See the possibilities

Elite Series

User Manual

EL-2800M-CXP
EL-2800C-CXP

2.8M Digital Progressive Scan Monochrome and Color Camera

Document Version:1.7
EL-2800-CXP_Ver.1.7_May2015

1048E-1305

Notice

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

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

Warranty

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

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that EL-2800M-CXP and EL-2800C-CXP comply with the following provisions applying to its standards.
EN 61000-6-3 (Generic emission standard part 1)
EN 61000-6-2 (Generic immunity standard part 1)

FCC

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

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

Warning

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

Supplement

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

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

重要注意事项

有毒，有害物质或元素名称及含量表

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

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

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

环保使用期限

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

数字「15」为期限15年。

Supplement

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

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

重要注意事项

有毒，有害物质或元素名称及含量表

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

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PPB)	多溴二苯醚 (PBDE)
螺丝固定座	×	○	○	○	○	○
光学滤色镜	×	○	×	○	○	○
连**接插**头	×	○	○	○	○	○
电**路板**	×	○	○	○	○	○
.....	.....	.....	.....	.....	.....	.....

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

环保使用期限

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

数字「15」为期限15年。

- Contents -

Introduction

Interface

The EL-2800M-CXP and EL-2800C-CXP employ CoaXPress as an interface system. In order to connect the camera to a PC, it requires the use of a Frame Graber board and the appropriate coaxial cable(s). The maximum video transfer rate per coaxial cable is 6.25 Gbps (CXP-6). The maximum rate per cable supported by the EL-2800 is 3.125 Gbps (CXP-3) but for RGB output, 6.25 Gbps is supported. In addition to video information, power and control signals can be transferred to the camera over this interface. For detailed specifications, please refer to "JIIA-NTF-001-2010" published by Japan Industrial Imaging Association, http://www.jiia.org.

Frame grabber boards used with EL-2800 series

As the EL-2800M-CXP and EL-2800C-CXP employ CoaXPress as an interface system, a CoaXPress-compliant frame grabber board is required. Each camera has a single CoaXPress interface connector.

Cables used with EL-2800 series

For the CoaXPress interface, coaxial cables are used. In the EL-2800M-CXP and EL-2800C-CXP, they use 75Ω 1.0/2.3 DIN receptacles (Amphenol ACX1785-ND or equivalent). The coaxial cable used to connect the camera must have a 75Ω 1.0/2.3 DIN-type plug at the camera side. An ordinary BNC cable cannot be used.

1. General

The EL-2800M-CXP and EL-2800C-CXP are new cameras in JAI's Elite Series. They provide high picture quality, such as high sensitivity and low noise, suitable for machine vision applications. The EL-2800M-CXP is a monochrome progressive scan CCD camera and the EL-2800C-CXP is the equivalent Bayer mosaic progressive scan CCD camera. Both are equipped with a 2/3 inch CCD sensor offering 2.83 million pixels resolution and a 4:3 aspect ratio. They provide 54.7 frames per second for continuous scanning with 1920 x 1440 full pixel resolution for both monochrome and raw Bayer output.

8-bit, 10-bit, or 12-bit output can be selected for both monochrome and Bayer outputs. The EL-2800C-CXP is also capable of performing in-camera color interpolation to produce 24-bit (8-bit per color) RGB output at 54.7 in Quad Tap Sensor Geometry. The new cameras feature a CoaXPress interface which uses coax cable with the capability of supplying power through the cable. The EL-2800M-CXP and EL-2800C-CXP use a single coaxial cable interface. A full pixel readout, partial scan readout, or binning mode (monochrome only) can be selected depending on the application.

EL-2800M-CXP and EL-2800C-CXP have various comprehensive functions needed for automated optical inspection applications, such as solid state device inspection or material surface inspection. They incorporate video processing functions such as a look-up table, shading compensation, and blemish compensation in addition to fundamental functions such as trigger, exposure setting and video level control.

As a common Elite Series feature, a new connector for lens control is employed. EL-2800M-CXP and EL-2800C-CXP support P-iris and motor-driven lenses as standard lens control capabilities. Factory options are available to configure this connector to support DC iris systems as well as provide a video iris output signal, or to provide additional TTL IN and OUT lines.

The latest version of this manual can be downloaded from: www.jai.com
The latest version of the Camera Control Tool for the EL-2800M-CXP and EL-2800C-CXP can be downloaded from: www.jai.com
For camera revision history, please contact your local JAI distributor.

2. Camera composition

The standard camera composition is as follows.

Camera body	1
Sensor protection cap	1
Dear Customer (sheet)	1

The following optional accessories are available.

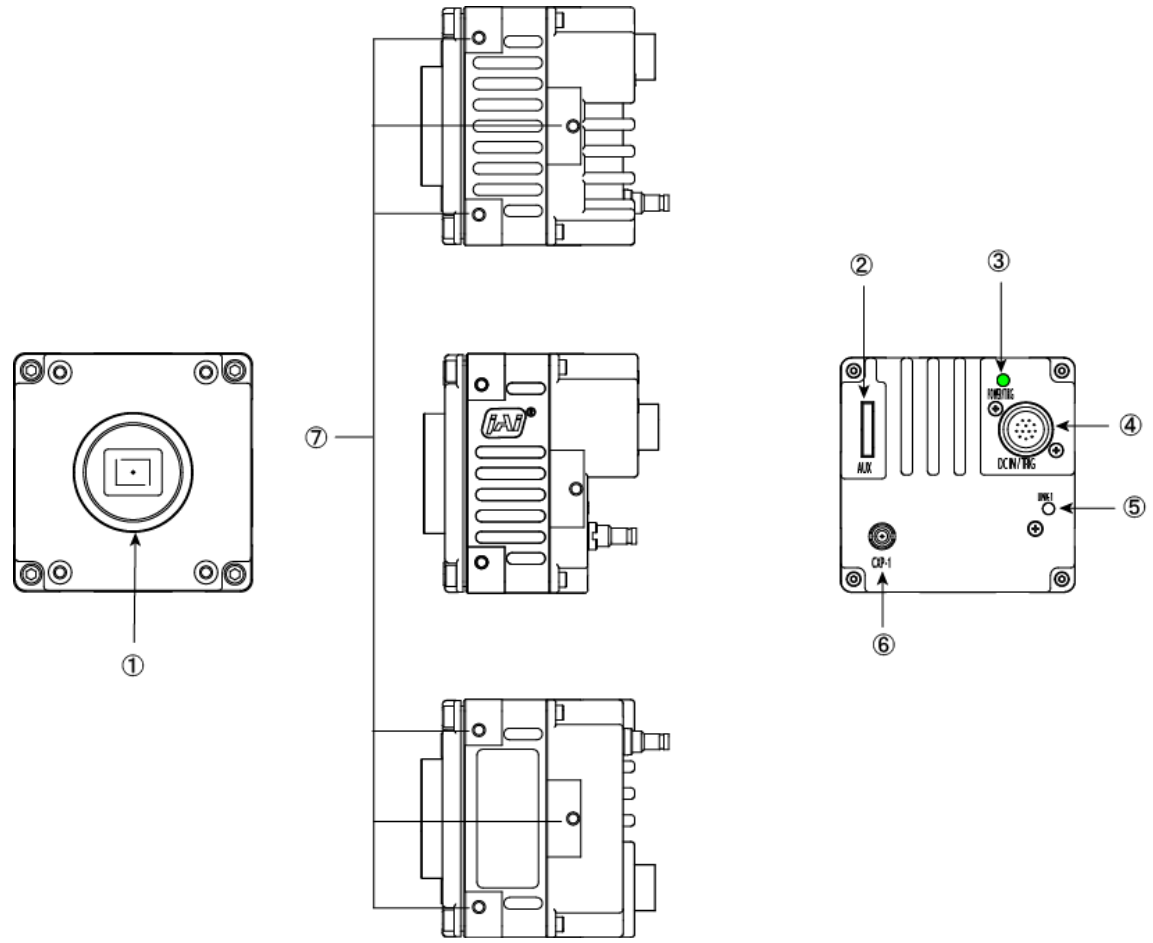
Tripod base	MP-42
Power supply unit	PD-12 series

3. Main features

- New Elite Series, 2/3 ” progressive scan camera
- Intelligent body design for easy and flexible installation
- Utilizes new CoaXPress interface using a single coaxial cable
- Aspect ratio 4:3, 1920(H) x 1440(V), 2.8 million effective pixels
- 4.54 µm square pixels
- S/N 61dB for monochrome and 58.5dB for color
- 8-bit, 10-bit, or 12-bit output for monochrome and Bayer or 8-bit per color output for RGB color
- 54.7 frames/second with full resolution in continuous operation for 1X -2YE output format (monochrome or Bayer) as well as for RGB output in Quad Sensor Tap Geometry and 6.25Gbps Link Configuration, 15.8 frames/second for 1X – 1Y output format including RGB output in-camera interpolation
- Various readout modes, including horizontal and vertical binning (EL-2800M-CXP only) and ROI (Region Of Interest) for faster frame rates
- 0dB to +30dB gain control for EL-2800M-CXP and 0dB to +27dB for EL-2800C-CXP
- 10 µs (1/100,000) to 8 seconds exposure control in 1 µs step
- Auto exposure control
- Timed and trigger width exposure control,
- RCT, PIV and sequential trigger modes for specific applications
- ALC control with combined function of AGC, auto exposure, and auto iris
- Various pre-processing circuits are provided
  Programmable LUT
  Gamma correction from 0.45 to 1.0
  Shading compensation
  Bayer white balance with manual or one-push auto (EL-2800C-CXP only)
  Bayer color interpolation (EL-2800C-CXP only)
  Blemish compensation
- Test pattern signal generator is built in
- Auto iris lens video output with H-sync
- New Hirose 10P connector for lens interface including P-Iris lens control
- C-mount for lens mount

4. Locations and functions

4.1 Locations and functions



①	Lens mount	C-mount (Note *1)
②	10-pin connector	Connector for lens control
③	LED	Indication for power and trigger input
④	12-pin connector	DC input and trigger input
⑤	LINK 1	LINK Status indication for CXP
⑥	CXP 1	CoaXPress connector
⑨	Mounting holes	Holes for mounting tripod base or direct installation. Depth 5 mm (Note*2)

*1) Note1: Rear protrusion on C-mount lens must be less than 10.0 mm.
*2) Note3: The part number for the tripod adapter plate (with 1/4"-20 thread) is MP-42 (option).

Fig. 1 Locations

4.2 Rear panel

The rear panel mounted LED provides the following information:

- Amber: Power connected – initiating
  This light goes OFF after initiating.
- Steady green: Camera is operating in Continuous mode
- Flashing green: The camera is receiving external triggering

Note: The interval of flashing does not correspond with external trigger duration.

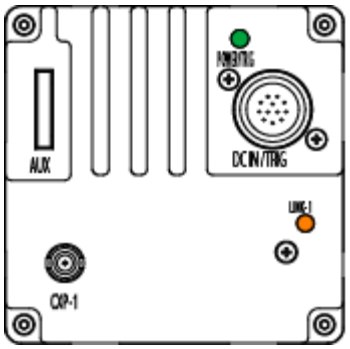


Fig. 2 Rear panel

LINK1
- Flashing green: Searching LINK (in case of using PoCXP)
- Flashing amber: Searching LINK (in case of PoCXP not being used)

5. Input and output

5.1 CoaXPress interface standard

The EL-2800M-CXP and EL-2800C-CXP use CoaXPress as their interface. CoaXPress is a PLUG-AND-PLAY interface and connects the camera and the frame grabber board by coaxial cable(s). Its maximum transfer rate is 6.25 Gbps per one coaxial cable. Additionally, CoaXPress interface supports power supplied through the coaxial cable as well as communication signals. In the CoaXPress interface, multiple coaxial cables can be used in order to achieve a faster transfer rate or a reduced transfer rate can be used to extend the cable length.
In the EL-2800M-CXP and EL-2800C-CXP, a single coaxial cable system is used.

