See the possibilities

User Manual

AT-140GE

Digital 3CCD Progressive Scan RGB Color Camera

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AT-140GE_Ver.1.3_May2012

1013E-1101

Notice

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Warranty

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

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that AT-140GE complies with the following provisions applying to its standards.
EN 61000-6-3 (Generic emission standard part 1)
EN 61000-6-2 (immunity)

FCC

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

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

Warning

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

Supplement

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

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

重要注意事项

有毒，有害物质或元素名称及含量表

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

部件名称	有毒有害物质或元素					
	铅（Pb）	汞（Hg）	镉（Cd）	六价铬（Cr(Ⅵ)）	多溴联苯（PPB）	多溴二苯醚（PBDE）
棱镜	×	○	○	○	○	○
光学滤色镜	×	○	×	○	○	○
…….	…….	…….	…….	…….	…….	…….	…….

○：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。

Table of 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.machinevisiononline.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.

Software installation

The JAI GigE Vision SDK & Control Tool can be downloaded from the JAI web site at www.jai.com. The JAI SDK is available for Windows XP and Vista, 32-bit and 64-bit.
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 AT-140GE complies with GenICam Standard Feature Naming Convention (SFNC) ver.1.3 and functions described in this booklet are described based on this standard.
The AT-140GE is a digital 3CCD progressive scan RGB color camera. It employs three 1/2-inch 1392 (h) x 1040 (v), 1.45 Megapixel CCDs and runs at 20 frames per second in full resolution mode. The AT-140GE has a GigE Vision interface and its output can be either 24-bit or 30-bit RGB. JAI developed a new 1/2-inch compact F4.0 prism optical system and in combination with a linear color matrix, the AT-140GE provides a higher fidelity of color reproduction. The AT-140GE also incorporates a dynamic shading circuit, gamma correction circuit and knee correction circuit to provide high picture quality. Functions like AOI and vertical binning allow higher frame rates.

The latest version of this manual can be downloaded from: www.jai.com
The latest version of the JAI GigE Vision SDK & Control Tool for the AT-140GE can be downloaded from: www.jai.com

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

2. Camera nomenclature

The standard camera composition consists of the camera main body and C-mount protection cap.

The camera is available in the following versions:

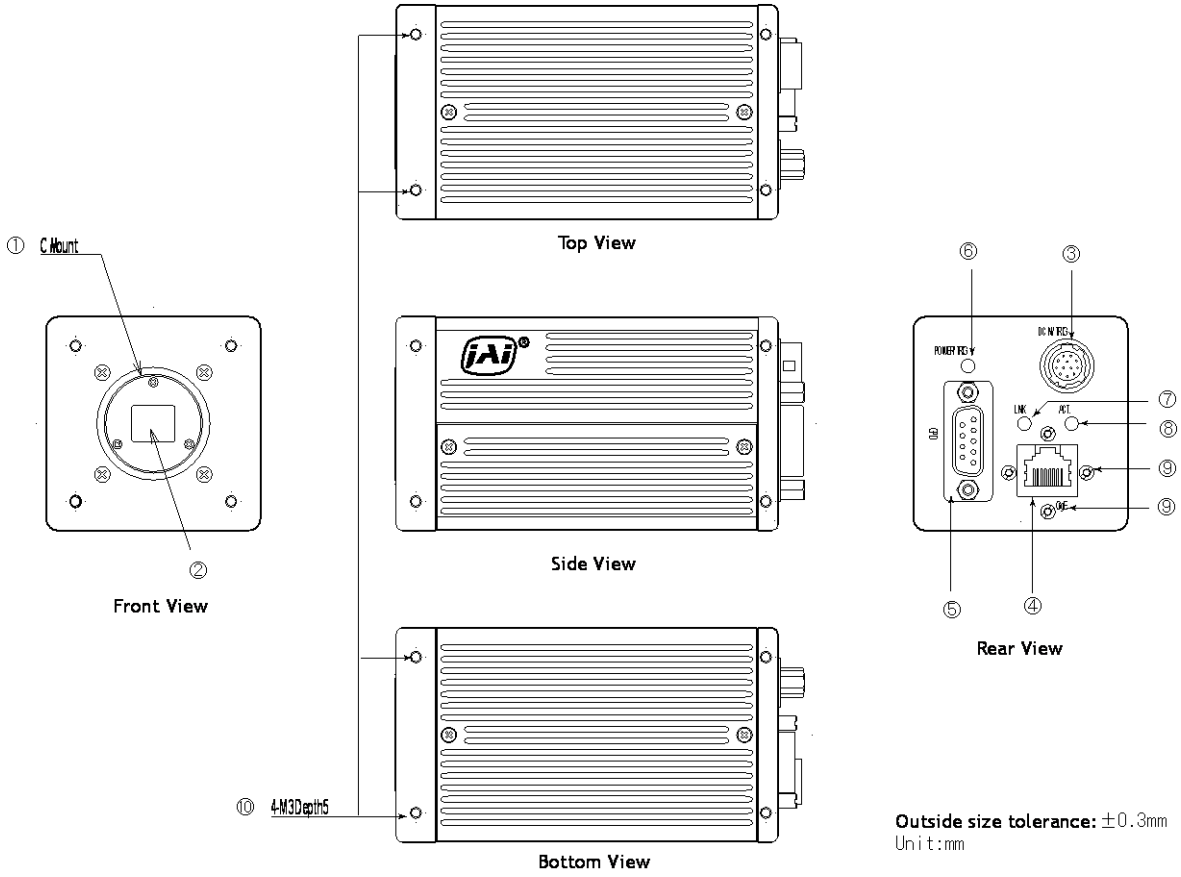
AT-140GE
Where A stands for "Advanced" family, T stands for "3 CCD", **140** represents the resolution "1.4 million pixels" , and **GE** stands for "GigE Vision " interface.

3. Main Features

- 3 x 1/2" CCD progressive scan RGB color camera for vision applications
- 3 x 1392(h) x 1040 (v) resolution with 4.65μm effective square pixels
- Compact RGB prism for C-mount lenses
- Shading reduction permits wider choice of lenses
- Maximum 20.814 frames per second with 1392 (h) x 1040 (v) pixels
- Variable partial scan is available for faster frame rate
- Maximum 59.94 fps with 1392 (h) x 8 (v) pixels in AOI mode
- Vertical binning for higher sensitivity and frame rate of 32.92 fps
- Horizontal binning is also available for increasing sensitivity (frame rate is not changed)
- 24-bit RGB output or 30-bit RGB output (RGB 8, RGB 10V1 or RGB 10V2 pixel format)
- Gamma can be set from 1.0 (OFF) to 0.45 and LUT is also available (selectable)
- Linear matrix circuit with sRGB or Adobe RGB pre-setting
- Built-in shading compensation circuit for color shading and flat field shading
- Acquisition control includes single frame, multi frame and continuous
- Exposure mode includes off, timed, trigger width and trigger controlled
- Trigger control includes frame start, exposure start and exposure end.
- Combination of Acquisition Control, Exposure Mode and Trigger Control provide various image capture options
- Manual, continuous, or one push white balance
- Analog iris video output for lens iris control
- LVAL synchronous/asynchronous operation (Trigger Overlap function)
- Comprehensive software tools and SDK for Windows XP/Vista/7 (32 bit “x86” and 64 bit “x64” JAI SDK Ver. 1.3.0 and after)

4. Locations and Functions

4.1. Locations and functions



1. Lens mount	Lens mount of C-mount type. *1)
2. CCD sensor	1/2 inch CCD
3. RJ-45 connector	GigE Vision interface with thumb screws
4. 12-pin connector	DC+12V, Trigger IN and EEN out
5. D-sub 9-pin connector	LVDS IN and TTL IN and OUT
6. LED	Power and trigger indications
7. LINK	Indication for Network connection
8. ACT	Indication for GigE communication
9.Holes for RJ-45 thumbscrews	Vertical type and horizontal type (*2)
10.Mounting holes	M3, max length 5mm (*3)

*1) Note: Applicable C-mount lens should be designed for 3-CCD cameras. Rear protrusion on C-mount lens must be less than 4mm.
Be advised: when using a lens with the iris diaphragm fully open, vignetting on corners may occur.

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

*3) Note: The tripod adapter plate MP-41 can be used.

Fig. 1. Locations

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.

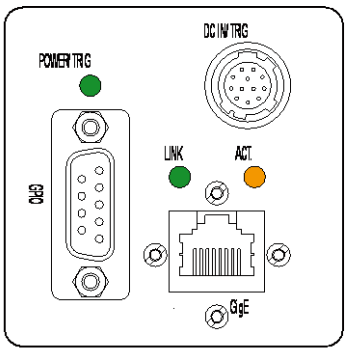


Fig.2 Rear Panel

5. Pin Assignment

5.1. 12-pin Multi-connector (DC-IN/Digital IO)

Type: HR10A-10R-12PB-01
(Hirose) male.
(Seen from rear of camera.)

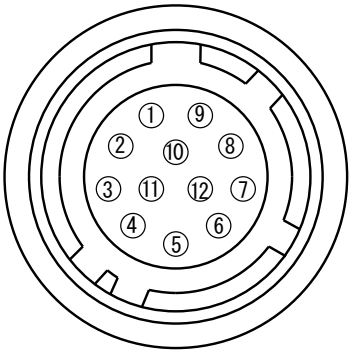
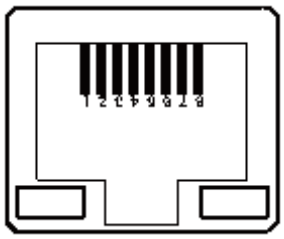


Fig. 3. 12-pin connector.

Pin no.	Signal	Remarks
1	GND	
2	DC input	+12V to +24V
3	Opt In 2(-) / GND (*1)	Line 6
4	Opt In 2 (+) / Iris video(*1)	
5	Opt In 1 (-)	Line 5
6	Opt In 1 (+)	
7	Opt Out 1 (-)-	Line 3
8	Opt Out 1 (+)	
9	Opt Out 2 (-)	Line 4
10	Opt Out 2 (+)	
11	DC input	+12V to +24V
12	GND	

*1) Default is Opt In 2. DIP switch SW700 changes to iris video output.

5.2. Digital Output Connector for Gigabit Ethernet



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

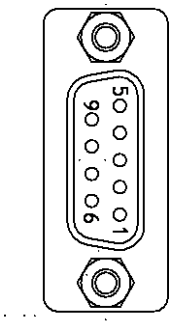
The AT-140GE cameras also accept industrial RJ-45 connectors with thumbscrews. This assures that the connector does not come undone in tough industrial environments.
Please contact the nearest JAI distributor for details on recommended industrial RJ-45 connectors.

Fig. 4. Gigabit Ethernet connector

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

5.3. D-Sub 9pin connector (For GPIO)



Type : DD-09SSG

Fig. 5. D Sub 9pin connector

No	I/O	Name	Note
1	I	LVDS In 1-	Line 8
2	I	LVDS In 1+	
3	I	TTL IN 1	Line 7 75ohm Terminator (Note 1)
4	O	TTL Out 1	Line 1
5		GND	
6		NC	
7		NC	
8	O	TTL OUT 2	Line 2
9		GND	

Note1) Can be changed by DIP switch (SW600).

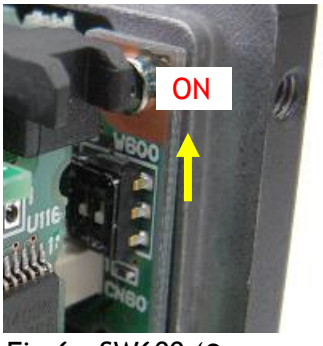
5.4. DIP switch

DIP switches are located on circuit boards. When the top cover is removed, please pay careful attention so that circuit boards are not damaged.

5.4.1 SW-600

This switch sets the 75 ohm trigger input termination to ON or OFF.
The factory default setting is OFF which is TTL level.

No	Functions	Setting	
		ON	OFF
1	**Trigger input termination**	**75Ω**	**TTL**
2	NC		



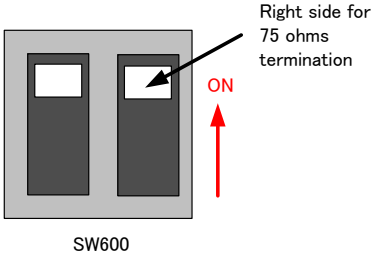


Fig.6. SW600 (On rear panel)

5.4.2 SW-100

This switch selects the ExposureActive signal. The factory default setting is TTL signal and it can be changed to the open collector signal.

No	Function	Setting	
		ON	OFF
1	Exposure Active output select	Open Collector signal	TTL signal
2	NC	-	-

Fig.7 SW100 (the right board when looking from the lens side)

5.4.3 SW-700

This DIP switch can select OPT IN or Iris video output through pin#3 and #4 of the HIROSE 12 pin connector.
The default setting is OPT IN.

No	Functions	Setting	
		ON	OFF
1	OPT IN(+) / Iris video OUT select	Iris video	OPT IN (+)
2	OPT IN(-) / Iris video OUT select	GND for iris video	OPT IN (-)

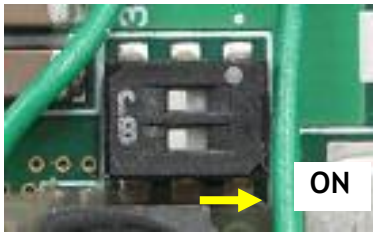


Fig.8 SW700 (On the top board)

6. Input and output Interface

6.1. Digital Interface

In the AT-140GE, the input and output interfaces for Hirose 12P and D-Sub 9P are configured as follows.

6.1.1 LineSelector

The following input and output signals are configured on Line 1 through Line 8.

① Line 1(TTL out1)
② Line 2(TTL out2)
③ Line 3(Opt out1)
④ Line 4(Opt out2)
⑤ Line 5(Opt in1)
⑥ Line 6(Opt in2)
⑦ Line 7(TTL in1)
⑧ Line 8(LVDS in)

6.1.2 LineInverter

This function changes the polarity of the signal.

6.1.3 LineStatus

The user can ascertain the status of input and output signals.

6.1.4 LineSource

This function lets you designate the signal source to output through Line 1 to Line 4 as part of the LineSelector configuration. Each signal is selected from the following five signals.

① AcquisitionTriggerWait
② AcquisitionActive
③ FrameTriggerWait
④ FrameActive
⑤ ExposureActive

6.1.5 LineMode

The current mode of signals (input or output) is displayed.

6.1.6 LineFormat

The interface of input and output circuits is displayed.

6.2. Opto-isolated Interface

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 figure at the right shows the functional principle (opto-coupler) of the opto-isolated inputs/outputs.

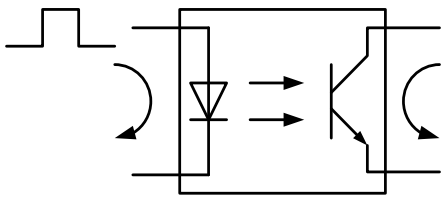


Fig.9 Opto-coupler

6.2.1 Recommended External Input circuit diagram for customer

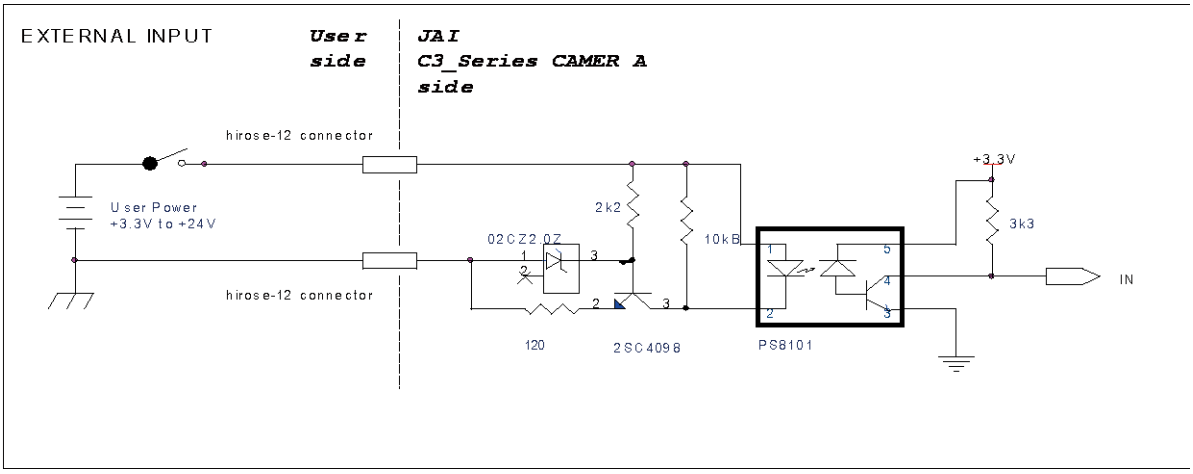


Fig.10 External Input Circuit, OPT IN 1 and 2

6.2.2 Recommended External Output circuit diagram for customer

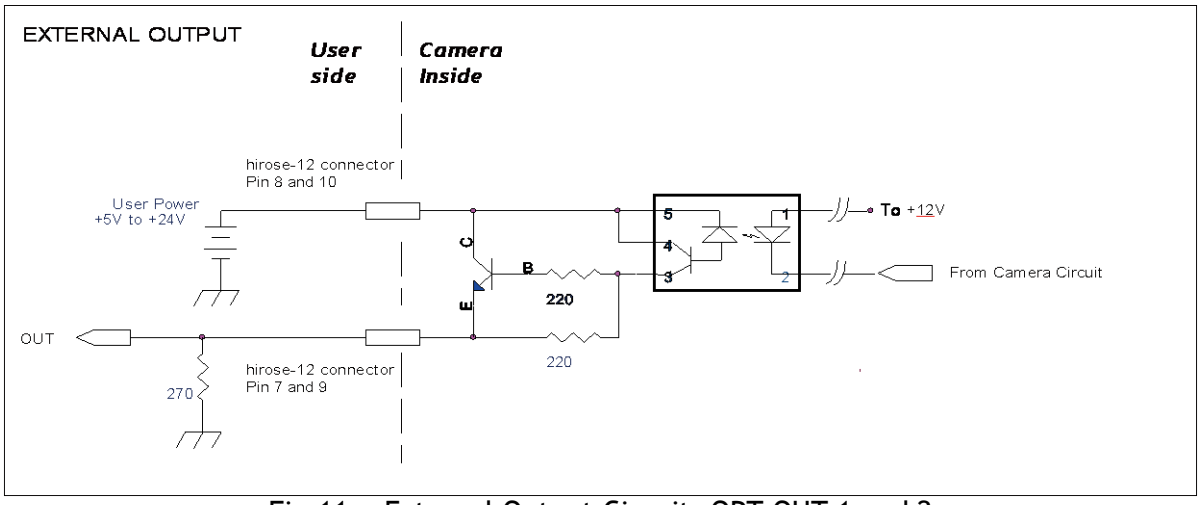
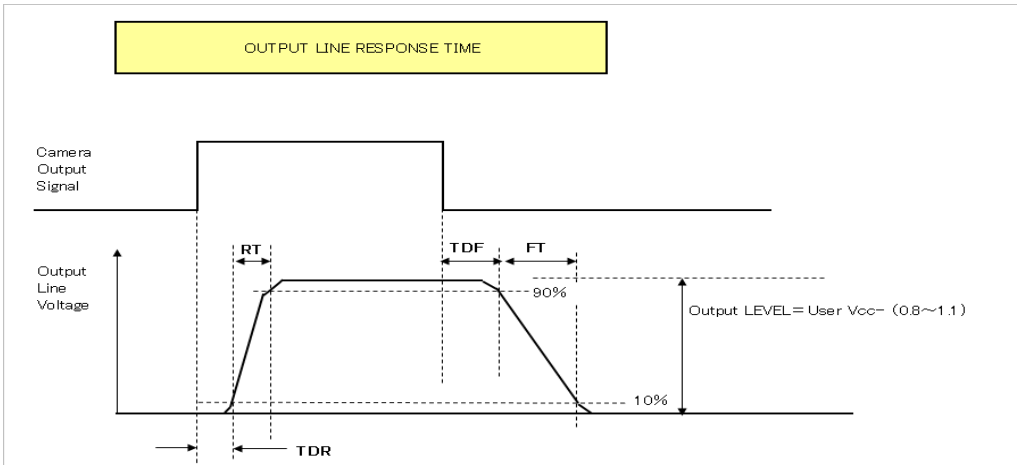


Fig.11 External Output Circuit, OPT OUT 1 and 2

6.2.3 Optical Interface Specifications

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



	User Power (VCC)			
	3.3V	5V	12V	24V
Time Delay Rising TDR(μs)	0.54	0.54	0.62	0.68
Rising Time RT(μs)	1.2	1.2	2.0	3.0
Falling Delay Time FDR(μs)	1.5	1.5	2.4	2.1
Falling Time FT(μs)	3.6	3.4	4.5	6.8

Fig.12 Optical Interface Performance

6.3. Iris video output

This signal can be used for lens iris control in self running mode. The signal is NUM luminance signal and passes through the gain circuit. However, due to reversed compensation applied, the gain settings do not influence this signal. The iris video output is 0.7 V p-p from 75 Ω and without sync.

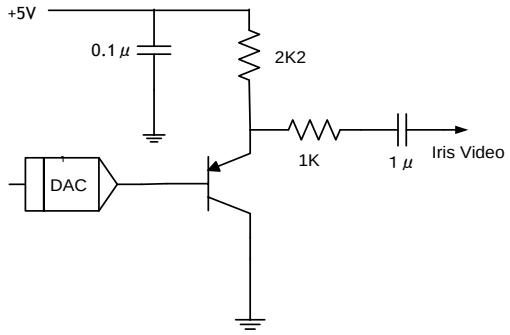


Fig. 13 Iris video output.

6.4. Trigger input

The trigger input is on Opt in pins #4 or #6 on the 12-pin connector (see section 6.2 for voltages and schematic) or pin#3 on the D-sub 9-pin connector. As shown in the diagram to the right, the input on the 9-pin connector is AC coupled. To allow a long pulse width, the input circuit is a flip-flop, which is toggled by the negative or positive differentiated spikes caused by the falling or rising trigger edges. The trigger polarity can be changed.
Trigger input level is 4 V ±2 V. It can be terminated by SW600:
ON for 75Ω; OFF for TTL(Factory default).

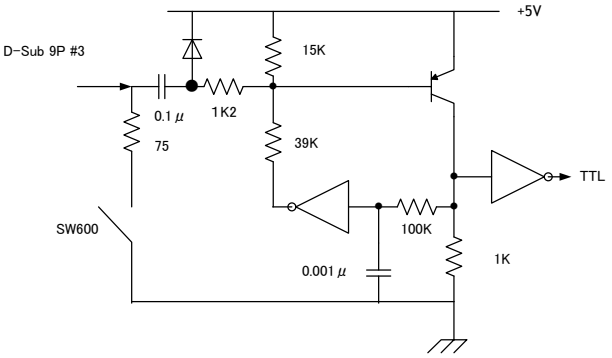


Fig.14 9-pin Trigger input.

6.5. Exposure Active output

Exposure Active signal (positive) is found on Opt-out on Hirose 12P (see section 6.2) or TTL out on D-sub 9-pin connector. The output circuit on the 9-pin (right) is 75 Ω complementary emitter followers. Output level ≥3 V from 75Ω (no termination). It can be changed to the open collector signal. When the open collector is used, the maximum current is 120mA. However, if a current of more than 50mA is flowed, it is necessary to use bigger diameter wires for connecting pin#8 and 9. In case of narrower wires, due to its resistance, it may not work properly.
This output can be changed to open collector signal by SW100.

