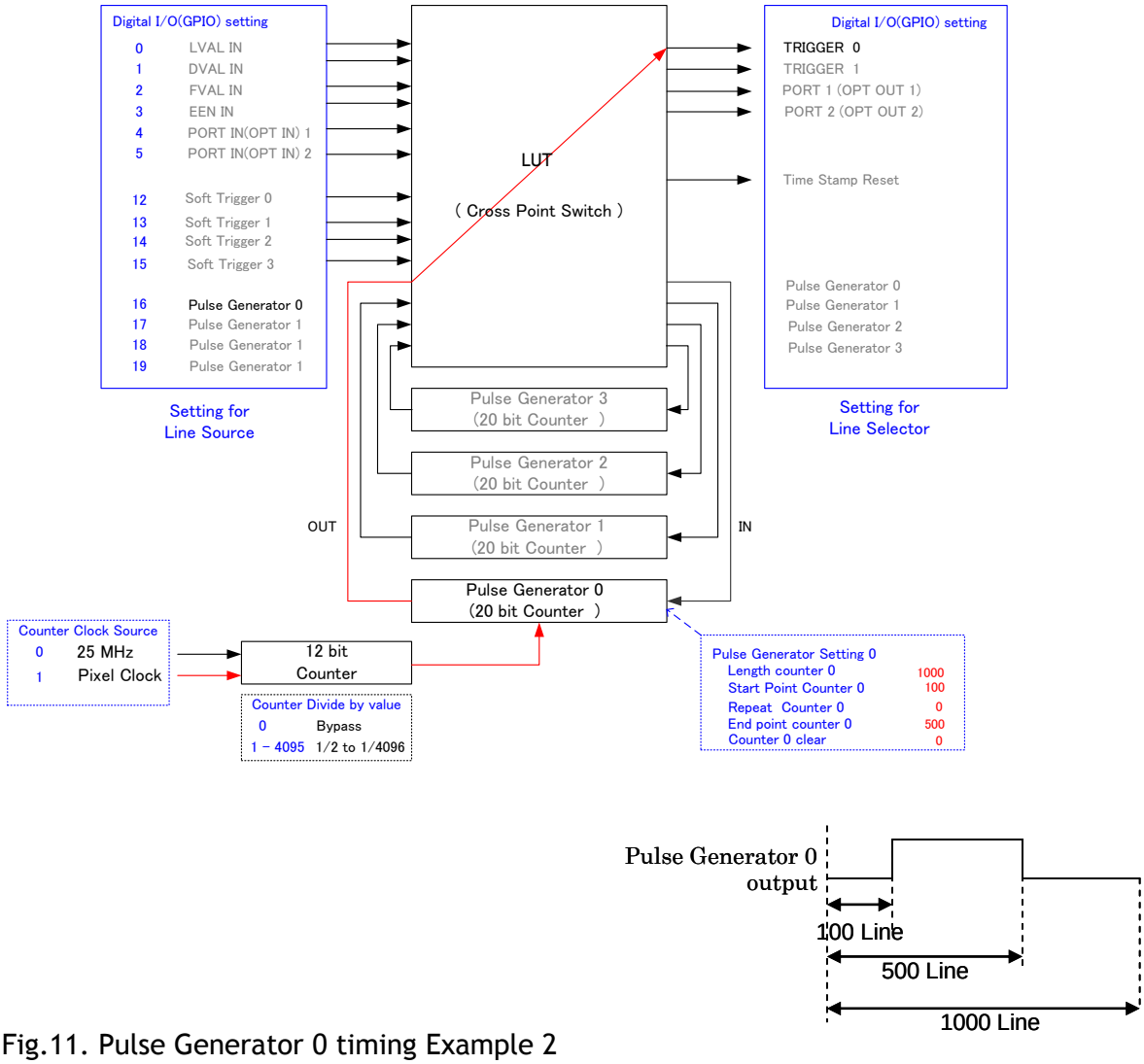


Fig.11. Pulse Generator 0 timing Example 2

7. GigE Vision Streaming Protocol (GVSP)

7.1. Digital Video Output (Bit Allocation)

Although the CM-030GE-RH is digital cameras, the image is generated by an analog component, the CCD sensor.
The table and diagram below show the relationship between the analog CCD output level and the digital output.

CCD out	Analog Signal *	Digital Out(10-bit)
Black	Setup 3.6%, 25mV	32LSB
200mV	700mV	890LSB
230mV	800mV	1023LSB

The standard setting for 10-bit video level is 890 LSB. 200 mV CCD output level equals 100% video output.

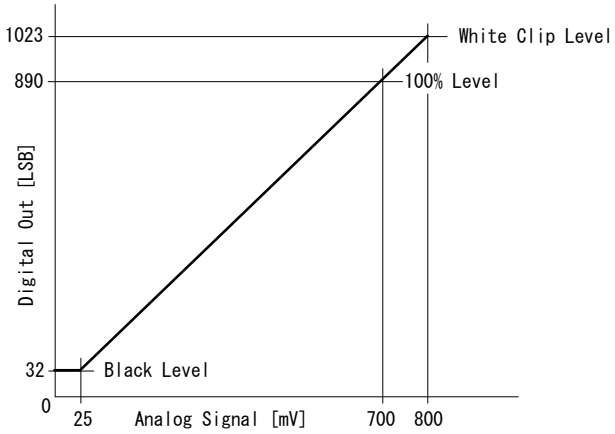


Fig. 12. Digital Output

7.2. Bit Allocation (Pixel Format / Pixel Type)

In the GigE Vision Interface, GVSP (GigE Vision Streaming Protocol) is used for an application layer protocol relying on the UDP transport layer protocol. It allows an application to receive image data, image information and other information from a device.
In the monochrome camera, CM-030GE-RH, the following pixel types supported by GVSP are available.
With regard to the details of GVSP, please refer to the GigE Vision Specification available from the AIA (www.machinevisiononline.org).

7.2.1 GVSP_PIX_MONO8 (8bit)

1Byte								2Byte								3Byte							
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

7.2.2 GVSP_PIX_MONO10 (10bit)

1Byte								2Byte								3Byte								4Byte							
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

7.2.3 GVSP_PIX_MONO10_PACKED (10 bit)

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

Address	Internal Name	Access	Size	Value
0xA410	Pixel Format type	R/W	4	0x01080001:Mono8 0x01100003:Mono10 0x010C0004:Mono10 Packed

8. Functions and Operations

8.1. GigE Vision Standard Interface

The CM-030GE-RH is designed in accordance with the GigE Vision standard. Digital images are transmitted over Cat5e or Cat6 Ethernet cables. All camera functions are also controlled via the GigE Vision interface.

The camera can operate in continuous mode, providing an endless stream of images. For capturing individual images related to a specific event, the camera can also be triggered. For precise triggering, it is recommended to use a hardware trigger applied to the Hirose 12-pin connector. It is also possible to initiate a software trigger through the GigE Vision interface. However, when using software trigger, certain latency inherent to the GigE interface must be expected. This latency, which manifests itself as jitter, greatly depends on the general conditions and traffic on the GigE connection. The frame rate described in this manual is for the ideal case and may deteriorate depending on conditions.

When using multiple cameras (going through a switch and/or a single path) or when operating in a system with limited transmission bandwidth the Delayed Readout Mode and Inter-Packet Delay functions can be useful.

8.2. Recommended Network Configurations

Although the CM-030GE-RH conforms to Gigabit Ethernet (IEEE 802.3) not all combinations of network interface cards (NICs) and switches/routers are suitable for use with the GigE Vision compliant camera. JAI will endeavor to continuously verify these combinations, in order to give users the widest choice of GigE components for their system design. Refer to Before using GigE Vision camera.

8.2.1 Guideline for network settings

To ensure the integrity of packets transmitted from the camera it is recommended to follow these simple guidelines:

1. Whenever possible use a peer-to-peer network.
2. When connecting several cameras, going through a network switch, make sure it is capable of handling jumbo packets and that it has sufficient memory capacity.
3. Configure inter-packet delay to avoid congestion in networks switches.
4. Disable screen saver and power save functions on computers.
5. Use high performance computers with multi-CPU, hyper-thread and 64-bit CPU, etc.
6. Only use Gigabit Ethernet equipment and components together with the camera.
7. Use at least Cat5e or preferably Cat6 Ethernet cables.
8. Whenever possible, limit the camera output to 8-bit.

8.2.2 Video data rate (network bandwidth)

The video bit rate for the CM-030GE-RH is:

Model	Pixel Type	Packet data volume (In case the Packet size is 1500)
CM-030GE-RH	MONO8	324 Mbit/s
	MONO10_PACKED	486 Mbit/s
	MONO10	648 Mbit/s

In case of using Jumbo Frames, the packet data will be improved by 2 %.
For CM-030GE-RH, Jumbo Frames can be set at a maximum of 4040 Bytes (Factory setting is 1428 Bytes).

8.2.3 Note for 100BASE-TX connection

- In case of connecting on 100BASE-TX, the maximum packet size should be 1500 bytes.
- In case of connecting on 100BASE-TX, the specifications such as frame rate, trigger interval etc. described in this manual cannot be satisfied.
- Depending on network conditions or the PC used, the following frame rate may not be achieved.

Pixel Type	Frame rate at Full Frame[fps]
MONO8, BAYRG8, BAYGB8	36.6 ～ 36.8
MONO10_PACKED	24.4
MONO10, BAYRG10, BAYGB10	18.2 ～ 18.4

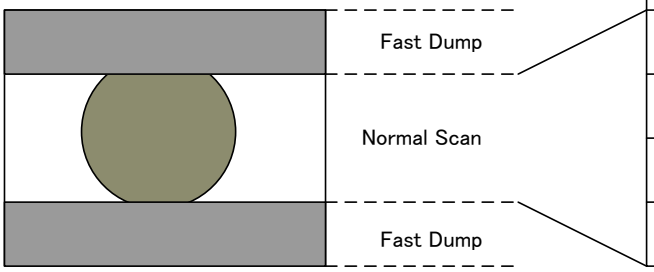
- 100BASE-T works in FULL DUPLEX. It does not work in HALF DUPLEX.

8.3. Basic functions

The CM-030GE-RH camera is a 17mm diameter small remote head camera with 330K pixels on a monochrome progressive CCD. The length between the camera head and the CCU is 2m and the cable is attached to the camera head. The frame rate is as high as 120.491 fps. The external trigger pulse is input via HIROSE 12-pin connector. In trigger modes, a frame rate of 120 fps can be achieved.
There are 5 trigger modes in addition to continuous operation. They are: Edge Pre-Select, Pulse Width Control, RCT, Sequence Trigger and Frame Delay Trigger.

8.3.1 Partial scan

Partial scan mode is a scanning system used to read out the center portion of the image in order to make the frame rate faster. As shown in the drawing below, the first and last part of the full frame is read out using a fast dump method enabling a faster frame rate for capturing images that don't require the full frame height.
CM-030GE-RH has preset partial scans of 2/3, 1/2, 1/4 and 1/8 frame height.



Mode	Start line	End line	Frame rate
2/3	83	410	172.97 fps
1/2	123	368	216.80 fps
1/4	185	306	349.83 fps
1/8	215	274	504.72 fps

Fig. 13 Partial scan

8.3.2 Vertical Binning

Binning mode is a function where the signal charge from 2 adjacent (vertical) pixels are added together and read out as one pixel. Binning results in half vertical resolution and a higher frame rate. In addition, by adding 2 pixels together, the sensitivity is doubled. The charge accumulated in 2 adjacent lines is added together in the horizontal CCD register. This is done by providing two pulses to the vertical CCD register for each line read out. Vertical binning cannot be used together with partial scanning.