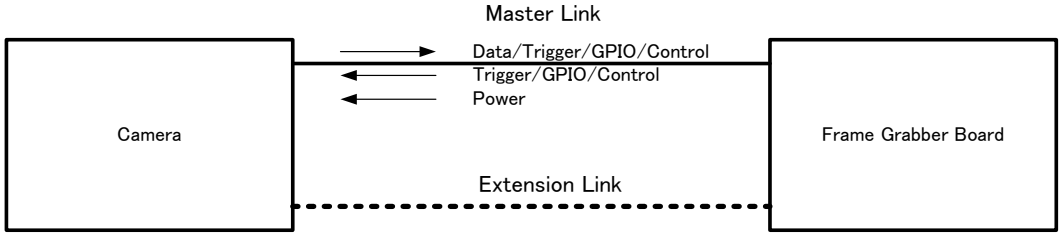


Fig.3 CoaXPress interface

The distance between camera and frame grabber board depends on the bit rate of the video and the cable used. Among the unique features of CoaXPress is its ability to supply DC power and provide trigger timing accuracy.
The maximum power supply per one cable is 13W with DC+24V voltage. The accuracy of the trigger is ±2 ns at 3.125 Gbps.
The CoaXPress compliance labeling is assigned to the following five cable types and the maximum bit rate and transmission length is indicated in the table below.

Table – 1 CoXPress Compliance Labeling

Compliance Labeling	Maximum Operational Bit Rate per coax (Gbps) and transmission length
CXP-1	1.250 (up to 212 m)
CXP-2	2.500 (up to 185 m)
CXP-3	3.125 (up to 169 m)
CXP-5	5.000 (up to 102 m)
CXP-6	6.250 (up to 68 m)

In the EL-2800M-CXP and EL-2800C-CXP, the maximum bit rate is 3.125 Gbps for Monochrome and Bayer color and 6.25 Gbps for RGB color per one cable.

For the details of the specifications, please refer to “JIIA-NTF-001-2010” published by Japan Industrial Imaging Association, http://www.jiia.org.

5.2 Connectors and pin assignment

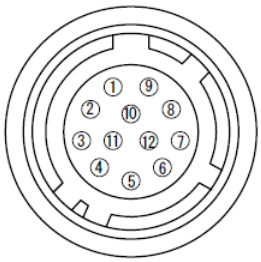
5.2.1 Digital Video Output (75Ω 1.0/2.3 DIN Receptacle)

Type: CoaXPress Connector (ACX1785-ND Amphenol Connector or equivalent)

CXP#1	PoCXP compliant

Maximum Bit Rate per one coax: 6.25 Gbps

5.2.2 12-Pin connector



Type: HR10A-10R-12PB-01 male or equivalent
Use the part number HR10A-10P-12S for the cable side

Fig.4 12-pin connector

5.2.2.1 Pin assignment

Table – 2 12P Pin assignment

Pin no.	Signal	Remarks
1	GND	
2	DC input	+12V to +24V
3	GND	
4	NC	
5	Opt IN -	Line 5
6	Opt IN +	
7	Opt OUT -	Line 2
8	Opt OUT +	
9	TTL out 1	Line 1 (Note*1)
10	TTL In 1	Line 4 (Note*2)
11	DC input	+12V to +24V
12	GND	

*1) Factory default setting is an Exposure Active signal with negative polarity.
*2) Factory default setting is a trigger input

5.2.3 AUX Standard Hirose 10-Pin connector for Lens

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

Fig.5 Hirose 10-pin connector

Table – 3 Hirose 10P Pin Assignment

No	I/O	Name	Note
1	O	DRIVE IRIS+	Motorized Lens
2	O	DRIVE FOCUS+	Motorized Lens
3	O	DRIVE ZOOM+	Motorized Lens
4	O	COMMON	Motorized Lens
5		GND	
6	O	P-IRIS OUT A+	P-Iris Lens
7	O	P-IRIS OUT A-	P-Iris Lens
8	O	P-IRIS OUT B+	P-Iris Lens
9	O	P-IRIS OUT B-	P-Iris Lens
10	O	GND	

5.2.4 AUX Type 2 HIROSE 10-Pin connector (Factory option)

HIROSE 10-Pin Connector 3260-10S3(55)
Note: This is a factory option.

Table – 4 Hirose 10P Pin assignment (Option)

No	I/O	Name	Note
1	O	Video Signal	Video Iris Lens
2	O	Power DC+12V	Video Iris Lens
3		NC	
4		NC	
5		GND	
6	O	DC IRIS DAMP-	DC Iris
7	O	DC IRIS DAMP+	DC Iris
8	O	DC IRIS DRIVE+	DC Iris
9	O	DC IRIS DRIVE-	DC Iris
10		GND	

5.2.5 AUX Type 3 HIROSE 10-Pin connector (Factory option)

HIROSE 10-Pin Connector 3260-10S3(55)
Note: This is a factory option.

Table – 5 Hirose 10P Pin Assignment (Option)

No	I/O	Name	Note
1	O	TTL OUT2	Line8
2	O	TTL OUT3	Line9
3	I	TTL_IN2	Line10
4		NC	
5		GND	
6	I	LVDS_IN1+	Line11
7	I	LVDS_IN1-	
8		NC	
9		GND	
10		GND	

5.3 Output

5.3.1 Digital output

5.3.1.1 Output level

Table – 6 Output level

CCD out			Analog Out (Equivalent)	Digital Out		
				8-bit	10-bit	12-bit
Black		0%	Setup 3.6%, 25mV	8LSB	32LSB	128LSB
Monochrome	574mV	100%	700mV	222LSB	890LSB	3560LSB
Color	386mV					
Monochrome	662mV	115%	800mV	255LSB	1023LSB	4095LSB
Color	445mV					

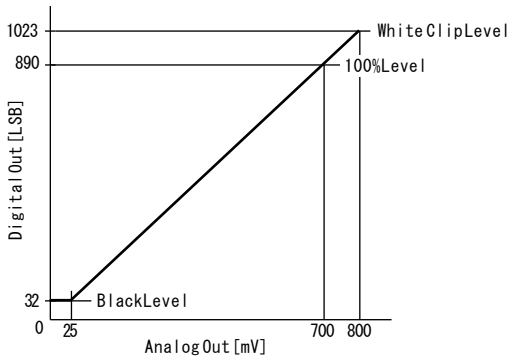


Fig.6 Bit allocation

5.4 Digital IN/OUT interface

In the EL-2800-CXP, the software control tool can assign the necessary signals to the digital I/O ports.

5.4.1 Line Selector

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

Table – 7 Line selector

Line Selector item	Description
Line 1 TTL 1 Out	TTL 1 output from 12P connector #9 pin located on the rear panel
Line 2 OPT Out	OPT output from 12P connector #7/8 pins located on the rear panel
Line 8 TTL 2 Out	TTL 2 output from “AUX” HIROSE 10-Pin connector #1 pin
Line 9 TTL 3 Out	TTL 3 output from “AUX” HIROSE 10-Pin connector #2 pin
NAND 0 In 1	NAND first gate, No. 1 input on GPIO
NAND 0 in 2	NAND first gate, No. 2 input on GPIO
NAND 1 In 1	NAND second gate, No. 1 input on GPIO
NAND 1 in 2	NAND second gate, No. 2 input on GPIO

Note: Line 8, 9, 10 and 11 are available if AUX Type 3 is used for AUX connector.

5.4.2 Line source

Line source signal is selected against the dedicated line selected in the line selector.
Table – 8 Line source

Line Source item	Description
Low	Connect Low Level signal to line item selected in Line Selector, **Default setting**
High	Connect High Level signal to line item selected in Line Selector
Frame Trigger Wait	Connect Frame Trigger Wait signal to line item selected in Line Selector
Frame Active	Connect Frame Active signal to line item selected in Line Selector
Acquisition Trigger Wait	Connect Acquisition Trigger Wait signal to line item selected in Line Selector
Acquisition Active	Connect Acquisition Active signal to line item selected in Line Selector
Exposure Active	Connect Exposure Active signal to line item selected in Line Selector
FVAL	Connect FVAL signal to line item selected in Line Selector
LVAL	Connect LVAL signal to line item selected in Line Selector
PulseGenerator0 Out	Connect Pulse Generator 0 signal to line item selected in Line Selector
PulseGenerator1 Out	Connect Pulse Generator 1 signal to line item selected in Line Selector
PulseGenerator2 Out	Connect Pulse Generator 2 signal to line item selected in Line Selector
PulseGenerator3 Out	Connect Pulse Generator 3 signal to line item selected in Line Selector
Line 4 TTL 1 In	Connect TTL 1 In signal to line 4 in Line Selector
Line 5 Opt In	Connect Opt In signal to line 4 in Line Selector
Line 7 Trigger packet In	Connect CXP trigger packet IN signal to line 7 in Line Selector
NAND 0 Out	Connect NAND 0 signal to line item selected in Line Selector
NAND 1 Out	Connect NAND 1 signal to line item selected in Line Selector
Line 10 TTL 2 In	Connect TTL 2 In signal to Line 10
Line 11 LVDS 1 In	Connect LVDS 1 In signal to Line 11

Note] As for LVAL, some line items cannot be connected. Refer to "5.4.6.2 GPIO matrix table"

5.4.3 Line Mode

Indicates the status of the interface, input or output.

5.4.4 Line Inverter

Sets the polarity of the selected input or output.

5.4.5 Line Status

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

5.4.6 Line Format

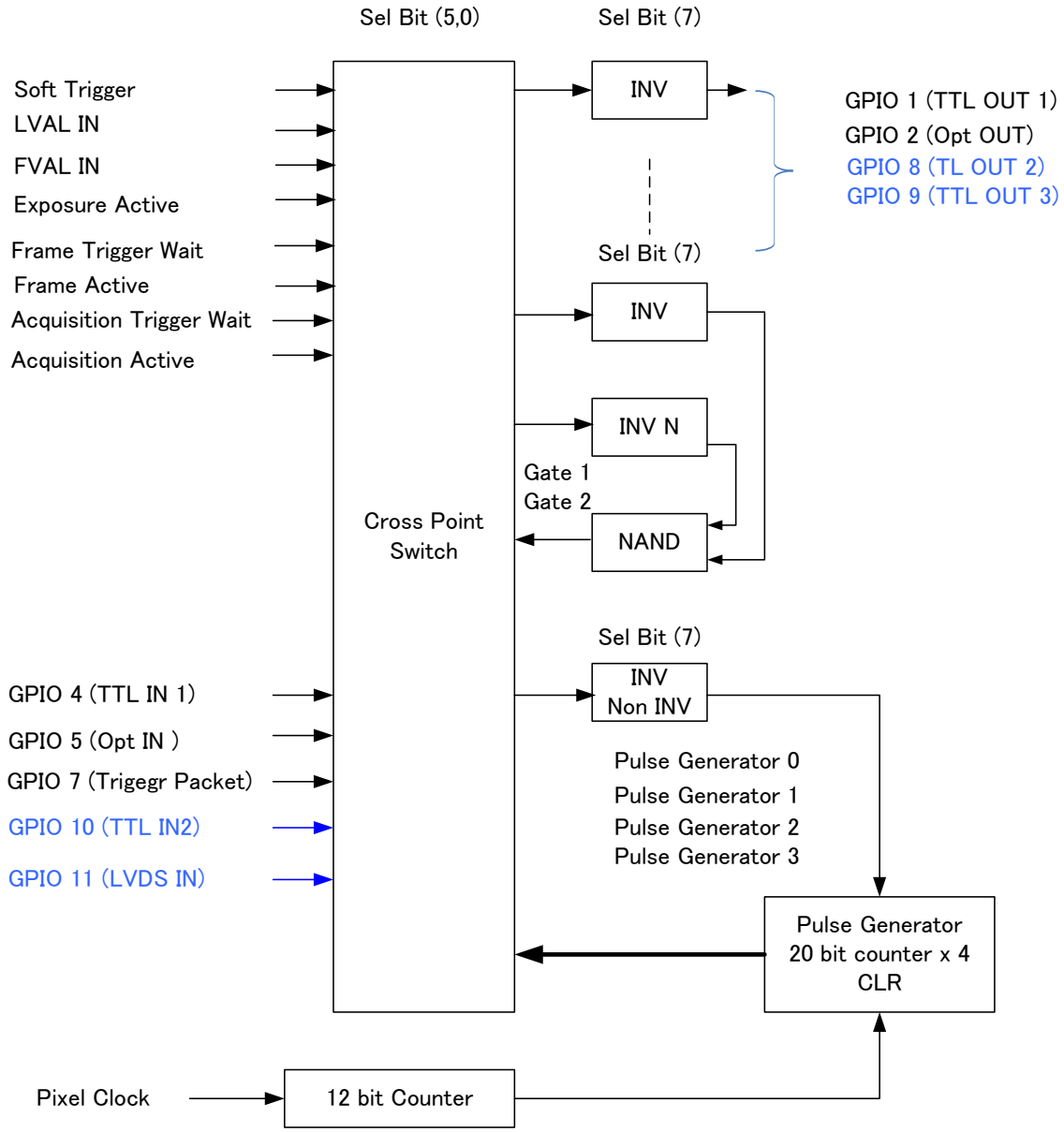
Display the input or output interface format of the line item selected in Line Selector.
(No Connect, TTL, LVDS, Opt Coupled)

5.4.7 GPIO

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

5.4.7.1 GPIO block diagram

Basic block diagram is as follows.