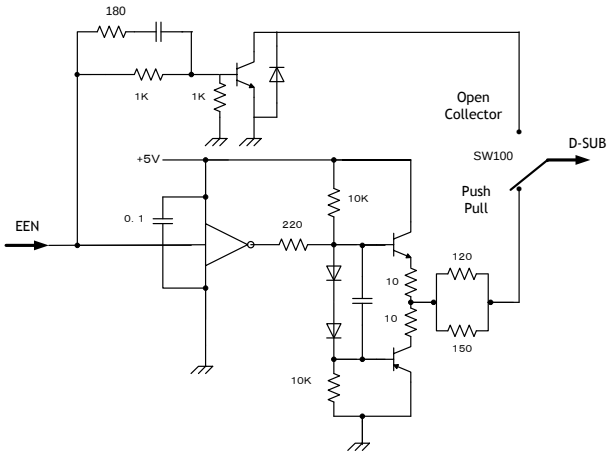
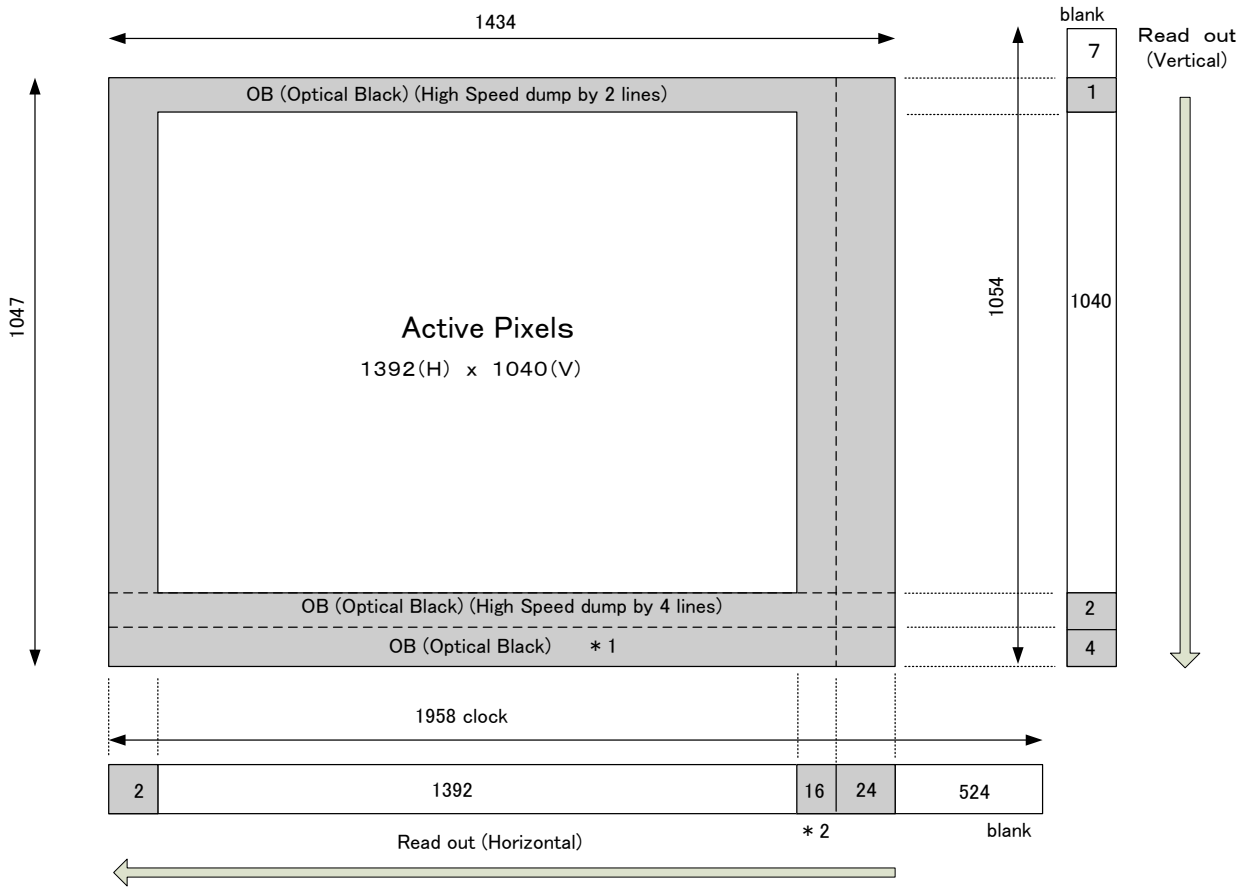


Fig.15 ExposureActive TTL output

7. Video signal output

7.1. Video output image



Note: The following OB area can be transferred.
For vertical : 4 pixels in *1
For horizontal : 16 pixels in *2

Fig.16 CCD sensor layout

7.2. AOI (Area of Interest)

In the AT-140GE, the output image size can be determined by setting the output area.

7.2.1 AOI parameters

In order to set the output area, 4 parameters including OffsetY, OffsetX, Width and Height should be determined.

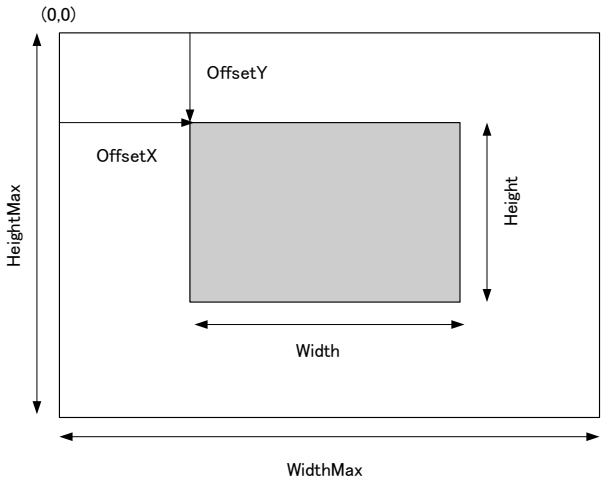


Fig.17 AOI setting

7.2.2 AOI setting details

In the AT-140GE, AOI settings must consider the optical black areas when specifying the area to be transferred.

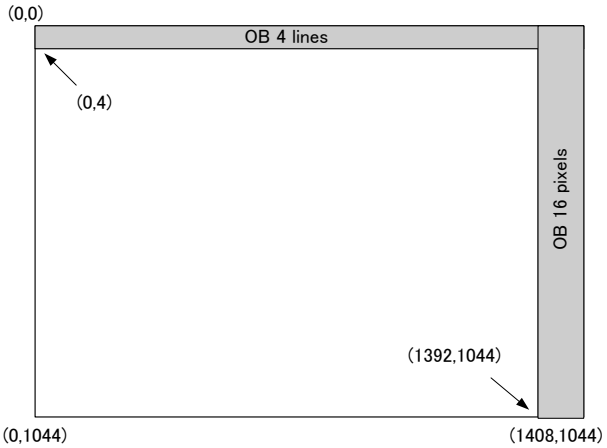


Fig.18 OB transfer

7.2.2.1 When only the image part is transmitted (OB is not transferred)

Offset X=0
Offset Y=4
Width =1392
Height = Effective lines

7.2.2.2 When the full image plus the vertical OB is transmitted

Offset X=0
Offset Y=0
Width =1392
Height = Effective lines +4

7.2.2. When the full image plus the horizontal OB is transmitted

Offset X=0
Offset Y=4
Width =1408
Height = Effective lines

Note: When the horizontal OB is transferred, the width must be set at its maximum.

7.3. In case of vertical binning and horizontal binning

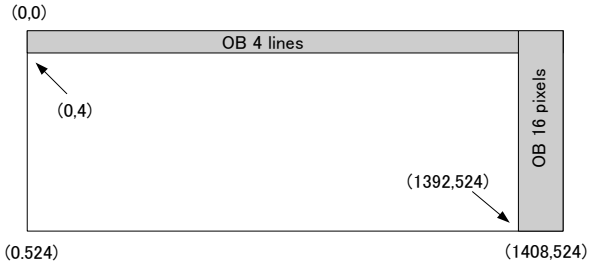


Fig.19 Vertical binning

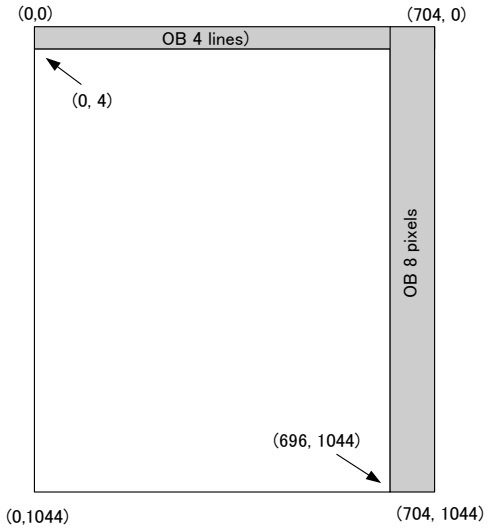


Fig.20 Horizontal binning

7.4. Digital video output (Bit allocation)

Although the AT-140GE is a digital camera, 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(24-bit)	Digital Out(32-bit)
Black	Setup 3.6%, 25mV	8LSB	32LSB
200mV	700mV	222LSB	890LSB
230mV	800mV	255LSB	1023LSB

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

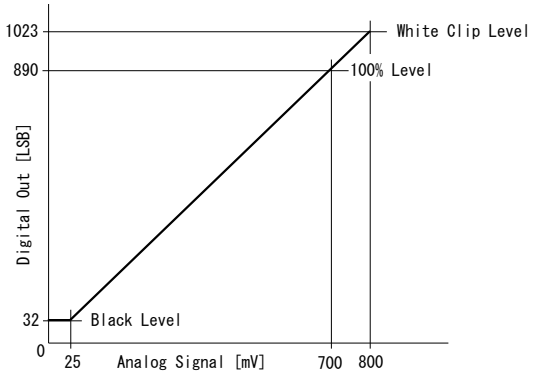


Fig.21 Digital output (10-bit output)

7.5. Pixel format and 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.
As for the sensors in the AT-140GE, 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).

7.5.1 GVSP_PIX_RGB8_PACKED (RGB 24bit output)

1 Byte								2 Byte								3 Byte							
R0								G0								B0							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

7.5.2 GVSP_PIX_RGB10V1_PACKED (RGB 30bit output)

1 Byte								2 Byte								3 Byte								4 Byte							
R0		G0		B0				R0								G0								B0							
0	1	0	1	0	1	X	X	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

7.5.3 GVSP_PIX_RGB10V2_PACKED (RGB 30bit output)

1 Byte								2 Byte								3 Byte								4 Byte							
R0										G0										B0											
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	X	X

7.6. Auto iris video output level

This video output signal is NUM luminance signal and does not have SYNC. It is available only in self running operation. It is also not available during AOI operation.
This signal is not affected by the gain control.

CCD out	Analog Out
200mV	700mV
230mV ↑	800mV

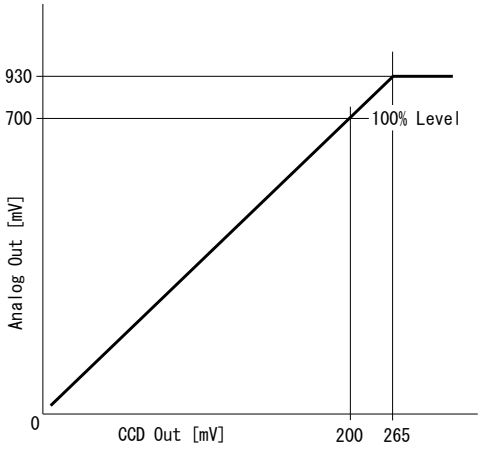
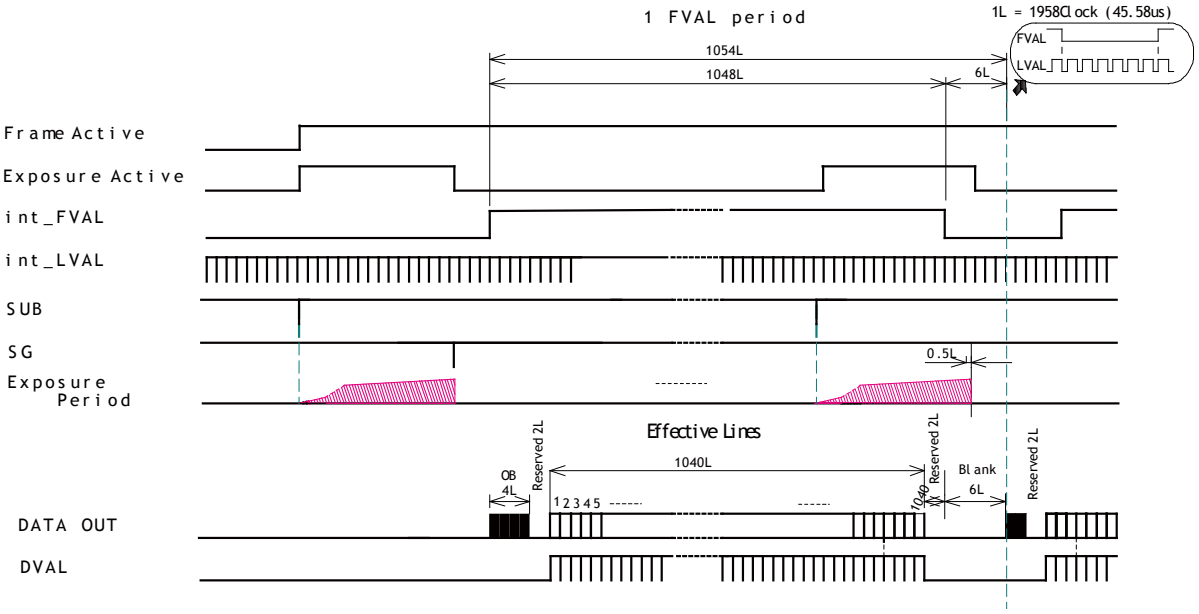


Fig.22 Iris video output

7.7. Video output timing

7.7.1 Binning Vertical = 1 (OFF)

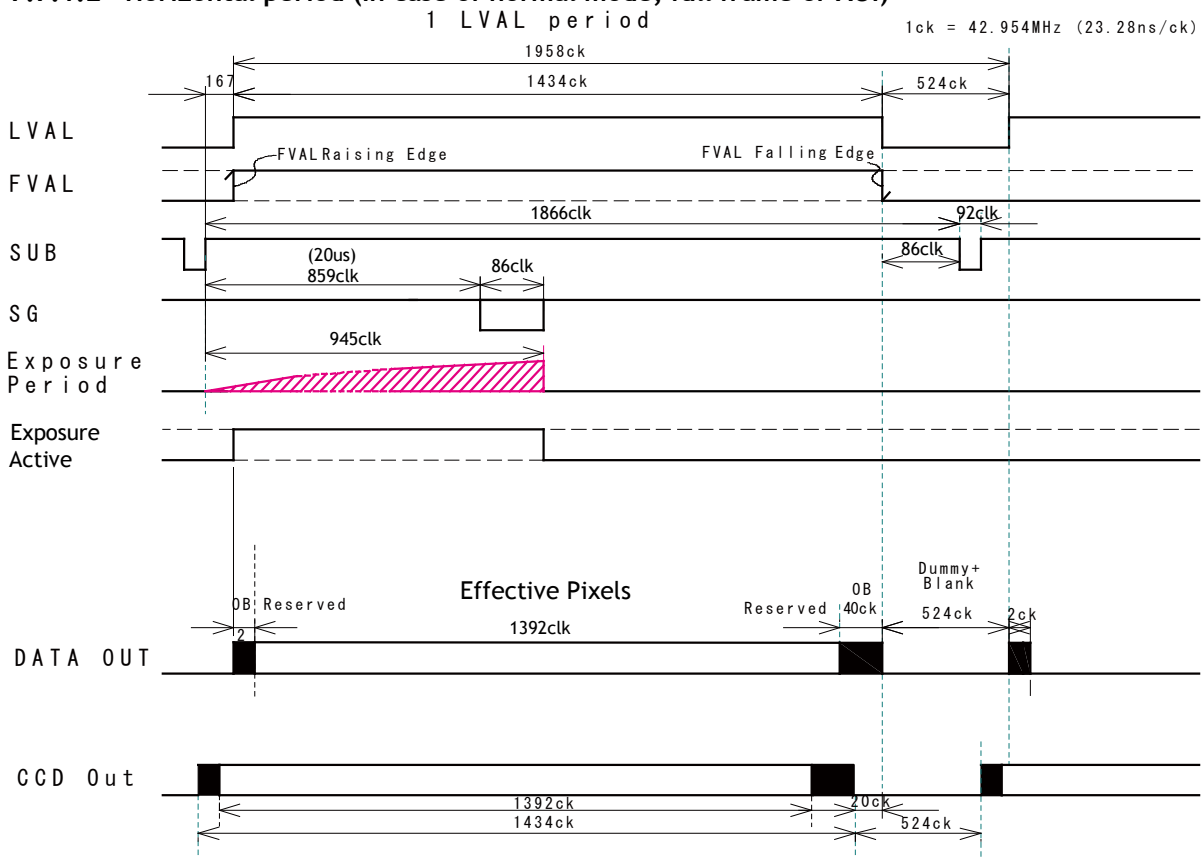
7.7.1.1 1 frame period



*) int_FVAL is “High” in the period of effective lines and OB.
*2) int_LVAL is always output.
*3) int_DVAL is output in the period of effective lines
*4) This timing chart explains the camera operating timing and the output is converted in the GigE vision interface. The transferred image is 1040 effective lines. When OB is transferred, OB parts are also included.

Fig.23 Vertical timing

7.7.1.2 Horizontal period (In case of normal mode, full frame or AOI)



*1) 1 clock is 1 pixel clock and OB is optical black period
*2) int_LVAL is “High” in the period of effective pixels and OB.
*3) This timing chart explains the camera operating timing and the output is converted in the GigE vision interface. The transferred image is 1040 effective lines. When OB is transferred, OB parts are also included.

Fig.24 Horizontal timing

7.7.2 Binning Vertical =2 (ON)

In this mode, the vertical transfer and the horizontal transfer functions are arranged to add adjacent pixels in vertical direction and to output as one pixel. This results in reducing the vertical resolution to 530 lines but the frame rate can be increased.

7.7.2.1 Vertical period

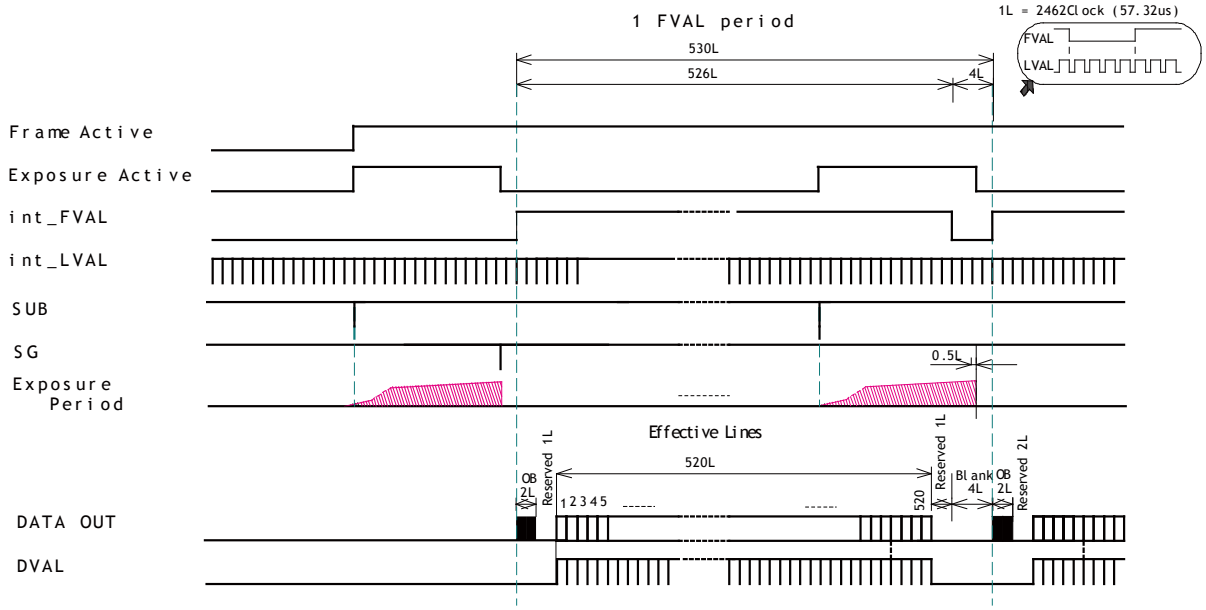


Fig.25 Vertical timing in Binning Vertical ON

7.7.2.2 Horizontal period

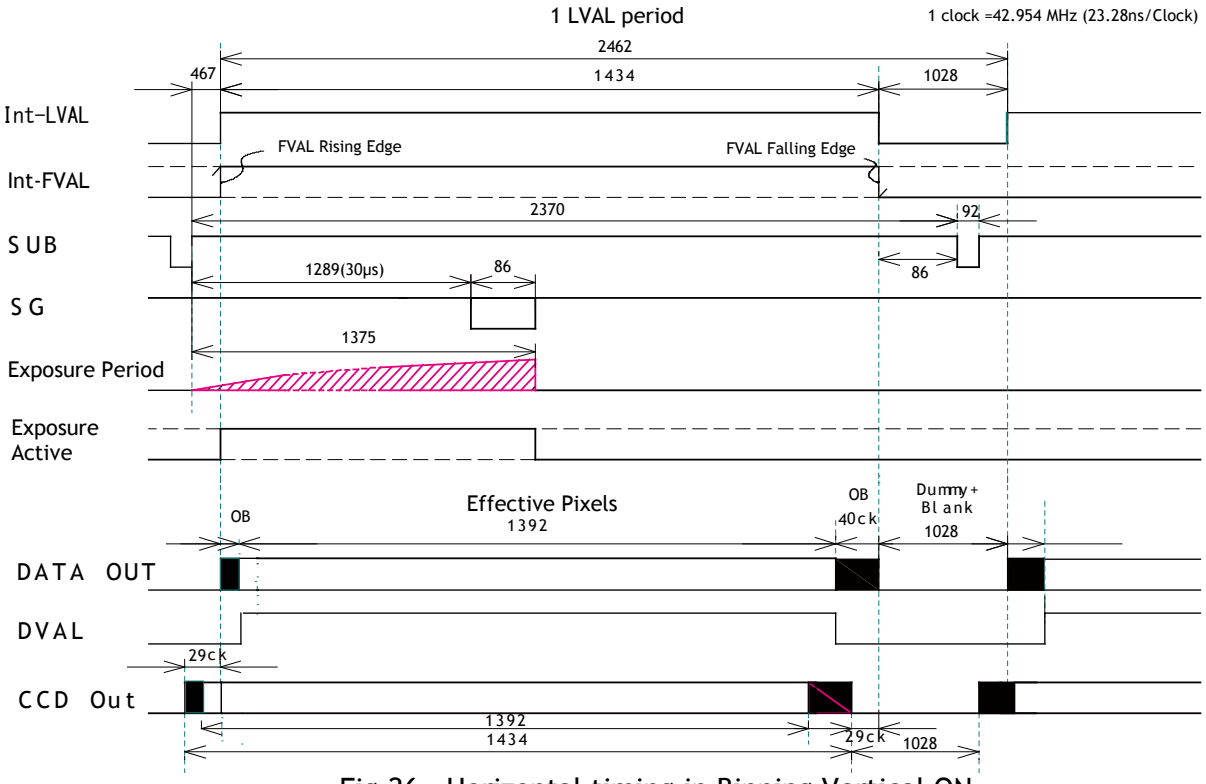


Fig.26 Horizontal timing in Binning Vertical ON

7.8. The calculation of AOI size and frame rate

The frame rate for an AOI setting is calculated by the following formula.

Frame rate (fps) = Horizontal frequency (21.938KHz) / Total lines

Total lines = ① OB period + ② Transition period before start line(L) +
③ Effective image period (L) + ④ Transition period after end line(L)
+ ⑤ Blank period (L)
Where,
OB period = 4L (Fixed)
Blank period = 6L (Fixed)

Transition period before start line = $\mathrm{Round}\left(\frac{4+\mathrm{Startline}-1}{3}\right)+1$

Transition period after end line = $\mathrm{Round}\left(\frac{1040-\mathrm{Endline}+2}{3}\right)$

Calculation example
Readout: 1/2 partial scan at the center (520L), Start line (261L), End line (780L)

OB period = 4L

Blank period =6L
Transition period before start line = (4+261-1) ÷3 +1= 88 + 1=89 → 89
Transition period after end line = (1040-780+2) ÷ 3 =87.3 → 88
Total lines = 4+89+520+88 +6 = 707
Frame rate = 21938/ 707 =31.03 fps

7.9. The relationship between LinePitch and Width

The setting range of LinePitch is changed when the output is set at 8-bit or 10-bit.
LinePitch can be set as follows.

RGB8Packed : 24-4224 bytes
RGB10V1Packed : 32-5632 bytes
RGB10V2Packed : 32-5632 bytes

Note: If the minimum is 8 pixels and the output is RGB 8bit,
8 pixels x 3 bytes = 24 bytes
If the maximum is 1408 pixels and the output is RGB 8bit,
1408 pixels x 3 bytes = 4224 bytes.

As for LinePitch and Width, if one is changed, the other will also be changed.
The relationship between LinePitch and width is;

RGB8Packed : Linepitch/3
RGB10V1Packed : Linepitch/4
RGB10V2Packed : Linepitch/4

As the width is changed, the output area will also be changed.

Full Image
LinePitch 4176

Full Image
LinePitch 2088

Full Image
LinePitch 2088
Offset x 348

7.10. The relationship between PxelSize and PixelFormat

PixelSize and PixelFormat are interlocked for each setting.
If PixelSize is Bpp24, PixelFormat is RGB8Packed
If PixelSize is Bpp32, PixelFormat is RGB10V1Packed or RGB10V2Packed

This relationship works reversely too.

7.11. The relationship between Binning Horizontal and Width/LinePitch

If Binning Horizontal is set at 1(OFF) or 2(ON), Width/LinePitch is changed accordingly.
Binning Horizontal = 1 Width is 1408 as the maximum
Binning Horizontal = 2 Width is 704 as the maximum

Note: If Binning Horizontal is reset to 1 after setting to 2, the maximum value is not changed. It is necessary to reset manually.

7.12. The relationship between Binning Vertical and Height

If Binning Vertical is set at 1(OFF) or 2(ON), Height is changed accordingly.
Binning Vertical = 1 Height is 1044 as the maximum
Binning Vertical = 2 Height is 524 as the maximum

Note: If Binning Vertical is reset to 1 after setting to 2, the maximum value is not changed. It is necessary to reset manually.

8. Network configuration

➲ **For details of the network settings, please refer to the "Getting Started Guide" supplied with the JAI SDK.**

8.1. GigEVision Standard interface

The AT-140GE 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 a 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. Equipment to configure the network system

8.2.1 PC

The PC used should have the following performance or better

1) Recommended CPU	: Core2 Duo 2.4GHz or better, Better than Core2 Extream
2) Recommended memory	: 2Gbyte or more
3) Video card	: Better than PCI Express Bus Ver.1.0 x16 VRAM should be better than 256MByte, DDR2
4) Other	: The resident software should not be used

8.2.2 Cables

GigEVision configures the system by using 1000BASE-T. (100BASE-T can be used with some restriction. Refer to chapter 8.3.6). In the market, CAT5e (125MHz), CAT6 (250MHz) and CAT7 (600MHz) cables are available for 1000BASE-T. There are crossover cables and straight through cables available. Currently, as most equipment complies with Auto MDI/MDI-X, please use straight through cables. (Among crossover cables, a half crossover type exists, which the Ethernet will recognize as 100BASE-T).

8.2.3 Network card (NIC)

The network card should comply with 1000BASE-T and also have the capability of JUMBO FRAMES. When the jumbo frame size is set at a larger number, the load on the CPU will be decreased. Additionally, as the overhead of the packet is decreased, the transmission will have more redundancy.

JAI confirms the following network cards.