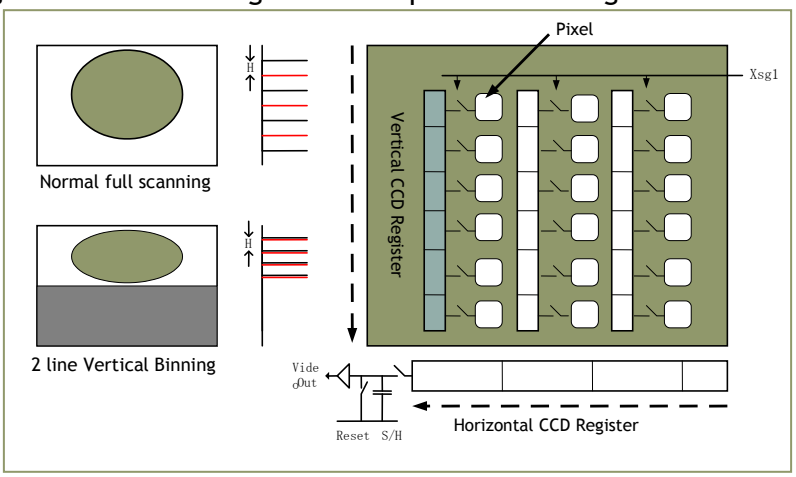


Fig. 14 Vertical Binning

8.3.3 Electronic Shutter

The CM-0303PMCL-RH has three methods for selecting the shutter speed: preset shutter (10 fixed steps), programmable exposure (from 2 to 511 lines in one-line increments) and GenICam standard Exposure Time Abs.

- **Preset Shutter**

The following shutter speeds can be selected by command SH=0 through SH=9.
OFF (1/120), 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000, 1/15000, 1/30000 seconds

Note1) When the trigger mode is selected in partial scan mode, the shutter off is the same as the exposure time of continuous normal scan mode (511L). If the shorter minimum trigger interval is required, set the exposure time shorter than line number of continuous scan in partial scan mode.

Note2) Preset shutter value is converted to a programmable exposure value inside the camera. Therefore, there is some variance, especially in vertical binning mode.

Preset Shutter Value[s]	Exposure lines [Line]	Actual exposure	
		FULL (µs)	VBinning(µs)
Off(1/120)	511	8299	5158
1/250	246	3995	4937
1/500	123	1998	2468
1/1000	62	1007	1244
1/2000	31	503	622
1/4000	15	244	301
1/8000	8	130	161
1/10000	6	97.4	120
1/15000	4	65	80.3
1/30000	2	32.5	40.1

- **Programmable Exposure (PE)**

The exposure time can be programmed in 16.24μs (LVAL period) increments. The range is from 2 LVAL to 511 LVAL.

Minimum exposure time 2L	Maximum exposure time 511L
16.24 μs x 2(L) = 32.48 μs	16.24 μs x 511 (L) ≈ 8.299 ms

In binning mode:

Minimum Exposure time 2L	Maximum exposure time 257L
20.069 μs x 2(L) = 40.138 μs	20.069 μs x 257 (L) ≈ 5.158 ms

- **Exposure Time Abs**

This is a function specified in the GenICam standard.
The shutter speed can be entered as an absolute exposure time in microseconds (μs) in register address 0xA018. The entered absolute time (Time Abs) is then converted to a programmable exposure (PE) value inside the camera.

The equations below show the relationship between the PE value used by the camera for the different readout modes and the "Exposure Time Abs" value entered in register 0xA018.
Due to rounding (decimals rounded down), some discrepancies may occur.

The relation between PE value and Time Abs:
Normal readout PE= 2 + INT(1) (Exposure time -32.5) μs / (942(2)/58000000(3))
V Binning readout PE= 2 + INT (Exposure time -40.1) μs / (1164/58000000)

Note: (1) INT means integer (rounded down). (2) Pixel clocks/line. (3) Pixel clock

- **GPIO in combination with Pulse Width Trigger**

More precise exposure time can be obtained by using the GPIO module in combination with Pulse Width Trigger mode. The clock generator and counter can be programmed in very fine increments. For an example, refer to 6.5.1 GPIO Plus PWC shutter

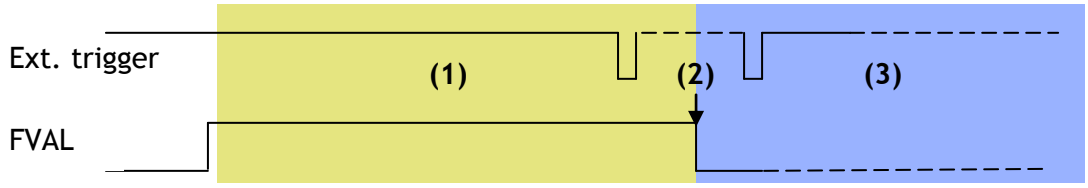
- Upper limit and lower limit of exposure time in each read out mode.

	Lower limit	Upper limit	
		μs	Line
Normal	32.5μs	8299μs	511L
2/3 Partial	32.5μs	5814μs	358L
1/2 Partial	32.5μs	4677μs	288L
1/4 Partial	32.5μs	2907μs	179L
1/8Partial	32.5μs	2046μs	126L
V Binning	40.1μs	5158μs	257L

8.3.4 Auto-detect LVAL-sync / async accumulation

This function replaces the manual setting found in older JAI cameras. Whether accumulation is synchronous or asynchronous in relation to LVAL depends on the timing of the trigger input. When a trigger is received while FVAL is high (during readout), the camera works in LVAL-synchronous mode, preventing reset feed-through in the video signal. There is a maximum jitter of one LVAL period from issuing a trigger and accumulation start.
When a trigger is received during FVAL low, the camera works in LVAL-asynchronous mode (no delay) mode.

This applies to both Edge Pre-select (EPS) trigger mode and Pulse Width Control (PWC) trigger mode.



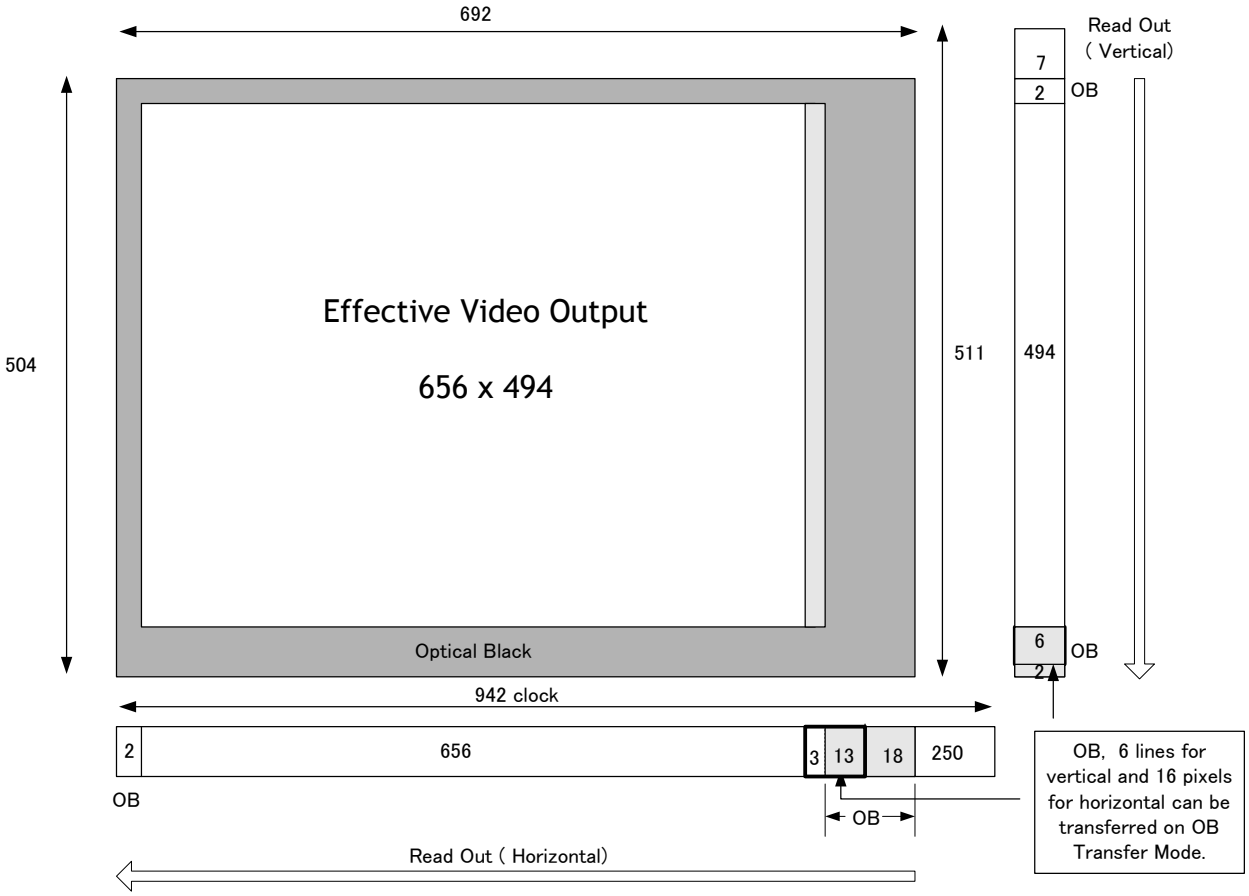
(1) In this period camera executes trigger at next LVAL (prevents feed-through noise)
(2) Avoid trigger at FVAL transition (+/- 1 LVAL period), as the function may randomly switch between "next LVAL" and "immediate".
(3) In this period camera executes trigger immediately (no delay)

Fig. 15 Auto-detect LVAL sync /async accumulation

8.4. Sensor Layout and timing

8.4.1 CCD Sensor Layout

The CCD sensor layout with respect to pixels and lines used in the timing and video full frame readout is shown below.



Important note:
In the GigE Vision standard, only effective video signal is transmitted. As the CM-030HE-RH has OB transfer mode, if this mode is used, 6 vertical pixels and 16 horizontal pixels can also be transmitted together with the effective video signal.
Note: OB of vertical pixels are transmitted only in the full scan mode. Refer to 8.5.7 Optical Black transfer mode.

Fig.16 CCD sensor layout

8.4.2 Horizontal timing

The LVAL period is shown for continuous mode.

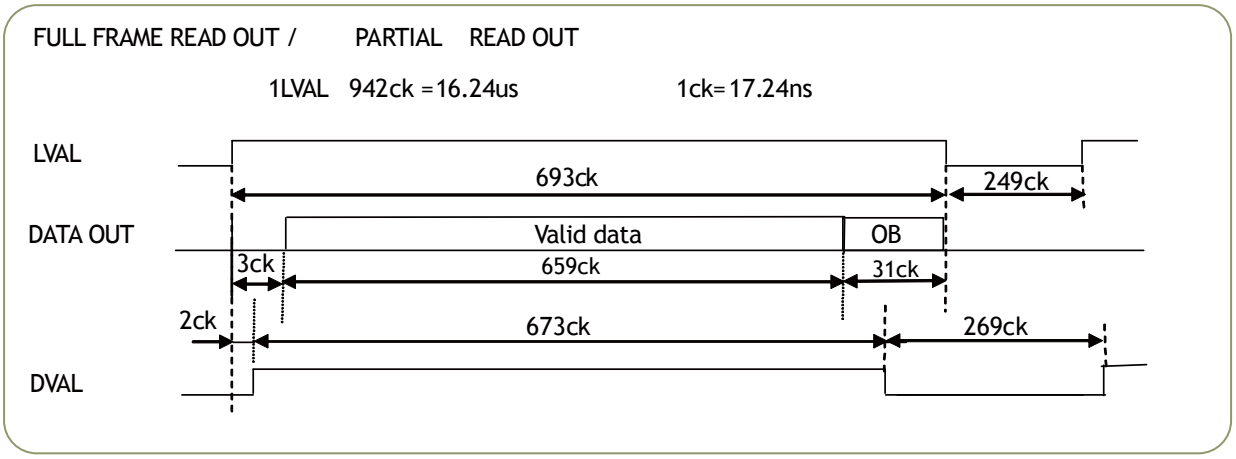


Fig. 17 Horizontal timing

8.4.3 Vertical timing

The FVAL period for continuous mode full scan is shown.