Note: For EL-2800-CXP, Camera Output Pixel Clock is 108 MHz.

Fig. 7 GPIO diagram

5.4.7.2 IN and OUT matrix table

The following table shows the input and output matrix.

Table - 9 GPIO IN and OUT matrix

Selector (Cross point switch output) / Source signal (Cross point switch input)	Trigger Selector			Line Selector								Pulse Generator Selector				
	Acquisition Start	Acquisition Stop	Frame Start	Line 1 - 12P TTL Out 1	Line 2 - 12P Opt OUT	Line 8 - TTL 2 Out	Line 9 - TTL 3 Out	NAND 1 In 1	NAND 1 In 2	NAND 2 In 1	NAND 2 In 2	Pulse Generator 0	Pulse Generator 1	Pulse Generator 2	Pulse Generator 3	
LOW	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
HIGH	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
Line 4 - 12P TTL In	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
Line 5 - 12P Opt IN	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
Line 7 - Trigger packet	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
NAND 1 Out 1	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
NAND 2 Out 1	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
Pulse Generator 0	O	O	O	O	O	O	O	O	O	O	O	×	O	O	O	
Pulse Generator 1	O	O	O	O	O	O	O	O	O	O	O	O	×	O	O	
Pulse Generator 2	O	O	O	O	O	O	O	O	O	O	O	O	O	×	O	
Pulse Generator 3	O	O	O	O	O	O	O	O	O	O	O	O	O	O	×	
Software Trigger	O	O	O	×	×	×	×	O	O	O	O	×	×	×	×	
FVAL	×	×	×	O	O	O	O	O	O	O	O	O	O	O	O	
LVAL	×	×	×	O	O	O	O	O	O	O	O	O	O	O	O	
Exposure Active	×	×	×	O	O	O	O	O	O	O	O	O	O	O	O	
Acquisition Trigger Wait	×	×	×	O	O	O	O	O	O	O	O	O	O	O	O	
Acquisition Active	×	×	×	O	O	O	O	O	O	O	O	O	O	O	O	
Frame Trigger Wait	×	×	×	O	O	O	O	O	O	O	O	O	O	O	O	
Frame Active	×	×	×	O	O	O	O	O	O	O	O	O	O	O	O	
Line 10 - TTL 2 In	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Extension GPIO Connection
Line 11 - LVDS 1 In	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
	Trigger Source			Line Source								Pulse Generator Clear Source				

5.5 Optical Interface

EL-2800-CXP is equipped with opto-isolated inputs and outputs, providing galvanic separation between the camera's inputs/outputs and peripheral equipment.
In addition to galvanic separation, the opto-isolated inputs and outputs can cope with a wide range of voltages; the voltage range for inputs is +3.3V to +24V DC whereas outputs will handle +5V to +24V DC.
The following drawing is the concept of photo coupler

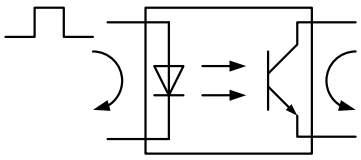


Fig.8 Photo coupler

5.5.1 Recommended External Input circuit diagram for customer

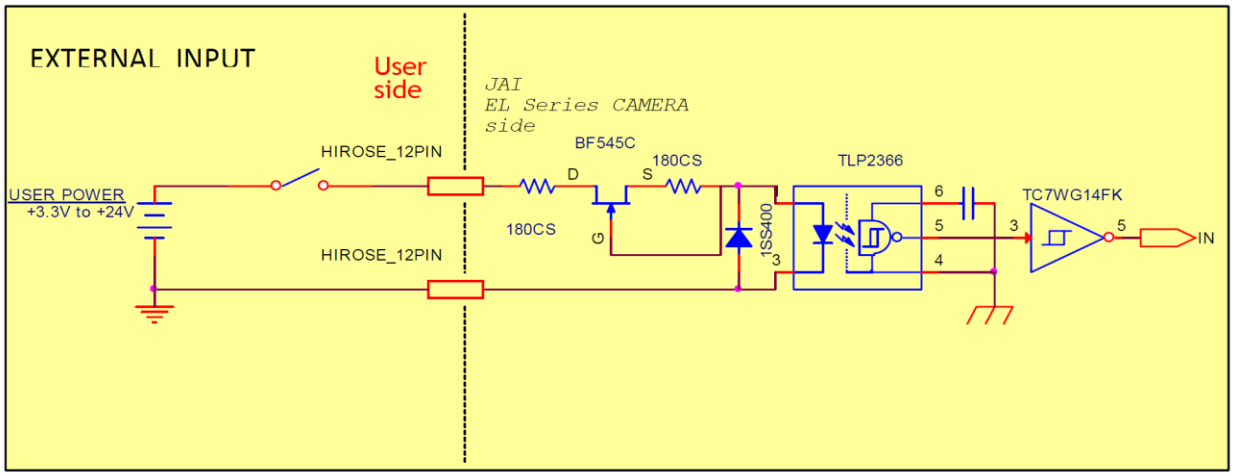


Fig.9 Example of external input circuit

5.5.2 Recommended External Output circuit diagram for customer

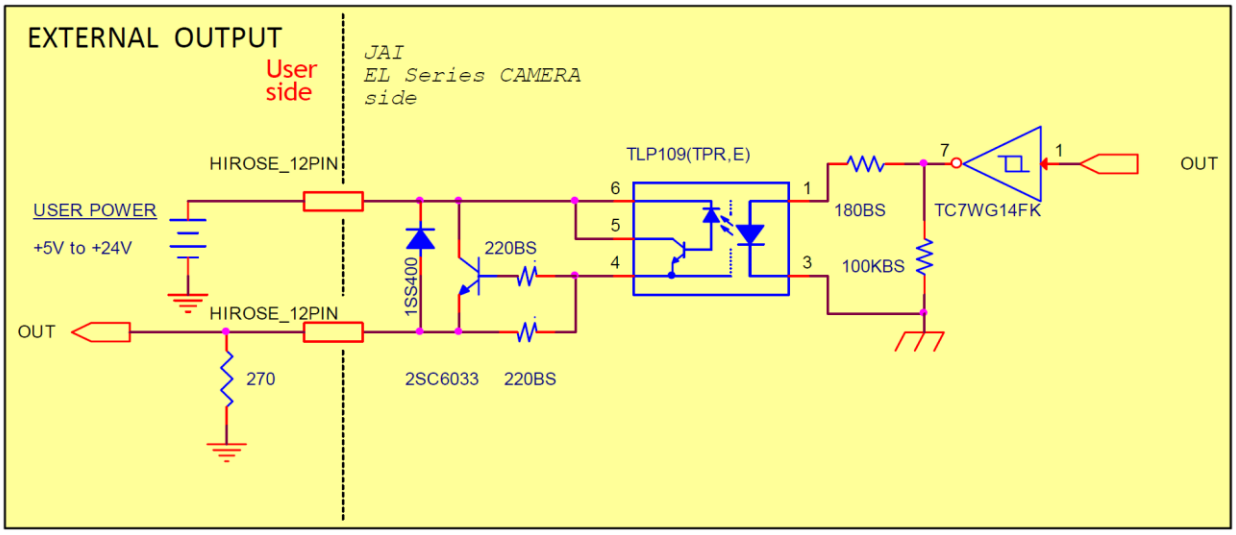
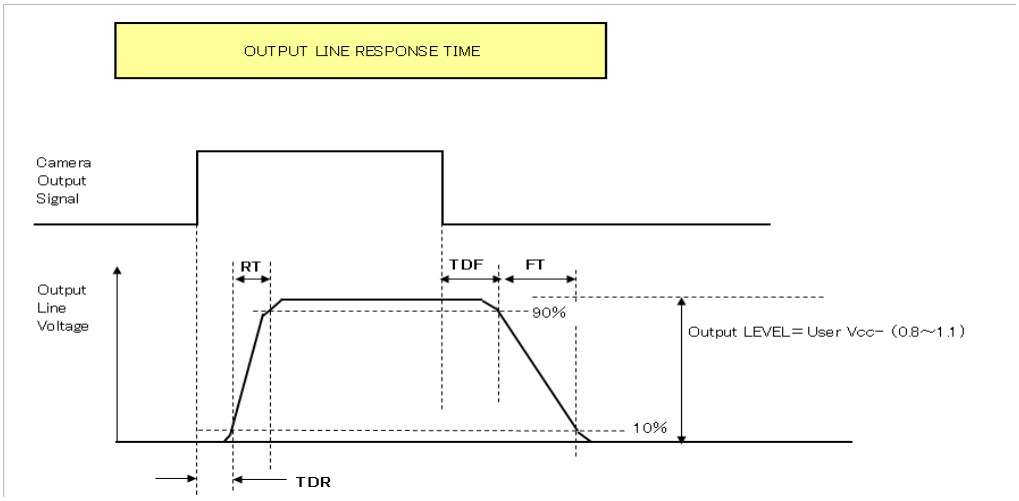


Fig.10 Example of external output circuit

5.5.3 Characteristics of optical interface

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



270Ω	User Power (VCC)			
	3.3V	5V	12V	24V
Time Delay Rise TDR (us)	0.54	0.54	0.62	0.68
Rise Time RT (us)	1.2	1.2	2	3
Time Delay Fall TDF (us)	1.5	1.5	2.4	2.1
Fall Time FT (us)	3.6	3.4	4.5	6.8

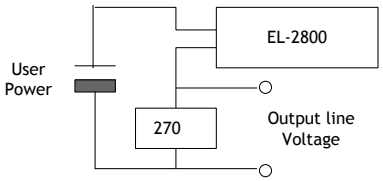


Fig.11 Optical interface characteristics

5.6 Pulse Generator

The EL-2800-CXP has a frequency divider using the pixel clock as the basic clock and four pulse generators. In each Pulse Generator, various Clear settings are connected to GPIO. The following shows Pulse Generator default settings.

Table - 10 Pulse Generator default settings

Display Name	Value							
Clock Pre-scaler	1							
	Pulse Generator							
Pulse Generator Selector	Length	Start Point	End Point	Repeat Count	Clear Source	Clear Inverter	Clear Activation	Clear Sync Mode
- Pulse Generator 0	1	0	1	0	Off	True	Off	Async Mode
- Pulse Generator 1	1	0	1	0	Off	True	Off	Async Mode
- Pulse Generator 2	1	0	1	0	Off	True	Off	Async Mode
- Pulse Generator 3	1	0	1	0	Off	True	Off	Async Mode

Note:]
When Pulse Generator Repeat Count is set to “0”, the camera is operating in Free Running mode.
However, based on the above default settings (Length=1, Start Point=0 and End Point=1), Pulse Generator stops at High output. Therefore, if Start Point=0 and End Point=1 are configured, Length should be “2” as the minimum active width.

5.6.1 Clock Pre-scaler

Clock pre-scaler (Divide Value) can set the dividing value of the frequency divider (12-bit length) and the pixel clock is used for this. Four built-in pulse generators work by the same clock. In the EL-2800M/C-PMCL, the pixel clock is 108 MHz.

5.6.2 Pulse Generator Selector

This is where you select one of the 4 pulse generators in order to set or modify its parameters.