NIC Manufacture	Type	PCI-X Bus	PCI-Express Bus	
Intel	PRO/1000MT Server Adapter	√	–	32bit or 64bit 33/66/100/133 MHz
Intel	PRO/1000MT Dual Port Server Adapter	√	–	32bit or 64bit 33/66/100/133 MHz
Intel	PRO/1000GT Quad Port Server Adapter	√	–	32bit or 64bit 66/100/133 MHz
Intel	PRO/1000PT Server Adapter	—	√ (x1)	2.5Gbps uni-directional 5Gbps bi-directional
Intel	Pro/1000 CT Desktop adaptor	—	√ (x1)	2.5Gbps uni-directional 5Gbps bi-directional
Intel	Gigabit ET2 Quad port Server Adapter	—	√ (x4)	10Gbps uni-directional 20Gbps bi-directional
Intel	Gigabit ET Dual port Server Adapter	—	√ (x4)	10Gbps uni-directional 20Gbps bi-directional
Intel	Gigabit EF Dual port Server Adapter	—	√ (x4)	10Gbps uni-directional 20Gbps bi-directional

8.2.4 Hub

It is recommended to use the metal chassis type due to the shielding performance. As the hub has a delay in transmission, please note the latency of the unit.

8.3. Recommended Network Configurations

Although the AT-140GE 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.

➲ **For details of the network settings, please refer to the "Getting Started Guide" supplied with the JAI SDK.**

8.3.1 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 network 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 and preferably Cat6 Ethernet cables.
8. Whenever possible, limit the camera output to 8-bit.

8.3.2 Video data rate (network bandwidth)

The video bit rate for the AT-140GE in Normal mode is:

Model	Pixel Type	Frame Rate	Packet data volume (assumes the packet size is 4036)
AT-140GE	RGB8Packed	20.814 fps	733 Mbit/s
	RGB10V1Packed RGB10V2Packed	20.814 fps (Note 1)	972 Mbit/s

Note1: Depending on the packet size, the frame rate of 20.81 fps may not be achieved. This figure will depend on the system configuration used (RESEND not possible)

- If Jumbo Frames (Max.16020) are not used, the packet data will be bigger by 2%.
- If Jumbo frames are used, the packet size may be automatically optimized to a smaller size.
- For details of setting Jumbo Frames, please refer to the "Getting Started Guide".

8.3.3 Note for setting packet size

The packet size is set to 1428 as the factory default. Users may enter any value for the packet size and the value will be internally adjusted to an appropriate, legal value that complies with the GenICam standard. The packet size can be modified in the GigE Vision Transport Layer Control section of the camera control tool.

Regarding data transfer rate, a larger packet size produces a slightly lower data transfer rate. The AT-140GE can support a maximum of 16020 byte packets provided the NIC being used has a Jumbo Frames function with a setting of a 16020 bytes or larger.

Caution: Do not set the packet size larger than the maximum setting available in the NIC or switch to which the camera is connected . Doing so will cause output to be blocked.

8.3.4 Calculation of Data Transfer Rate

In order to calculate the data transfer rate, the following parameters and formula are required.

Setting parameter

Item	Unit	Symbol
Image Width	[pixels]	A
Image Height	[pixels]	B
Bits per Pixel	[bits]	C
Frame Rate	[fps]	D
Packet Size	[Bytes]	E
Number of Packets (including Data Leader & Trailer Packet)	[packets]	G
Data Transfer Rate	[Mbit/s]	J

Fixed value

Item	Unit	value
Data Leader Packet Size	[Bytes]	90
Data Trailer Packet Size	[Bytes]	64

Formula to calculate Data Transfer Rate

J= {90+64+(E+18)*(G-2)} *8*D/1000000

Where, **G=ROUNDUP{A*B*C/8/(E-36)}+2**

The following table shows Bits per Pixel (Item C) which depends on the pixel format.

Pixel format	Bit
RGB8	24
RGB10V1Packed	30
RGB10V2Packed	30

Calculation example: AT-140GE Pixel type RGB8

Item	Unit	Symbol	Setting
Image Width	[pixels]	A	1392
Image Height	[pixels]	B	1040
Bits per Pixel	[bits]	C	24
Frame Rate	[fps]	D	20.814
Packet Size	[Bytes]	E	4036
Number of Packets (including Data Leader & Trailer Packet)	[packets]	G	
Data Transfer Rate	[Mbit/s]	J	

G=ROUNDUP {(1392 x 1024 x 24/ 8 / (4036-36)) + 2 = 1086 + 2 = 1088
J={90+62+(4036+18)x(1088-2)} x 8 x 20.814 / 1000000 = 733 Mbit/s

8.3.5 Simplified calculation (Approximate value)

A simple way to calculate the approximate data transfer rate is the following.
Transfer data = image width (pixel) x Image Height (pixel) x depth per pixel(depending on the pixel format) x frame rate / 1,000,000 (convert to mega bit)

In the case of the AT-140GE with the full image and RGB 8bit pixel format;
The data transfer rate = 1392 x 1040 x 24 x 20.814 / 1000000 = 723 Mbit/s

8.3.6 Note for 100BASE-TX connection

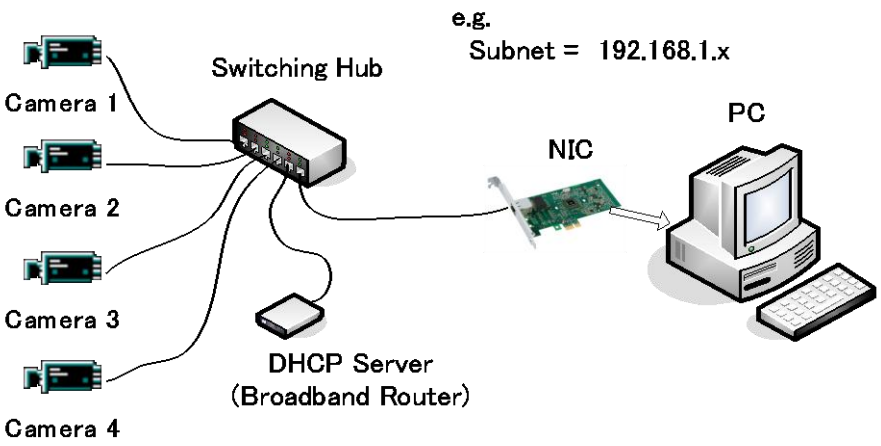
- In order to use 100Mbps network, 100BASE-TX and Full Duplex are available. Half Duplex cannot be used.
- In the case of connecting on 100BASE-TX, the maximum packet size should be 1500 bytes.
- In the case of connecting on 100BASE-TX, the specifications such as frame rate, trigger interval and so on described in this manual cannot be satisfied.

Pixel Type	Frame rate at Full Frame scan[fps]
RGB8_Packed	Approx. 2
RGB10V1_Packed,RGB10V2_Packed	Approx.1.5

Note: The above frame rates are based on approx. 70Mbps of total frame transfer data.

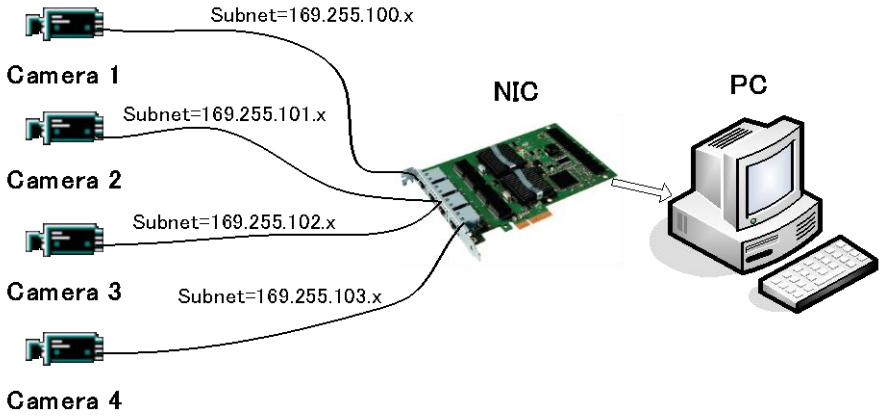
8.4. GigE camera connecting examples

8.4.1 Using a switching hub for 1 port



- All cameras and NIC belong to the same subnet
- The accumulated transfer rate for all cameras should be within 800Mbps
- The packet size and the packet delay should be set appropriately in order for the data not to overflow in the switching hub.

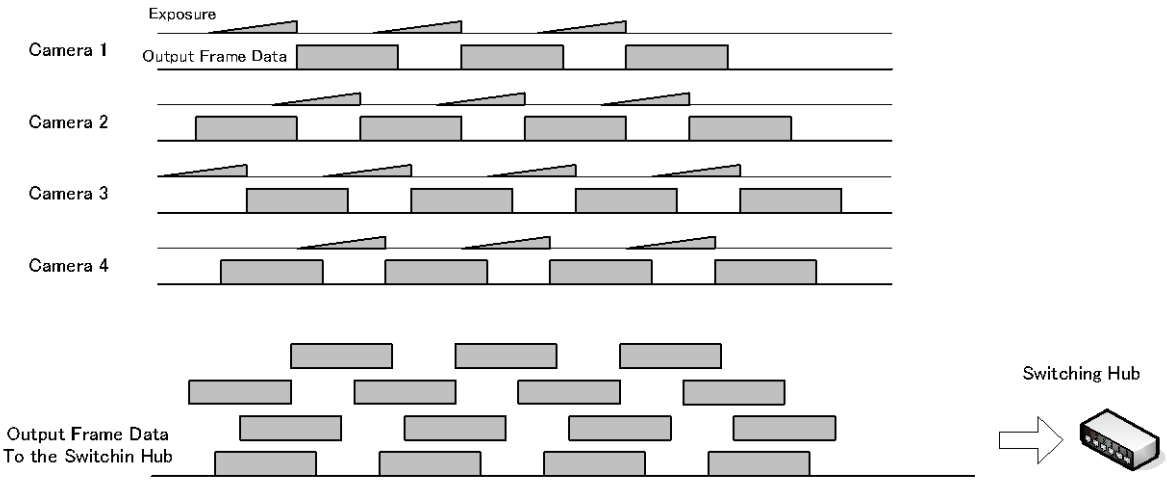
8.4.2 Connecting a camera to each port of a multi-port NIC



- This is the example for using a 4-port NIC
- The pair of the connecting camera and the NIC constructs one subnet. As for the IP configuration, it is appropriate to use the persistent IP.
- In this case, each camera can use the maximum 800Mbps band width. However, the load for the internal bus, CPU and the application software become heavy, so a powerful PC will most likely be required.

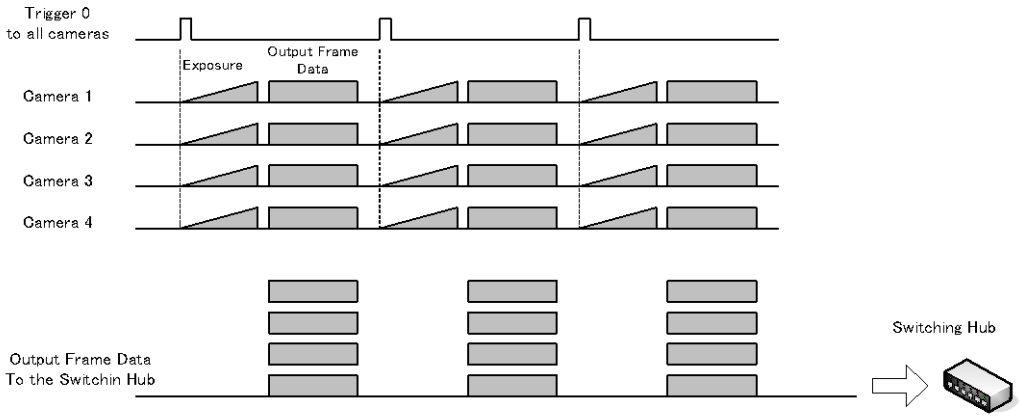
8.4.3 The data transfer for multiple cameras

8.4.3.1 If delayed readout is not used in continuous mode



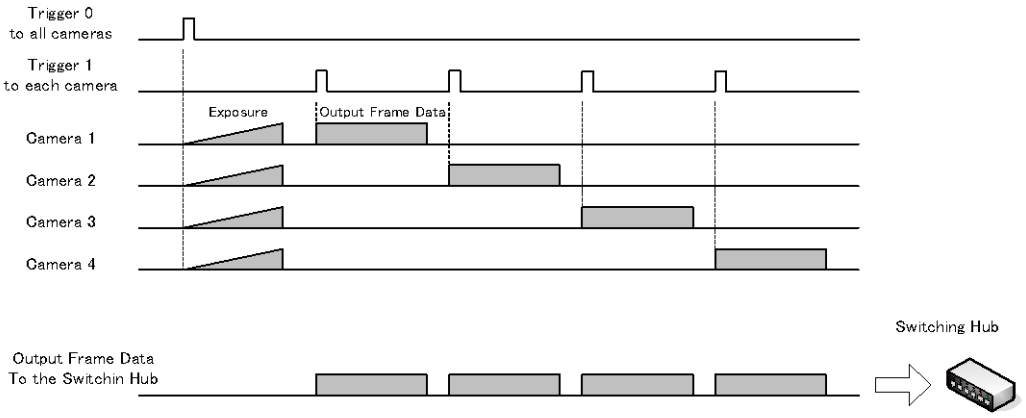
- The packet delay should be set larger. The data traffic is controlled by the buffer of the hub. It is necessary to check the buffer value of the unit.

8.4.3.2 If delayed readout is not used in trigger mode



- The packet delay should be set larger. The data traffic is controlled by the buffer of the hub. It is necessary to check the buffer value of the unit.

8.4.3.3 If delayed readout is used



- The packet delay should be set smaller, and the packet delay trigger controls the data traffic. If the camera has a pulse generator, it can control the data traffic.

9. Core functions

➲ **The function naming of the AT-140GE complies with GenICam SFNC ver.1.3.**
Most of the camera's core operation is controlled by a combination of standard GenICam features related to acquisition, triggering, and exposure. Additional control is provided via built-in counter, timer, and event functions.

9.1. Acquisition function

Before using trigger and exposure controls, various acquisition controls must be set. The operation of the camera depends on the interrelationship of all three feature sets.

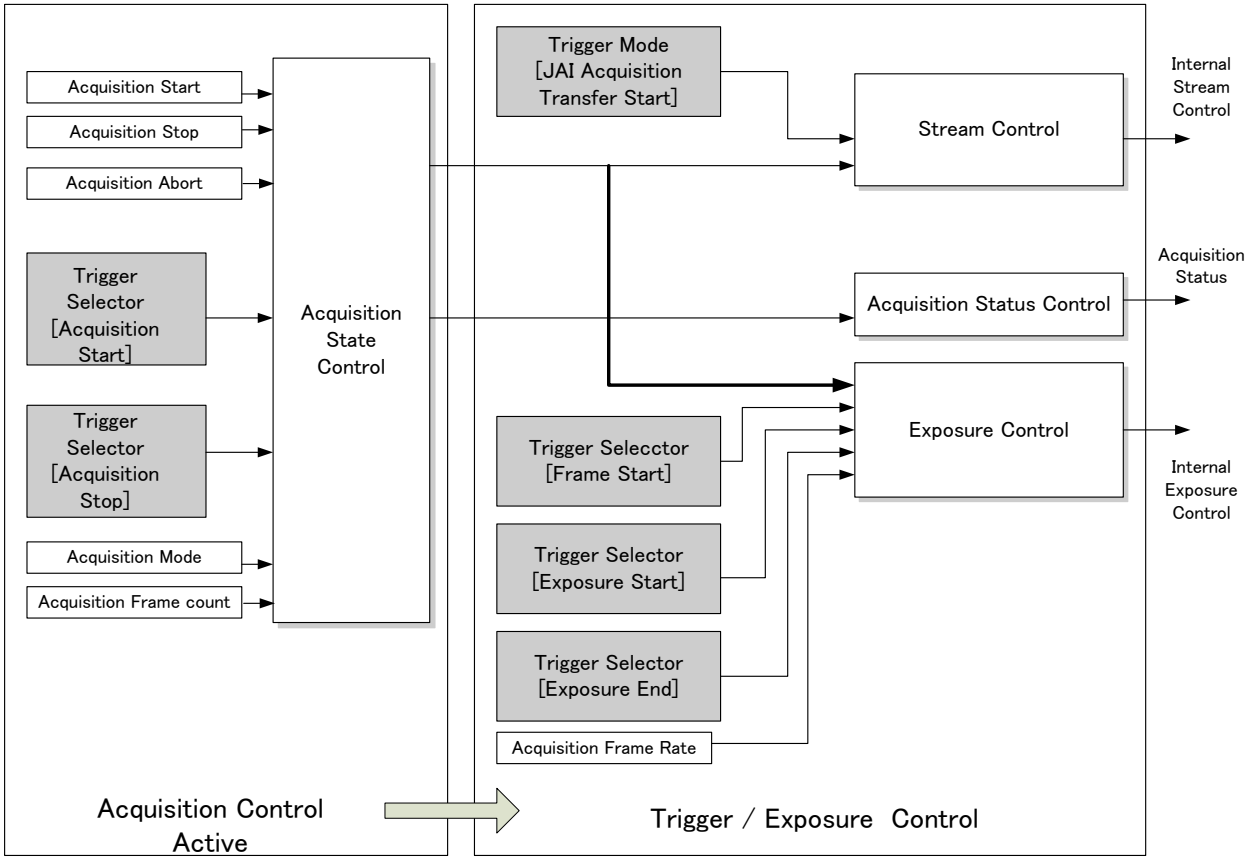


Fig.27 Acquisition control, Trigger/Exposure control work flow

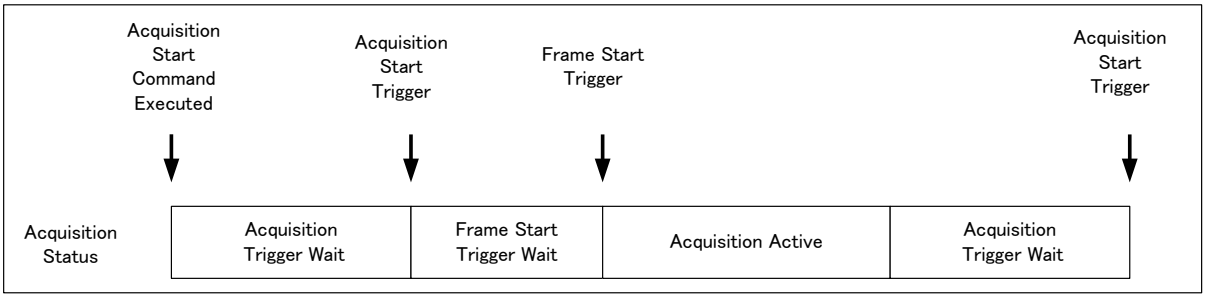
9.1.1 Basic image acquisition flow

The basic commands for acquiring images are as follows:

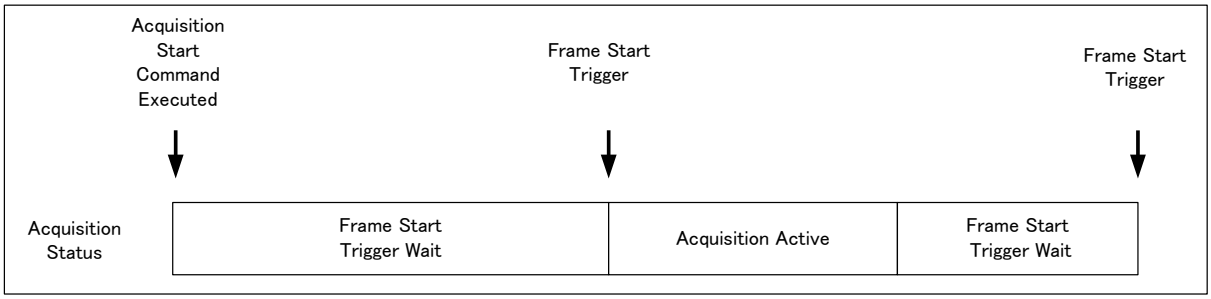
Acquisition mode	To determine the number of the frame to be captured
Trigger Selector	
Acquisition Start Trigger	Select if the acquisition start is controlled externally
Acquisition End	Select if the acquisition end is controlled externally
Trigger Selector	
Frame & Exposure start	Select if the acquisition of the frame is controlled externally.

Exposure mode To set the exposure method
The flow of these commands is shown below.
The following drawings are based on the conditions that the Acquisition mode is Single and the Trigger selector is Frame Start.

If the acquisition start is set at ON (The acquisition is controlled externally)



If the acquisition start is set at OFF (The acquisition is controlled internally)



The following sections provide the details for each command set.

9.1.2 Acquisition mode

The AT-140GE has three settings for capturing images.
① Single frame
AcquisitionStart command outputs one frame. Then the acquisition is stopped.
② MultiFrame
AcquisitionStart command outputs frames which are set by AcquisitionFrameCount. After the set frames are output, the acquisition is stopped.
③ Continuous
AcquisitionStart command outputs frames until AcquisitionEnd is initiated.

9.1.2.1 Single Frame

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 AcquisitionEnd 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)

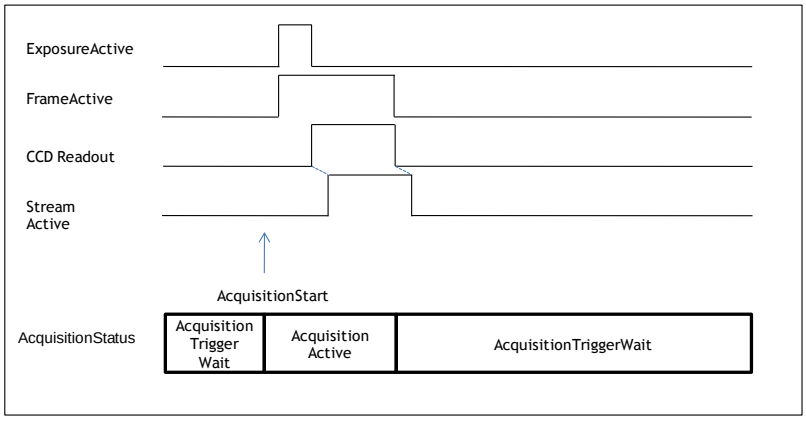


Fig.28 Single frame timing

This drawing shows a case where the AcquisitionStart trigger is “ON”. If the acquisition trigger is OFF, FrameActive is always high.

◆ Forcing acquisition to stop
While AcquisitionActive is “TRUE”, if AcquisitionEnd or AcquisitionAbort is initiated, AcquisitionActive becomes “FALSE” (stop capturing).

Related functions: AcquisitionStart、AcquisitionStop、AcquisitionAbort

9.1.2.2 MultiFrame

In this mode, the AcquisitionStart command captures the number of frames which are specified by AcquisitionFrameCount. AcquisitionFrameCount can be set in the range of 1 to 255 frames. After all frames are captured , this operation is automatically stopped.

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

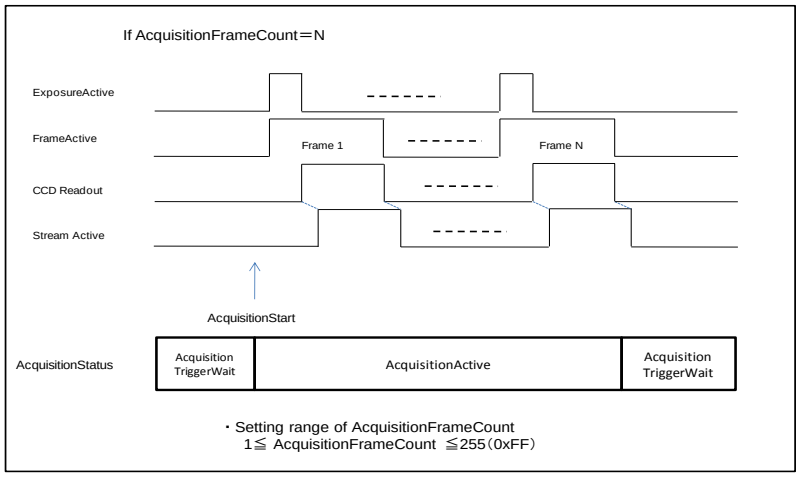


Fig.29 Multi Frame timing

This diagram shows a case where the AcquisitionStart trigger is “ON”. If the AcquisitionStart trigger is OFF, FrameActive is always high.

◆ Forcing acquisition to stop
While AcquisitionActive is “TRUE”, if AcquisitionEnd or AcquisitionAbort is initiated, AcquisitionActive becomes “FALSE” (stop capturing).
Once the operation is set to “FALSE”, the internal FrameCount is reset.

Related functions: AcquisitionStart、AcquisitionFrameCount, AcquisitionEnd、AcquisitionAbort

9.1.2.3 Continuous mode

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 AT-140GE.

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

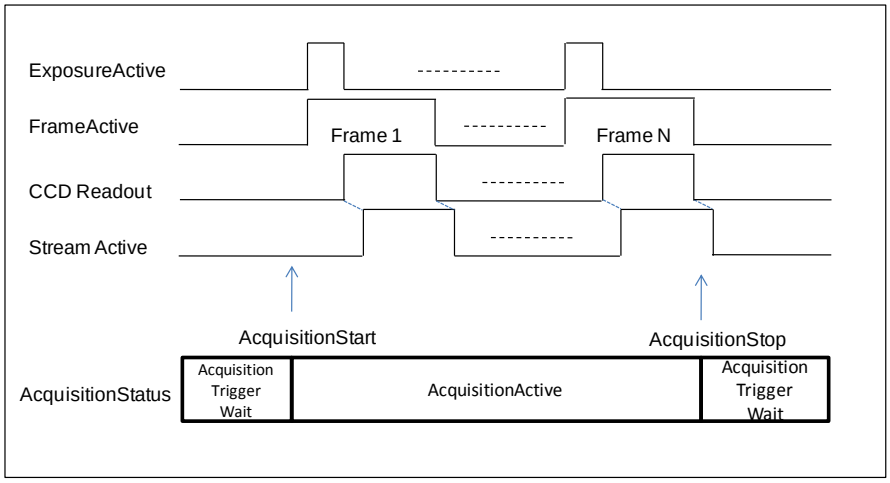


Fig.30 Continuous timing

This drawing shows a case where the AcquisitionStart trigger is “ON”. If the AcquisitionStart trigger is OFF, FrameActive is always high.