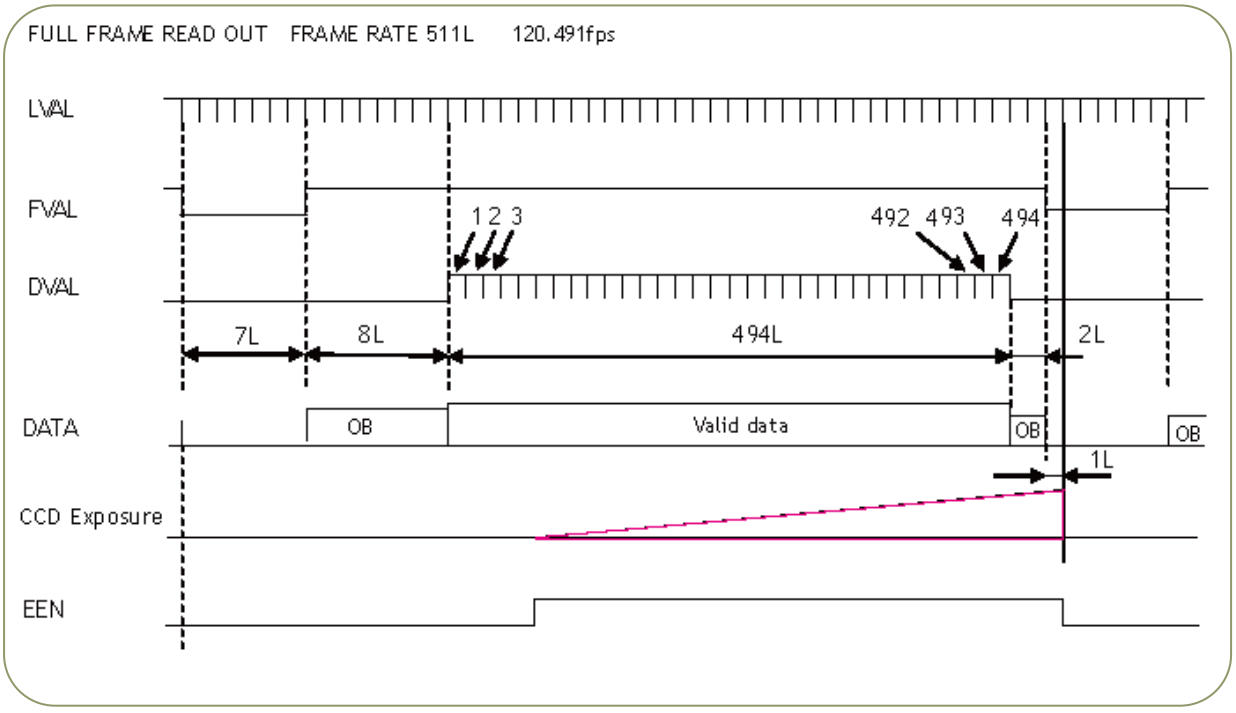
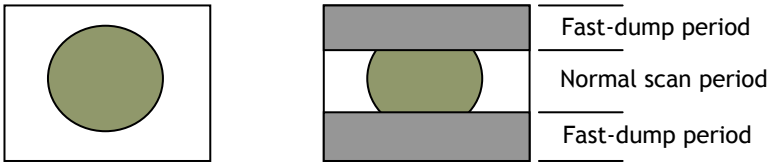


Fig. 18 Vertical timing for full scan

8.4.4 Partial Scan

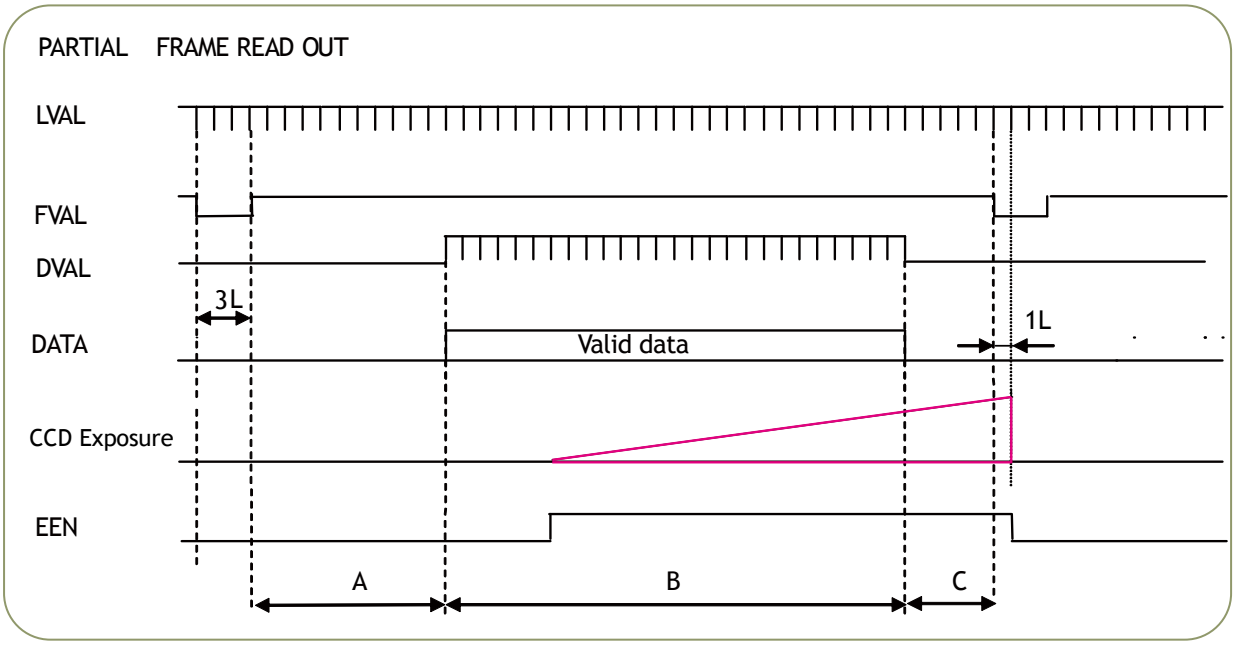
Partial scan allows a higher frame rate by reading out a smaller center portion of the image. This is particularly useful when inspecting objects that do not fill the whole height of the image.



Full scan Partial scan

Vertical Timing

The diagram and table below provide vertical timing information for the fixed partial scan settings 2/3, 1/2, 1/4, and 1/8



Values for vertical timing in partial scan continuous mode.

AREA	FVAL Low (L)	A (L)	B (L)		C (L)	Total line (L)	frame rate (L)
			Start line	End line			
2/3	3	14	328		11	356	172.95
			83	410			
1/2	3	19	246		16	284	216.80
			123	368			
1/4	3	27	122		24	176	349.83
			185	306			
1/8	3	31	60		28	124	504.72
			215	274			

Fig. 19 Vertical timing for partial scanning

Horizontal Timing

The horizontal timing for partial scanning is the same as for full scanning.

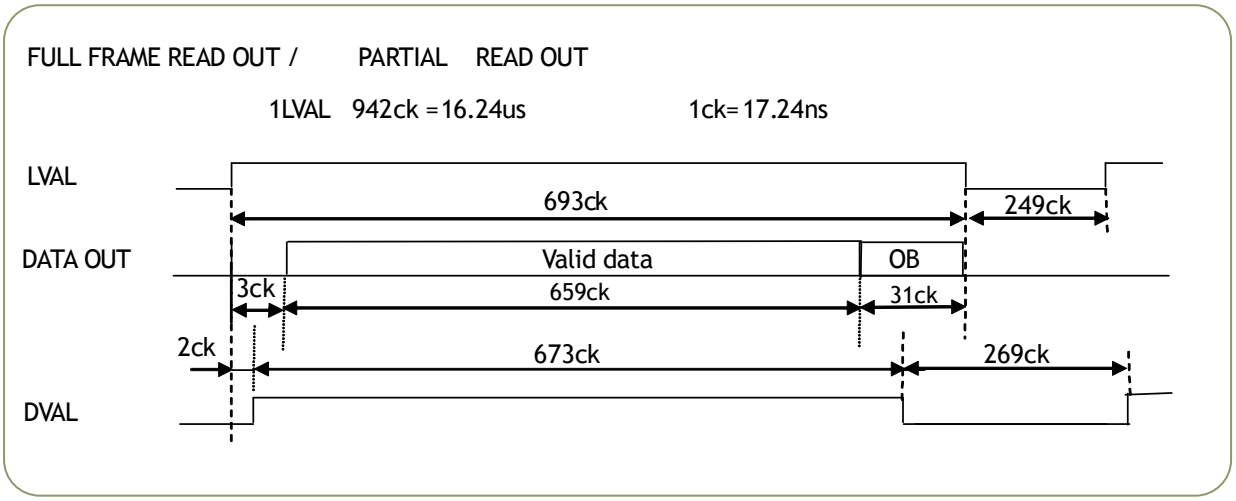


Fig. 20 Horizontal timing for partial scanning

8.4.5 Vertical Binning

Vertical binning combines charge from two adjacent lines, reducing the vertical resolution to half and at the same time increasing frame rate and sensitivity. By activating this function, the frame rate is increased to 193.9 fps.

Important Note

Vertical Binning cannot be used together with the Partial Scan mode.

Horizontal Timing

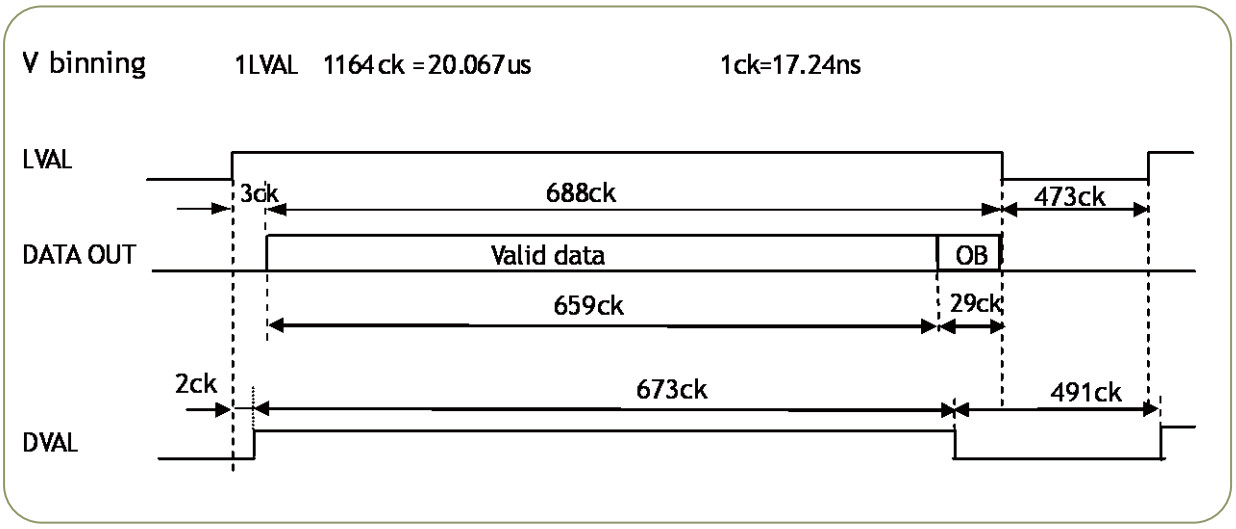


Fig.21 Horizontal Timing for Vertical Binning

Vertical timing

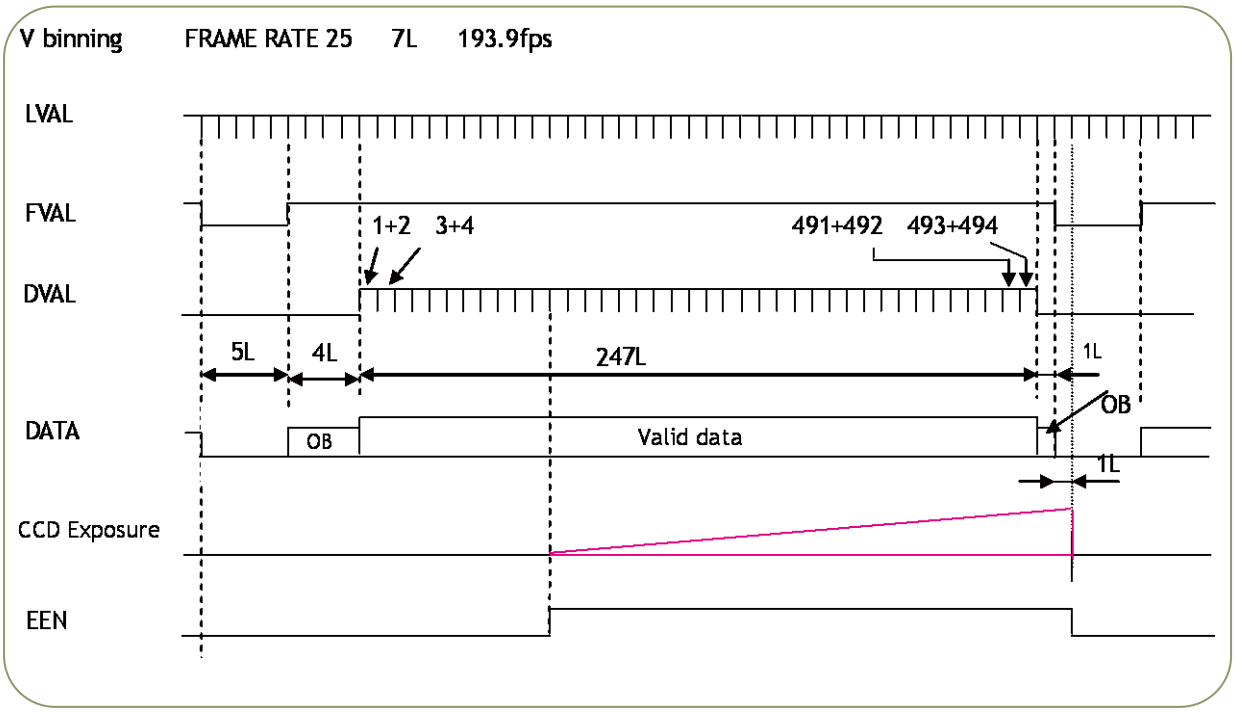


Fig.22 Vertical Timing for Vertical Binning

8.5. Operation Modes

This camera can operate in 4 primary modes.