Table - 11 Pulse Generator setting

Trigger Selector item	Description
Pulse Generator 0	If Pulse Generator 0 is selected, Length、Start Point、End Point、Repeat Count、Clear Source、Clear Inverter, Clear Activation and Clear Sync Mode of pulse generator 0 are displayed under the selector.
Pulse Generator 1	If Pulse Generator 1 is selected, Length、Start Point、End Point、Repeat Count、Clear Source、Clear Inverter, Clear Activation and Clear Sync Mode of pulse generator 1 are displayed under the selector.
Pulse Generator 2	If Pulse Generator 2 is selected, Length、Start Point、End Point、Repeat Count、Clear Source、Clear Inverter, Clear Activation and Clear Sync Mode of pulse generator 2 are displayed under the selector.
Pulse Generator 3	If Pulse Generator 3 is selected, Length、Start Point、End Point、Repeat Count、Clear Source、Clear Inverter, Clear Activation and Clear Sync Mode of pulse generator 3 are displayed under the selector.

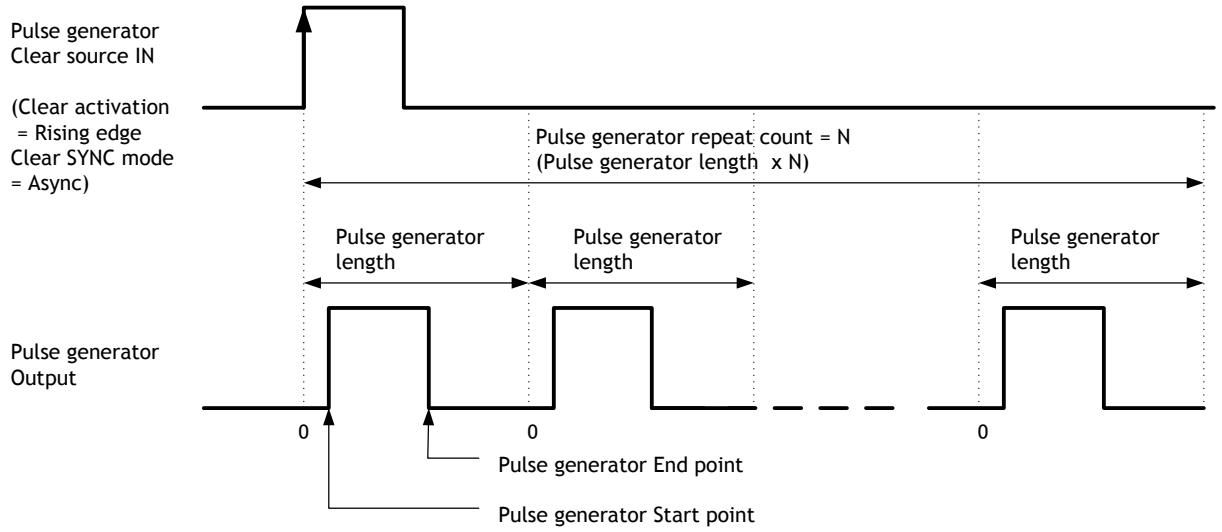


Fig.12 Pulse Generator Pulse construction

5.6.3 Pulse Generator Length

Set the counter up value (number of clocks, refer to Table 12) for the selected pulse generator.
If Repeat Count value is “0”, and if Pulse Generator Clear signal is not input, the pulse generator generates the pulse repeatedly until reaching this counter up value.

5.6.4 Pulse Generator Start Point

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

5.6.5 Pulse Generator End Point

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

5.6.6 Pulse Generator Repeat Count

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

5.6.7 Pulse Generator Clear Activation

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

5.6.8 Pulse Generator Clear Sync Mode

Set the count clear method for the selected pulse generator.
In Async Mode, if the clear signal is input during the length setting value, the counter will stop counting according to the clear signal input.
In Sync Mode, if the clear signal is input during the length setting value, the counter will continue to count until the end of the length setting value and then clear the count.
Both modes clear the repeat count when the counter is cleared.

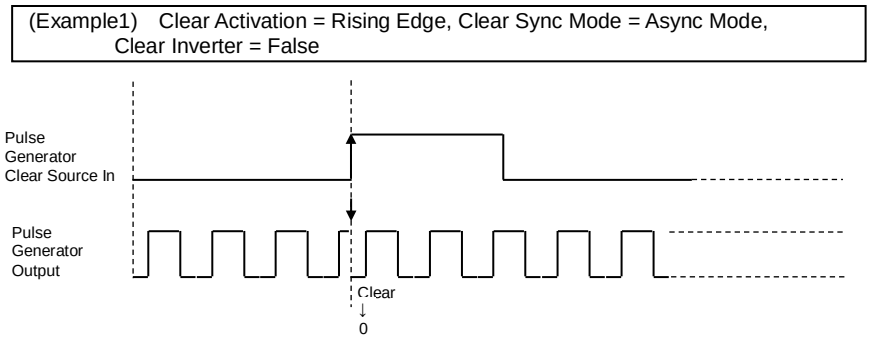


Fig.13 Counter clear in Async mode

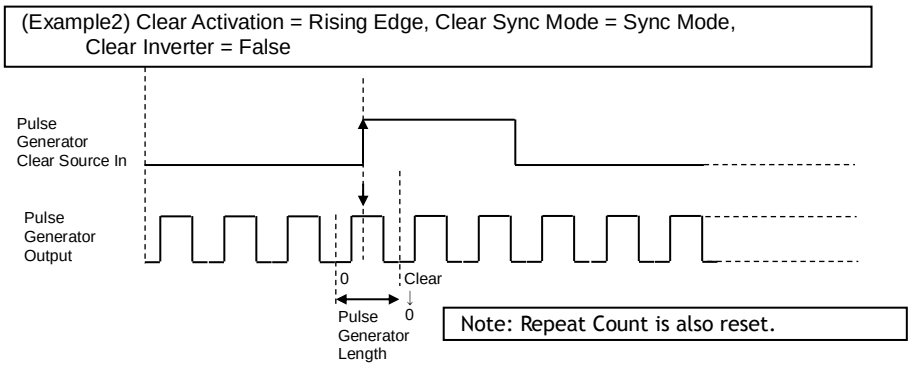


Fig.14 Counter clear in Sync mode

5.6.9 Pulse Generator Clear Source

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

Table - 12 Pulse generator clear source

Pulse Generator Clear Source item	Description
Low	Connect Low level signal to Clear Source for the selected pulse generator. **Default setting**
High	Connect High level signal to Clear Source for the selected pulse generator.
Frame Trigger Wait	Connect Frame Trigger Wait signal to Clear Source for the selected pulse generator.
Frame Active	Connect Frame Active signal to Clear Source for the selected pulse generator.
Exposure Active	Connect Exposure Active signal to Clear Source for the selected pulse generator.
Acquisition Trigger Wait	Connect Acquisition Trigger Wait signal to Clear Source for the selected pulse generator.
Acquisition Active	Connect Acquisition Active signal to Clear Source for the selected pulse generator.
FVAL	Connect FVAL signal to Clear Source for the selected pulse generator.
LVAL	Connect LVAL signal to Clear Source for the selected pulse generator.
PulseGenerator0 Out	Connect Pulse Generator 0 output to Clear Source for the selected pulse generator.
PulseGenerator1 Out	Connect Pulse Generator 1 output to Clear Source for the selected pulse generator.
PulseGenerator2 Out	Connect Pulse Generator 2 output to Clear Source for the selected pulse generator.
PulseGenerator3 Out	Connect Pulse Generator 3 output to Clear Source for the selected pulse generator.
TTL 1 In	Connect TTL 1 IN signal to Clear Source for the selected pulse generator.
Opt In	Connect Opt IN signal to Clear Source for the selected pulse generator.
Trigger packet	Connect Trigger packet signal to Clear Source for the selected pulse generator.
Nand0 Out	Connect NAND 0 output signal to Clear Source for the selected pulse generator.
Nand1 Out	Connect NAND 1 output signal to Clear Source for the selected pulse generator.
Line 10 TTL 2 In	Connect TTL 2 IN signal to LINE 10.
Line 11 LVDS 1 In	Connect LVDS 11 1 IN signal to Line 11

Note:
The pulse generator output cannot be used as the clear input to the same pulse generator. Refer to "5.4.6.2 GPIO matrix table".

5.6.10 Pulse Generator Inverter

Clear Source Signal can have polarity inverted.

5.6.11 Pulse Generator Setting table

Table - 13 Pulse Generator setting parameters

Display Name	Value
Clock Pre-scaler	1 to 4096
Pulse Generator Clock (MHz)	[Pixel Clock:108MHz]÷[Clock Pre-scaler]
Pulse Generator Selector	- Pulse Generator 0
	- Pulse Generator 1
	- Pulse Generator 2
	- Pulse Generator 3
- Pulse Generator Length	1 to 1048575
- Pulse Generator Length (ms)	([Clock Source]÷[Clock Pre-scaler]) $^{-1}$ x [Pulse Generator Length]
- Pulse Generator Frequency (Hz)	[Pulse Generator Length (ms)] $^{-1}$
- Pulse Generator Start Point	0 to 1048574
- Pulse Generator Start Point (ms)	([Clock Source]÷[Clock Pre-scaler]) $^{-1}$ x [Pulse Generator Start Point]
- Pulse Generator End Point	1 to 1048575
- Pulse Generator End Point (ms)	([Clock Source]÷[Clock Pre-scaler]) $^{-1}$ x [Pulse Generator End Point]
- Pulse Generator pulse-width (ms)	[Pulse Generator End Point (ms)]－[Pulse Generator Start Point (ms)]
- Pulse Generator Repeat Count	0 to 255
- Pulse Generator Clear Activation Clear Mode for the Pulse Generators	- Off
	- High Level
	- Low level
	- Rising Edge
	- Falling Edge
- Pulse Generator Clear Sync Mode	- Async mode
	- Sync mode
- Pulse Generator Clear Source	- Low
	- High
	- Frame Trigger Wait
	- Frame Active
	- Exposure Active
	- Acquisition Trigger Wait
	- Acquisition Active
	- FVAL
	- LVAL
	- PulseGenerator0
	- PulseGenerator1
	- PulseGenerator2
	- PulseGenerator3
	- TTL_In1
	- Opt In
	- Trigger packet
	- Nand0 Out
	- Nand1 Out
	- Line 10 - TTL 2 In
	- Line 11 - LVDS 1 In
- Pulse Generator Inverter (Polarity) Pulse Generator Clear Inverter	- False
	- True

Note:
1. If Pulse Generator Repeat Count is set to “0”, the pulse generator works in Free Running mode.

6. Sensor layout, output format and timing

6.1 Sensor layout

CCD sensors used in the EL-2800M and EL-2800C have the following tap and pixel layout.

6.1.1 Monochrome sensor

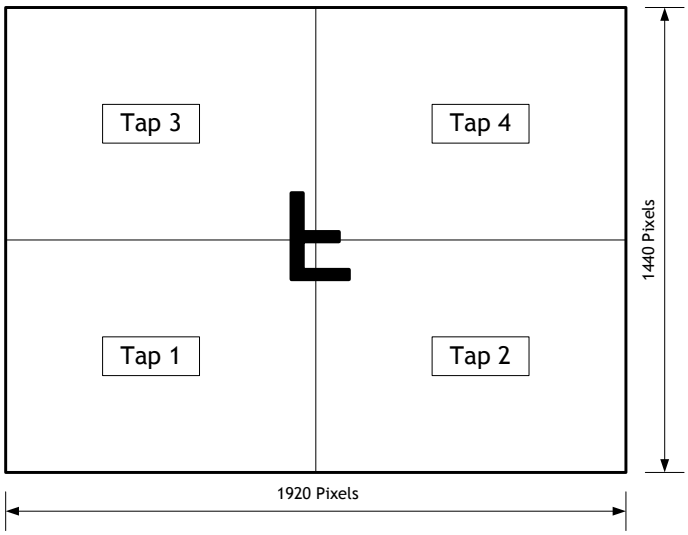


Fig.15 Monochrome sensor layout

6.1.2 Bayer color sensor

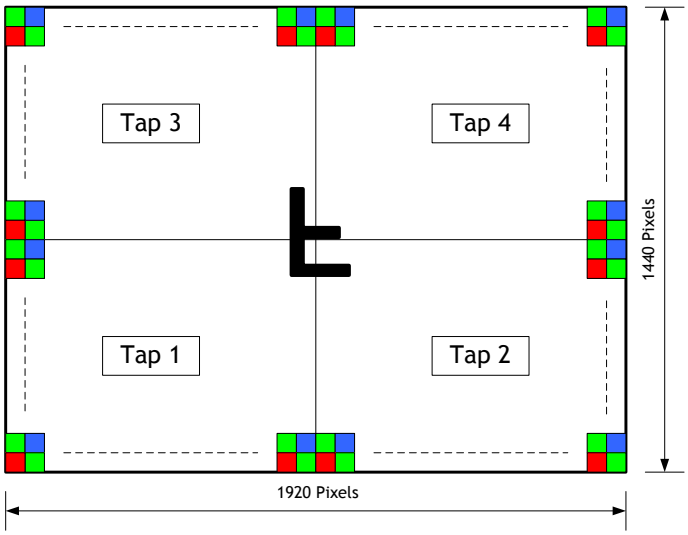


Fig.16 Bayer color sensor layout

6.2. Sensor readout (Sensor Tap Geometry)

The following drawings show how the image is read out from the sensor. This is different from how the image is read out from the camera.