Related functions: AcquisitionStart、AcquisitionStop、AcquisitionAbort

9.1.3 AcquisitionAbort

AcquisitionAbort forces capture to stop if the AcquisitionAbort command is set while AcquisitionTriggerWait is effective or during exposure. The exact behaviour depends on the status of acquisition and readout:

Condition 1 - While reading out from CCD:
CCD readout and streaming continue. After they are completed, AcquisitionActive becomes "FALSE" (stop capturing).
At this moment, if AcquisitionStart is set, restart the capturing.

Condition 2 – Acquisition is active, but CCD readout is not yet initiated:
After the exposure is completed, the output is not initiated. AcquisitionActive becomes "FALSE".

Condition 3 - Awaiting a trigger:
AcquisitionActive immediately becomes "FALSE" (capturing is not possible).

9.1.4 AcquisitionFrameCount

If Acquisition Mode is set to MultiFrame, AcquisitionFrameCount can set the number of frames to be captured each time the AcqusitionStart command is input.
Setting range is 1 to 255 frames.

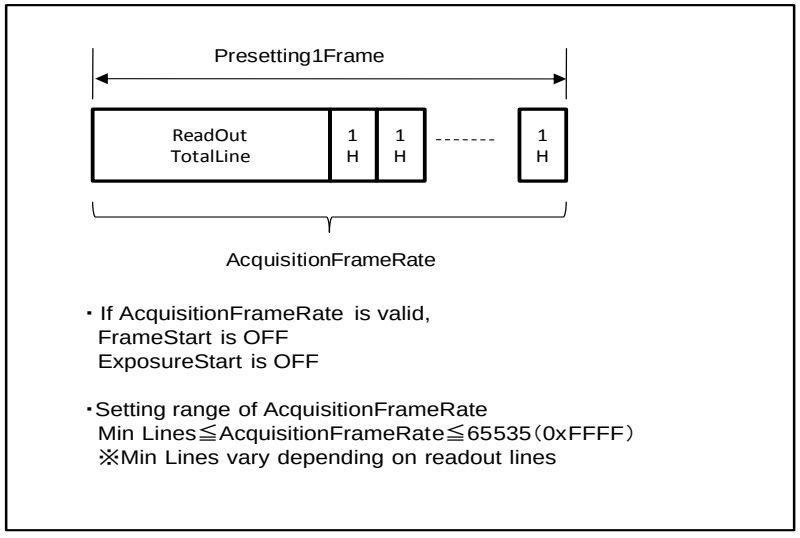


Fig.31 Acquisition Frame Count

9.1.5 AcquisitionFrameRate

1) In the trigger OFF mode (self running mode), it is possible to set the exposure period longer than the number of lines required for CCD drive in the designated area of interest (AOI).
2) The number of lines set by AcquisitionFrameRate determines the frame period.
3) The range of lines which can be set by AcquisitionFrameRate is 1 to 65535(16-bits). The shortest period is dictated by the number of lines required for the desired partial scan/AOI readout (see formula in section 7.8).
4) AcquisitionFrameRate cannot be used if the trigger mode is ON.
5) This function is useful for a long term exposure or time lapse output.

9.1.5.1 Setting the self running mode (Trigger OFF)

The self running mode can be utilized under one of the following conditions:

① ExposureMode is OFF
② ExposureMode is Timed and FrameStart is OFF and ExposureStart is OFF.
③ ExposureMode is TriggerWidth and FrameStart is OFF and ExposureStart is OFF.
④ ExposureMode is TriggerControlled and ExposureStart or ExposureEnd is OFF.

The following table shows the configurations for "free running" the camera.
If the exposure mode is set Timed and the frame start and exposure start of the trigger selector are set OFF, the exposure can be controlled.

Trigger Selector / ExposureMode	Frame Start	Exposure Start	Exposure End	Operation
OFF	OFF	OFF	—	Trig OFF (Free run) No exposure Control
Timed	OFF	OFF	—	Trig OFF (Free run) ***Exposure can be controlled***
TriggerWidth	OFF	OFF	—	Trig OFF (Free run) No exposure control
Trigger Controlled	—	—	OFF	Trig OFF (Free run) No exposure control
	—	OFF	—	Trig OFF (Free run) No exposure control

Note: "-" means that this setting does not impact the operation.

The shortest frame period varies depending on the number of lines to be read out (e.g., partial scanning 520 image lines requires a total of 707 lines to be read out – see formula in section 7.8). If the line number setting is smaller than the number of lines required to support the AOI, the line number setting is ignored and the frame period is based on the total number of OB, blanking, transition, and image lines. If all pixels are read out, the maximum frame rate is 20.814Hz which is 1054 total lines.

9.1.5.2 The calculation of the frame rate for the setting area

1. Binning Vertical=1 (OFF)

Line frequency ＝42954000Hz/1958clk=21937Hz
Frame frequency＝21937Hz /total number of lines
Note: for the minimum 8-line partial scan, the total line number is 366.

2. Binning Vertical=2 (ON)

Line frequency ＝42954000Hz/2462clk=17447Hz
Frame frequency ＝17447Hz / Setting total line number

Please refer to chapter 7.8 for the formula for line number calculation.

9.1.6 AcquisitionStatus

AcquisitionStatus can show the operating status of the following signals set by AcquisitionStatusSelector.
Each function is:

AcquisitionTriggerWait :	Effective if waiting for a trigger
AcquisitionActive :	Effective if capture is allowed
AcquisitionTransfer :	Effective while the data is transferring
FrameTriggerWait :	Effective if waiting for FrameTrigger
FrameActive :	Effective during FrameEffective period
FrameTransfer :	Effective while the data is transferring
ExposureActive :	The longest exposure period is provided if R, G and B channel exposure times are different.

The following diagrams show different scenarios for Exposure Mode and Trigger Mode and their effect on AcquisitionStatus.

① **If ExposureMode=OFF**

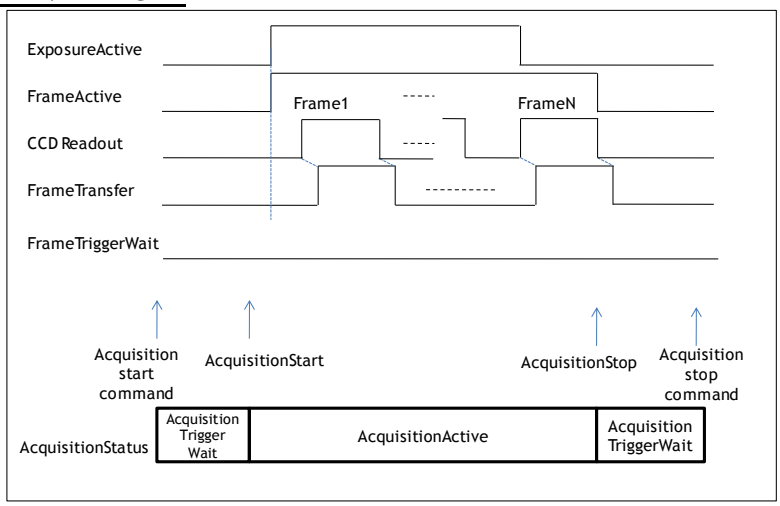


Fig.32 Acqusition Status

② **If ExposureMode=On, Trigger mode=OFF**

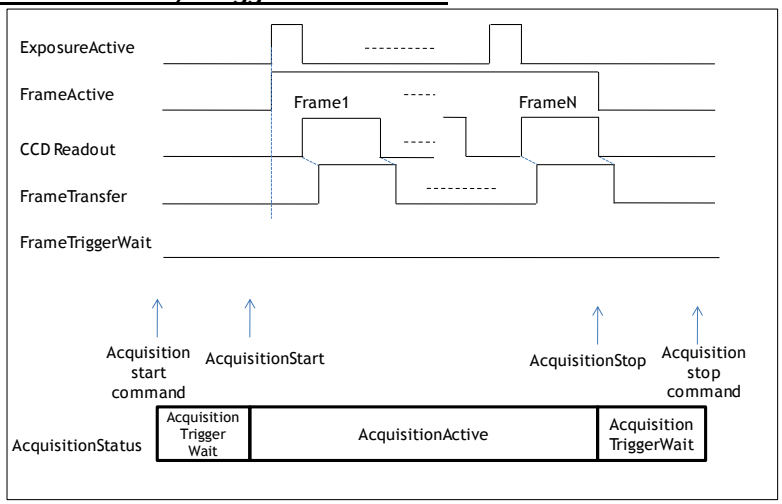


Fig.33 Acquisition status

③ If ExposureMode=On, trigger mode =ON

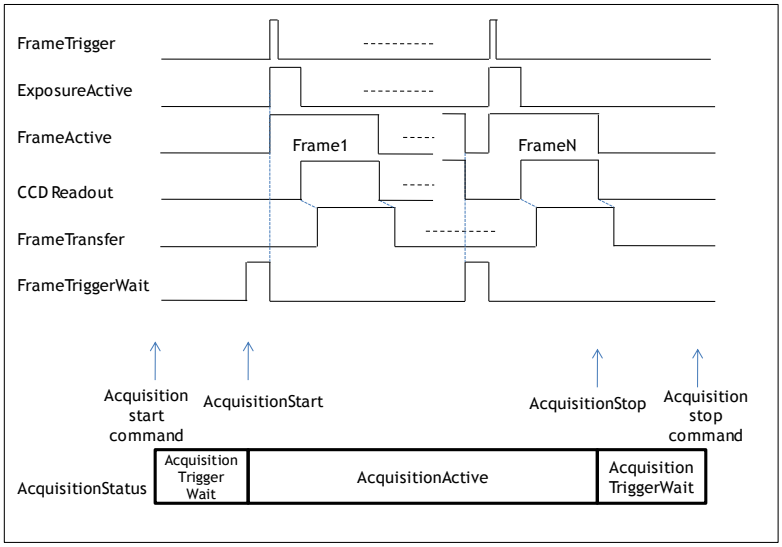


Fig.34 Acqusiition status

9.2. Trigger Control

9.2.1 TriggerSelector(TriggerMode)

This is the function to set the trigger operation. This will set how to control the output and the exposure.

9.2.1.1 Acquisition

This is the trigger function to control the output. This controls AcquisitionStart and AcquisitionEnd. A description of the configuration process is as follows:

◆ AcquisitionStart trigger: Set whether the capture start is to be controlled externally or not.

TriggerMode On : After AcquisitionStart command is input, input the signal selected by AcquisitionStart trigger as the trigger, and make AcquisitionActive effective.

TriggerMode Off : AcquisitionStart command is input. It makes AcquisitionActive effective regardless of AcquisitionStart.

◆ AcquisitionEnd trigger: Set whether the end of the capture is to be controlled externally or not.

TriggerMode On : While AcquisitionActive is effective, input the signal selected by AcquisitionEnd as the trigger, and make AcquisitionActive invalid.

TriggerMode Off : AcquisitionStart command is input. It makes AcquisitionActive invalid regardless of the trigger source.

Note: Refer also to section 9.1.1

9.2.1.2 Exposure

These commands are used for setting the exposure control.
They include FrameStart、ExposureStart、and ExposureEnd.
If ExposureMode is set to any setting except OFF, the combination of the ExposureMode setting and the TriggerControl setting will determine the type of exposure and whether triggering is OFF or ON.
The following table shows the combination and the operation.

TriggerSelector / ExposureMode	Frame Start	Exposure Start	Exposure End	Operation	Previous JAI trigger name
OFF	OFF	OFF	—	Trig OFF(Free run) No Exposure Control	Trigger OFF
Timed	OFF	OFF	—	Trig OFF(Free run) Exposure Control Is possible	Trigger OFF
	ON	—	—	Trig On FrameStart Trigger	EPS
	OFF	ON	—	Trig On ExposureStart Trigger	EPS
TriggerWidth	OFF	OFF	—	Trig OFF(Free run) No Exposure Control	Trigger OFF
	ON	—	OFF	Trig On FrameStart Trigger	PWC
	OFF	ON	—	Trig On ExposureStart Trigger	PWC
Trigger Controlled	—	—	OFF	Trig OFF(Free run) No Exposure Control	Trigger OFF
	—	OFF	—	Trig OFF(Free run) No Exposure Control	Trigger OFF
	OFF	ON	ON	Trig On	Start/Stop

Note: "—" means that this setting does not impact the operation.

- FrameStart trigger : Set whether the start of the frame is to be controlled externally or not.
  TriggerMode On : While AcquisitionActive is effective and ExposureMode is set at Timed or TriggerWidth, start exposure using the signal selected by FrameStart trigger.
  TriggerMode Off : While AcquisitionActive is effective, self running operation takes place.

- ExposureStart trigger: Under the following conditions, this works the trigger to start the exposure.
  - Frame start trigger is OFF and
  - ExposureMode is set at Timed or TriggerWidth orTriggerControlled.

  Note: If TriggerControlled is selected, ExposureEnd must be ON too.

  TriggerMode On : While AcquisitionActive is effective , FrameStart is OFF and is set at Timed, TriggerWidth or TriggerControlled, starts the exposure by using the signal selected by ExposureStart as the trigger signal.

TriggerMode Off : While AcquisitionActive is effective, self running operation takes place.

◆ ExposureEnd trigger : When ExposureMode is set at TriggerControlled, this controls the stop timing only when ExposureStart is ON.

TriggerMode On : While AcquisitionActive is effective, ExposureMode is TriggerControlled and ExposureStart is ON, the exposure is stopped by using the signal selected by ExposureEnd as the trigger and the data is output.

TriggerMode Off : While AcquisitionActive is effective, self running operation takes place.

9.2.2 Memory readout control

It is possible to control the readout timing after the signal from the CCD is stored in the Frame Memory.

◆ JAI_AcquisitionTransferStart : This activates the memory readout control.

TriggerMode ON : While AcquisitionActive is effective, AcquisitionTransferStart outputs the stored data.

TriggerMode OFF : While AcquisitionActive is effective, the stream is output.

9.2.3 Triggersoftware

This is one of the trigger sources and is the software trigger command.
This has one command signal to each of the 6 items of TriggerSelector.
To use this function, TriggerSource must be set at TriggerSoftware.

9.2.4 Triggersource

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

① Off
② Software
③ Line 1(TTL out1)
④ Line 2(TTL out2)
⑤ Line 3(Opt out1)
⑥ Line 4(Opt out2)
⑦ Line 5(Opt in1)
⑧ Line 6(Opt in2)
⑨ Line 7(TTL in1)
⑩ Line 8(LVDS in)
⑪ Timer1Start
⑫ Timer1End
⑬ Counter1Start
⑭ Counter1End
⑮ UserOut1
⑯ UserOut2
⑰ UserOut3

⑱ UserOut4
⑲ Action1
⑳ Action2

9.2.5 TriggerActivation

This determines the behaviour of the trigger.

RisingEdge : Initiate at the signal rising edge
FallingEdge : Initiate at the signal falling edge
AnyEdge : Initiate at either the signal rising edge or falling edge
LevelHigh : Initiate during the signal high level
When receiving the trigger, if this is effective, the trigger is automatically received.
LevelLow : Initiate during the signal low level
When receiving the trigger, if this is effective, the trigger is automatically received.

Note: When TriggerWidth is used, TriggerActivation should be set at either LevelHigh or LevelLow.

9.2.6 Triggeroverlap

This function sets whether the trigger can be received during the data readout when FrameStart or ExposureStart is ON.

Off : The trigger cannot be accepted during CCD readout.
This works the same as LVAL asynchronous trigger.
ReadOut : The trigger can be accepted during CCD readout.
This works as LVAL synchronous trigger if the CCD is reading out the data. If CCD is not reading out the data, it works as LVAL async.

9.2.7 Triggerdelay

This function delays the trigger signal against the trigger input.
Step is 1usec/Step.
The setting range is from 0 to 65,535usec at 16bit.

9.3. Exposure Control

This is the function to manage the exposure settings.

9.3.1 Exposure Mode

The exposure mode can be selected from the following choices.

Off : No exposure control.

Timed : The exposure time is to be set in microseconds.
If FrameStart and ExposureStart in TriggerSelector are “OFF”, the exposure is controlled in Free Run.
If FrameStart or ExposureStart in TriggerSelector is “ON”, this functions as the EPS mode.

TriggerWidth： This mode controls the exposure time by the pulse width.
If FrameStart and ExposureStart in TriggerSelector is “OFF”, The camera operates in Free Run.
If FrameStart or ExposureStart in the TriggerSelector is “ON”, this functions as the PWC mode.

TriggerControlled：The exposure is controlled by ExposureStart and ExposureEnd.

The following is the table for the combination of ExposureMode and TriggerControl and its function.

TriggerSelector / ExposureMode	Frame Start	Exposure Start	Exposure End	Operation	Previous JAI trigger name
OFF	OFF	OFF	—	Trig OFF(Free run) Exposure control	Trigger OFF
Timed	OFF	OFF	—	Trig OFF(Free run) Exposure control is possible	Trigger OFF
	ON	—	—	Trig On FrameStart Trigger	EPS
	OFF	ON	—	Trig On ExposureStart Trigger	EPS
TriggerWidth	OFF	OFF	—	Trig OFF(Free run) No Exposure control	Trigger OFF
	ON	—	OFF	Trig On FrameStart Trigger	PWC
	OFF	ON	—	Trig On ExposureStart Trigger	PWC
Trigger Controlled	—	—	OFF	Trig OFF(Free run) No Exposure control	Trigger OFF
	—	OFF	—	Trig OFF(Free run) No Exposure control	Trigger OFF
	OFF	ON	ON	Trig On	Start/Stop

Note: “—” means that this setting does not impact the operation.

9.3.2 ExposureTime

This is effective only if ExposureMode is set to “Timed”.
This command can set the exposure time.
By using JAI_Exposure_Time Enable, the exposure time of R, G and B channels can be set the same time or set independently.

False： ExposureTime is effective.
True： JAI_ExposureTime_R, JAI_ExposureTime_G and JAI_ExposureTime_B are effective.

The setting step for the exposure time;
Trigger On： 1μsec/Step
Trigger OFF： 1Line/Step

The setting range of the exposure time;
Trigger On : 66μs - 65535μs
Trigger Off : 1L - the maximum value which can be set

9.3.3 ExposureAuto

This is auto exposure control function and is effective only in the "Timed" mode.
The brightness is controlled by JAI AGC Reference.
ExposureAuto includes OFF, Once and Continuous modes.
The setting range is;
JAI AGC Reference : 0-255
ExposureTime : 72L - the maximum value which can be set

9.4. UserOutputSelector

In addition to TriggerSoftware, the user can use the following commands as the trigger input sources.

UserOutput1
UserOutput2
UserOutput3
UserOutput4

The setting value is "False" or "True".

9.5. Counter function

This function can count up the internal pulse counts.

9.5.1 CounterSelector

The AT-140GE has one counter.
The counter function is activated by setting ConterEventSource, CounterResetSource or StartSource. **Yes**

9.5.2 CounterEventSource

CounterEventSource can be selected from the following signals.
CounterEventSource works as the trigger to start the count up.
① Off
② AcquisitionTrigger
③ AcquisitionStart
④ AcquisitionEnd
⑤ FrameStart
⑥ Line 1(TTL out1)
⑦ Line 2(TTL out2)
⑧ Line 3(Opt out1)
⑨ Line 4(Opt out2)
⑩ Line 5(Opt in1)
⑪ Line 6(Opt in2)
⑫ Line 7(TTL in1)
⑬ Line 8(LVDS in)

9.5.3 CounterEventActivation

This selects the timing for when the counter starts up.

RisingEdge： The counting starts at the signal rising edge.
FallingEdge：The counting starts at the signal falling edge.
AnyEdge： The counting starts at any edge of the signal.

9.5.4 CounterResetSource

The reset source can be selected from the following signals.
The reset source works as the trigger to reset the counter.

① Off
② Software
③ Line 1(TTL out1)
④ Line 2(TTL out2)
⑤ Line 3(Opt out1)
⑥ Line 4(Opt out2)
⑦ Line 5(Opt in1)
⑧ Line 6(Opt in2)
⑨ Line 7(TTL in1)
⑩ Line 8(LVDS in)
⑪ Action1
⑫ Action2

9.5.5 CounterResetActivation

This selects the timing for resetting the counter.

RisingEdge： The counter is reset at the signal rising edge.
FallingEdge：The counter is reset at the signal falling edge.
AnyEdge： The counter is reset at any edge.
LevelHigh： The counter is reset during the signal “HIGH” level.
LevelLow： The counter is reset during the signal “LOW” level.

9.5.6 CounterValue

This can read the counter value or set the default value when the counter starts.

9.5.7 CounterValueAtReset

This can store the value just before reset and read the value.

9.5.8 CounterDuration

This can set the CounterCompleted value of the counter.
The counter itself can count up to the maximum (FFFF).

9.5.9 CounterStatus

This shows the counter status.

CounterIdle：	The counter is not operating. The CounterTriggerSource is “Off”.
CounterTriggerWait：	When the counter is waiting for the start trigger
CounterActive：	The counter is operating.
CounterCompleted：	When the counting value reaches CounterDuration
CounterOverflow：	If the counter counts past the maximum value

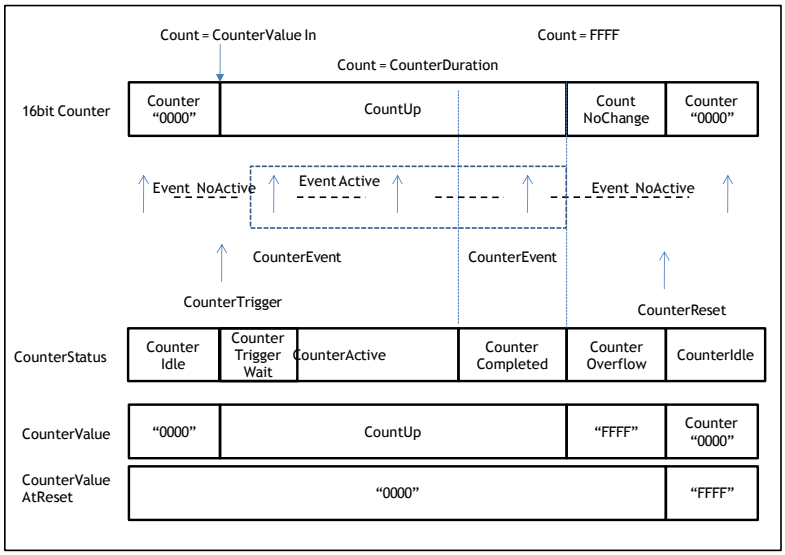


Fig.35 Counter Status

9.5.10 CounterTriggerSource

This is used to select the counter trigger from the following signals.
The counter trigger is the trigger that starts the count up.

① Off
② AcquisitionTrigger
③ AcquisitionStart
④ AcquisitionEndFrame
⑤ TriggerFrameStart
⑥ FrameEnd
⑦ Line 1(TTL out1)
⑧ Line 2(TTL out2)
⑨ Line 3(Opt out1)
⑩ Line 4(Opt out2)
⑪ Line 5(Opt in1)
⑫ Line 6(Opt in2)
⑬ Line 7(TTL in1)
⑭ Line 8(LVDS in)
⑮ Action1
⑯ Action2

9.5.11 CounterTriggerActivation

This selects the timing for starting the count up.

RisingEdge : The counter starts at the signal rising edge.
FallingEdge : The counter starts at the signal falling edge.
AnyyEdge : The counter starts at any edge.
LevelHigh : The counter starts when the signal becomes "HIGH" level.
LevelLow : The counter starts when the signal becomes "LOW" level.

9.6. Timer Control

9.6.1 TimerSelector

There is one internal timer. The timer function starts if the start trigger, TimerDelay and TimerDuration are set.

9.6.2 TimerDuration

This is used to set the maximum value of the timer.

9.6.3 TimerDelay

This can set the period to start the timer. This results in the delay of the timer start.

9.6.4 TimerValue

This can set the default value of the timer and read the current setting value.

9.6.5 TimerStatus

This checks the current status of the timer and provides one of the following.

TimerIdle :	When the timer is not operating. When TimerTriggerSource is OFF.
TimerTriggerWait :	When the timer is waiting for the start trigger
TimerActive :	When the timer is operating
TimerCompleted :	When the timer reaches its maximum value

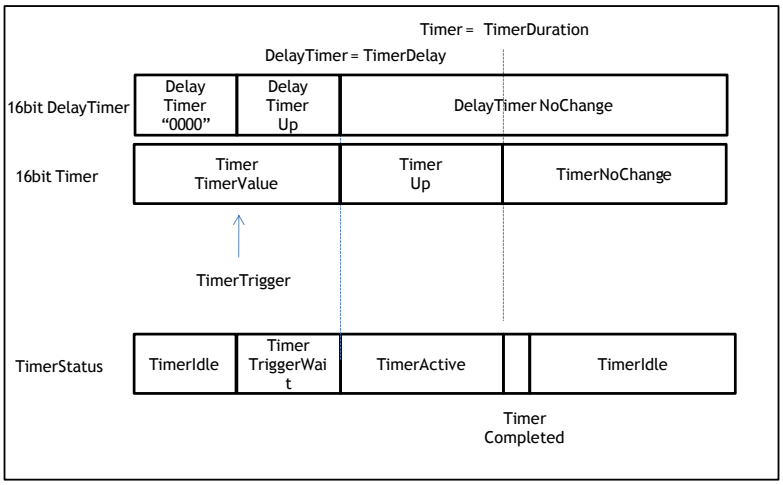


Fig.36 Timer Status

9.6.6 TimerTriggerSource

The start trigger signal to the timer can be selected from the following list.