1. *Continuous Mode* Pre-selected exposure.
2. *Edge Pre-select Mode* Pre-selected exposure.
3. *Pulse Width Control Mode* Pulse width controlled exposure.
4. *RCT Mode* Pre-selected exposure.
5. *Sequential trigger mode (EPS)* Pre-selected exposure.
6. *Frame delay readout (EPS, PWC)*
7. *OB transfer mode*

8.5.1 Continuous operation

For applications not requiring asynchronous external triggering, this mode should be used. For timing details, refer to fig. 17 through fig. 22.

To use this mode:

Set function:	Trigger mode	Continuous
	Scanning	Full, partial
	V Binning	ON / OFF
	Shutter mode	Pre-set, programmable, Exposure Time Abs

8.5.2 Edge Pre-select Trigger Mode

An external trigger pulse initiates the capture, and the exposure time (accumulation time) is defined by preset, programmable or Exposure Time Abs register.
The resulting video signal will start to be read out after the selected shutter time.

For timing details, refer to fig. 17 through fig. 24.

To use this mode:

Set function:	Trigger mode	Edge pre-select
	Scanning	Full, Partial
	V Binning	ON / OFF
	Shutter mode	Edge pre-select, programmable, Exposure Time Abs
Input:	Ext. trigger.	12-pin Hirose GPIO

Important notes on using this mode

1. The minimum trigger interval >2 LVAL.
2. Depending on the timing of the leading edge of the trigger pulse in relationship to FVAL, accumulation will be synchronous or asynchronous in relationship to LVAL. See 8.3.4 Auto-detect LVAL-sync / async accumulation.
3. The minimum trigger interval is as follows.

Scan mode	Minimum interval [L]
Normal Full	513
2/3 Partial	359
1/2 Partial	287
1/4 Partial	179
1/8 Partial	125
Vertical binning	259

Note: In order to keep the minimum trigger interval in the partial scan mode, the exposure time should not exceed the line number at normal scan. If the exposure time is set longer than that, the trigger interval is longer by (Exposure time – normal scan line number). The maximum exposure time is 511L.

LVAL_sync timing

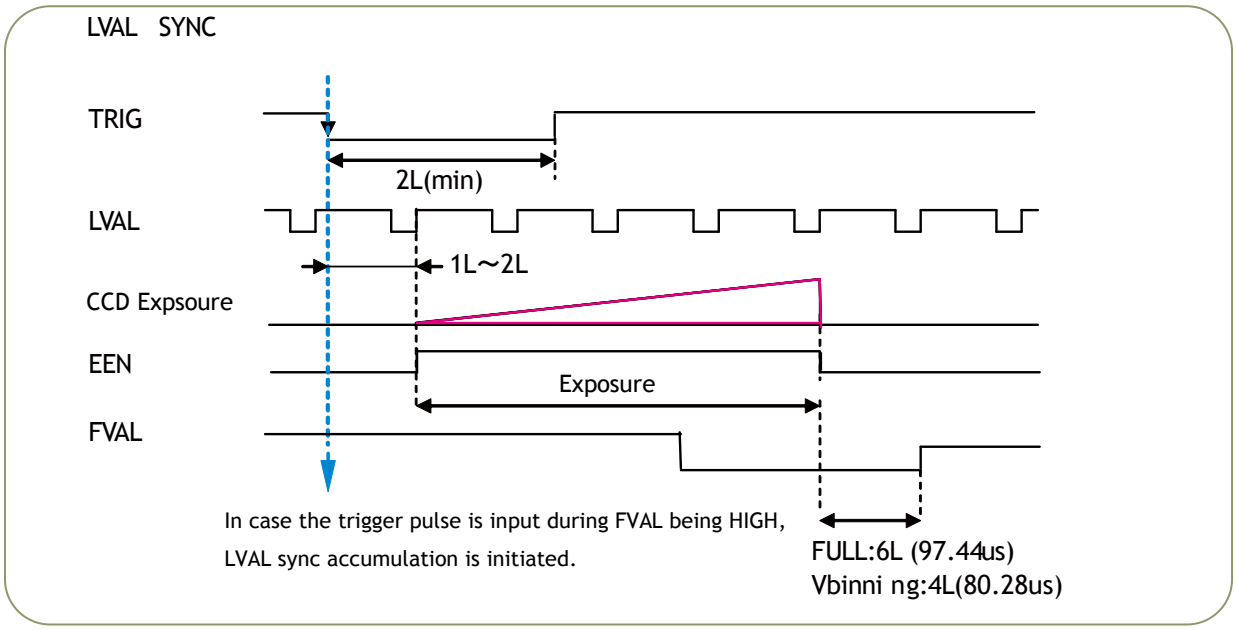


Fig. 23 Edge Pre-select trigger mode. LVAL synchronized.

LVAL_async timing

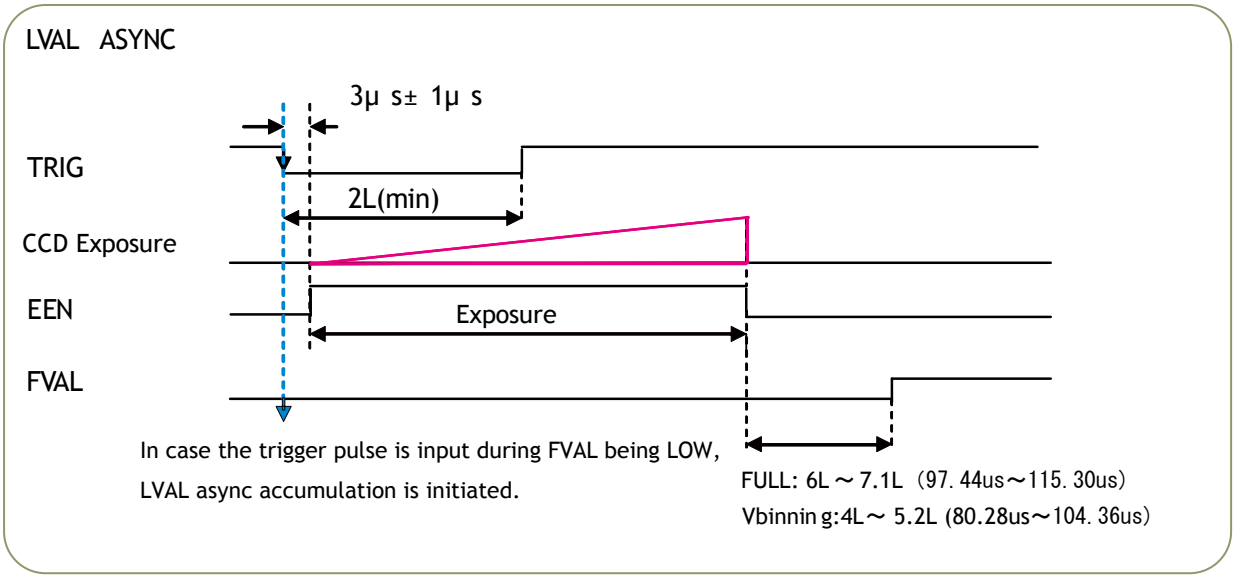


Fig.24 Edge Pre-select trigger mode. LVAL asynchronous

8.5.3 Pulse Width Control Trigger Mode

In this mode the accumulation time is equal the trigger pulse width. Here it is possible to have a long time exposure. The maximum recommended time is <240 frames (2 seconds).

For timing details, refer to fig. 17 through fig. 22 and fig. 25 & 26.

To use this mode:

Set function:	Trigger mode	Pulse width control
	Scanning	Full, Partial
	Vertical binning	ON / OFF
Input:	Ext. trigger.	HIROSE 12-pin GPIO

Important notes on using this mode

1. The minimum trigger interval > 2 LVAL
2. Depending on the timing of the leading edge of the trigger pulse in relationship to FVAL, accumulation will be synchronous or asynchronous in relationship to LVAL. See 8.3.4 Auto-detect LVAL-sync / async accumulation
3. The minimum trigger interval is as follows.

Scan mode	Minimum interval [L]
Normal Full	513
2/3 Partial	359
1/2 Partial	287
1/4 Partial	179
1/8 Partial	125
Vertical binning	259

Note: In order to keep the minimum trigger interval in the partial scan mode, the exposure time should not exceed the line number at normal scan. If the exposure time is set longer than that, the trigger interval is longer by (Exposure time – normal scan line number). The maximum exposure time is 511L.

LVAL_sync timing

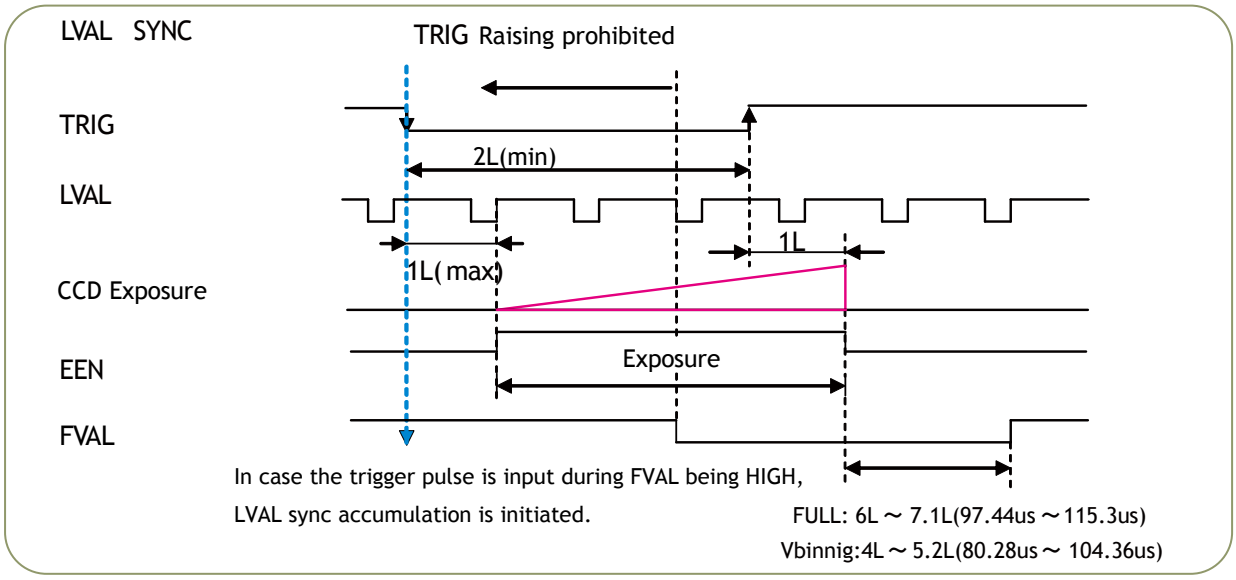


Fig. 25 Pulse width trigger mode. LVAL synchronized.