6.2.1 4 taps readout (1X2-2YE)

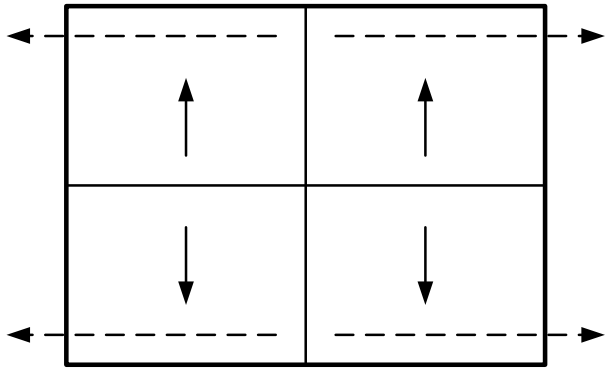


Fig.17 Sensor readout 4-tap

6.2.2 2 Taps readout (2XE-1Y)

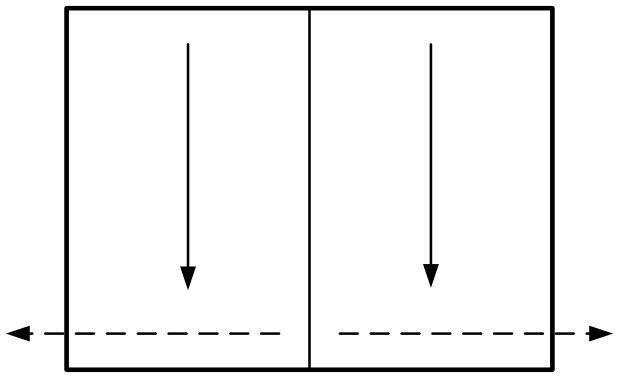


Fig.18 Sensor readout 2-Tap

6.2.3 1 tap readout (1X-1Y)

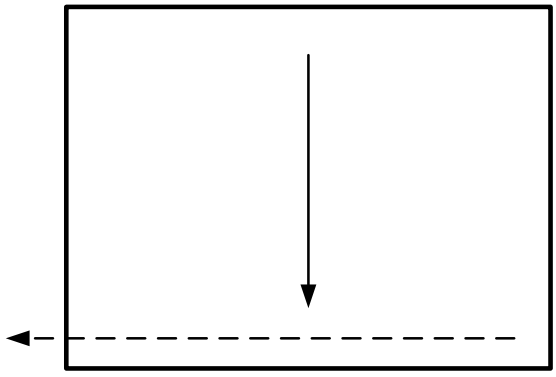


Fig.19 Sensor readout 1-tap

6.3. Camera output format and sensor readout system

The following table shows the camera output format based on GenIcam S.F.N.C version 1.5.1.

Table – 14 Camera output format

Sensor readout output (Sensor Tap geometry)	Camera output format (Tap Geometry)	Reference figure
1 tap readout (1X-1Y)	1X-1Y	6.2.1
2 taps readout (2XE-1Y)	1X-1Y	6.2.1
4 taps readout (1X2-2YE)	1X-2YE	6.2.2

6.3.1 1X-1Y

1X-1Y is defined in GenICam SFNC Ver. 1.5.1 for 1-tap camera output format as the following.

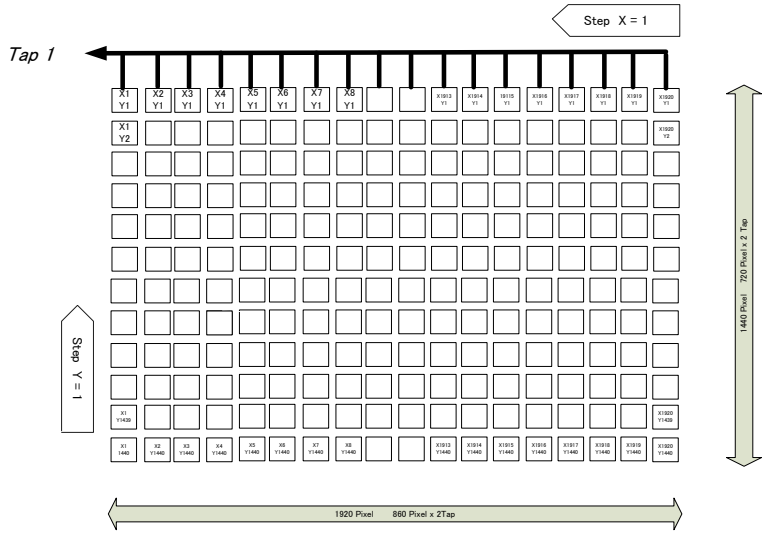


Fig.20 1X-1Y Camera output format

6.3.2 1X-2YE

1X2-2YE is 2-tap camera output format based on GenICam SFNC Ver. 1.5.1.

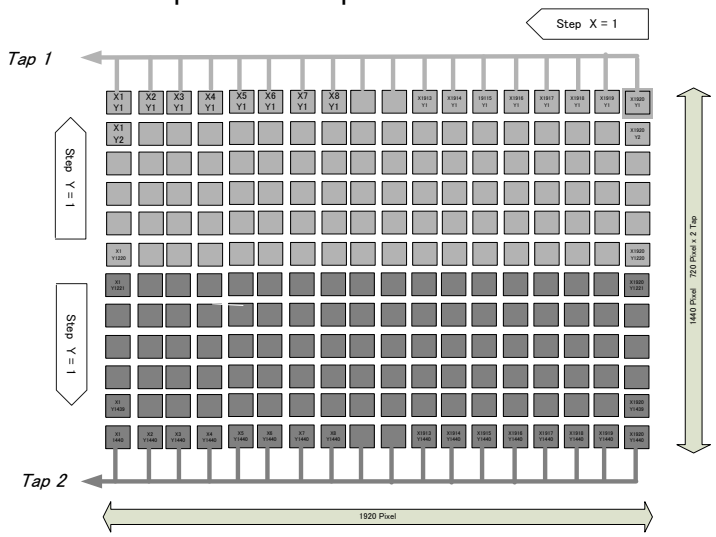


Fig.21 1X-2YE camera output format

6.4 The relationship between tap geometry and frame rate

In the EL-2800-CXP, the frame rate is related to Pixel Format, Sensor Tap Geometry (sensor readout system), Tap Geometry (camera output format), Bit Rate and Link Configuration.
The following table 15 shows these relationships.

Table – 15 Tap geometry and frame rate relationship map

Pixel Format	Sensor Tap Geometry	Tap Geometry (Camera Out)	Frame Rate (fps)	Bit Rate (Bit)	Data rate (Mbps)	Link Configuration	
						3.125Gbps	6.25Gbps
Mono Bayer	1X2-2YE (Quad)	1X-2YE	54.7	8	1207.7	OK	OK
				10	1509.6	OK	OK
				12	1811.5	OK	OK
	2XE-1Y (Double)	1X-1Y	27.4	8	606.0	OK	OK
				10	757.6	OK	OK
				12	909.1	OK	OK
	1X-1Y (Single)		15.8	8	349.5	OK	OK
				10	436.8	OK	OK
				12	524.2	OK	OK
RGB	1X-2YE	1X-2YE	54.7	24	3623.0	NG	OK
	2XE-1Y	1X-1Y	27.4	24	1818.1	OK	OK
	1X-1Y		15.8	24	1048.4	OK	OK

Note: 1) Mono, Bayer or RGB is selected in the pixel format. The setting parameters for Mono or Bayer are the same.
2) The camera output format to be used is selected in Tap Geometry.
3) If 1X-2YE is selected in Tap Geometry, Sensor Tap Geometry is automatically set to 1X2-2YE. If IX-1Y is selected, the customer should choose 2XE-1Y or 1X-1Y in Sensor Tap Geometry according the application.
4) Link configuration should be selected 6.25 Gbps if 1X-2YE is selected in RGB pixel format. In other cases, the customer can choose either 3.125 Gbps or 6.25 Gbps according to the application.

6.5 Output timing

6.5.1 Horizontal timing

6.5.1.1 Output format 1X-2YE (Pixel clock: 108 MHz)

Vertical binning OFF

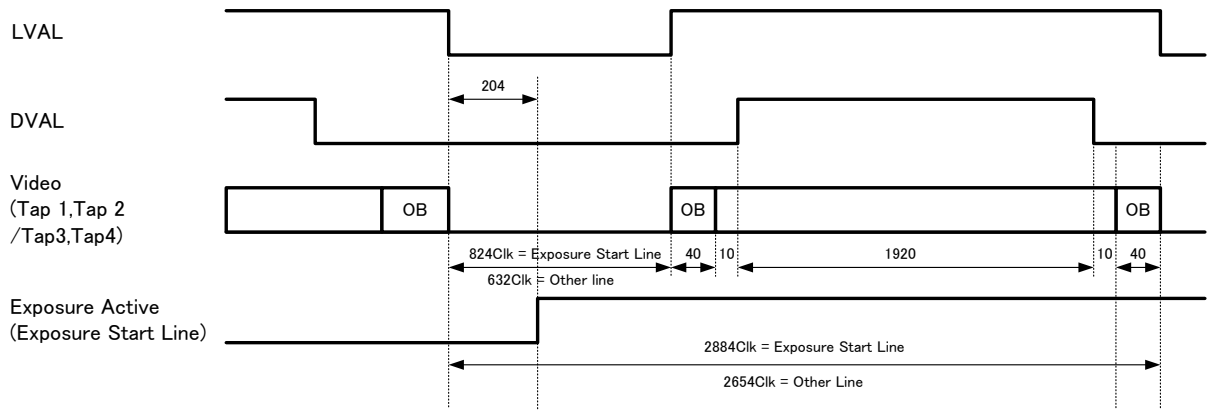


Fig.22 1X-2YE Horizontal Timing (Vertical timing OFF)

6.5.1.2 Output format 1X-2YE (Pixel clock: 108 MHz)

Vertical binning ON

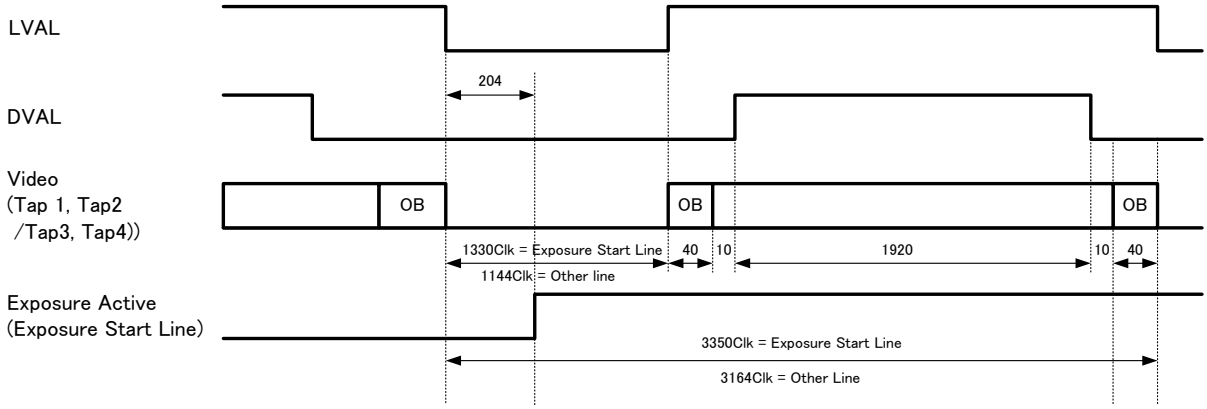


Fig. 23 1X-2YE Horizontal timing (Vertical binning ON)