① Off
② AcquisitionTrigger
③ AcquisitionStart
④ AcquisitionEnd
⑤ FrameTrigger
⑥ FrameStart
⑦ FrameEnd
⑧ Line 1(TTL out1)
⑨ Line 2(TTL out2)

⑩ Line 3(Opt out1)
⑪ Line 4(Opt out2)
⑫ Line 5(Opt in1)
⑬ Line 6(Opt in2)
⑭ Line 7(TTL in1)
⑮ Line 8(LVDS in)
⑯ Timer1End
⑰ Timer2End
⑱ Action1
⑲ Action2

9.6.7 TimerTriggerActivation

The timing of the start trigger to the timer can be selected from the following.

RisingEdge： The timer starts at the signal rising edge.
FallingEdge：The timer starts at the signal falling edge.
AnyEdge： The timer starts at any edge.
LevelHigh： The timer starts when the signal becomes "HIGH" level.
LevelLow： The timer starts when the signal becomes "LOW" level.

9.7. Event Control

9.7.1 EventSelector

The event can be selected from the following list.

AcquisitionTrigger、FrameStart、FrameEnd、ExposureStart、ExposureEnd、
Line1RisingEdge、
Line1FallingEdge、Line2RisingEdge、Line2FallingEdge、Line3RisingEdge、
Line3FallingEdge, Line4RisingEdge、Line4FallingEdge、Line5RisingEdge、
Line5FallingEdge、Line6RisingEdge、Line6FallingEdge、Line7RisingEdge、
Line7FallingEdge、Line8RisingEdge、Line8FallingEdge

9.8. Video Send Mode

The Video Send Mode is the function to select how the image information will be read out from the camera.

Normal：	Ordinary operation
Sequence Mode：	Sequence ROI operation
Multi Mode：	Multi ROI operation

9.9. ActionControl

ActionControl is used to activate the specific functions of multiple cameras on the same network at the same time. For instance, it can be used to trigger multiple cameras at the same time.

ActionControl appears as two inputs (Action 1, Action 2) and is connected with 6 Triggers, CounterReset of the counter, CounterTrigger and Timer.
If ActionControl is used, the input source to the trigger should be set to Action 1 or Action 2 in advance.

10. Operation modes

10.1. Continuous mode (Free run)

For applications not requiring asynchronous external triggering, this mode should be used. In this mode it is possible to use a lens with a video controlled iris. As for the timing, please refer to chapter 7.7 “Video output timing”. In continuous mode, exposure time can be controlled by the frame rate or by the electronic shutter. The following examples describe the GenICam settings used to configure the camera for continuous operation.

10.2. Trigger operation with “timed” exposure (Previously called EPS)

An external trigger pulse initiates the capture, and the exposure time (accumulation time) is set in advance. The minimum active period of the trigger is 66µsec and the minimum trigger interval is shown below.

Mode	Minimum trigger interval
Overlap is set at “Readout” and the trigger is input during the readout(LVAL Sync)	1054L + 3L
Overlap is set at “OFF” or “Readout” and the trigger is input when the readout is not active. (LVAL Async)	Exposure time + 1054L + 3L
Note: 1) On the above table, 1054L is FVAL interval on normal continuous mode 2) If BinningVertical is effective, 1L is different from the normal scanning. So, the minimum trigger interval will be different.	

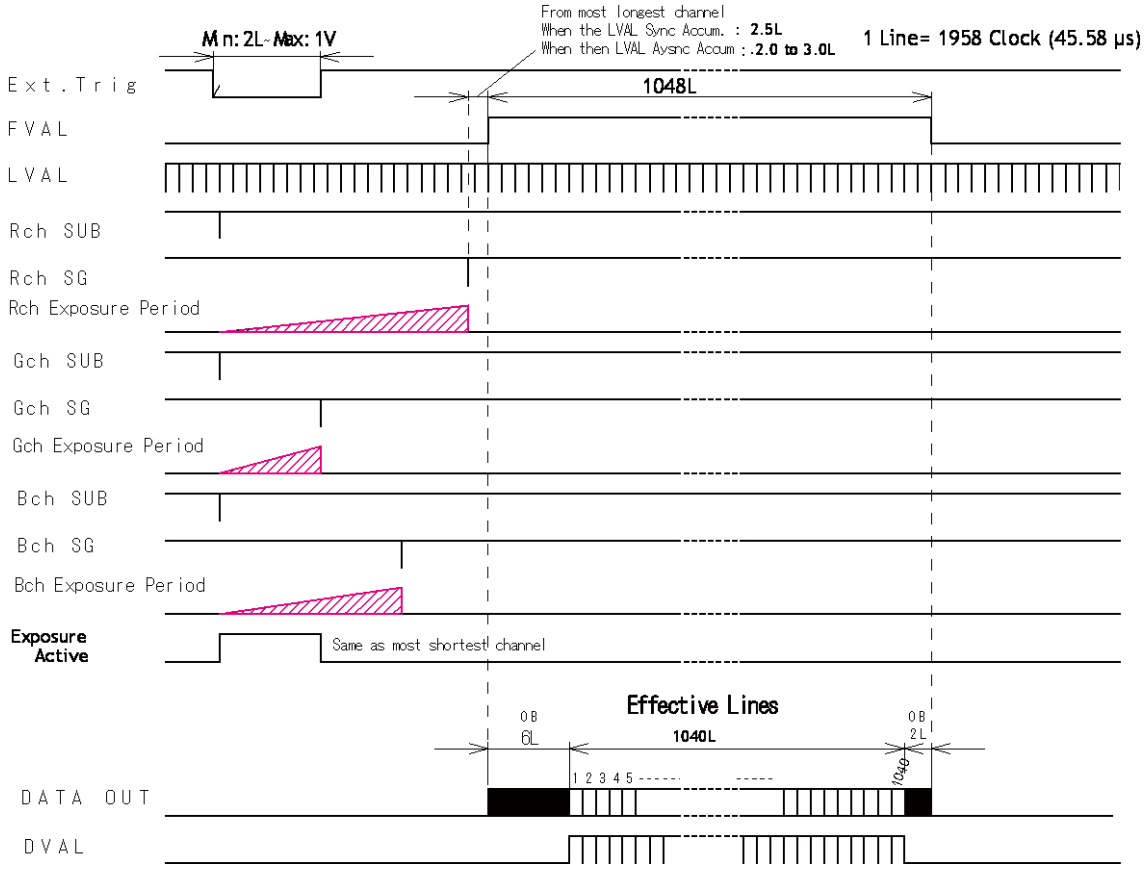


Fig. 37 Trigger control with timed exposure (Full pixels readout)

Note: If the exposure time of R channel is 1/21sec. and the exposure time of G channel is 1/50,000sec., the image quality of the green channel may not be guaranteed due to the fundamentals of CCD operation. In this mode, it is recommended to use the same exposure time for all three channels. If it is necessary to use different exposure times, please check the image quality first.

10.3. Trigger operation by "TriggerWidth" (Previously called PWC)

In this mode the accumulation time is equal to the trigger pulse width. Here it is possible to have a long time exposure. The minimum active period of the trigger is 2L and the minimum trigger interval is shown as follows.

Mode	Minimum trigger interval
Overlap is set at "Readout" and the trigger is input during the readout (LVAL Sync)	1. If Exposure time < 1054L 1054L + 3L 2. If Exposure time ≥ 1054L Exposure time +2L
Overlap is set at "OFF" or "Readout" and the trigger is input when the readout is not active. (LVAL Async)	Exposure time + 1054L + 3L
Note: 1) On the above table, 1054L is FVAL interval in normal continuous mode 2) In BinningVertical, 1L is different from the normal scanning. So, the minimum trigger interval will be different.	

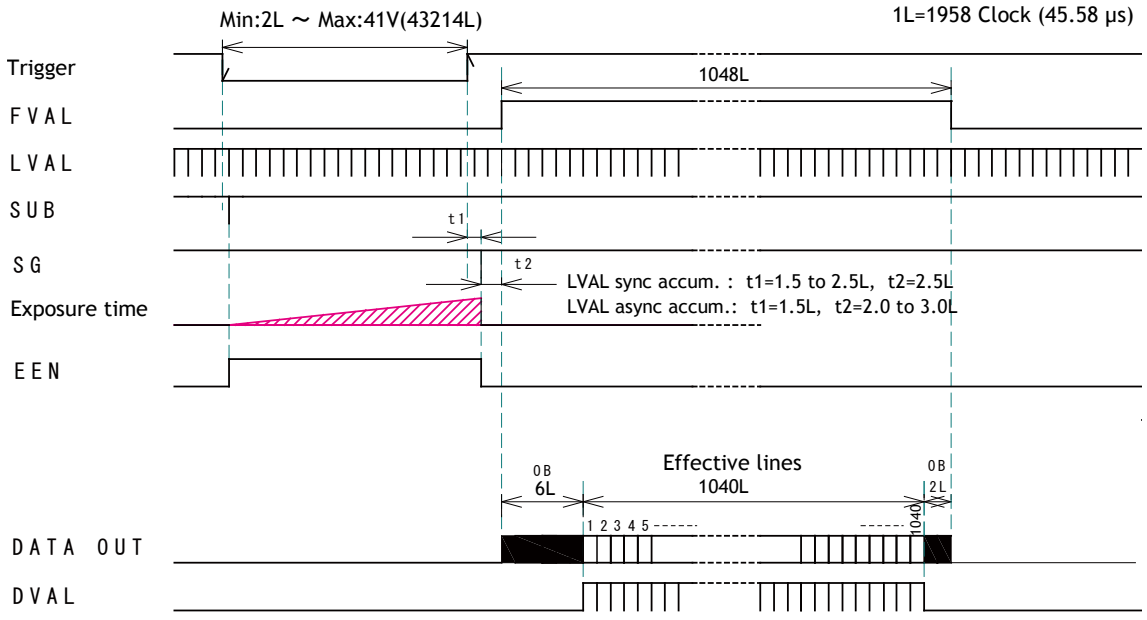


Fig.38 Trigger control by TriggerWidth (Full pixel readout)

10.4. Trigger operation by TriggerControlled

The timing of the exposure start and the exposure end is controlled by consecutive triggers. After the start trigger is input, the exposure is activated. When the end trigger is received, the exposure is stopped to output the image data.
The minimum active period of the trigger is 66μsec. and the minimum trigger interval is shown as follows.

Mode	Minimum trigger interval
Overlap is set at “Readout” and the trigger is input during the readout (LVAL Sync)	1.Exposure time < 1054L 1054L + 3L 2.Exposure time ≥ 1054L Exposure time +2L
Overlap is set at “OFF” or “Readout” and the trigger is input when the readout is not active. (LVAL Async)	Exposure time + 1054L + 3L
Note: 1) On the above table, 1054L is FVAL interval in normal continuous mode 2) In BinningVertical, 1L is different from the normal scanning. So, the minimum trigger interval will be different.	

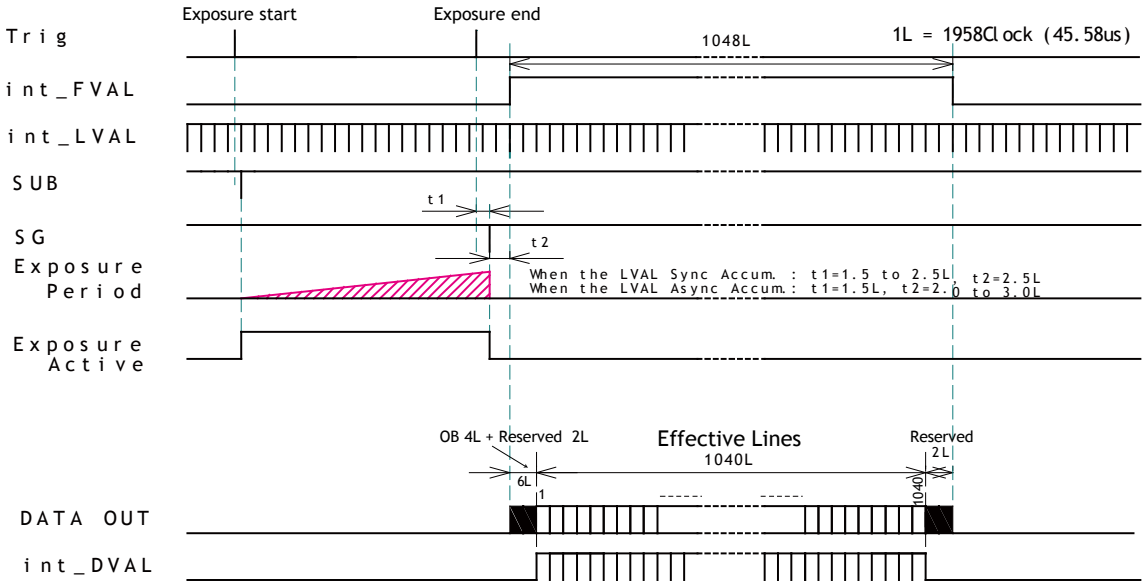


Fig. 39 Trigger operation by TriggerControlled

10.5. Trigger input and exposure start timing

Triggeroverlap

This function is used to set whether the trigger can be accepted during the data readout in cases where FrameStart trigger or ExposureStart trigger are “ON”.

OFF: While the CCD reads out the data, the trigger cannot be accepted. This works as LVAL asynchronous operation.

ReadOut: While the CCD reads out the data, the trigger can be accepted. In this mode, if the trigger is input during CCD readout, it works as LVAL synchronous and if the trigger is input while the CCD is not reading out, it works as LVAL asynchronous. This is the same behaviour as LVAL SYNC/ASYNC auto detection.

Note: During synchronous reset, a jitter of up to 1 LVAL will occur from trigger input to exposure start and end. During asynchronous reset, there is no jitter.

The minimum trigger interval is shown as follows. The synchronous reset shows the shorter interval.

Mode	Minimum trigger interval
Synchronous reset	1054L + 3L
Asynchronous reset	Maximum exposure time + 1054L + 3L

Note: The above table is based on Exposure mode Timed, Trigger ON.

10.5.1 Synchronous reset timing

10.5.1.1 In the case of Expsoure mode = Timed, Trigger = ON (Full frame)

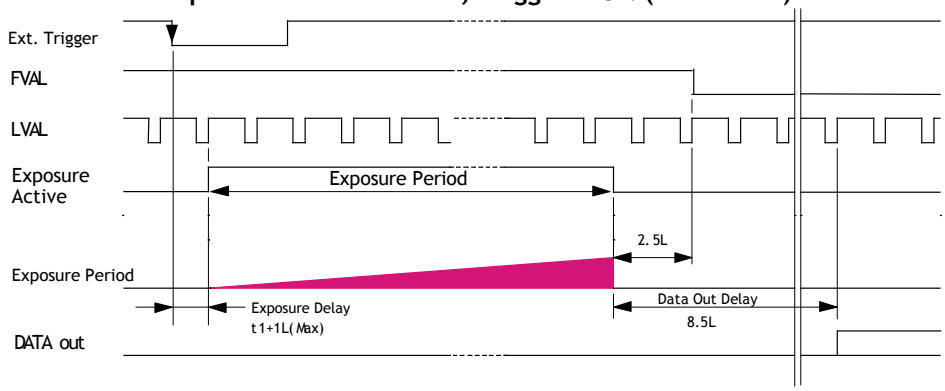


Fig.40 Synchronous reset （Timed）

10.5.1.2 In the case of Expsoure mode = Trigger width, Trigger = ON (Full frame)

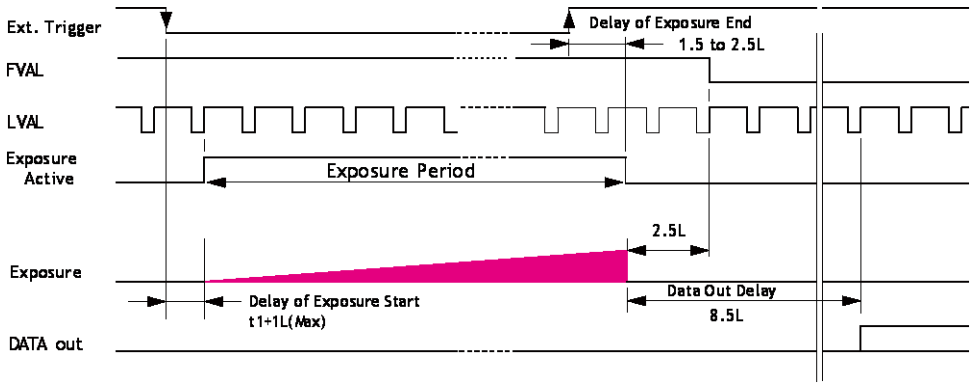


Fig.41 Synchronous reset (Trigger width)

10.5.2 Asynchronous reset timing

10.5.2.1 In the case of Expsoure mode = Timed, Trigger = ON (Full frame)

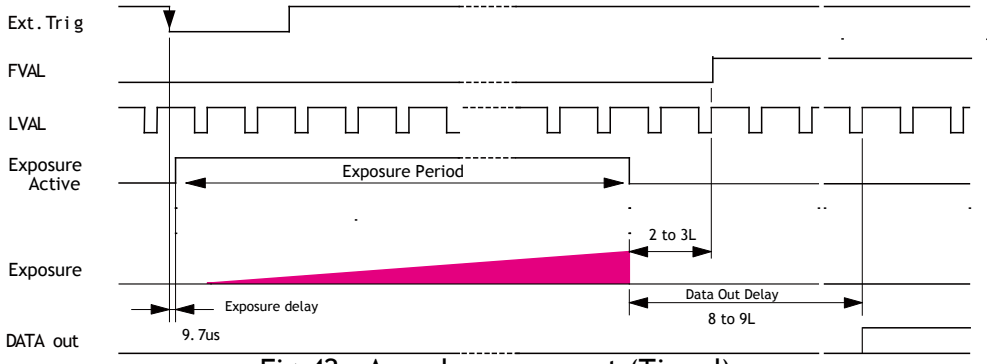
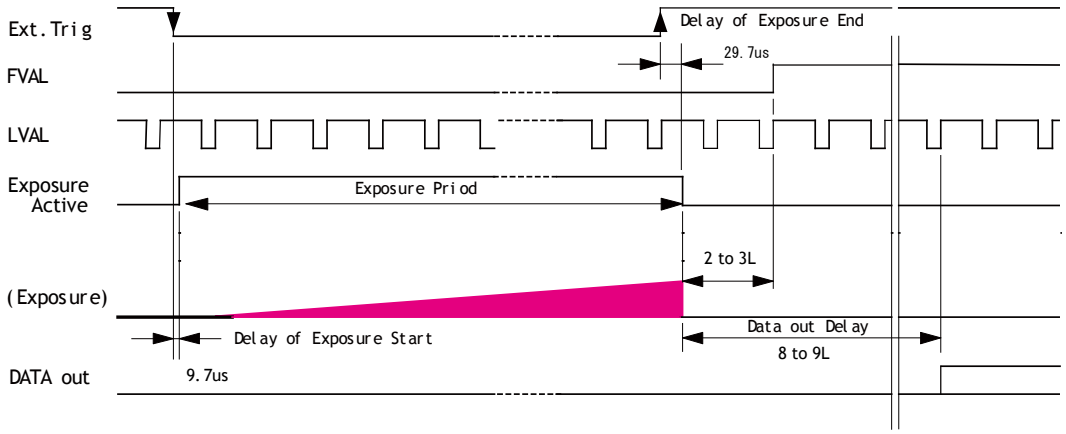


Fig.42 Asynchronous reset (Timed)

10.5.2.2 In the case of Expsoure mode = Trigger width, Trigger = ON (Full frame)



Note: In BinningVertical, the delay of exposure end is 39.7μsec. (1L=1720clock)

Fig. 43 Asynchronous reset (Trigger width)

10.6. Sequence Trigger Mode

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. As each trigger input is received, the image data within the preset sequence is output as described below.

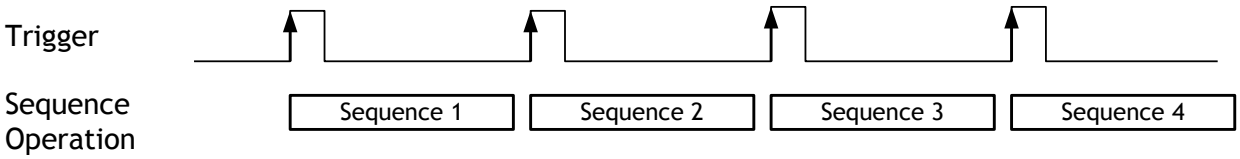


Fig.44 Sequential Trigger Mode

This function is effective when the video send mode is set at the Sequence Mode.
In Sequence Mode, the following parameters can be set (see section 12.4.5.10 for an example).

Sequence ROI index:	The index (ID) to which the settings will be applied
Sequence ROI FrameCount:	The number of frames to capture at this index
Sequence ROI Next index:	Indicate the next index (ID) in the sequence
Sequence ROI Width:	Set the horizontal readout width
Sequence ROI Height:	Set the vertical readout lines
Sequence ROI Offset X:	Set the horizontal offset
Sequence ROI Offset Y:	Set the vertical offset
Sequence ROI Gain:	Set the gain
Sequence ROI Exposure Time:	Set the exposure time

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

ID	ROI				Exposure time	Gain	Frame count
	Width	Height	Offset X	Frame count			
1	1392	1040	0	1	1054	0	1
2	1392	1040	0	1	1054	0	1
3	1392	1040	0	1	1054	0	1
4	1392	1040	0	1	1054	0	1
5	1392	1040	0	1	1054	0	1
6	1392	1040	0	1	1054	0	1
7	1392	1040	0	1	1054	0	1
8	1392	1040	0	1	1054	0	1
9	1392	1040	0	1	1054	0	1
10	1392	1040	0	1	1054	0	1

The other necessary register for the sequence ROI mode is Sequence Repetition. It sets the number of times the sequence will repeat in the range of 1 to 255 or indefinitely (Sequence Repetition = 0).

10.7. Multi ROI Mode

A maximum of 5 preset ROI images can be taken from one image.
Using this function, the total data can be smaller than a full frame.

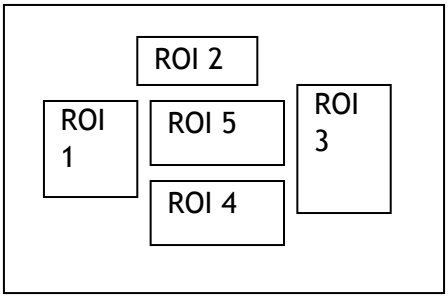


Fig 45. Multi ROI

If the Video Send Mode Selector is set to Multi Mode, this function becomes effective.
In the Multi ROI Mode, the following items can be set (see section 12.4.5.11 for an example).

Multi ROI Index :	This is the index (0-4) to which the setting will be applied
Multi ROI Next Index :	Indicate the next index to read out
Multi ROI Width :	Set the horizontal readout width
Multi ROI Height :	Set the vertical readout lines
Multi ROI Offset X :	Set the horizontal offset
Multi ROI Offset Y:	Set the vertical offset

Each ROI can be overlapped.

10.8. Delayed Readout Mode (JAI Custom Control)

If multiple cameras need to be simultaneously triggered by one trigger pulse, this function can be used in order for the Ethernet bandwidth to accommodate the added traffic without conflicts. Refer to the chapter 8.4 too.
This function can be set by the following;

Set VideosendmodeSelector in the JAI Custom Control to Multi ROI and
Set JAI_AcqusitionTransferStart to ON, then the readout can be controlled by the external trigger signal which is selected in JAI_AcqusitionTransferStart.

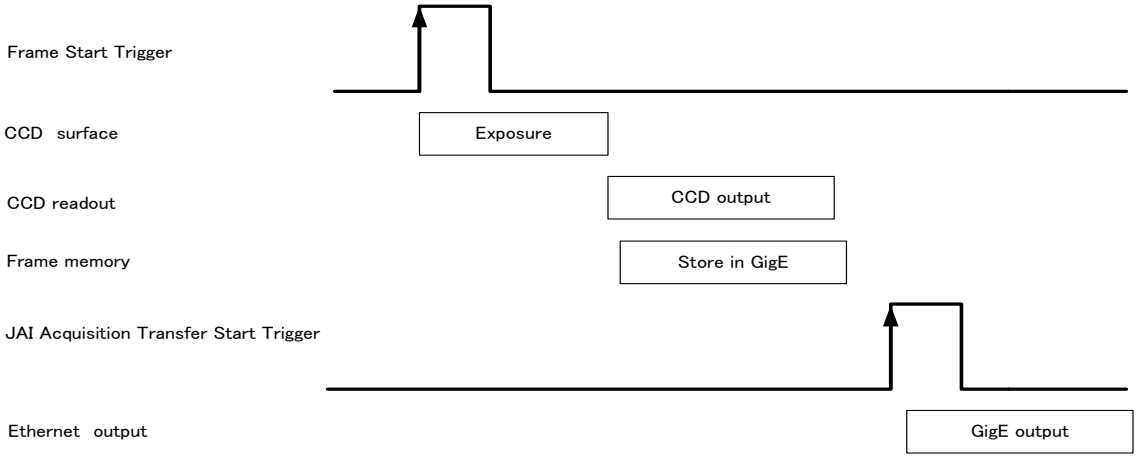


Fig.46 Delayed Read Out

10.9. Mode and function matrix table

The following table shows the possible combination of mode and function.
○ for effective and × for invalid

Trigger operation mode	Binning Vertical	Exposure Time	Frame Count	Multi ROI	Sequence ROI	Auto Iris out	Auto Exposure /Gain
Continuous	OFF/ON	×	○	○	×	○	○
Timed continuous	OFF/ON	○	○	○	×	○	○
Timed triggered	OFF/ON	○	×	○	○	×	×
TriggerWidth triggered	OFF/ON	×	×	○	×	×	×
TriggerControlled triggered	OFF/ON	×	×	○	×	×	×

11. Image processing

11.1. Basic construction

The AT-140GE is a 3CCD camera equipped with F4, 1/2 inch prism optics. Red, green and blue color signals are taken from each of the 1.45-megapixel CCDs which have been filtered to the appropriate spectral wavelengths. A 32-bit microprocessor controls all functions in the AT-140GE camera. The CCD sensor output is normalized in CDS and preamplifiers. The signals are then digitized to 16 bits. Digital gain control, color matrix, look-up tables and setup can do signal processing in 16 bits before the signal is converted to a 32- or 24-bit RGB pixel format via the GigE Vision interface.