LVAL_async timing

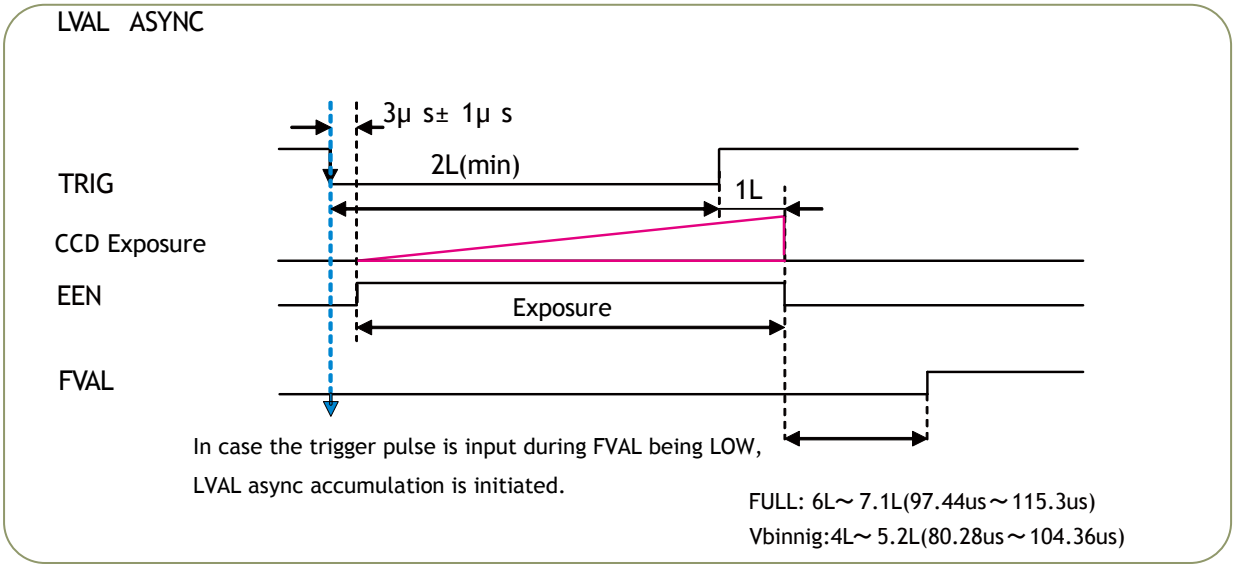


Fig.26 Pulse Width trigger mode. LVAL asynchronous

8.5.4 RCT Trigger mode

The RCT mode operates like EPS (Edge Pre-select) mode with smearless function. An external trigger pulse will immediately stop the video read out, reset and restart the exposure, then operate as normal mode until the next trigger. After the trigger pulse is input, a fast dump read out is performed. In the CM-030GE-RH, this period is 1.0231ms which is 63L. The exposure time is determined by the pre-set shutter speed. If no further trigger pulses are applied, the camera will continue in normal mode and the video signal is not output. The fast dump readout has the same effect as "smearless readout". Smear above bright areas is reduced for the trigger frame.
RCT mode is available only in LVAL asynchronous.

Important notes on using this mode

1. When the shutter setting is either PE=511 or OFF, EEN is kept as HIGH.
2. The minimum trigger interval is as follows (if PE is 2L):

Scan mode	Minimum interval [L]
Normal Full	578
2/3 Partial	423
1/2 Partial	351
1/4 Partial	243
1/8 Partial	189
Vertical binning	324

Note: In order to keep the minimum trigger interval in the partial scan mode, the exposure time should not exceed the line number at normal scan. If the exposure time is set longer than that, the trigger interval is longer by (Exposure time – normal scan line number). The maximum exposure time is 511L.

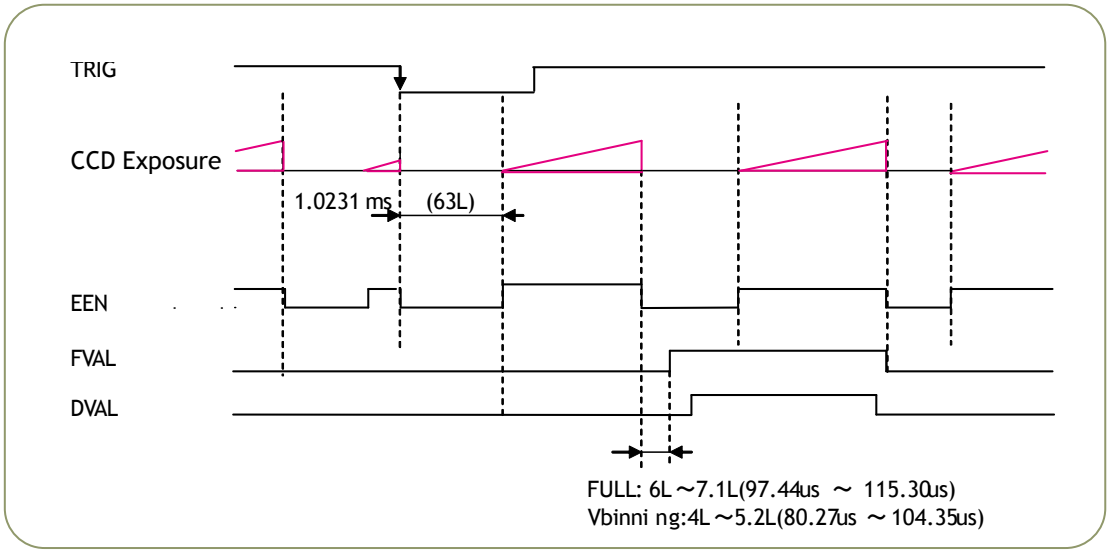
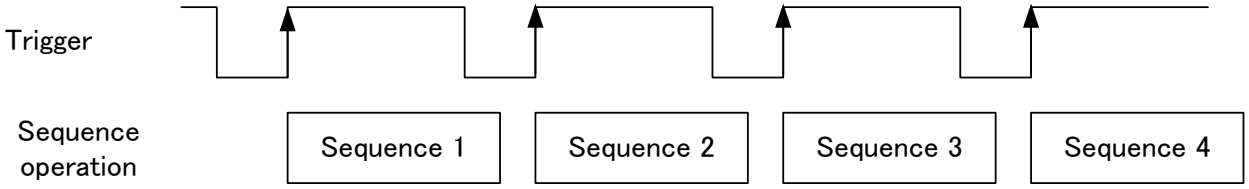


Fig. 27 RCT mode

8.5.5 Sequential Trigger Mode (EPS trigger)

This mode allows the user to define a preset sequence of up to 10 images, each with its own ROI, Shutter and Gain values. As each trigger input is received, the image data with the preset sequence is output as described below.



Signals added to trigger can be selected by 0xB060 Camera Trigger Selector in the register map via GPIO. The camera will functions on the rising edge of the trigger and Negative or Positive should be determined accordingly.

The following default settings can be modified by the user to define a sequence.

ID	ROI				Shutter	Gain
	Width	Height	Offset X	Offset Y		
1	656	494	0	0	511	0
2	656	494	0	0	511	0
3	656	494	0	0	511	0
4	656	494	0	0	511	0
5	656	494	0	0	511	0
6	656	494	0	0	511	0
7	656	494	0	0	511	0
8	656	494	0	0	511	0
9	656	494	0	0	511	0
10	656	494	0	0	511	0

The following registers are used to configure the sequence.

0xC0F4 Sequence Repetitions (Number of Repetitions – Note: 0 = repeat indefinitely)
0xC0F8 Sequence Ending Position (Ending Position)
0xA30C Sequence Reset Command (1 only)
0xB060 Selection for camera trigger 0
0xA040 Trigger mode selection and 0x09 for Sequential EPS mode

Example of settings

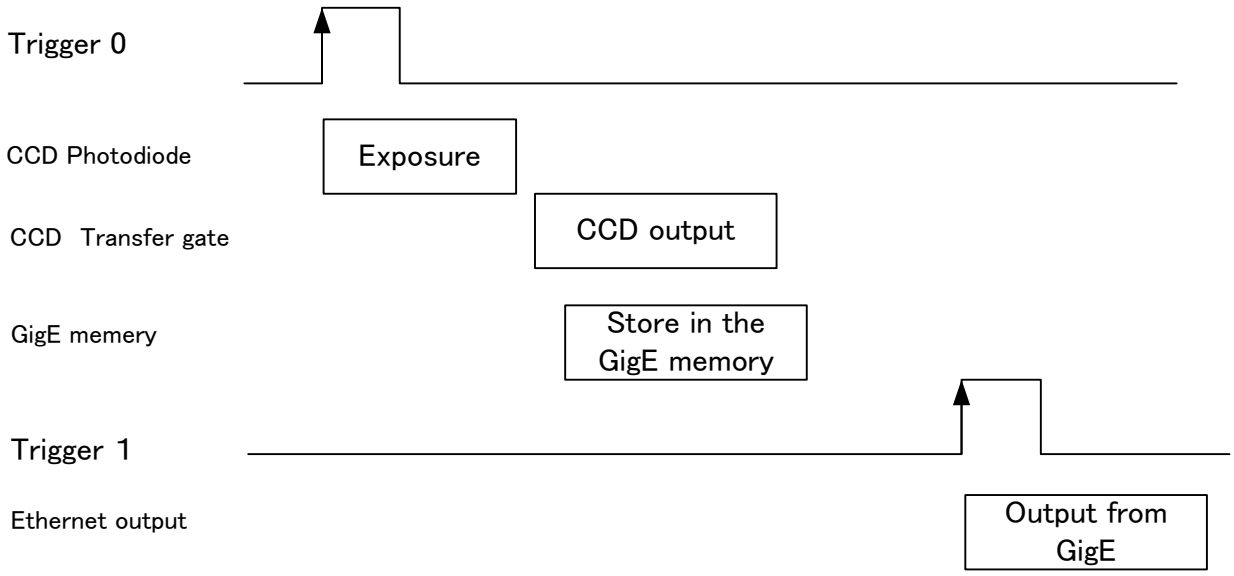
Setting: Repeat 5 times from ID 1 through ID 8
0xC0F4 Set to 0x05
0xC0F8 Set to 0x08
0xB060 For instance, Pin 6 of the 12-pin Hirose connector for Opto IN 1
0xA040 Sequential PS (9)
0xA3F0 Set this to (1) for start
0xA040 Set Normal Mode to (0) for stop

Note:1) As for the details of register, refer to Register Map.
Note:2) It is recommended to set the exposure time in the order from the shortest to the longest one.
Note:3) The minimum trigger interval is > Exposure time (expressed in L(Line)) + FVAL on Normal scan (511L) + 1L)
Note:4) Do not input the trigger just after the sequence is reset. It requires at least 500ms delay.
Note:5) In sequential mode, the exposure should be adjusted so that the LVAL async mode can always function.

8.5.6 Delayed Readout Mode (EPS and PWC)

This mode can be used to delay the transmission of a captured image. When several cameras are triggered simultaneously and connected to the same GigE interface, it allows the cameras to be read out in sequence, preventing congestion.

The image data is not transmitted directly by the trigger 0 and it is stored in the memory located at Ethernet Interface. By the falling edge of the soft trigger 1, the image data is output.