6.5.2.1 Output format 1X-1Y (Camera Output Pixel clock: 108 MHz)

Vertical binning OFF

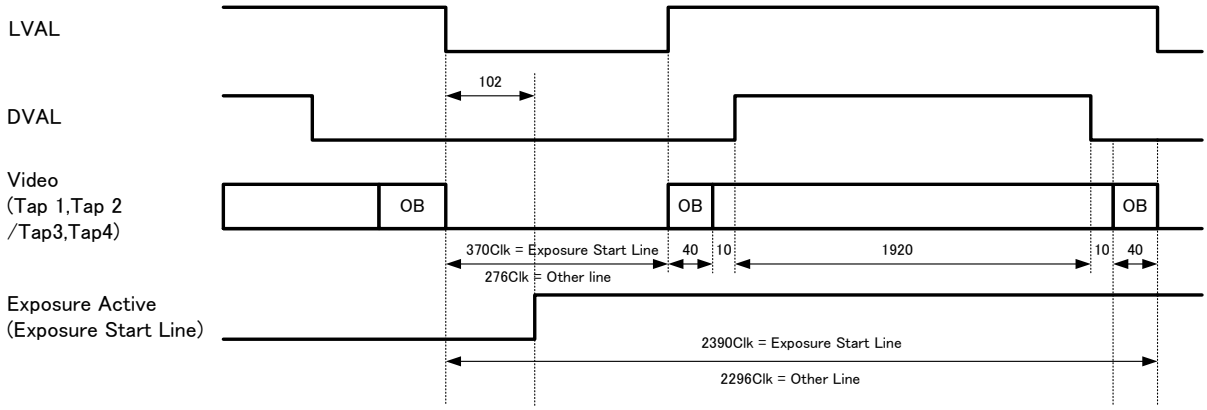


Fig.24 1X-1Y Horizontal Timing (Vertical timing OFF)

6.5.2.2 Output format 1X-1Y (Camera Output Pixel clock: 108 MHz)

Vertical binning ON

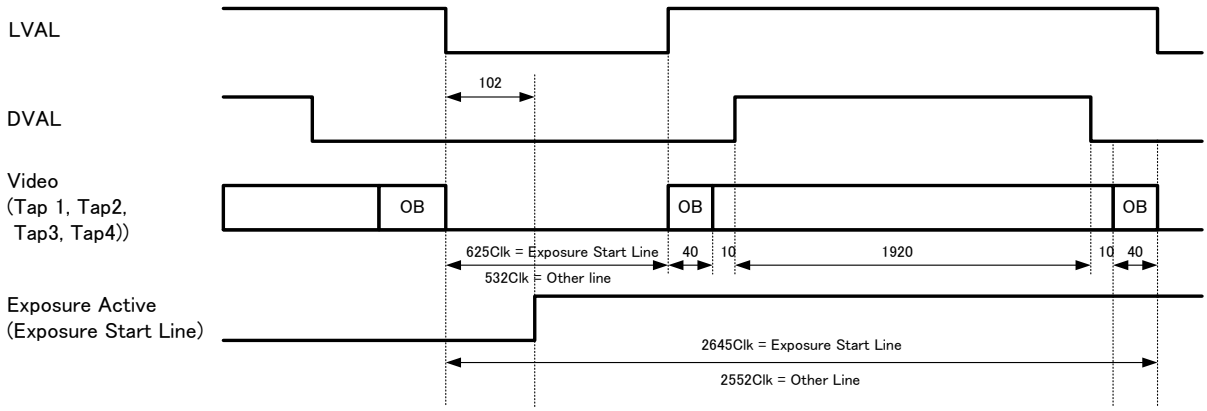


Fig. 25 1X-1Y Horizontal timing (Vertical binning ON)

6.5.2 Vertical timing

6.5.2.1 Output format 1X-2YE Vertical binning OFF

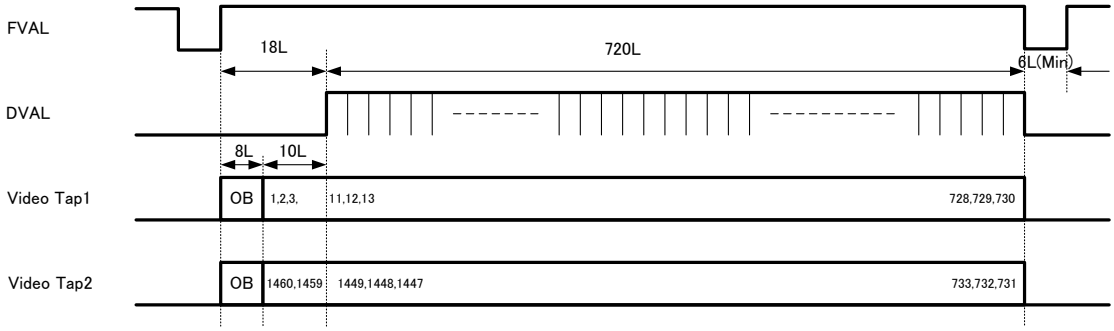


Fig.26 1X-2YE Vertical Timing (Vertical timing OFF)

6.5.2.2 Output format 1X-2YE Vertical binning ON

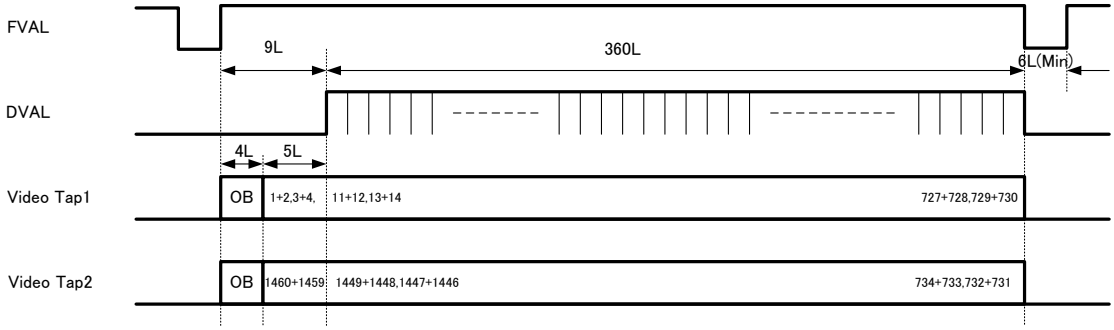


Fig. 27 1X-2YE Vertical timing (Vertical binning ON)

6.5.2.3 Output format 1X-1Y Vertical Binning OFF

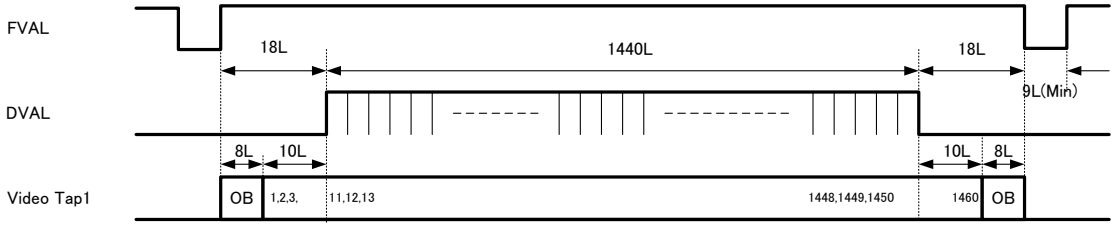


Fig.28 1X-1Y Vertical timing (Vertical binning OFF)

6.5.2.4 Output format 1X-1Y Vertical Binning ON

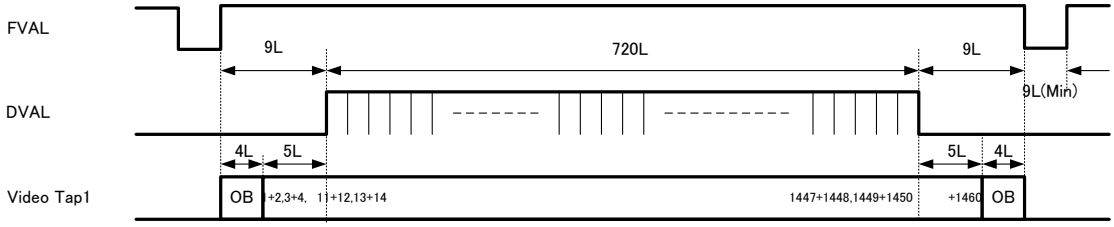


Fig.29 1X-1Y Vertical timing (Vertical binning ON)

7. Operating modes

The following controls are related to capturing the image.

7.1. Acquisition control (change the frame rate)

7.1.1 Acqusition mode

In the EL-2800M-CXP and EL-2800C-CXP, the following three acquisition modes are available.

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

7.1.1.1 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 AcquisitionStop is input and is incremented when the AcquisitionStart command is called.
In the case of PIV operation, single frame mode is not available.

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

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

The following diagrams show the Single Frame Timing relationships.

Conditions:
Acquisition mode: Single
Trigger selector: Acquisition Start
Trigger mode: OFF

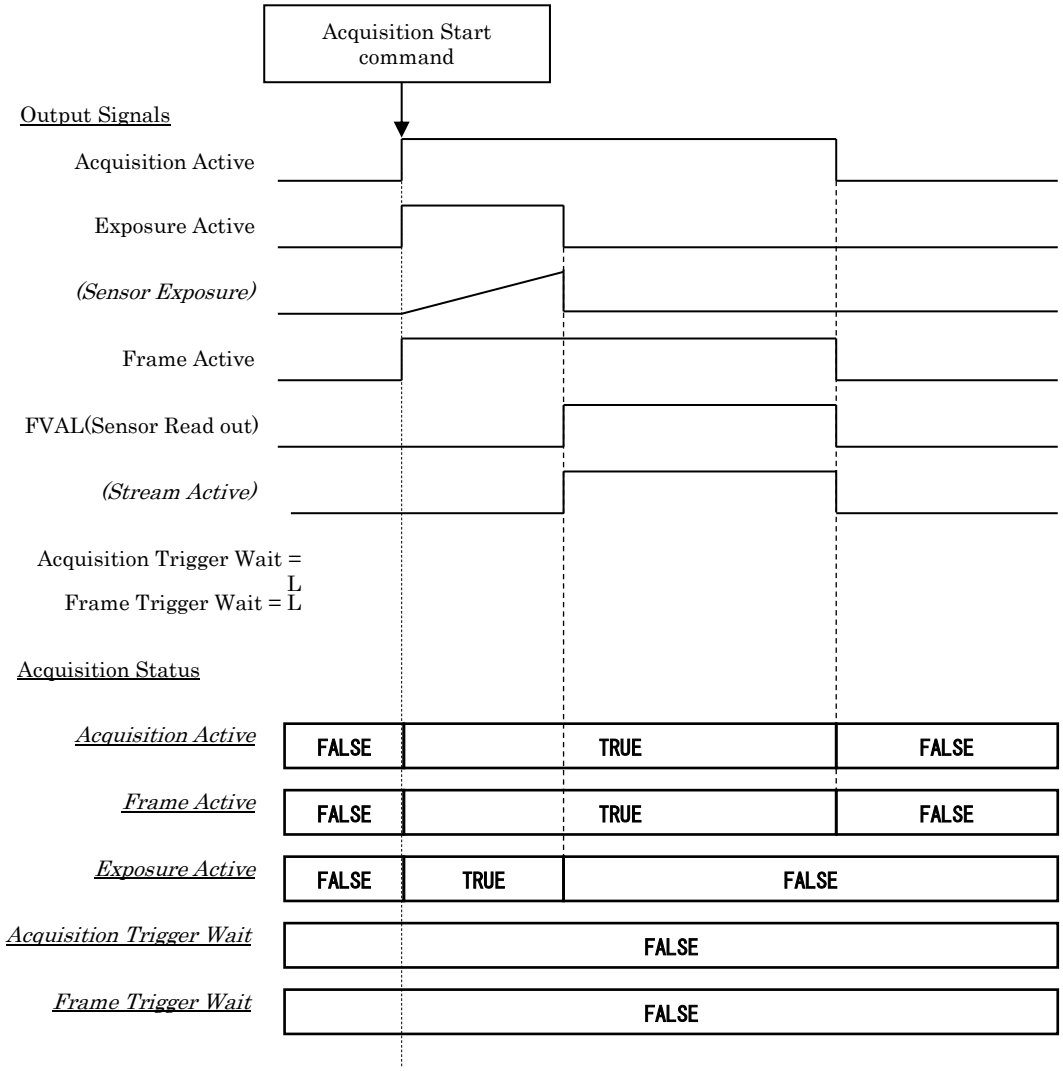


Fig.30 Single frame timing (Acquisition Start OFF)

Note: Signal in ( ) shows the internal operation inside the camera.