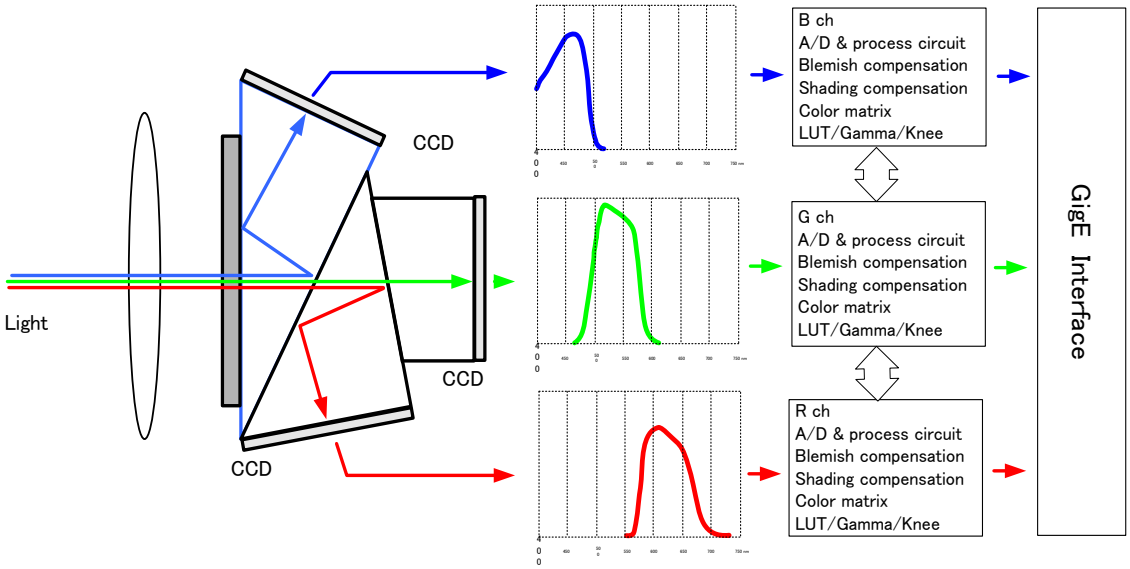


Fig.47 Principle diagram for signal processing

11.2. Shading compensation

The AT-140GE implements a digital shading compensation circuit for the white shading which could be caused in the prism or optical system. The whole image is divided horizontally and vertically and uses the center level as the reference. The circuit will compensate the difference between the center and each divided area. The range for compensation is a maximum of 25%. In the factory, the shading compensation is activated and stored in the “Factory” area of the memory. The user can uses this data if the shading compensation is ON. The factory default is OFF.
The AT-140GE has two shading compensation circuits.

1. **Color shading compensation**
   In this mode, the shading is compensated using the G channel as the reference. R and B channels are adjusted to match the characteristics of the G channel. White balancing can then be used to match the R, G and B levels.

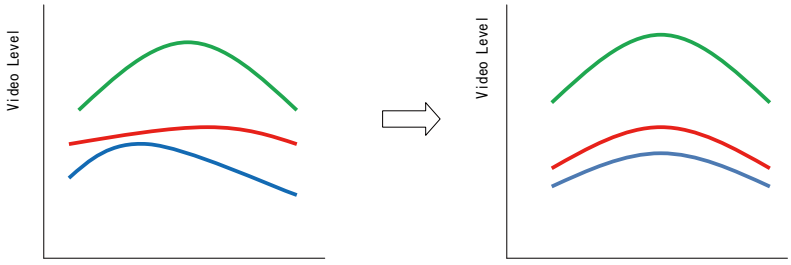


Fig.48 Conceptual drawing for color shading compensation

2. Flat shading compensation

In this mode, each channel can be adjusted to achieve flat characteristics.

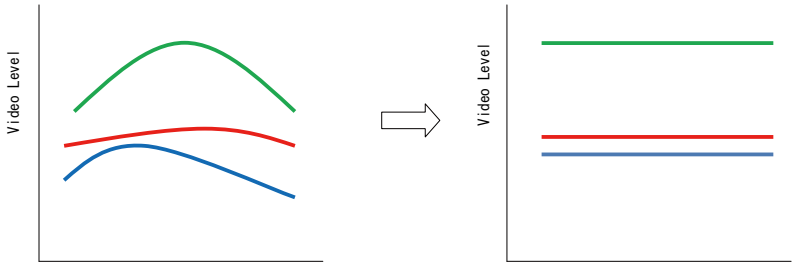


Fig.49 Conceptual drawing for flat shading compensation

Note: The maximum level of shading compensation is 25%. Under certain circumstances relating to lighting conditions or lenses used, it may not be possible to fully compensate for shading.
The following applies to the lens consideration.
Use a lens with a 1/2-inch optical format designed for a 3CCD camera. The shading will depend on the focal length and F number. Wide angle lenses or using a lens with the iris fully open may cause the shading characteristics to deteriorate.

In order to perform the shading compensation,

Shading correction mode: Select Flat shading or Color shading
Shading Enable: True
Shading selector: Select R, G or B
In case of color shading, select R or B
Shading correct: Perform Shading Calibration
In order to store the data, select user I or 2 in User selector and activate User set load.

11.3. Auto White balance

The AT-140GE has 2 auto white balance modes: one-push auto white balance or continuous auto white balance. Both modes adjust the R channel and B channel using the G channel as the reference, in order to set all three channels equal.
The reference color temperature is 7800K.

The measuring area for the auto while balance is the same as the area of the output (AOI).

	Continuous	One push	OFF(Manual)
Tracking range	0.5 to 2.0	0.5 to 2.0	0.5 to 2.0
Adjustable range(R and B)	-6dB ～ +6dB	-6dB ～ +6dB	-6dB ～ +6dB
Store the setting value	No	Yes	Yes

Note: In continuous mode, if the white part is not enough to make an adjustment, the white balance may not achieve a proper white color.
Note: The completion of one-push auto white requires a maximum of 5 seconds to complete.

11.4. Gain

The analog gain and the digital gain can be set externally.
The gain functions are as follows.

Analog All: This is the master gain control. This can set R, G and B simultaneously. The range is 0 to 15dB.
Analog Red: R gain for WhiteBalance. The range is ±6dB.
Analog Blue: B gain for WhiteBalance. The range is ±6dB.
Digital All: This is for fine tuning of the master gain. The range is ±3dB.
Digital Red: This is for fine tuning of the R channel. The range is ±3dB.
Digital Blue: This is for fine tuning of the B channel. The range is ±3dB.
Note: If WhiteBalance (Balance Ratio) is set, the level of Analog Red and Analog Blue is applied.

11.4.1 GainAuto

This enables auto level control using Gain. JAI AGC Reference can control the brightness of the auto gain. Selections for GainAuto are OFF, Once or Continuous.
The adjusting range is:

JAI AGC Reference : 0 to 255
Gain : 0 to 15dB（5.6 times）

11.5. BlackLevel

The black level of the image can be controlled by 1 LSB step for 10-bit output.

11.6. Linear matrix

The AT-140GE incorporates a linear color matrix circuit to improve color reproduction. Because this circuit processes signals in the linear stage, before the gamma correction circuit, the gamma circuit does not affect color reproduction.
The linear matrix is set by “Color Transformation Selector”. This is “OFF” at the default setting.

This circuit has:

1. Linear : OFF
2. RGB to RGB : Individual settings for R, G and B are possible.
3. RGB to Custom 1 : sRGB setting. Standard which HP and Microsoft specify for printers and monitors. This preset is based on this standard.
4. RGB to Custom 2 : Adobe RGB setting. Standard which Adobe systems specify. This preset is based on this standard.

Important Note:
If sRGB or Adobe RGB is used, please note the following procedure.
1) Achieve white balance under the condition of D65 (6500K) illumination.
2) Gamma should be set at 0.45 and set the linear matrix at either sRGB or Adobe RGB.
3) Monitor should comply with sRGB or Adobe RGB color reproduction capability.

11.7. LUT (Look Up Table) and gamma

The AT-140GE provides a LUT (Look UP Table) to adjust the gamma. JAI LUT mode is used for this function.
If LUT is selected, the required gamma characteristics can be achieved.
The gamma can be set from 1.0 to 0.45.

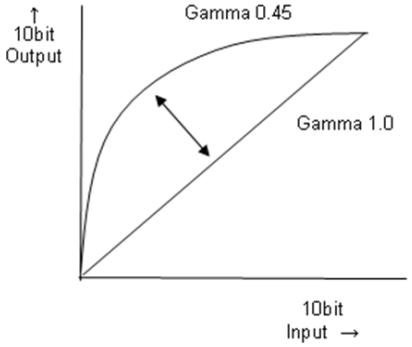


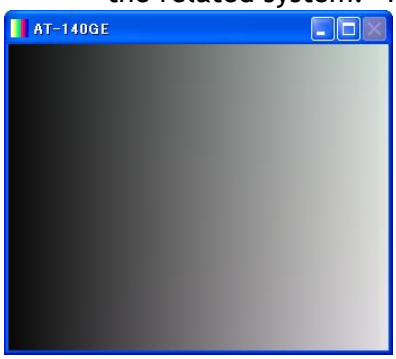
Fig.50 Gamma setting

CCD out	Analog Signal	Digital Out(32bit)	Digital Out(24bit)
Black	Setup 3.6%, 25mV	32LSB	8LSB
200mV	700mV	890LSB	222LSB
230mV ↑	800mV	1023LSB	255LSB

Note: The analog signal is used only internally.

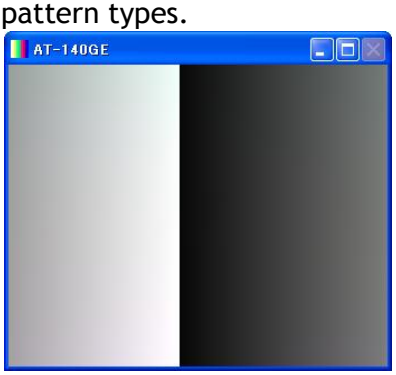
11.8. Test pattern generator

The AT-140GE has an internal test pattern generator. These signals are output as the last process of the digital signal processing circuit and can be used for adjustment of the related system. The AT-140GE has a total of 6 test pattern types.

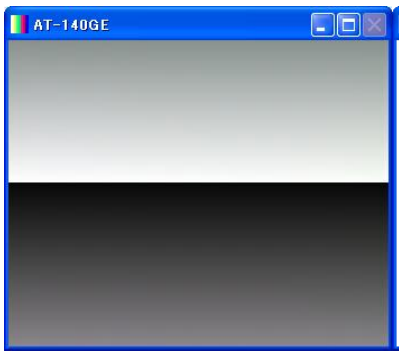


Gray Horizontal ramp

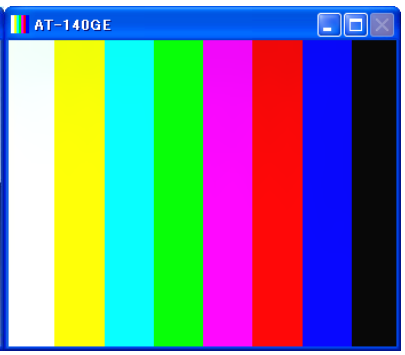
Gray Vertical Ramp



Gray Horizontal Ramp Moving
(The starting point of the gradation moves to the right.)



Gray Vertical Ramp Moving
(The starting point of the gradation moves to the bottom.)



Color Bar

Fig.51 Test patterns

12. Examples of operation using JAI Control Tool

12.1. About GenICam™ SFNC1.3

The AT-140GEis designed as conforming to GenICam SFNC1.3. GenICam SFNC stands for GenICam Standard Feature Naming Convention. By defining the standard cases and the standard features, general-purpose software can control cameras from any manufacturers which conform to the GenICam standard.

JAI, in the past, used traditional feature names in order to maintain naming continuity with previous cameras. However, starting with the AT-140GE and after, JAI GigE Vision cameras will now fully comply with GenICam SFNC feature names.

Accordingly, terminologies used for functions will be much different from previous models. This manual explains the basic operation using feature names specified in the GenICam SFNC 1.3 specification.

The latest version of JAI GigE Vision cameras comply with GenICam SFNC1.3. However, JAI can offer the following options for customers who use older versions of GIgE Vision cameras.

JAI provides the following software.
1. Version prior to SFNC 1.3 for older camera version
2. Downgrade to old version from the latest SFNC 1.3 version

Please contact local sales representatives for the details

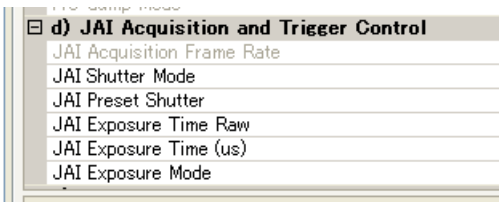
12.2. JAI SDK Ver.1.3

JAI SDK has also been upgraded to version 1.3.
In a GigE Vision compliant camera, all features are described in the XML file inside the camera and after connecting JAI Control Tool software, all features are downloaded to the JAI Control Tool software. If customers use older versions of cameras together with the Control Tool software ver.1.3, feature properties shown in the Control Tool exhibit old features name, enabling customers to operate cameras in a familiar way.

If the latest version of the camera is connected, some traditional JAI feature names such as JAI Preset Shutter, will display in the Feature Properties in addition to the newer GenICam SFNC 1.3 names.

These feaures can be set as usual and settings for those features are reflected automatically in the GenICam SFNC 1.3 feature names.

◦



The features shown above will vary depending on the specific camera.

12.3. Examples of camera operation

The following explains the operation of the camera using the GenICam SFNC 1.3 Control Tool.

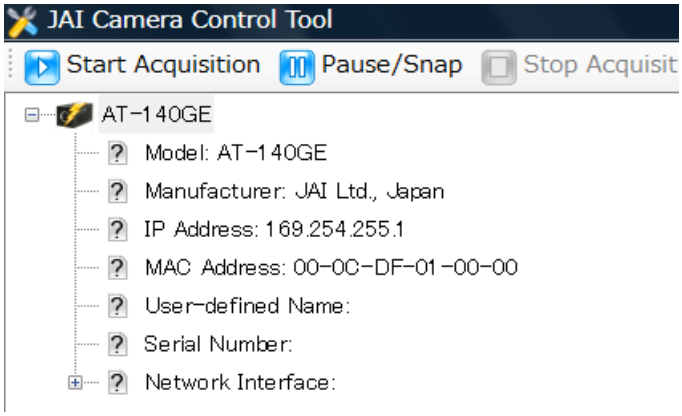
12.3.1 Operational cautions

1. Features shaded gray in the Features Properties can not be set.
2. If the image size is to be changed, image capturing should first be stopped before setting the size parameters.

12.3.2 Connecting camera(s)

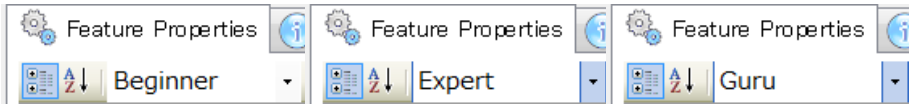
Connect the camera to the network. If the connection is established, start the JAI Control Tool. The model name of the connected camera and icon will be displayed in the screen.

After clicking the icon, the status will change to indicate the camera is successfully connected to the Control Tool.



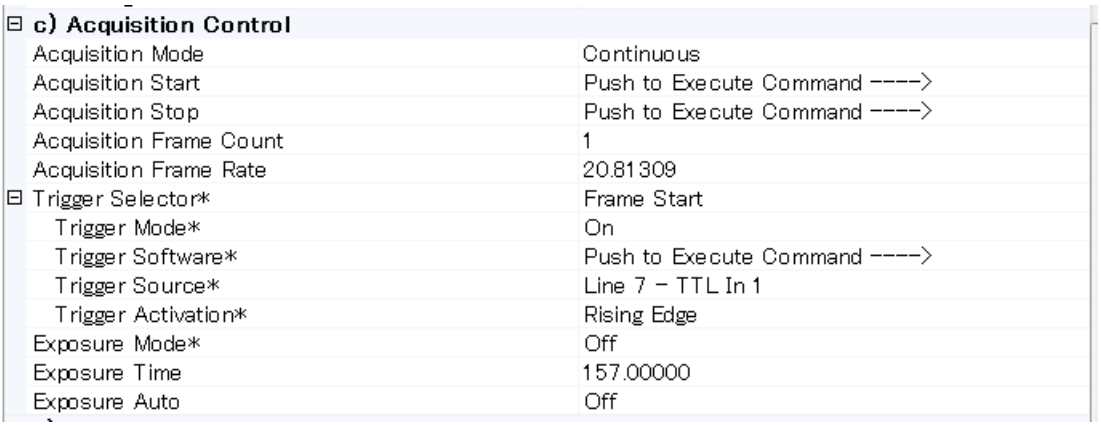
12.2.3 Camera setting layers

GenICam has 3 levels of settings. Those are Beginner, Expert and Guru.
The number of available settings increase with each level up to a maximum in the Guru layer.



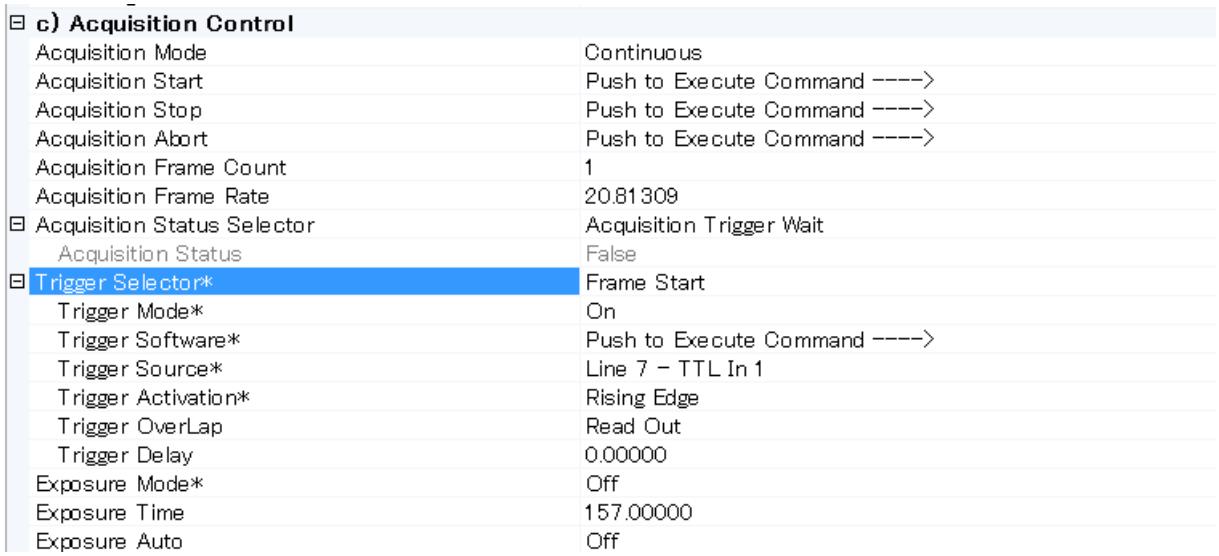
The following examples of Acquisition control menus illustrate how settings expand from level to level.

Beginner



c) Acquisition Control	
Acquisition Mode	Continuous
Acquisition Start	Push to Execute Command ---->
Acquisition Stop	Push to Execute Command ---->
Acquisition Frame Count	1
Acquisition Frame Rate	20.81309
Trigger Selector*	Frame Start
Trigger Mode*	On
Trigger Software*	Push to Execute Command ---->
Trigger Source*	Line 7 - TTL In 1
Trigger Activation*	Rising Edge
Exposure Mode*	Off
Exposure Time	157.00000
Exposure Auto	Off

Expert



c) Acquisition Control	
Acquisition Mode	Continuous
Acquisition Start	Push to Execute Command ---->
Acquisition Stop	Push to Execute Command ---->
Acquisition Abort	Push to Execute Command ---->
Acquisition Frame Count	1
Acquisition Frame Rate	20.81309
Acquisition Status Selector	Acquisition Trigger Wait
Acquisition Status	False
Trigger Selector*	Frame Start
Trigger Mode*	On
Trigger Software*	Push to Execute Command ---->
Trigger Source*	Line 7 - TTL In 1
Trigger Activation*	Rising Edge
Trigger OverLap	Read Out
Trigger Delay	0.00000
Exposure Mode*	Off
Exposure Time	157.00000
Exposure Auto	Off

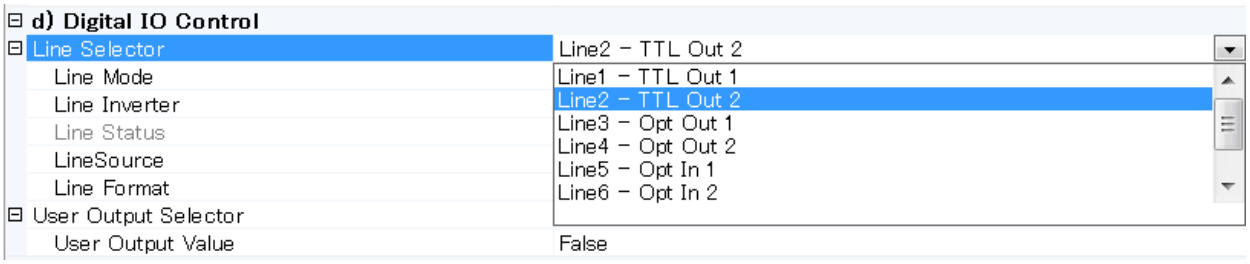
Guru

⊟ **c) Acquisition Control**	
Acquisition Mode	Continuous
Acquisition Start	Push to Execute Command ---->
Acquisition Stop	Push to Execute Command ---->
Acquisition Abort	Push to Execute Command ---->
Acquisition Frame Count	1
Acquisition Frame Rate	20.81309
Acquisition FrameRate Abs	20.81309
⊟ Acquisition Status Selector	Acquisition Trigger Wait
Acquisition Status	False
⊟ Trigger Selector*	Frame Start
Trigger Mode*	On
Trigger Software*	Push to Execute Command ---->
Trigger Source*	Line 7 - TTL In 1
Trigger Activation*	Rising Edge
Trigger OverLap	Read Out
Trigger Delay	0.00000
Trigger Delay Abs	0.00000
Trigger Delay Raw	0
Exposure Mode*	Off
Exposure Time	157.00000
Exposure Time (us)	157.00000
Exposure Time Raw	3
Exposure Auto	Off

12.4. Input and output settings

12.4.1. Connection with the external devices

The relation of the line input and output (Digital I/O) and the external terminal in the JAI GigE Vision cameras is fixed. Refer to the chapter 6.1 for the details.



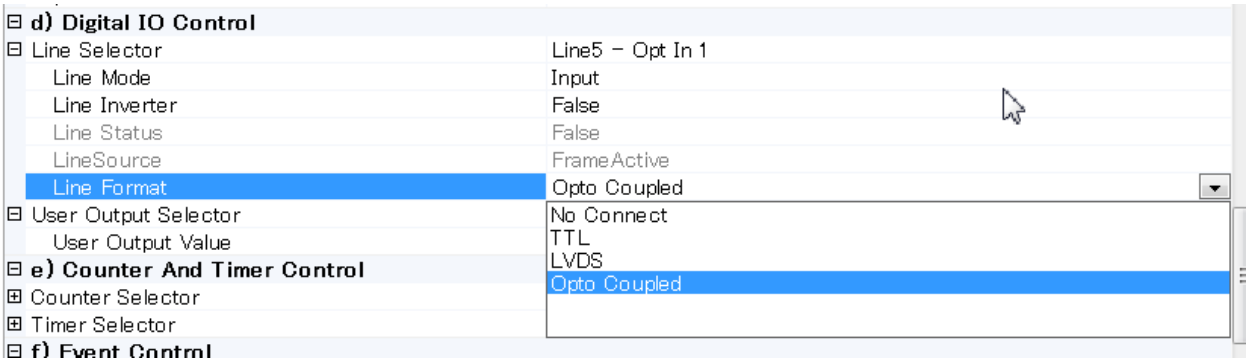
In the Control Tool, they are displayed as Line1-TTL Out 1.

Note: These settings are only available in the Expert and Guru setting layers.

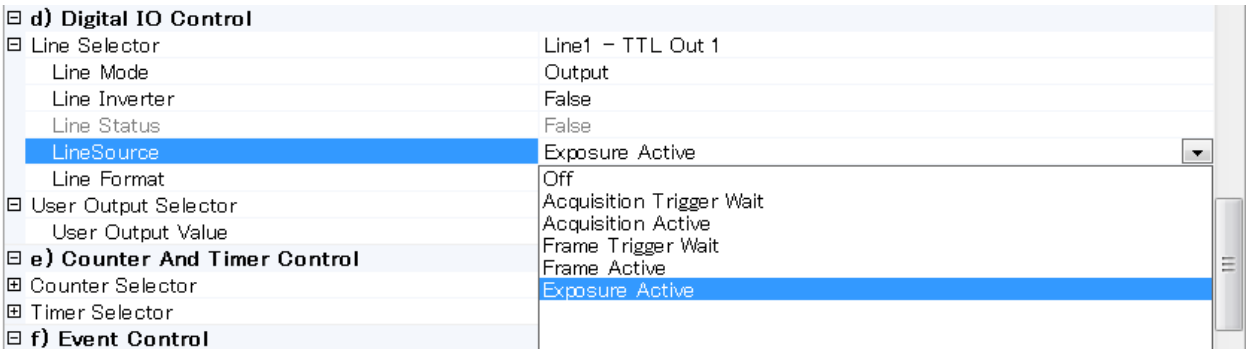
12.4.2. Setting inputs and outputs

12.4.2.1 Select signal to connect with Line which is selected by Line selector

This function determines which signal is connected with Digital I/O (Line 1 through Line 8). The following figure is an example of setting Line 5 -Opt In 1. In this case, Line Source is the signal to connect with Line 5 -Opt In 1. But Frame Active is available for only output and accordingly, it is not selectable in the Control tool. Line Format is automatically set at Opto Coupled.