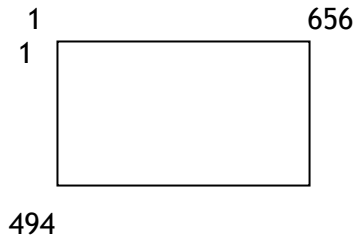
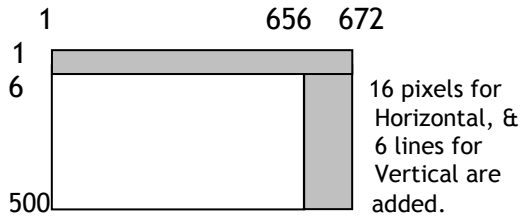
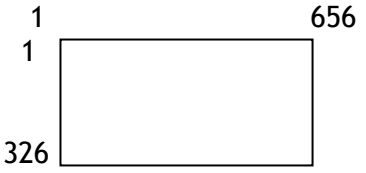
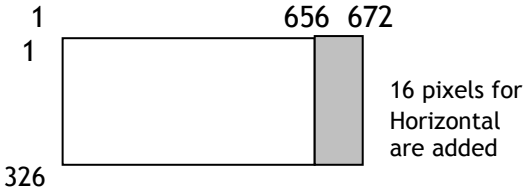
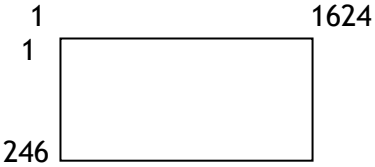
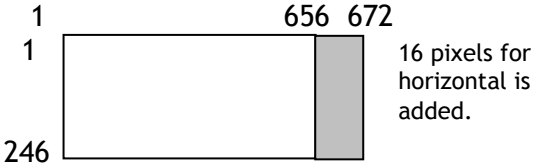
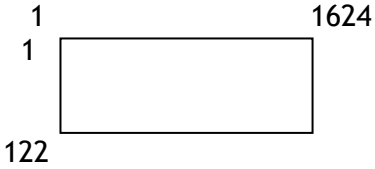
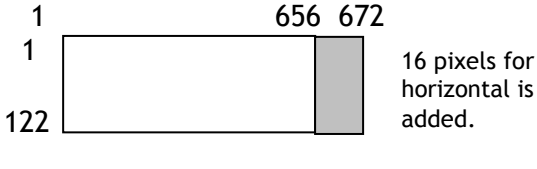
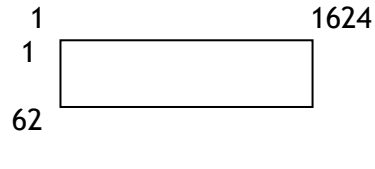
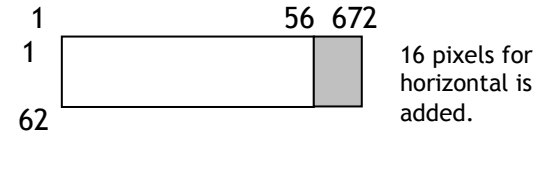
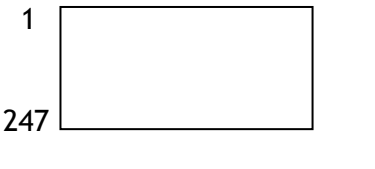
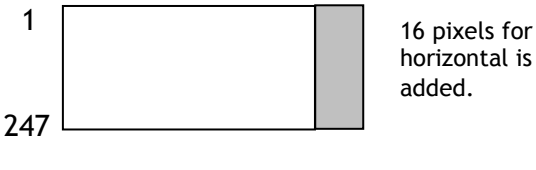
Example of setting

0xA040 PS Delayed Readout (0x11)
0xB060 Trigger 0 select, e.g. 0x04 OPT IN 1
0xB-064 Trigger 1 select, e.g. 0x05 OPT IN 2

For the details of Registers, please refer Camera Register Map which is included in the SDK.

8.5.7 Optical Black transfer mode

It is possible for the user to decide whether the optical black (OB) portion of the image will be transferred or not. The optical black part can be used for black reference in the application software. Setting register 0xA41C turns the optical black transfer ON or OFF. The default condition is OFF.

	OB Transfer Mode OFF	OB Transfer Mode ON
Normal Scan		
2/3 Partial Scan		
1/2 Partial Scan		
1/4 Partial Scan		
1/8 Partial Scan		
V Binning Scan		

8.5.8 Multi ROI mode (Multi Region of Interest)

In this trigger mode, up to 5 ROIs located on one image can be output by one trigger input. By using this mode, the data stream can be smaller. Each ROI can be overlapped.

Please note that if the accumulated data size is bigger than the data size of 1 frame, the frame rate will be reduced.

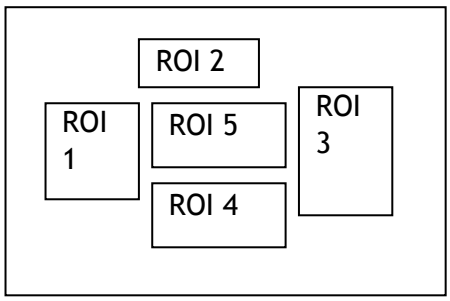


Fig.28 Multi ROI conceptual drawing

8.5.9 Mode and function matrix.

The following table shows which functions will work in the different modes for CM-030GE-RH.

Func. / Trigger Mode	Shutter		Partial scan	V Binning	Accumulation
	Pre-select	Programmable			LVAL sync/async
Cont.	Yes	Yes	Yes	Yes	-
EPS	Yes	Yes	Yes	Yes	Auto
PWC	-	-	Yes	Yes	Auto
RCT	Yes	Yes	Yes	Yes	Async only
Sequence EPS	Yes	Yes	Yes	Yes	Async only
Frame Delay EPS	Yes	Yes	Yes	Yes	Auto
Frame Delay PWC	-	Yes	Yes	Yes	Auto

Fig. 29 Mode and function matrix.

9. External Appearance and Dimensions

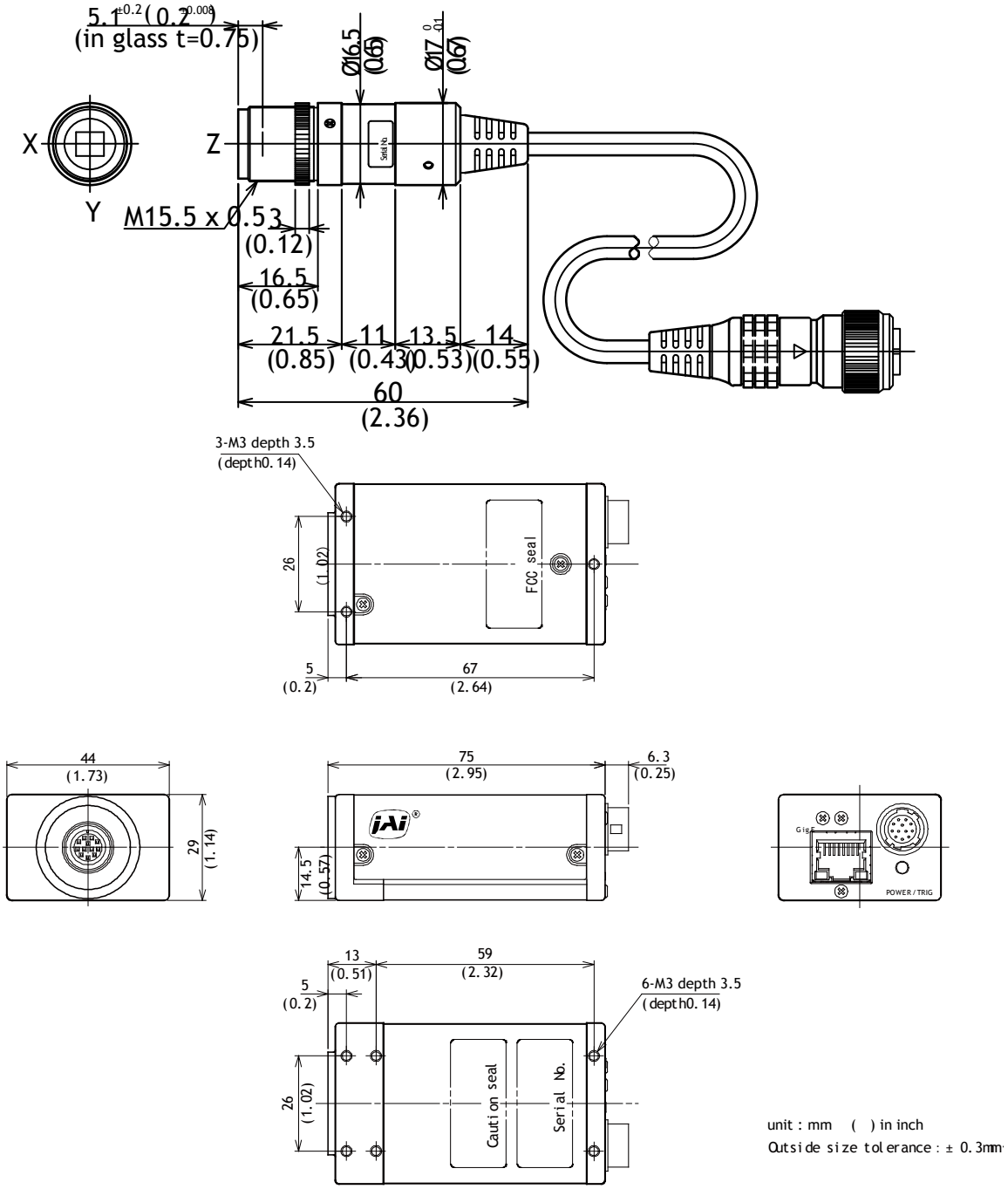


Fig. 30 Outline.

10. Specifications

10.1. CM-030GE-RH Camera sensitivity response

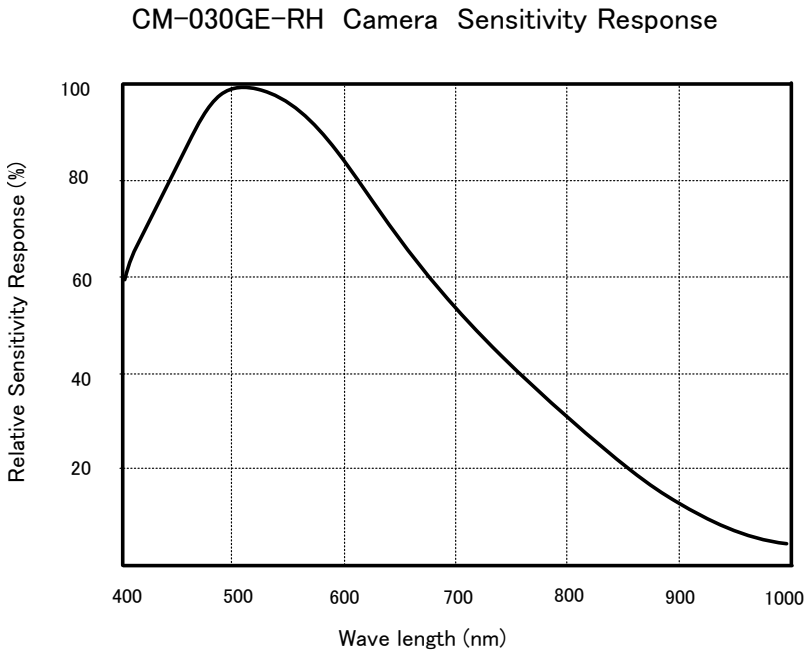


Fig. 31 CM-030GE-RH Sensitivity response

10.2. Specification table

Specifications	CM-030GE-RH
Scanning system	Progressive scan
Synchronization	Int. X-tal.
Frame rate full frame	120.491 frames/sec. Progressive (511 lines/frame)
Pixel clock	58 MHz
Line frequency	61.571 kHz (942 pixel clock/line)
CCD sensor	1/3" Monochrome ICX424ALB
Sensing area	6.4 (h) x 4.8 (v) mm
Cell size	4.65 (h) x 4.65(v) μm
Active pixels	656 (h) x 494 (v)
Pixels in video output. Full 2/3 partial 1/2 partial 1/4 partial 1/8 partial	656 (h) x 494 (v) 120.491 fps. H = 61.571 kHz 656 (h) x 328 (v) 172.95 fps H= 61.571 kHz 656 (h) x 246 (v) 216.80 fps. H = 61.571 kHz 656 (h) x 122 (v) 349.83 fps. H = 61.571 kHz 656 (h) x 60 (v) 504.72 fps. H = 61.571 kHz
Vertical Binning	1/2 Binning 656(h) x 247(v) 193.88 fps (Note: Binning and partial scan can not be used at the same time)
Sensitivity on sensor (minimum)	0.41 Lux (Max. gain, Shutter OFF, 50% video)
S/N ratio	More than 50 dB (0dB gain)
Digital Video output	GigE Vision Interface, Mono8, Mono10, Mono10_Packed
OB transfer mode	ON / OFF
Gain	Manual -3 to +12 dB
GPIO Module Input/output switch Clock Generator (One) Pulse Generators (Four)	Configurable 14-in / 9-out switch 12-bit counter based on 25MHz clock or Pixel clock 20-bit counter programmable for length, start point, stop point, repeat
Trigger modes	Edge Pre-Select , Pulse Width, Reset Continuous, Sequence, Frame Delay
Event message	SYNC / ASYNC mode (Trigger mode status when exposure starts) Exposure start, Exposure end, Trigger IN, Video start, Video end
Accumulation	LVAL synchronous or asynchronous automatic selection
Preset Shutter speed	OFF(1/120) , 9 fixed steps 1/250 to 1/30,000 second
Programmable exposure	2L to 511L (32.48 μs to 8.299 ms)
Exposure Time Abs	25 μsec – 8307 μsec
Pulse width control	2L to 240 frames (32.48μs to 2 seconds)
Control interface	Register based, GigE Vision and GenICam compliant
Functions controlled GigE interface	Shutter, trigger, scanning, readout, polarity, black level, gain, GPIO settings, ROI
GigE®Vision Streaming protocol	Packet size, delayed readout, packet delay Jumbo frame can be set up to 4040. (Default packet size 1428 Bytes)
Rear Panel indicators	Power, trigger input, GigE LINK, GigE ACT
Output connector	RJ-45 Ethernet connector
Operating temperature	-5°C to +45°C
Humidity	20 – 90% non-condensing
Storage temp/humidity	-25°C to +60°C/20% to 90% non-condensing
Vibration	10G (20Hz to 200Hz, XYZ)
Shock	70G
Regulatory	CE (EN61000-6-2 and EN61000-6-3), FCC part 15 class B, RoHS, WEEE
Power	+12V DC to +24V DC ± 10%. 350mA (At +12V input, Full Frame, 8-bit)

Specifications	CM-030GE-RH
Lens mount	ϕ 17mm Exclusive mount
Dimensions	Head ϕ 17 x 46mm (ϕ x D) with 2m cable CCU 44 x 29 x 75 mm (H x W x D)
Weight	Head with 2m cable 120g, CCU 130g

Note: Above specifications are subject to change without notice
Note: Approximately 30 minutes of warm up required in order to meet specifications.