Conditions:
Acquisition mode: Single
Trigger selector: Acquisition Start
Trigger mode: ON

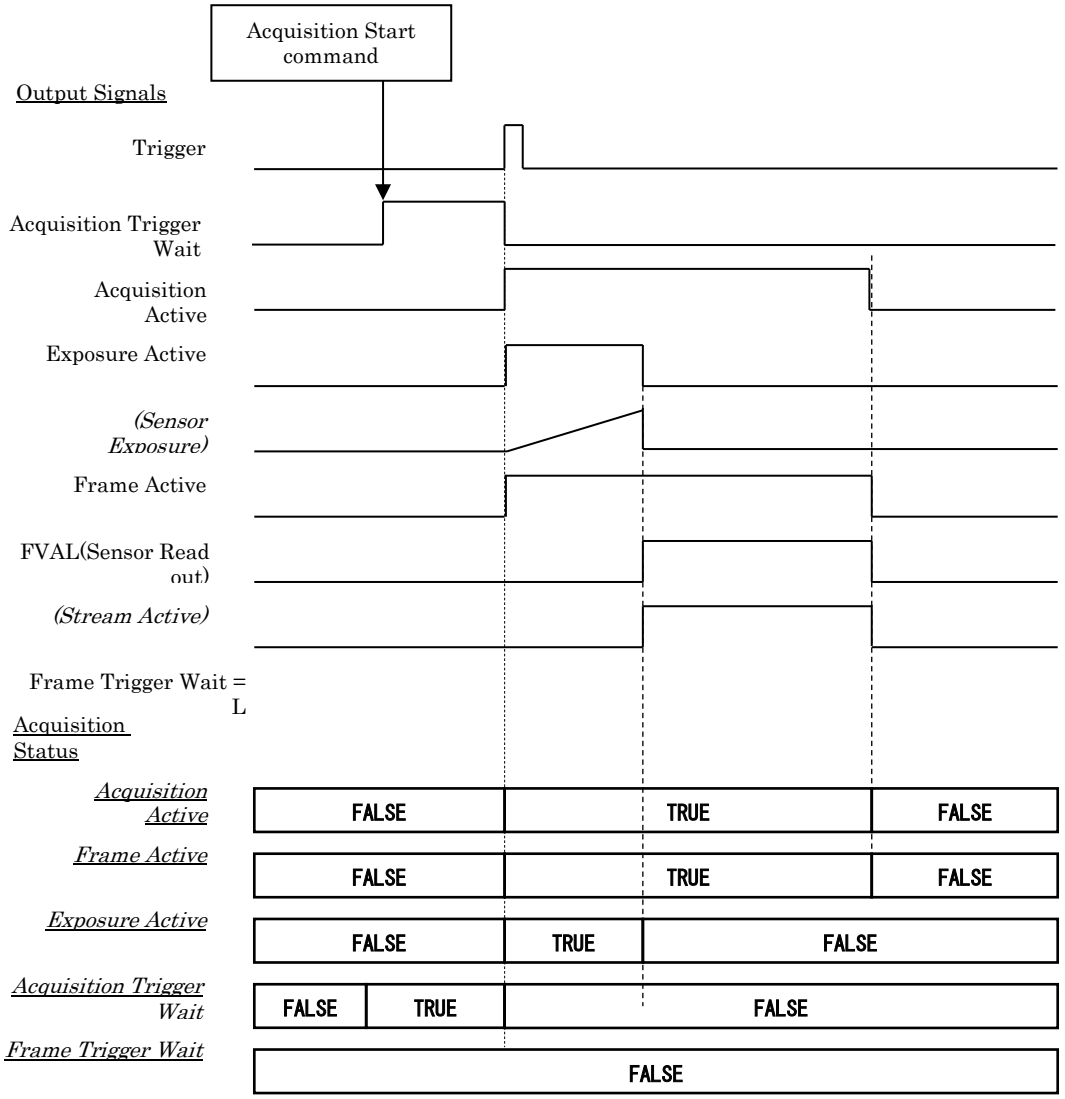


Fig. 31 Single Frame Timing (Acquisition Start ON)

Conditions:
Acquisition mode: Single
Trigger selector: Frame Start
Trigger mode: ON

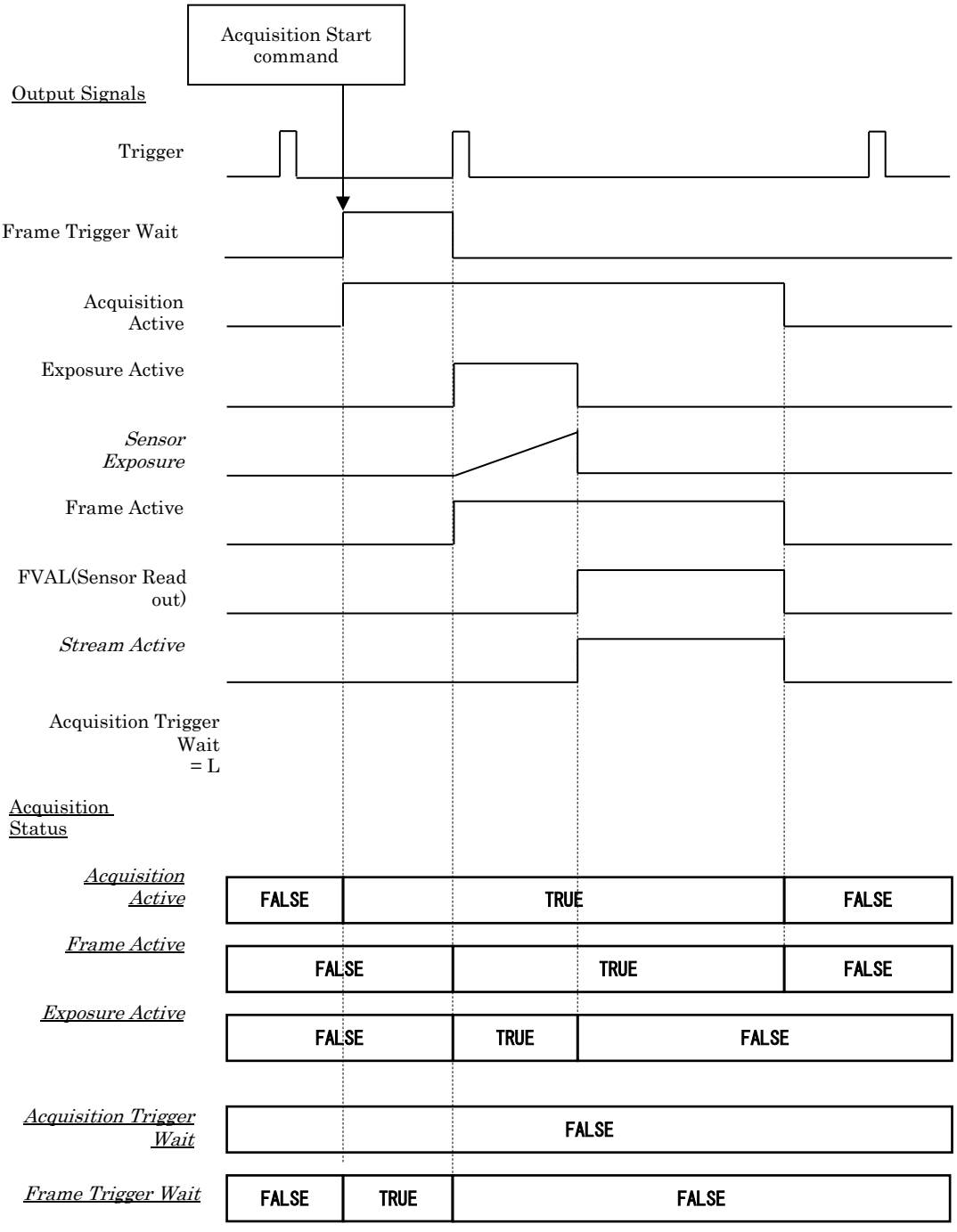


Fig. 32 Single Frame Timing (Frame Start ON)

7.1.1.2 MultiFrame

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

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

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

- Acqusition Frame Count (16-bit): Can be set in the range of 1 to 65535
  In PIV mode, Acquisition Frame Count (16-bit) can be set in the range of 2 to 65535.
  The setting for PIV mode is 2 steps.

The following diagrams show the Multi Frame Timing relationships.

Conditions:
Acquisition mode: Multi
Trigger selector: Acquisition Start
Acquisition Frame Count: 2
Trigger mode: OFF

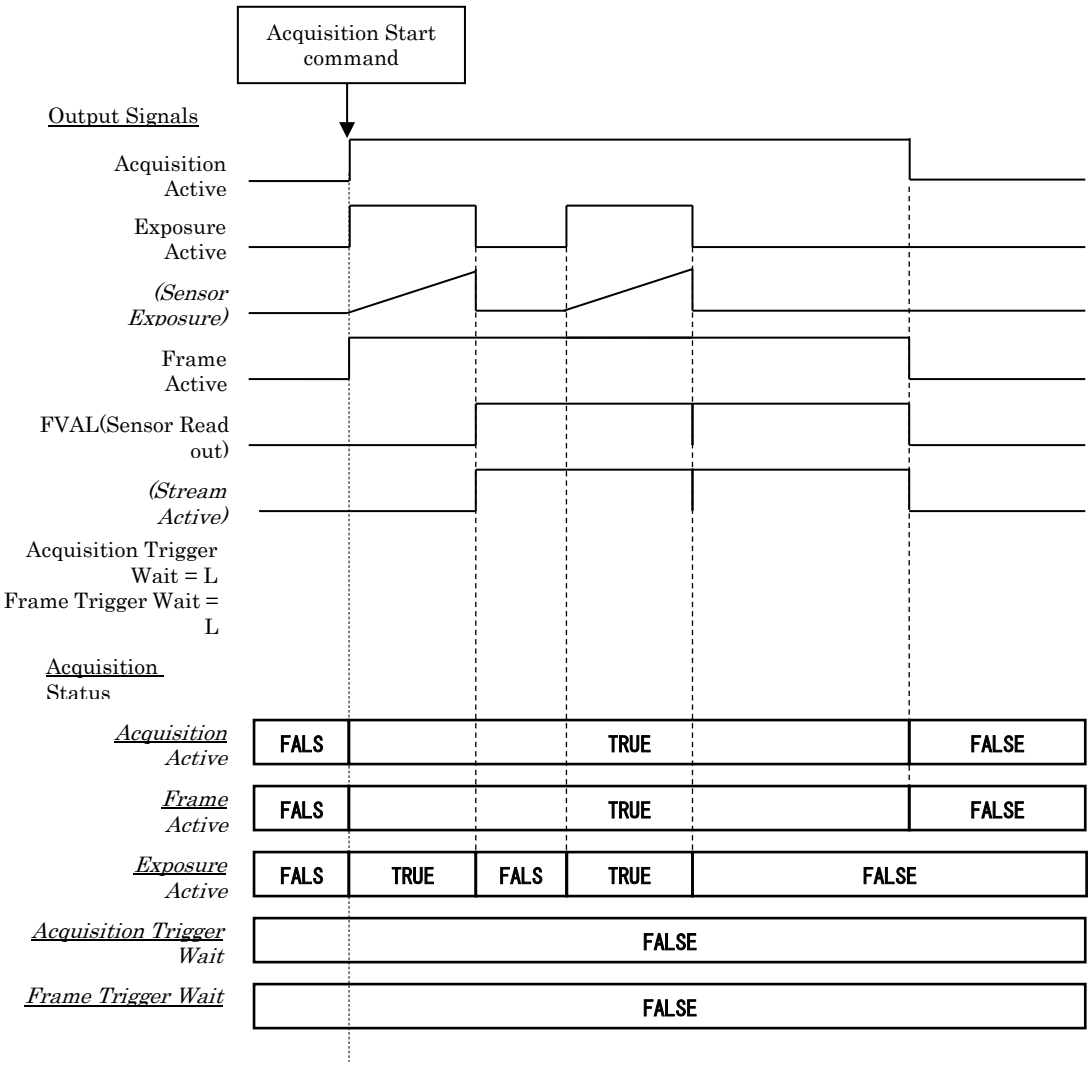


Fig.33 Multi Frame Timing (Acquisition Start OFF)