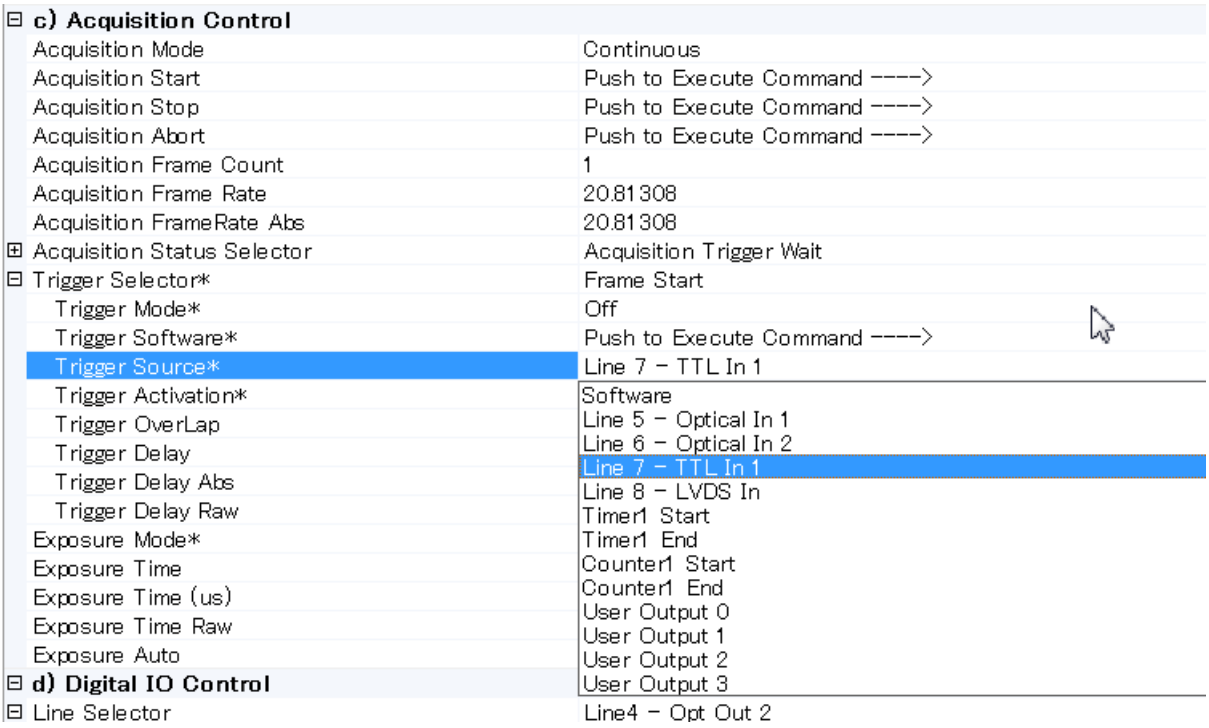
The following figure is an example of setting output so that the signal output from Line1 – TTL Out 1is selected from signals in the Line Source. In this case, Exposure Activeis selected to output through TTL Out 1. TTL is automatically selected as Line Format.



12.4.2.2 Select Trigger Source

Which signal is used as the trigger signal can be configured by the Trigger Source in the Trigger Selector of Acquisition Control.

In the following figure, Frame Start is selected as the trigger and the trigger source is configured Line7 – TTL In 1. In the following picture, Trigger Mode is OFF. But to activate the trigger, it should be set ON.



12.4.3. Specify the image size to be captured

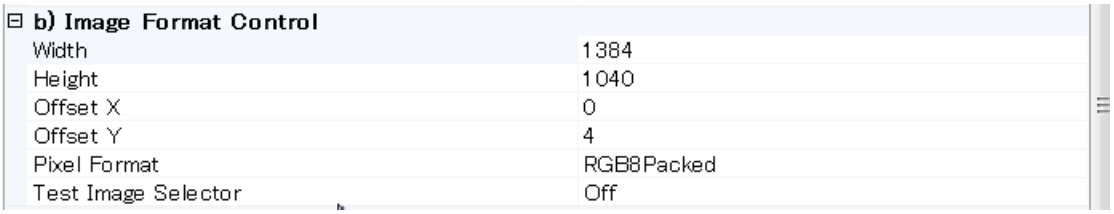
Refer also to the chapter 7.2.
The following parameters are required to specify the image size.

OFFSET X	Specify the starting position of the image in the horizontal direction
Width	Specify the width of the image
OFFSET y	Specify the starting line of the image
Height	Specify the height of the image

In order to readout full pixels,
OFFSET x = 0
Width = Maximum number of pixels in the horizontal direction
OFFSET y =4
Height= Maximum number of pixels in the vertical direction

In the AT-140GE, total pixels include pixels in the OB. In order to transfer the full pixel image without OB, a setting of OFFSET x = 0 and OFFSET y = 4 is the starting point. Refer to the chapter 7.2.2.

Beginner



Expert , Guru

b) Image Format Control	
Sensor Width	1392
Sensor Height	1040
Sensor Taps	One
Sensor Digitization Taps	One
Width Max	1408
Height Max	1044
Width	1384
Height	1040
Offset X	0
Offset Y	4
Line Pitch	4152
Binning Horizontal	1
Binning Vertical	1
Pixel Format	RGB8Packed
Pixel Coding	RGBPacked
Pixel Size	Bpp24
Pixel Color Filter	None
Test Image Selector	Off

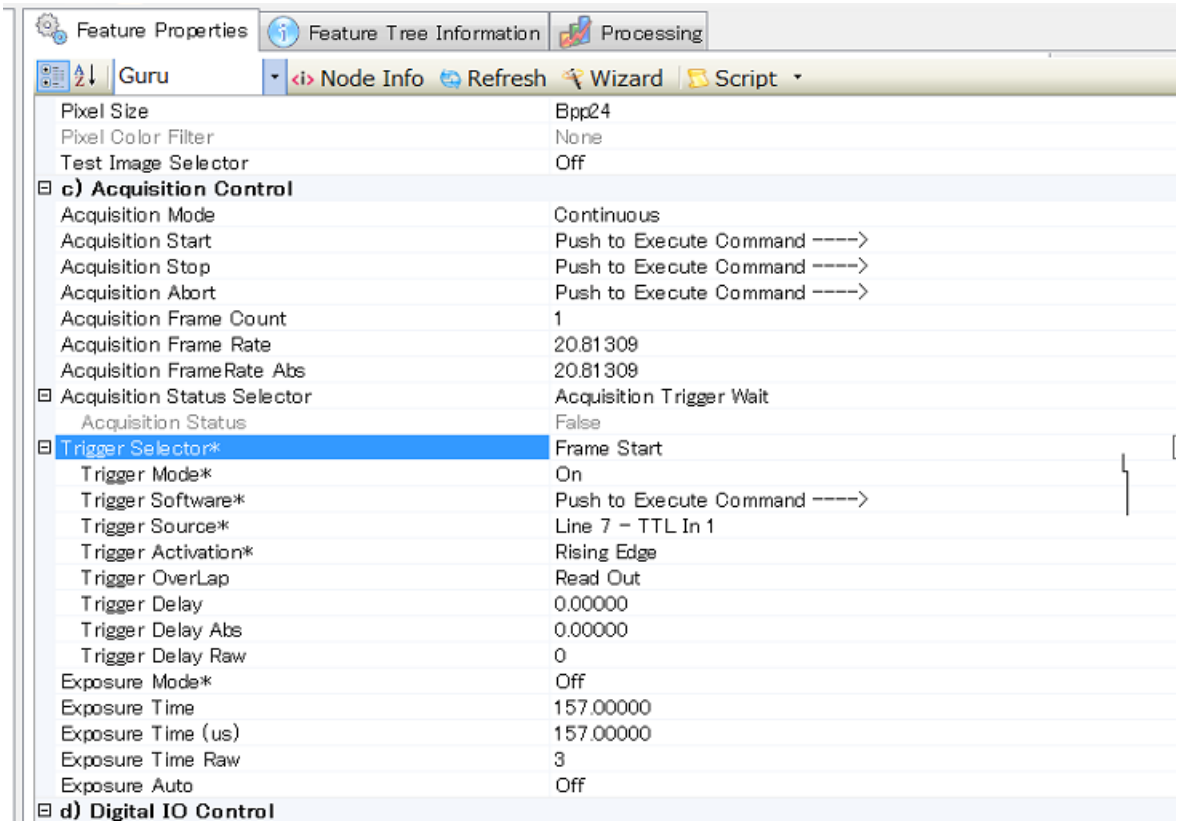
Full pixels readout

Full pixels and OB (part)

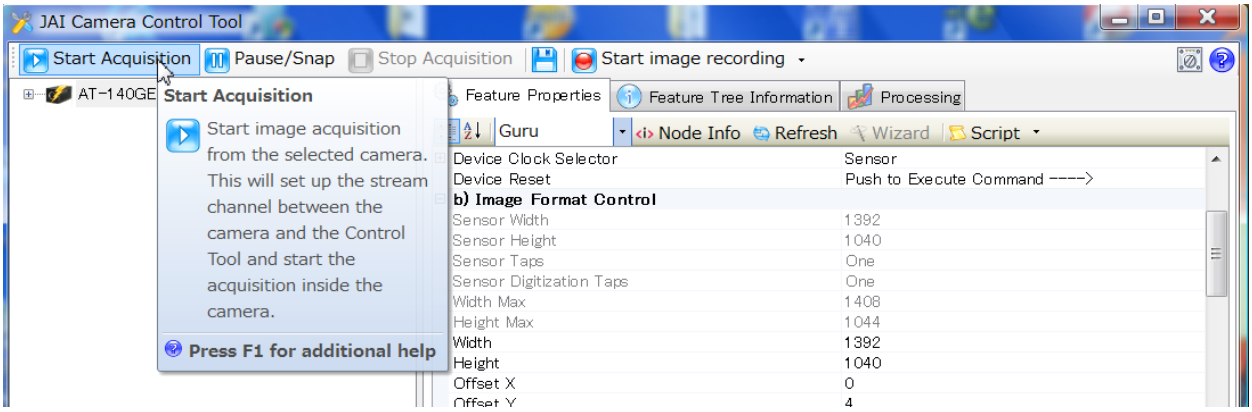
Line Pitch is explained in chapter 7.9.
The resulting image is shown below.
This is the result of Line Pitch set to 2088 which is half of full width.
The half image, starting from the beginning of the full image is enlarged and output.
(This is a picture captured in TIFF)

12.4.4. Acquisition of the image

The settings related to image acquisition are configured in the Acquisition Control. The following shows theAcquisition Control screen (Guru layer)



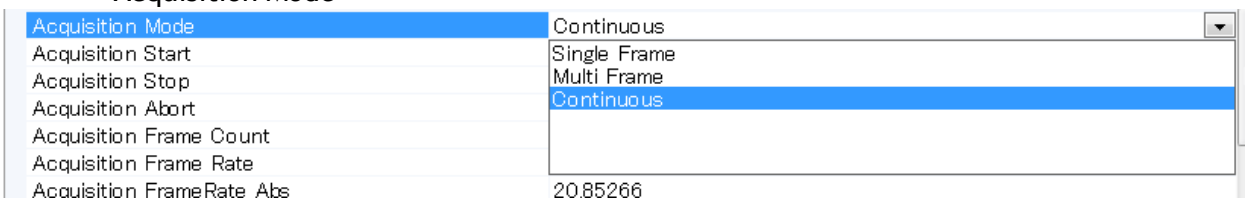
After setting the acquisition, click Start Acquisition button.



12.4.4.1 Basic settings

The basic setting items are Acquisition Mode, Trigger Selector, Exposure Mode.

Acquisition Mode



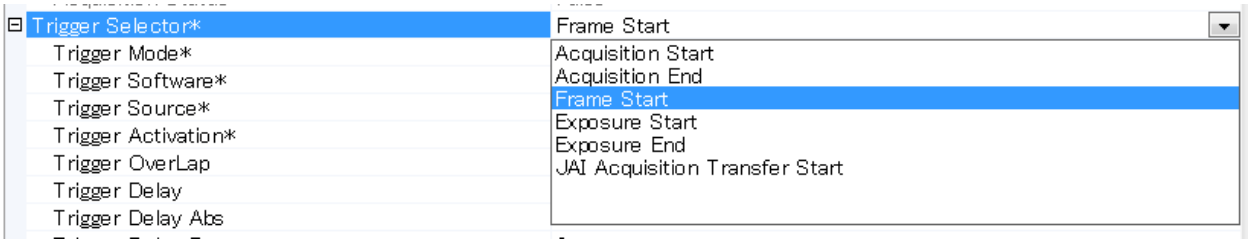
Acquisition Mode can be selected from Continuous, Single Frame and Multi Frame.

Continuous: If the trigger is input, the image is continuously captured. In order to stop the acquisition, Acquisition End command must be executed.

Single Frame: If the trigger is input, only one frame is captured and after the completion of capturing, the acquisition is automatically stopped.

Multi Frame: If the trigger is input, frames which are set by Acquisition Frame Count are captured and after the completion of capturing, the acquisition is automatically stopped.

Trigger Selector



Trigger Selector includes Acquisition Start and Acquisition End commands which determine the start point and end point of acquisition, and Trigger commands which set the trigger timing.

Acquisition Start has ON or OFF setting. Refer to chapter 9.1 for the details.

ON: In this case, if Acquisition Start Trigger is applied, the status is waiting the trigger input.
The acquisition starts in the order of Acquisition start Trigger input and Trigger signal input.

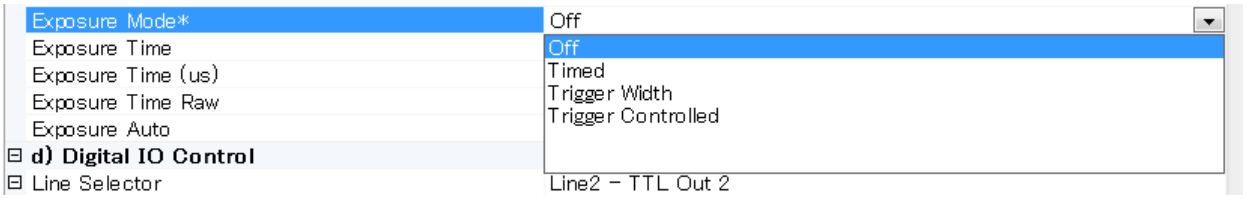
OFF: In this case, the camera runs freely. If the trigger signal is input, the acquisition starts immediately.

Trigger setting

Select from Frame Start, Exposure Start, Exposure End and JAI Acquisition Transfer Start and set the details.

Frame Start: The exposure starts at the point of frame start.
Exposure Start : The exposure starts at the point of exposure start.
Exposure End : This command stops the exposure. This is used together with Exposure Start and Trigger Controlled.
JAI Acquisition Transfer Start : This command makes the delayed readout from the camera effective.

Exposure Mode setting



Timed : The exposure is effective only for setting duration.
Trigger Width : The exposure time is equal to the trigger width.
Trigger Controlled : Exposure Start Trigger starts the exposure and Exposure End stops the exposure.

12.4.5. Setting examples

12.4.5.1 Capture the image continuously with fastest frame rate

Acquisition Mode	Continuous	
Acquisition Frame Rate	20.814 fps	
Trigger selector	Acquisition Start	Trigger mode : OFF
	Acquisition End	Trigger mode : OFF
	Frame Start	Trigger mode : OFF
	Exposure Start	Trigger mode : OFF
	Exposure Stop	Trigger Mode: OFF
	JAI Acquisition Transfer Start	Trigger Mode: OFF
Exposure Mode	OFF or Timed	
Exposure Time	Any value	If Exposure Mode is Timed

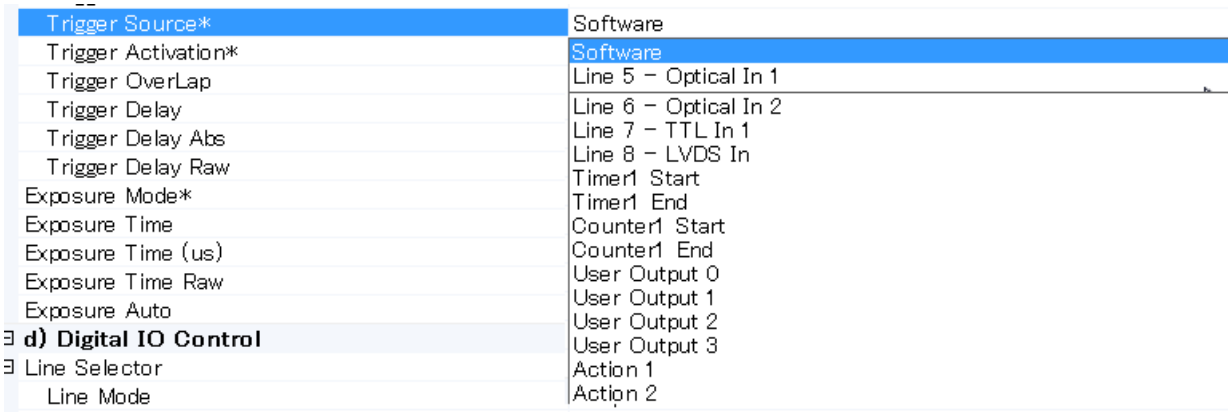
12.4.5.2 Capture the image with a half of the frame rate (increasing the sensitivity)

Acquisition Mode	Continuous	
Acquisition Frame Rate	10 fps	
Trigger selector	Acquisition Start	Trigger mode : OFF
	Acquisition End	Trigger mode : OFF
	Frame Start	Trigger mode : OFF
	Exposure Start	Trigger mode : OFF
	Exposure Stop	Trigger Mode: OFF
	JAI Acquisition Transfer Start	Trigger Mode: OFF
Exposure Mode	OFF or Timed	
Exposure Time	Any value	If Exposure Mode is Timed

12.4.5.3 Capture one frame of the image with preset exposure time using the external trigger

Acquisition Mode	Single Frame	
Trigger selector	Acquisition Start	Trigger mode : OFF
	Acquisition End	Trigger mode : OFF
	Frame Start	Trigger mode : ON
	Exposure Start	Trigger mode : OFF
	Exposure Stop	Trigger Mode: OFF
	JAI Acquisition Transfer Start	Trigger Mode: OFF
Exposure Mode	Timed	
Exposure Time	Any value	

Frame Start　settings



Trigger Source	Choose from the above selection
Trigger Activation	Rising Edge, Falling Edge, Any Edge
Trigger　Overlap	Off or Read Out
Trigger Delay	Any value、　Normally set to 0

12.4.5.4 Capture multi frames of the image with preset exposure time using the external trigger

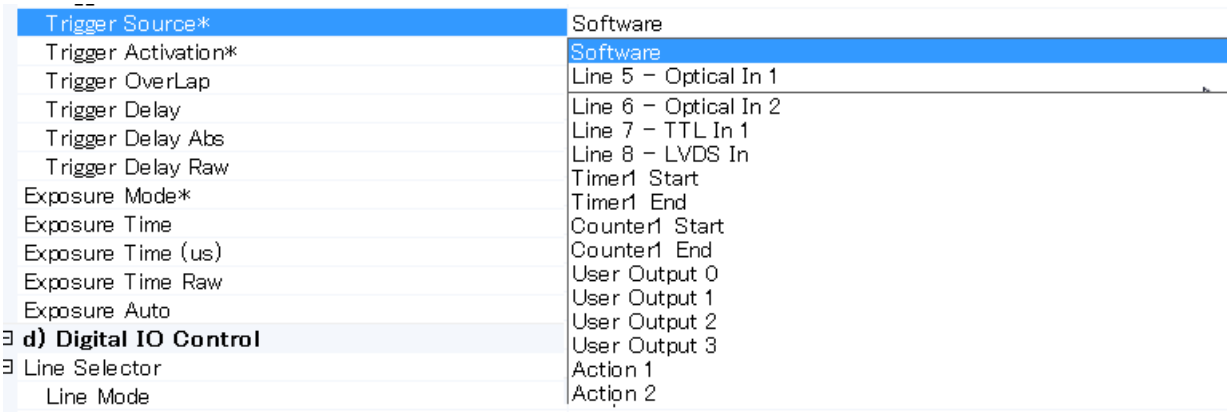
In the 12.4.5.3 example, the following setting should be changed.

Acquisition Mode	Multi Frame
Acquisition Frame Count	Any value which can be set

12.4.5.5 Capture one frame of the image with the trigger width using the external trigger

Acquisition Mode	Single Frame	
Trigger selector	Acquisition Start	Trigger mode : OFF
	Acquisition End	Trigger mode : OFF
	Frame Start	Trigger mode : ON
	Exposure Start	Trigger mode : OFF
	Exposure Stop	Trigger Mode: OFF
	JAI Acquisition Transfer Start	Trigger Mode: OFF
Exposure Mode	Trigger Width	

Frame Start setting



Trigger Source	Choose from the above selection
Trigger Activation	Level High or Level Low
Trigger Overlap	Off or Read Out
Trigger Delay	Any value、 Normally set to 0

12.4.5.6 Capture multi frames of the image with the trigger width using the external trigger

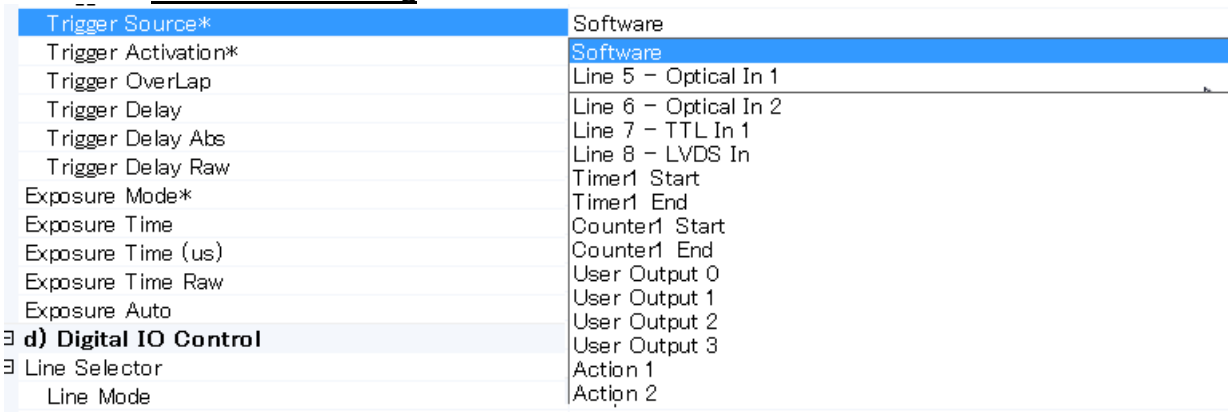
In the example 12.4.5.5, the following setting should be changed.

Acquisition Mode	Multi Frame
Acquisition Frame Count	Any value which can be set

12.4.5.7 Capture the image continuously with preset exposure time by using the external trigger

Acquisition Mode	Continuous	
Trigger selector	Acquisition Start	Trigger mode : OFF
	Acquisition End	Trigger mode : OFF
	Frame Start	Trigger mode : ON
	Exposure Start	Trigger mode : OFF
	Exposure Stop	Trigger Mode: OFF
	JAI Acquisition Transfer Start	Trigger Mode: OFF
Exposure Mode	Timed	
Exposure Time	Any value	

Frame Start setting



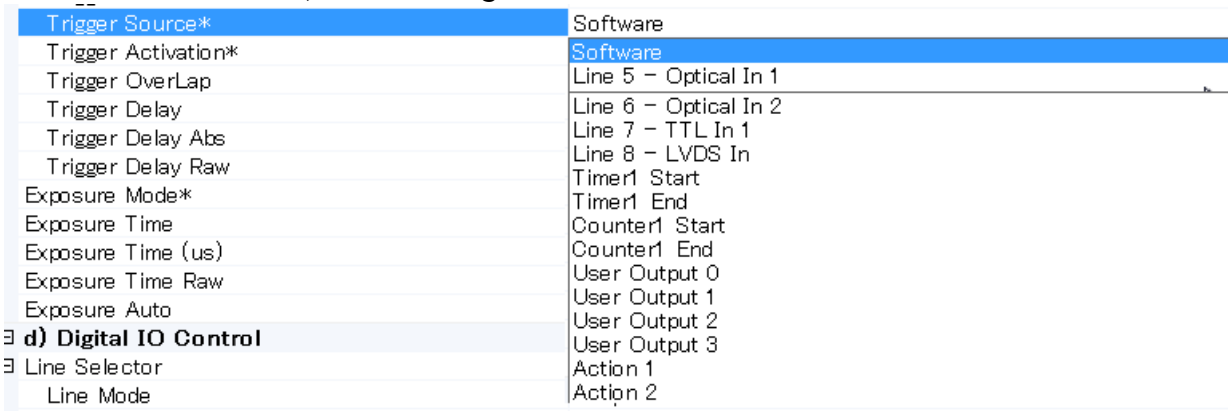
Trigger Source	Choose from the above selection
Trigger Activation	Rising Edge, Falling Edge, Any Edge
Trigger Overlap	Off or Read Out
Trigger Delay	Any value、 Normally set to 0

12.4.5.8 Capture the image by Exposure Start trigger and stop by Exposure End.

Acquisition Mode	Single Frame	
Trigger selector	Acquisition Start	Trigger mode : OFF
	Acquisition End	Trigger mode : OFF
	Frame Start	Trigger mode : OFF
	Exposure Start	Trigger mode : ON
	Exposure Stop	Trigger Mode: ON
	JAI Acquisition Transfer Start	Trigger Mode: OFF
Exposure Mode	Trigger controlled	

Exposure Start and Exposure End setting

For each item, the following should be set.