Register Map

The table below provides detailed information for the hardware registers used for controlling the camera and obtaining information on the status of the camera. The content of this register map is also found in the XML file, as stipulated by the GenICam standard.

Device Information

Address	Display Name (JAI Control Tool)	GenICam name	Read / Write	Size	Value / Range of value	Description	Default value
0x0048	Device Vendor Name	DeviceVendoeName	R	32		Manufacture of this device	
0x0068	Device Model Name	DeviceModelName	R	32		Model Name of this device	
0x0088	Device Version	DeviceVersion	R	32		Version of this device	
0x00A8	Device Manufacturer Info	DeviceManufacturerInfo	R	48		Provides extended manufacturer information about the device.	
0x00D8	Device ID	DeviceID	R	16		Camera serial number	
0x00E8	Device User ID	DeviceUserID	RW	16		User assignable string (16 Byte)	
0xA714	FPGA version	DeviceFPGAVersion	R	4			
0xA640	Device Reset	DeviceReset	W	4	Command=1		

Image Format Control

Address	Display Name (JAI Control Tool)	GenICam name	Read / Write	Size	Value / Range of value	Description	Default value
0xA400	Width Max	WidthMax	R	4	656	Width max	1024
0xA404	Height Max	HeightMax	R	4	494	Height max	768
0xA410	Pixel Format	PixelFormat	RW	4	0x01080001 0x010C0004 0x01100003	Mono8 Mono10Packed Mono10	Mono8
0xA500	ROI Mode	ROIMode	RW	4	1 to 5	1:ROI disable 2 to 5: Enable	0xA500
0xA504	ROI 1 Width	Width	RW	4	8 - 656	Width	W.Max
0xA508	ROI 1 Height	Height	RW	4	8 – 494	Height	H.Max
0xA50C	ROI 1 Offset X	OffsetX	RW	4	0 – 648	Horizontal offset	0
0xA510	ROI 1 Offset Y	OffsetY	RW	4	0 – 486	Vertical offset	0
0xA514	ROI 2 Width	Width2	RW	4	8 - 656	Width 2	W.Max
0xA518	ROI 2 Height	Height2	RW	4	8 – 494	Height 2	H.Max
0xA51C	ROI 2 Offset X	OffsetX2	RW	4	0 – 648	Offset X2	0
0xA520	ROI 2 Offset Y	OffsetY2	RW	4	0 – 486	Offset Y2	0
0xA524	ROI 3 Width	Width3	RW	4	8 - 656	Width 3	W.Max

0xA528	ROI 3 Height	Height3	RW	4	8 – 494	Height 3	H.Max
0xA52C	ROI 3 Offset X	OffsetX3	RW	4	0 – 648	Offset X3	0
0xA530	ROI 3 Offset Y	OffsetY3	RW	4	0 – 486	Offset Y3	0
0xA534	ROI 4 Width	Width4	RW	4	8 - 656	Width 4	W.Max
0xA538	ROI 4 Height	Height4	RW	4	8 – 494	Height 4	H.Max
0xA53C	ROI 4 Offset X	OffsetX4	RW	4	0 – 648	Offset X4	0
0xA540	ROI 4 Offset Y	OffsetY4	RW	4	0 – 486	Offset Y4	0
0xA544	ROI 5 Width	Width5	RW	4	8 - 656	Width 5	W.Max
0xA548	ROI 5 Height	Height5	RW	4	8 – 494	Height 2	H.Max
0xA54C	ROI 5 Offset X	OffsetX5	RW	4	0 – 648	Offset X 5	0
0xA550	ROI 5 Offset Y	OffsetY5	RW	4	0 – 486	Offset Y 5	0
0xA080	Fast Dump	FastDumpEnable	RW	4		For enabling variable partial scan	
0xA084	Binning Vertical	BinningVertical	RW	4	1=Binning OFF 2=1/2 V Binning		1
0xA098	Sync Mode	SyncMode	RW	4	0=Sync 1=Async		
0xA13C	Test Image Selector	TestImageSeleector	RW	4	0=OFF 1=White Noise 4=H Rmap Scale 5=V Ramp Scale 6= Moving Ramp Scale		0
0xA41C	OB Transfer Enable	OBTransferEnable	RW	4			

Acquisition and Trigger Control

Address	Display Name (JAI Control Tool)	GenICam name	Read / Write	Size	Value / Range of value	Description	Default value
0xA604	Acquisition Mode	AcquisitionMode	RW	4	0=Stop 1=Start	Acquisition start and stop	0
0xA414	Acquisition frame rate	AcquisitionFrameRate	RW	4	0=Full speed 1=1/2 speed 2=1/4 speed 3=1/8 speed		0
0xA000	Shutter mode	ShutterMode	RW	4	1= Programmable exposure in line 2=Programmable exposure(us) 3=Auto Exposure Constantly	Sets exposure time for image capture.	1
0xA004	Preset Shutter	PresetShutter	RW	4	0=OFF 1=1/250 2=1/500 3=1/1000 4=1/2000 5=1/4000 6=1/8000 7=1/10000 8=1/15000 9=1/30000		0
0xA008	Exposure Time Raw	ExposureTimeRaw	RW	4	0 to 511 (OFF)	Flexible setting of exposure time ranging from 32.5 µs	511

						to 8.299 ms using the LVAL period (L) as increment. 1L is 16.24us.	
0xA018	Exposure Time (us)	ExposureTimeAbs	RW	4	32 to 8307 (OFF)	Actual exposure time in microseconds, µs. The camera will round value off to match LVAL increments.	33333
0xA040	Exposure Mode	ExposureMode	RW	4	00=Continuous trigger 01=Edge pre-select 02=Pulse-width control 09=Sequential EPS trigger 17=Delayed readout EPS trigger 18=Delayed readout PWC trigger		0

Analog Control

Address	Display Name (JAI Control Tool)	GenICam name	Read / Write	Size	Value / Range of value	Description	Default value
0xA0C4	Gain Raw	GainRaw	RW	4	-89 to 341	Value 0＝0dB	0
0xA0E0	Black Level in Raw Format	BlackLevelRaw	RW	4	0 ～ 1024		

Group name : Digital IO

Address	Display Name (JAI Control Tool)	GenICam name	Read / Write	Size	Value / Range of value	Description	Default value
0xA600	Soft trigger 0	SoftTrigger0	WO	4	0=Low 1=HIGH		0
0xA644	Soft trigger 1	SoftTrigger1	WO	4	0=Low 1=HIGH		0
0xA648	Soft trigger 2	SoftTrigger2	WO	4	0=Low 1=HIGH		0
0xA64C	Soft trigger 3	SoftTrigger3	WO	4	0=Low 1=HIGH		0
0xB060	Camera trigger 0	CameraTrigger0	RW	4			
0xB064	Camera trigger 1	CameraTrigger 1	RW	4			
0xB070	GPIO Port 1 (Optical Out 1)	GPIO_Port1	RW	4	Line Source Bit31 ~ Bit25 Bit24:Line Inverter 0=False (Active High) 1=True(Active Low)	Line Source 127:OFF 0:LVAL 1:DVAL 2:FVAL 3:EEN 4:GPIO Port In 1(Optical In 1) 5:GPIO Port In 2(Optical In 2) 12:Software Trigger 0 13:Software Trigger 1 14:Software Trigger 2 15:Software Trigger 3 16:Pulse Generator 0 17:Pulse Generator 1 18:Pulse Generator 2 19:Pulse Generator 3	
0xB078	GPIO Port 2 (Optical Out 2)	GPIO_Port2	RW	4			
0xB090	Pulse Generator 0	PulseGenerator0	RW	4			
0xB094	Pulse Generator 1	PulseGenerator1	RW	4			
0xB098	Pulse Generator 2	PulseGenerator2	RW	4			
0xB09C	Pulse Generator 3	PulseGenerator3	RW	4			
0xB0A0	TimeStamp Reset	TimeStampReset	RW	4			

Pulse Generator

Address	Display Name (JAI Control Tool)	GenICam name	Read / Write	Size	Value / Range of value	Description	Default value
0xB000	Clock Source	ClockSource	RW	4	0=25MHz 1=PixelClock		
0xB004	Clock Pre-scaler	ClockPreScaler	RW	4	0x000 0x001 0x002 | 0xFFF	Bypass Divide by 2 Divide by 3 | Divide by 4096	0
0xB008	Pulse Generator Length 0	PulseGeneratorLength0	RW	4	1～1048575	Defines the length of the counter 0	1
0xB00C	Pulse Generator Start Point 0	PulseGeneratorStartPoint 0	RW	4	0～1048574	Defines the starting point of the counter 0	0
0xB010	Pulse Generator Repeat Count 0	PulseGeneratorRepeatCo unt0	RW	4	0 - 255	Defines the repeat count of the counter 0	0
0xB014	Pulse Generator End Point 0	PulseGeneratorEndPoint0	RW	4	1～1048575	Defines the end point of the counter 0	1
0xB018	Clear Mode for the Pulse Generator 0	PulseGeneratorClear0	RW	4	0 :Free Run 1:High Level 2: Low Level 4: Rising Edge 8: Falling Edge		0
0xB01C	Pulse Generator Length 1	PulseGeneratorLength1	RW	4	1～1048575	Defines the length of the counter 1	1
0xB020	Pulse Generator Start Point 1	PulseGeneratorStartPoint 1	RW	4	0～1048574	Defines the starting point of the counter 1	0
0xB024	Pulse Generator Repeat Count 1	PulseGeneratorRepeatCo unt1	RW	4	0 - 255	Defines the repeat count of the counter 1	0
0xB028	Pulse Generator End Point 1	PulseGeneratorEndPoint1	RW	4	1～1048575	Defines the end point of the counter 1	1
0xB02C	Clear Mode for the Pulse Generator 1	PulseGeneratorClear1	RW	4	0 :Free Run 1:High Level 2: Low Level 4: Rising Edge 8: Falling Edge		0
0xB030	Pulse Generator Length 2	PulseGeneratorLength2	RW	4	1～1048575	Defines the length of the counter 2	1
0xB034	Pulse Generator Start Point 2	PulseGeneratorStartPoint 2	RW	4	0～1048574	Defines the starting point of the counter 2	0
0xB038	Pulse Generator Repeat Count 2	PulseGeneratorRepeatCo unt2	RW	4	0 - 255	Defines the repeat count of the counter 2	0
0xB03C	Pulse Generator End Point 2	PulseGeneratorEndPoint2	RW	4	1～1048575	Defines the end point of the counter 2	1
0xB040	Clear Mode for the Pulse Generator 2	PulseGeneratorClear2	RW	4	0 :Free Run 1:High Level 2: Low Level 4: Rising Edge 8: Falling Edge		0
0xB044	Pulse Generator Length 3	PulseGeneratorLength3	RW	4	1～1048575	Defines the length of the counter 3	1
0xB048	Pulse Generator Start Point 3	PulseGeneratorStartPoint 3	RW	4	0～1048574	Defines the starting point of the counter 3	0
0xB04C	Pulse Generator Repeat Count 3	PulseGeneratorRepeatCo unt3	RW	4	0 - 255	Defines the repeat count of the counter 3	0
0xB050	Pulse Generator End Point 3	PulseGeneratorEndPoint3	RW	4	1～1048575	Defines the end point of the counter 3	1

0xB054	Clear Mode for the Pulse Generator 3	PulseGeneratorClear3	RW	4	0 :Free Run 1:High Level 2: Low Level 4: Rising Edge 8: Falling Edge		0

Sequences

Address	Display Name (JAI Control Tool)	GenICam name	Read / Write	Size	Value / Range of value	Description	Default value
	Sequence Selector	SequenceSelector			Sequence Selector Value 0=Sequence 1 1=Sequence 2 2=Sequence 3 3=Sequence 4 4=Sequence 5 5=Sequence 6 7=Sequence 8 8=Sequence 9 9=Sequence 10	Sequence Selector value is the INDEX for each sequence。	
0xC000	Sequence Exposure Time Raw	SequenceExposureTimeRaw	RW	4	2 - 511	Shutter value Base Address INDEX=0 to 9 (Base Address + Index *4)	511
0xC078	Sequence Master Gain Raw	SequenceMasterGain	RW	4	-89 to 341	Gain value Base Address INDEX=0 to 9 (Base Address + Index *4)	0
0xC0FC	Sequence ROI Size X	SequenceROISizeX	RW	4	8 - 656	ROI width value Base Address INDEX=0 to 9 (Base Address + Index *4)	Width max
0xC124	Sequence ROI Size Y	SequenceROISizeY	RW	4	8 - 494	ROI Height value Base Address INDEX=0 to 9 (Base Address + Index *4)	Height Max
0xC14C	Sequence ROI Offset X	SequenceROIOffsetX	RW	4	0 - 648	ROI H Offset value Base Address INDEX=0 to 9 (Base Address + Index *4)	0
0xC174	Sequence ROI Offset Y	SequenceROIOffsetY	RW	4	0 - 486	ROI V Offset value Base Address INDEX=0 to 9 (Base Address + Index *4)	0
0xC0F0	Reset Sequence Settings	SequenceResetCommand	RW	4	1 only	Sequence3 reset	1
0xC0F4	Sequence Repetition Count	SequenceRepetitions	RW	4	0 to 255	Sequence repeat count	0
0xC0F8	Last Sequence	SequenceEndingPosition	RW	4	1 to 10	Last sequence number setting	1
0xA30C	Save Sequence Settings	SequenceSaveCommand	RW	4	1	Save sequences	1

GigE Transport Layer

Address	Display Name (JAI Control Tool)	GenICam name	Read / Write	Size	Value / Range of value	Description	Default value
0xA418	Payload size	PayloadSize	R	4		Return image size of 1 frame	
0x0000	GigE Major Version	GevVersionMajor	R	4		Version of the GigE Standard to which the device is compliant.	0001
	GigE Minor Version	GevVersionMinor					0000
0x0004	Is Big Endian	GevDeviceModeIsBigEndian	R	4	0:Littel-endian 1:Big-endian	0:Little endian 1:Big endian 1:UTF-8	1
	Character set	GevDeviceModeCharacterSet			0:Unknown ,1:UTF-8		1

0x0008	MAC address	GevMacAddress	R	4		Upper 4 bytes of the MAC address	
0x000c	MAC address	GevMacAddress	R	4		Lower 4 bytes of the MAC address	
0x0010	Support LLA	GevSupportedIPConfigurationLLA	R	4	Bit 31: persistent Bit 30: DHCP Bit 29: LLA	Bits can be OR-ed. All other bits are reserved and set to 0. DHCP and LLA bits must be on.	All True
	Support DHCP	GevSupportedConfigurationDHCP					
	Support Persistent IP	GevSupportedConfigurationPersistentIP					
0x0014	Current IP configuration LLA	GevCurrentIPConfigurationLLA	RW	4	Bit 31: persistent Bit 30: DHCP Bit 29: LLA	Bits can be OR-ed. LLA is always activated and is read only.	LLA is always true
	Current IP configuration DHCP	GevCurrentIPConfigurationDHCP					
	Current IP configuration Persistent IP	GevCurrentIPConfigurationPersistentIP					
0x0024	Current IP address	GevCurrentIPAddress	R	4			
0x0034	Current Subnet Mask	GevCurrentSubnetAddress	R	4			
0x0044	Current Default Gteway	GevCurrentDefaultGateway	R	4			
0x0200	First URL	GevFirstURL	R	512		File extension .XML indicates uncompressed text file. File extension .ZIP indicates compressed using ZIP.	
0x0400	Second URL	GevSecondURL	R	512			
0x0600	Number Of Interfaces	GevNumberOfInterfaces	R	4		Indicates the number of physical network interfaces on this device.	
0x064C	Persistent IP Address	GevPersistentIPAddress	RW	4		Valid if Persistent IP is enabled	
0x065C	Persistent Subnet Mask	GevPersistentSubnetMask	RW	4		Valid if Persistent IP is enabled	
0x066C	Persistent Default Gateway	GevPersistentDefaultGateway	RW	4		Valid if Persistent IP is enabled	
0x0900	Message Channel Count	GevMessageChannelCount	R	4		number of available message channel	
0x0904	Stream Channel Count	GevStreamChannelCount	R	4		number of available stream channel	
0x0934	Supported Optional Commands User-defined Name	GevSupportedOptionalCommandsUser-definedName	R	4	Bit 31:multiple read Bit 30:WRITEMEM Bit29: PACKETRESEND Bit 28:EVENT Bit 27:EVENTDATA Bit 1:Serial No. Bit 0:User defined name 0=false 1=True	This is a capability register indicating which one of the non-mandatory GVCP commands are supported by this device.	
	Supported Optional Commands Serial number	GevSupportedOptionalCommandsSerialnumber					
	Supported Optional Commands EVENTDATA	GevSupportedOptionalCommandsEVENTDATA					
	Supported Optional Commands EVENT	GevSupportedOptionalCommandsEVENT					
	Supported Optional Commands PACKET RESEND	GevSupportedOptionalCommandsPACKETRESEND					
	Supported Optional Commands WRITEMEM	GevSupportedOptionalCommandsWRITEMEM					
	Supported Optional Commands Concatenation	GevSupportedOptionalCommandsConcatenation					
0x0938	Heartbeat Timeout	GevHeartbeatTimeout	RW	4	0 ～4294967295		0
0x093C	Timestamp Tick Frequency	GevTimestampTickFrequency	R	4	Timestamp tick frequency is 0 if timestamp is not supported.	In milliseconds. Internally, the heartbeat is rounded according to the clock used for heartbeat.	

0x0940		GevTimestampTickFrequency	R	4		64-bit value indicating the number of timestamp clock ticks in 1 second. This register holds the most significant bytes.	
0x0944	Timestamp control Latch	GevTimestampcontrolLatch	W	4	Command 2	This register holds the least significant bytes. Used to latch the current timestamp value. No need to clear to 0.	
	Timestamp control Reset	GevTimestampcontrolReset			Command 1		
0x0948	Timestamp Tick Value	GevTimeStampValue	R	4	High	Latched value of the timestamp (most significant bytes)	
0x094C		GevTimeStampValue	R	4	Low	Latched value of the timestamp (least significant bytes)	
0x0A00	Control Channel Privilege Feature	GevCCP	R	4	0:Open Access 1:Exclusive 2:Control 3:Exclusive Control	control channel privilege register	0
0x0B00	Message Channel Port	GevMCPHostPort	R	4		message channel port register	0
0x0B10	Message Channel Destination Address	GevMCDA	R	4		message channel destination address register	
0x0B14	Message Channel Transmission Timeout	GevMCTT	R	4		message channel transfer timeout: ms	300
0x0B18	Message Channel Retry Count	GevMCRC	R	4		message channel retry count	2
0x0D00	Stream Channel Port	GevSCPHostPort	R	4		primary stream port register	
0x0D04	Packet Size	GevSCPSPacketSize	RW	4	1476 ～16020	primary stream channel packet size register/ packet size includes IP, UDP&GVSP Header	1476
	Do Not Fragment	GevSCPSDoNotFragment			0=False 1=True	This bit is copied into the ”don’t fragment Ebit of IP header of each stream packet. It can be used by the application to prevent IP fragmentation of packets on the stream channel.	1
0x0D08	Packet Delay	GevSCPD	RW	4	0 ～ 125000	Set the delay in between packets	0
0x0D18	Strem Channel Destination Address	GevSCDA	R	4		primary stream channel destination address register	

Event Generation

Address	Display Name (JAI Control Tool)	GenICam name	Read / Write	Size	Value / Range of value	Description	Default value

0xA610	Event Selector Acquisition Trigger	GevEventtreigger	RW	4	Selector Value 0	Event message ON/OFF	0
	Exposure Start	GevEventStartOfExposure			1		0
	Exposure End	GevEventEndOfExposure			2		0
	Frame Transfer Start	GevEventStartOfTransfer			3		0
	Frame Transfer End	GevEventEndOfTransfer			4		0
	Event Notification	EventNotification			0=Disable 1=Enable		

User Sets

Address	Display Name (JAI Control Tool)	GenICam name	Read / Write	Size	Value / Range of value	Description	Default value
0xA300	UserSet Save	UserSetSave	W	4	1=User area1	Allows use to save all camera settings. Last used area number becomes new default.	1
0xA304	UserSet Load	UserSetLoad	W	4	0=Factory area 1=User area1	Allow the user to recall all camera settings.	0
0xA308	UserSet Selector	UserSetSelector	RW	4	Whenreceiving following commands,store the parameters 0xA300 0xA304	Check the used data, 0=Factory or1=User	0

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.
Remove power from the camera during any modification work, such as changes of jumper and switch settings.

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 camera captures stripes, straight lines or similar sharp patterns, a jagged image on the monitor may appear.

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.

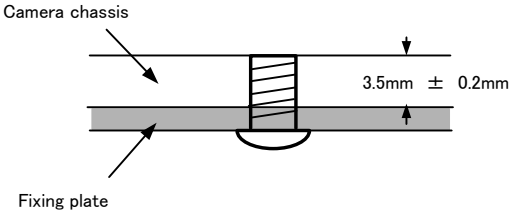
Patterned Noise
When the sensor captures a dark object at high temperature or is used for long time integration, fixed pattern noise may appear in the image.

3. Caution when mounting a lens on the camera

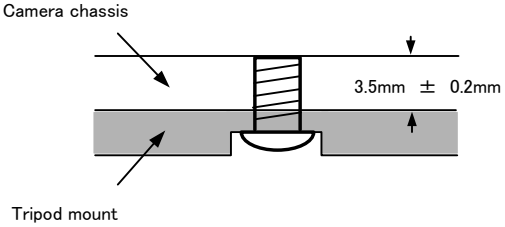
When mounting a lens on the camera dust particles in the air may settle on the surface of the lens or the image sensor of the camera. It is therefore important to keep the protective caps on the lens and on the camera until the lens is mounted. Point the lens mount of the camera downward to prevent dust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

4. Caution when mounting the camera

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



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



5. Exportation

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

6. References

1. This manual for CM-030GE-RH can be downloaded from www.jai.com
2. Datasheet for CM-030GE-RH can be downloaded from www.jai.com
3. Camera control software can be downloaded from www.jai.com

Index

Change History

Month/Year	Revision	Changes
Dec2009	1.0	New release
March 2011	1.1	Delete Register 0xA1FC temperature because this is not implemented.
Feb 2013	1.2	Change the power supply from +12V to "+12V to +24V".

User's Record

Camera type: **CM-030GE-RH**

Revision: **……..**

Serial No. **……..**

Firmware version. **……..**

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

User's Mode Settings.

User's Modifications.

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

Visit our web site at www.jai.com

See the possibilities