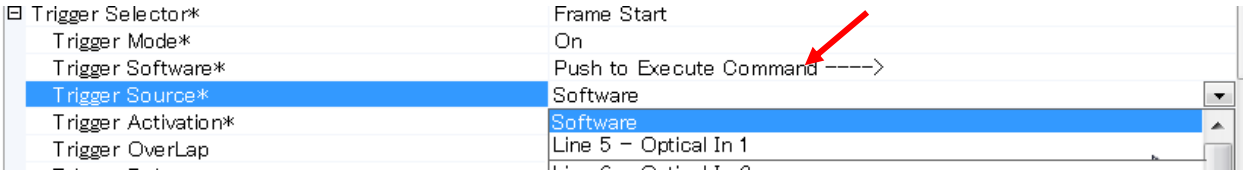


Trigger Source	Choose from the above selection
Trigger Activation	Rising Edge, Falling Edge, Any Edge
Trigger Overlap	Off
Trigger Delay	0

12.4.5.9 Capture the image using Software Trigger

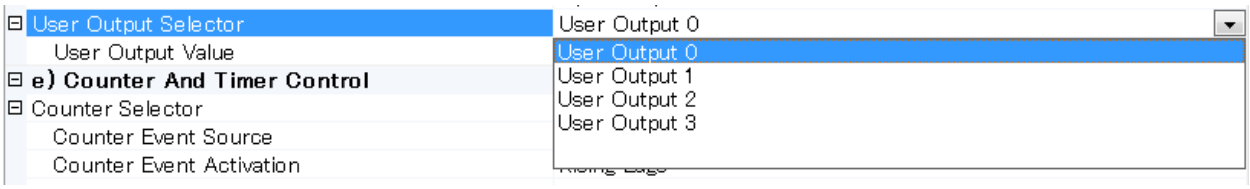
Acquisition Mode	Continuous	
Trigger selector	Acquisition Start	Trigger mode : OFF
	Acquisition Stop	Trigger mode : OFF
	Frame Start	Trigger mode : ON
	Exposure Start	Trigger mode : OFF
	Exposure Stop	Trigger Mode: OFF
	JAI Acquisition Transfer Start	Trigger Mode: OFF
Exposure Mode	OFF or Timed	
Exposure Time	Any value	If Exposure Mode=Timed

Frame Start setting

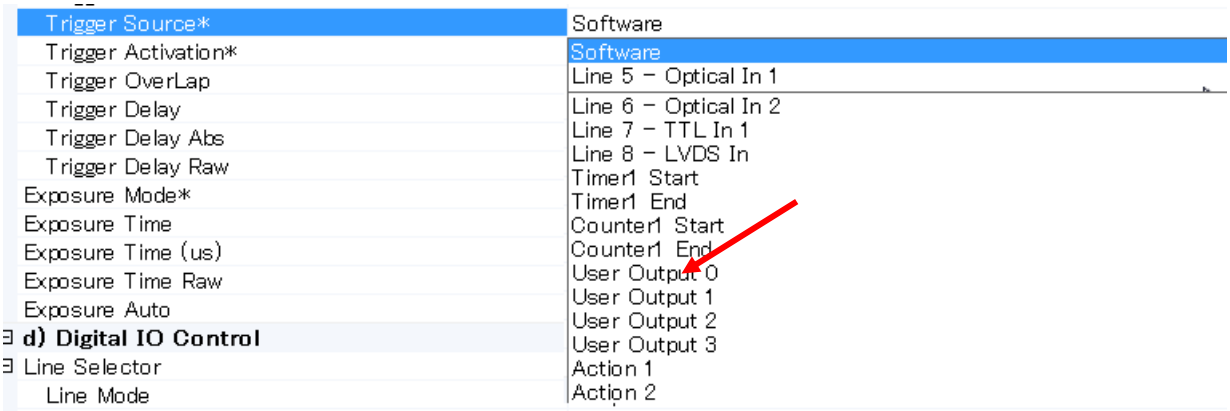


Select “Software” in the Trigger Source and execute Trigger Software command. Software trigger is generated inside the camera and the settings are not changed. Therefore, it is useful if the customer tests the trigger function.

In order to use the software trigger, use “User Output”.



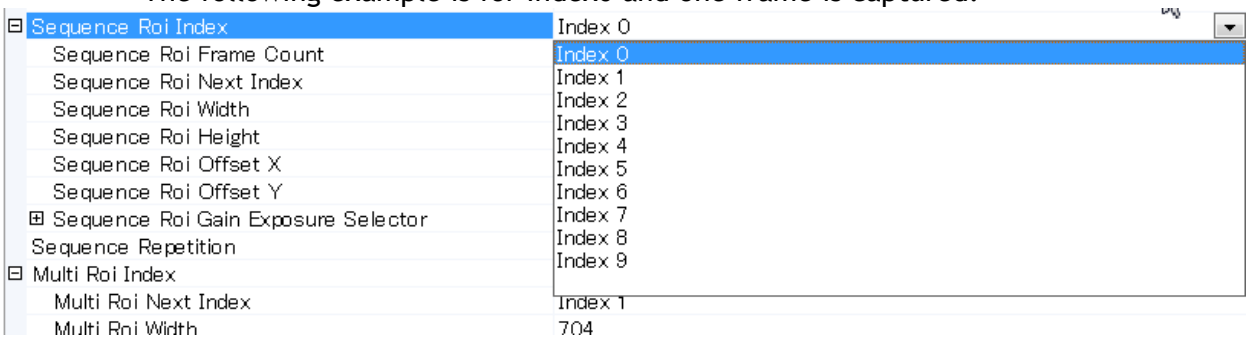
Select User Output, and select the same user output in the Trigger Source.

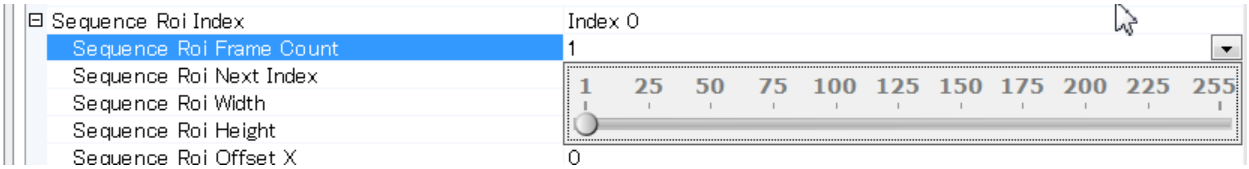


12.4.5.10 Sequence Trigger setting

Set Video Send mode selector in the JAI Custom Control to Sequence mode. Then, set each image by Sequence ROI Index in the JAI Custom Control.

The following example is for Index0 and one frame is captured.

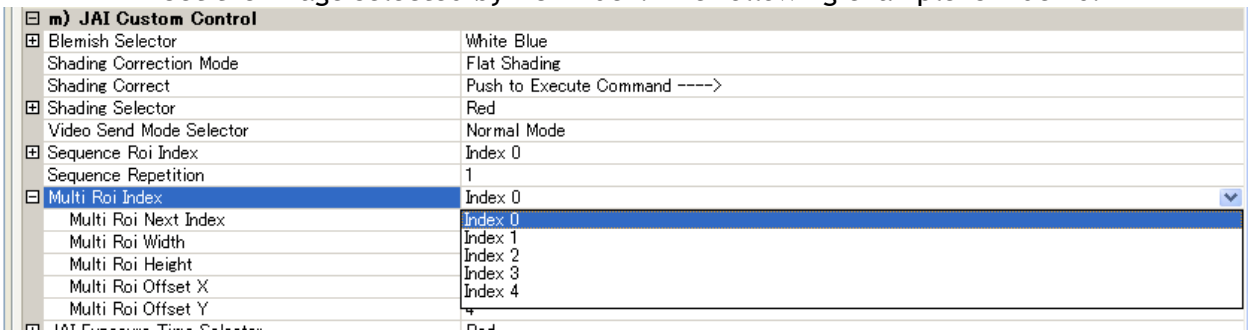




Then, in the Sequence ROI Next Index, the next image is set. Other images are set in the same manner. Next index can also set the order of capturing the images. In order to stop the sequence, the next index of the last index should be set "OFF".

12.4.5.11 Multi ROI setting

Set "Video Send Mode Selector" in the JAI Custom Control to "Multi ROI mode".
Set the image selected by ROI Index. The following example is Index 0.



Then, the next image is set by Multi ROI Next Index.
The following example is for Index 1.

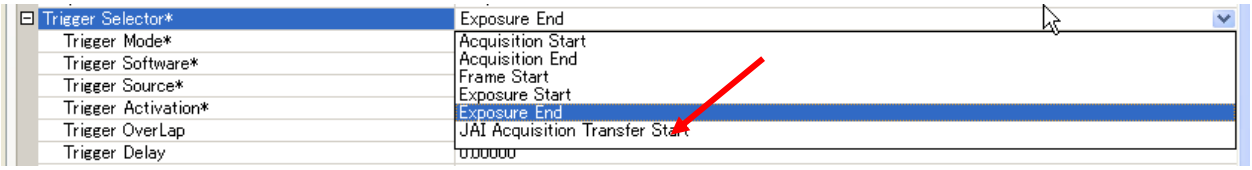
After that, set the image of Index 1 by Multi ROI Index.
While repeating the above procedure, set the necessary ROI. Maximum of 5 images can be set. On the last image setting, set “Multi ROI Next Index” to “OFF”.

12.4.5.12 Delayed readout setting

If a system using multiple cameras is configured, it can use delayed readout in order to improve the traffic in the PC port. Refer to the chapter 8.4.3.3.

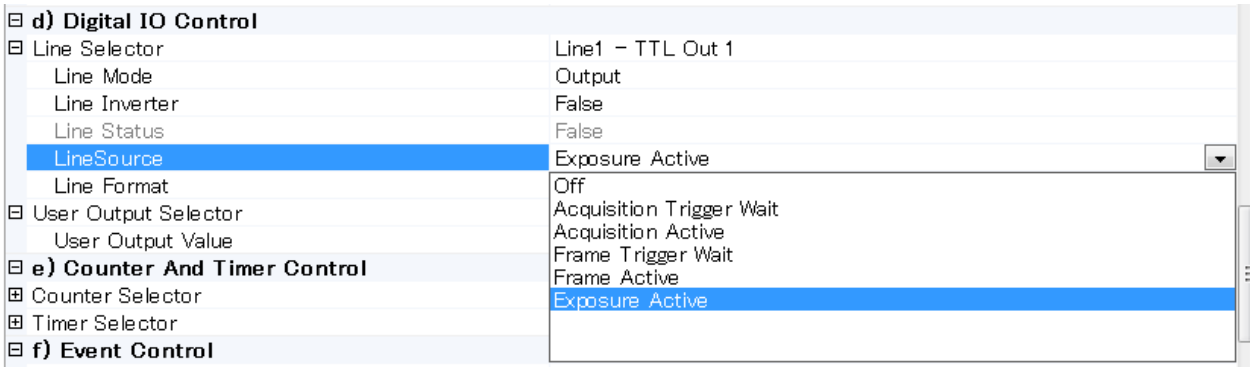
Setting:
Trigger selector: JAI Acquisition Transfer Start
Trigger mode: ON

This should be applied to all connecting cameras.



12.4.5.13 Operate the external strobe light

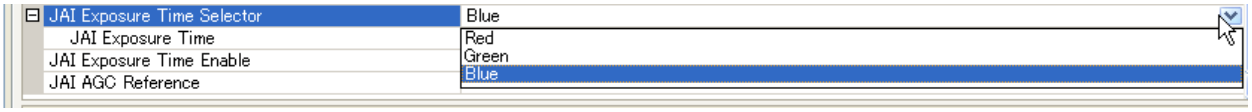
“Exposure Active” can be used as the strobe driven signal.
Then set “LINE” for signal output.
The following example selects Line 1- TTL Out 1 as the output terminal.



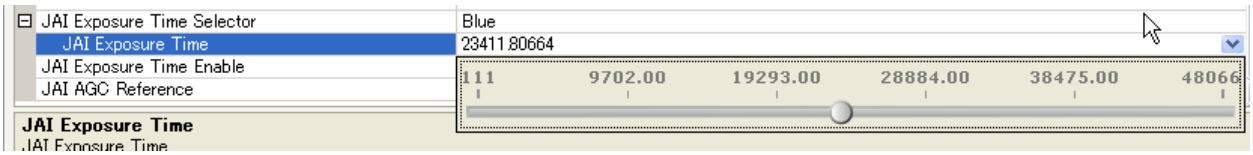
12.4.5.14 Achieve white balance using individual exposure time for R,G,B

In the AT-140GE, if “Exposure Mode” is set to “Timed” , it is possible to white balance by adjusting individual exposure times for R, G and B channels. A better S/N ratio can be achieved as compared to using gain.

Select each R, G or B channel in the ”JAI Exposure Time Selector”.



Set the exposure time for each channel in the “JAI Exposure Time”.

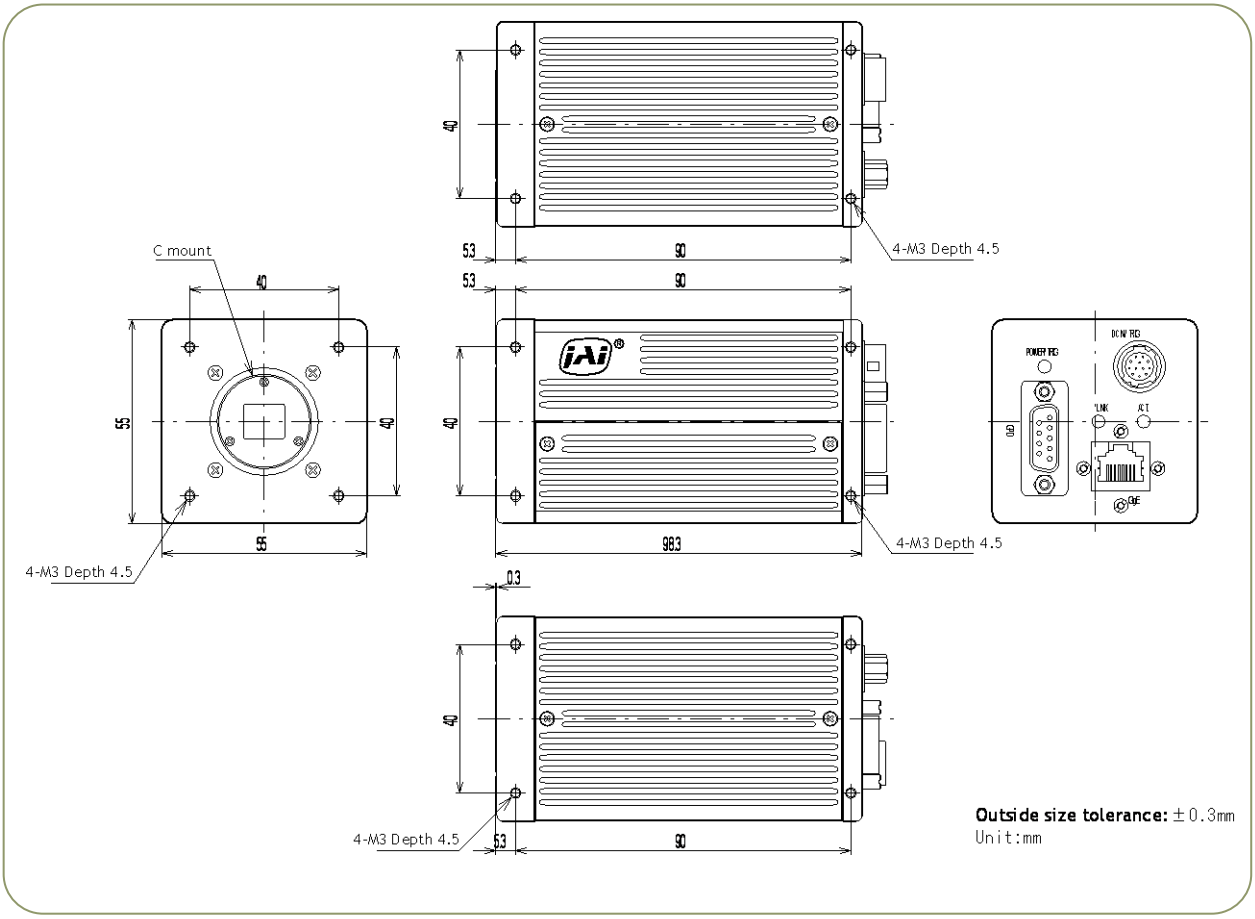


12.4.6 How to view the XML file

All features and registers are stored in the camera as an XML file.
The XML file is stored in the following folder.

Program ⇒ GenICam 2.0 ⇒ XML ⇒ Transportlayers ⇒ JAI

13. External Appearance and Dimensions



***Note**: Rear protrusion on C-mount lens must be less than 4.0mm*

Fig. 52 Outline

14. Specifications

14.1. Camera sensitivity response

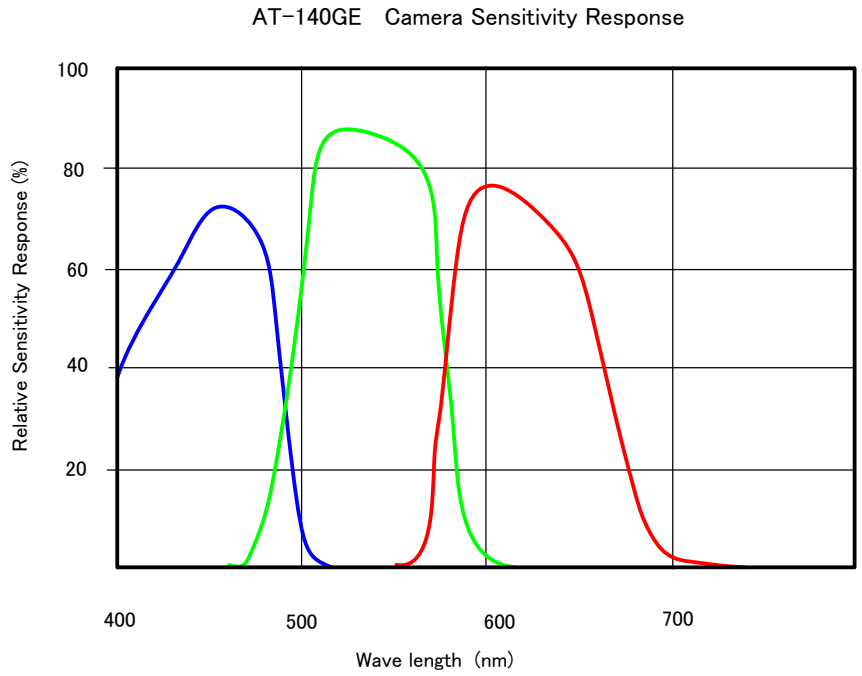


Fig.53 AT-140GE Camera Sensitivity response

14.2. Specification table

Specifications	AT-140GE			
Optical system	1/2 inch F4.0 prism			
Scanning system	Progressive			
Synchronization	Int. X-tal			
CCD sensors	3 x 1/2" IT CCD on prism. Sony ICX267AL			
Sensing area	6.47 (h) x 4.84 (v) mm 1/2 inch diagonal			
Cell size	4.65 (h) x 4.65 (v) μm			
Active Image Output pixels	1392 (h) x 1040 (v)			
Pixel clock	42.954 MHz			
Scanning lines	More than 1054 lines (Binning Vertical=1, Full area readout)			
Horizontal frequency / Vertical frequency (Frame rate) at Continuous mode		Effective/total lines	Horizontal freq.	Frame rate
	Full area Binning Vertical=1	1040- / 1054	21.938 KHz	20.814 fps (*1)
	Minimum line setting Binning Vertical=1	8 / 366	21.938 KHz	59.94 fps (*2)
	Vertical binning Binning Vertical=2	520 / 530	17.447 KHz	32.92 fps
	*1: Full area readout and fastest frame rate *2: 8-line readout and fastest frame rate			
Horizontal Binning	Binning horizontal= 1(OFF), 2(ON) The frame rate and line rate is not changed.			
OB transfer mode	ON / OFF			
Digital Video output	GigE Vision interface RGB8Packed, RGB10V1Packed, RGB10V2Packed			
Video output for lens iris	0.7 V p-p, 75 Ω NUM luminance signal w/o Sync			
Sensitivity (on sensor) (min.)	0.83 Lux, (full frame, gain=+15dB, trigger=OFF, 50% video			
S/N ratio	>50 dB. (0dB gain)			
Inputs	HIROSE 12 pin: OPT x 2 HIROSE 9 pin : TTL/75Ω x 1, LVDS x 1			
Outputs	HIROSE 12 pin: OPT x 2 HIROSE 9 pin: TTL x 2			
Gain Gain range	Analog Analog All (Master gain) : 0db to +15dB (0.0359dB/step) Analog Red (R gain) : -6dB to +6dB (0.0359dB/step) Analog Blue (B gain) : -6dB to +6dB (0.0359dB/step) Digital Digital All (Digital Master gain) : -3dB to +3dB (0.0541dB /step) Digital Red (R gain) : -3dB to +3dB (0.0541dB /step) Digital Blue All (B gain) : -3dB to +3dB (0.0541dB /step)			
Acquisition Control	Single frame, Multi frame ,Continuous			
Trigger Control	Acquisition start, Acquisition end, Frame start, Exposure start, Exposure end JAI Acquisition transfer start			
Exposure Control	In conjunction with the trigger control, the operation mode can be set. 1.OFF 2.Timed: Setting unit is: Trigger mode OFF(Self running) : 1 line step (*1) Trigger mode ON: 1μ second step (*2) 3.Trigger width: Exposure for the pulse width duration 4.Trigger controlled : Exposure the duration between start and stop *1) Timed: Trigger mode OFF Clock =1 line, Counter for exposure =16bit *2)Trigger mode ON Clock 1MHz, Counter for exposure=16bit			
Timer function	X 1 (Clock=1MHz, Timer counter and timer delay counter = 16bit)			
Counter function	X 1 (Counter=16bit)			
Event message	The internal signal status can be output as the event message			
White balance	Manual/one push, continuous, Gain range: -6 to +6 dB / tracking range 4000K to 9000K White balance setting in factory: 7800K			

LUT / Gamma	LUT or gamma can be selected 1024 LUT setting points, 10-bit values Gamma: 1.0 to 0.45
Linear Matrix	Manual for R, G and B / Preset (sRGB, Adobe RGB)
Shading Compensation	ON /OFF (Color shading and flat field shading)
Black level	± 128LSB (at 10-bit output)
Event message	Exposure start, Exposure end, Trigger IN, Video start, Video end, GPIO status
Video output connector	RJ-45 x 1
Control interface	Gigabit Ethernet (IEEE802.3, ATA GigE Vision Standard) Packet size can be set from 1476 bytes to 16K(16020) bytes. (Default is 1476)
Operating temperature	-5°C to +45°C.
Humidity	20 - 80% non-condensing
Storage temp./humidity	-25°C to 60°C./20% - 80% non-condensing
Vibration	3 G (15 Hz – 200 Hz in XYZ)
Shock	50 G
Regulations	CE (EN 61000-6-2, EN 61000-6-3), FCC part 15 class B, RoHS
Power	10.8V to 26.4V DC. 0.66 A (Typical , Full frame, DC +12V in)
Lens mount	C-mount (Rear protrusion on C mount must be less than 4mm) The lens used should be designed for 3CCD cameras.
Flange back	17.526mm, Tolerance +0 to –0.05mm
Optical axis	Center ±0.1mm
Dimensions	55 x 55 x 98.3 mm (HxWxD)
Weight	340g

Note: 1) Above specifications are subject to change without notice
2) Specifications are valid after a 30 min. warm up period.

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 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.

Vertical Aliasing
When the CCD camera captures stripes, straight lines or similar sharp patterns, the image on the monitor may appear jagged.

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.

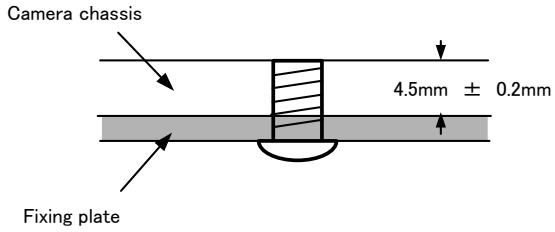
Patterned Noise
When the sensor captures a dark object at high temperature or is used for long time integration, fixed pattern noise may appear on the video monitor screen.

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.

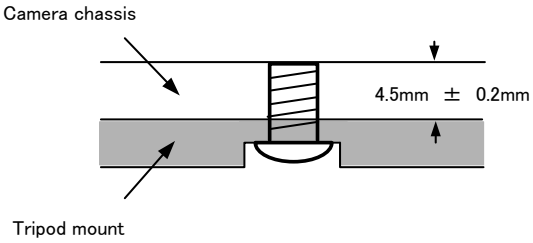
4. Caution when mounting the camera

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 and datasheet for the AT-140GE can be downloaded from www.jai.com
2. Camera control software can be downloaded from www.jai.com

Change history

Date	Revision	Changes
Nov. 2010	1.0	New release
Mar. 2012	1.1	Add the description of how to perform the shading compensation
May 2012	1.2	Delete Blemish Compensation function
May 2012	1.3	Change the description on sections 6.4 and 6.5 as well as fig.14 and fig 15.

User's Record

Camera type: **AT-140GE**

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*
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Visit our web site at www.jai.com