Conditions:
Acquisition mode: Multi
Trigger selector: Acquisition Start
Acquisition Frame Count: 2
Trigger mode: ON

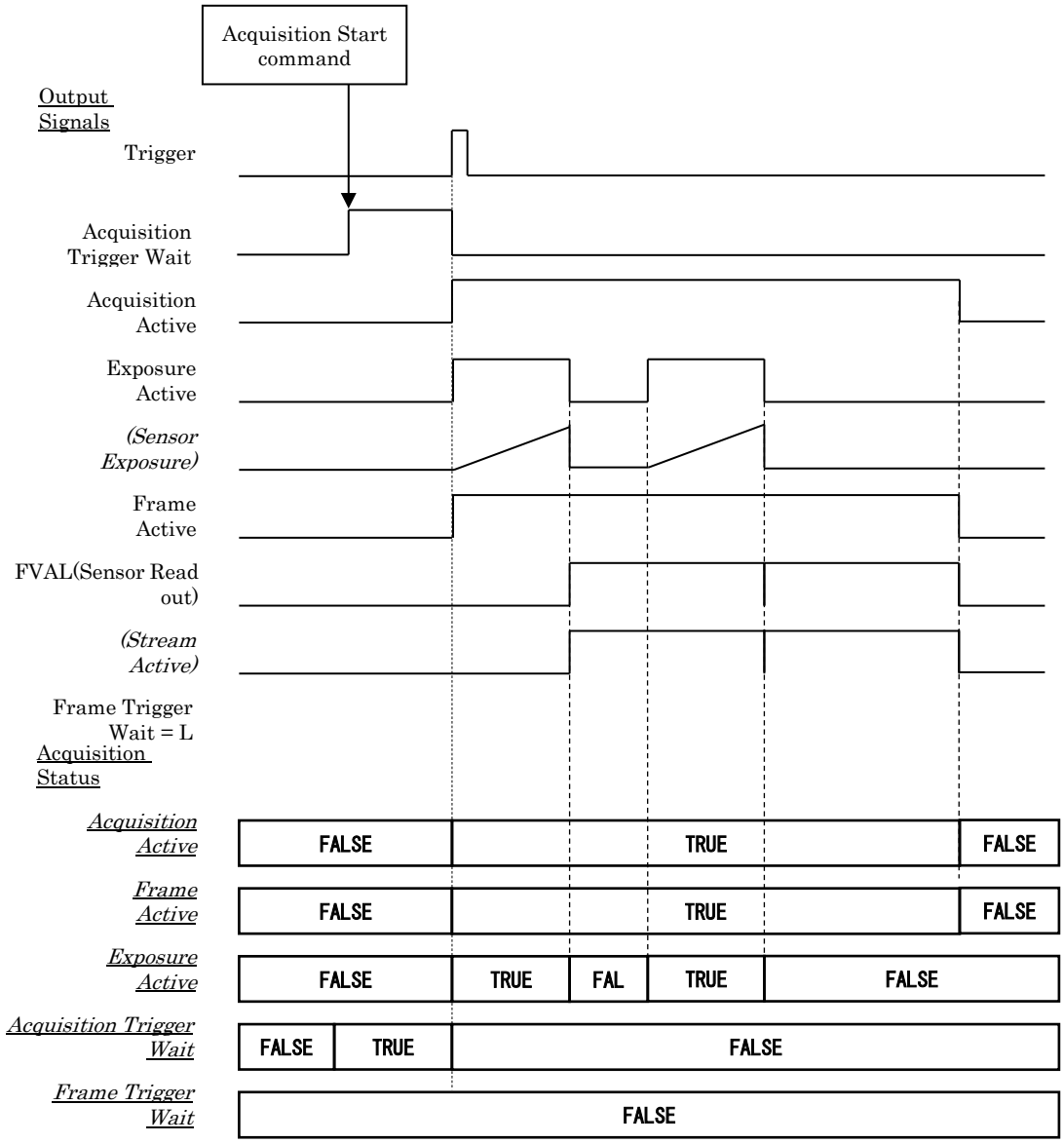


Fig.34 Multi Frame Timing (Acquisition Start ON)

Conditions:
Acquisition mode: Multi
Trigger selector: Frame Start
Acquisition Frame Count: 2
Trigger mode: ON

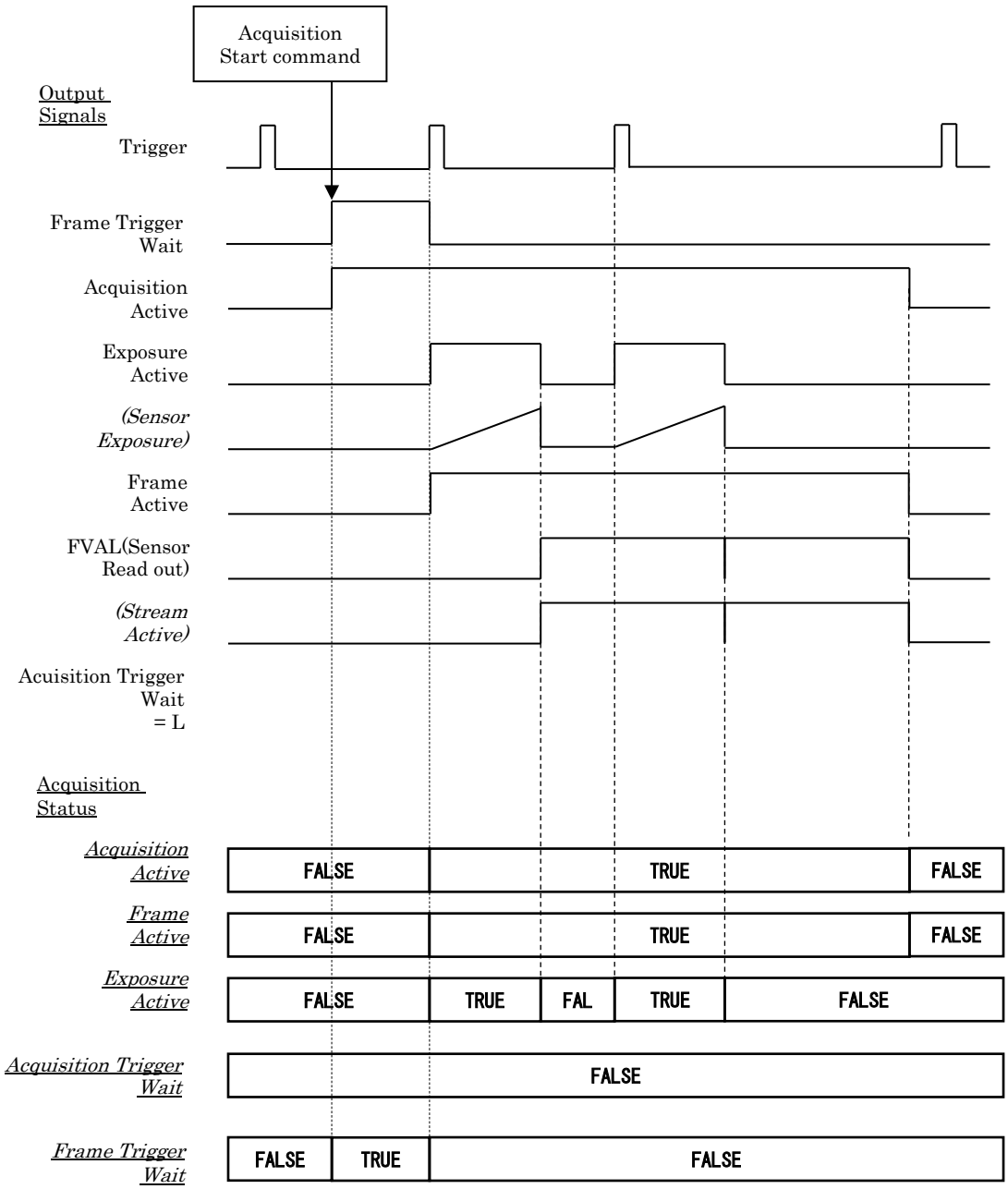


Fig.35 Multi Frame Timing (Frame Start ON)

7.1.1.3 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 EL-2800M-CXP and EL-2800C-CXP.

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

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

The following diagrams show the Continuous Timing relationships.

Conditions:

Acquisition mode:	Continuous
Trigger selector:	Acquisition Start
Trigger mode:	OFF

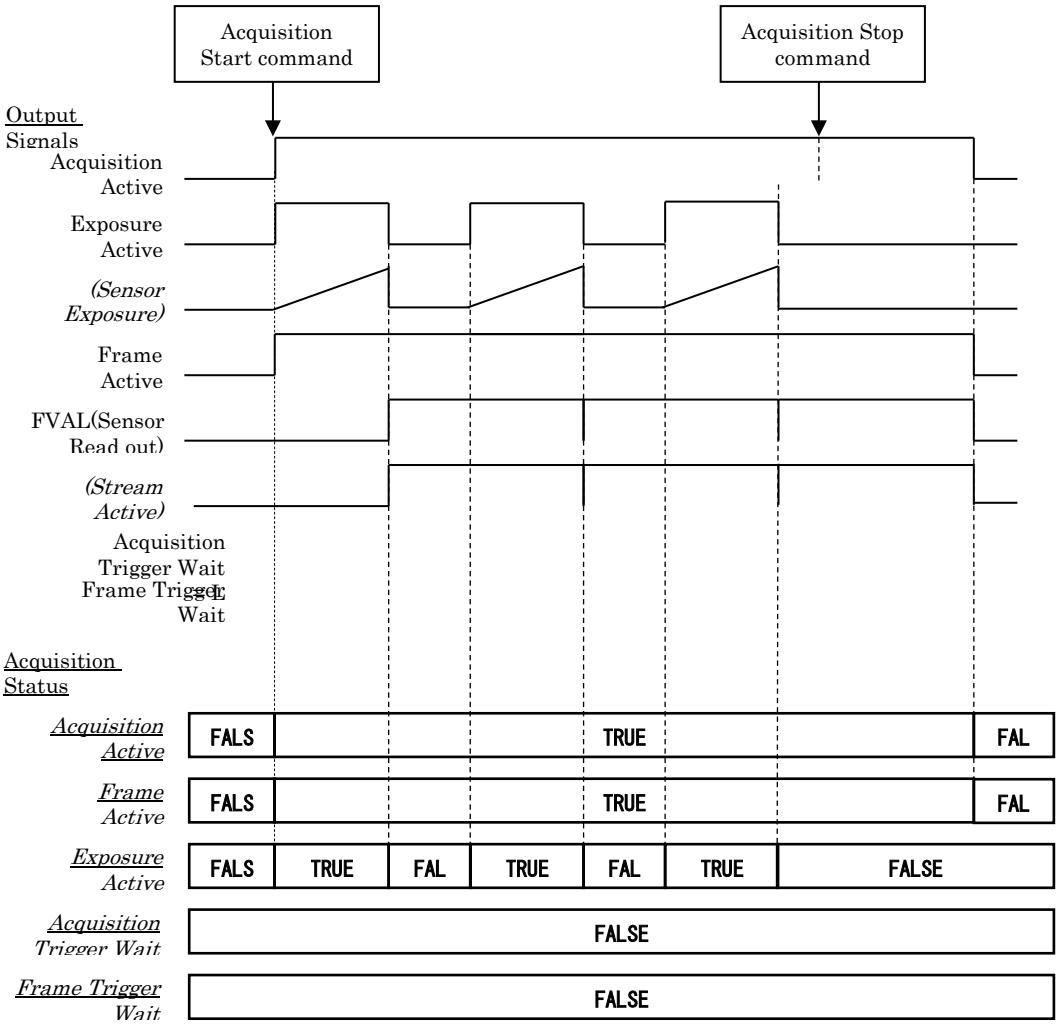


Fig.36 Continuous Timing (Acquisition Start OFF)

Conditions:
Acquisition mode: Continuous
Trigger selector: Acquisition Start
Trigger mode: ON

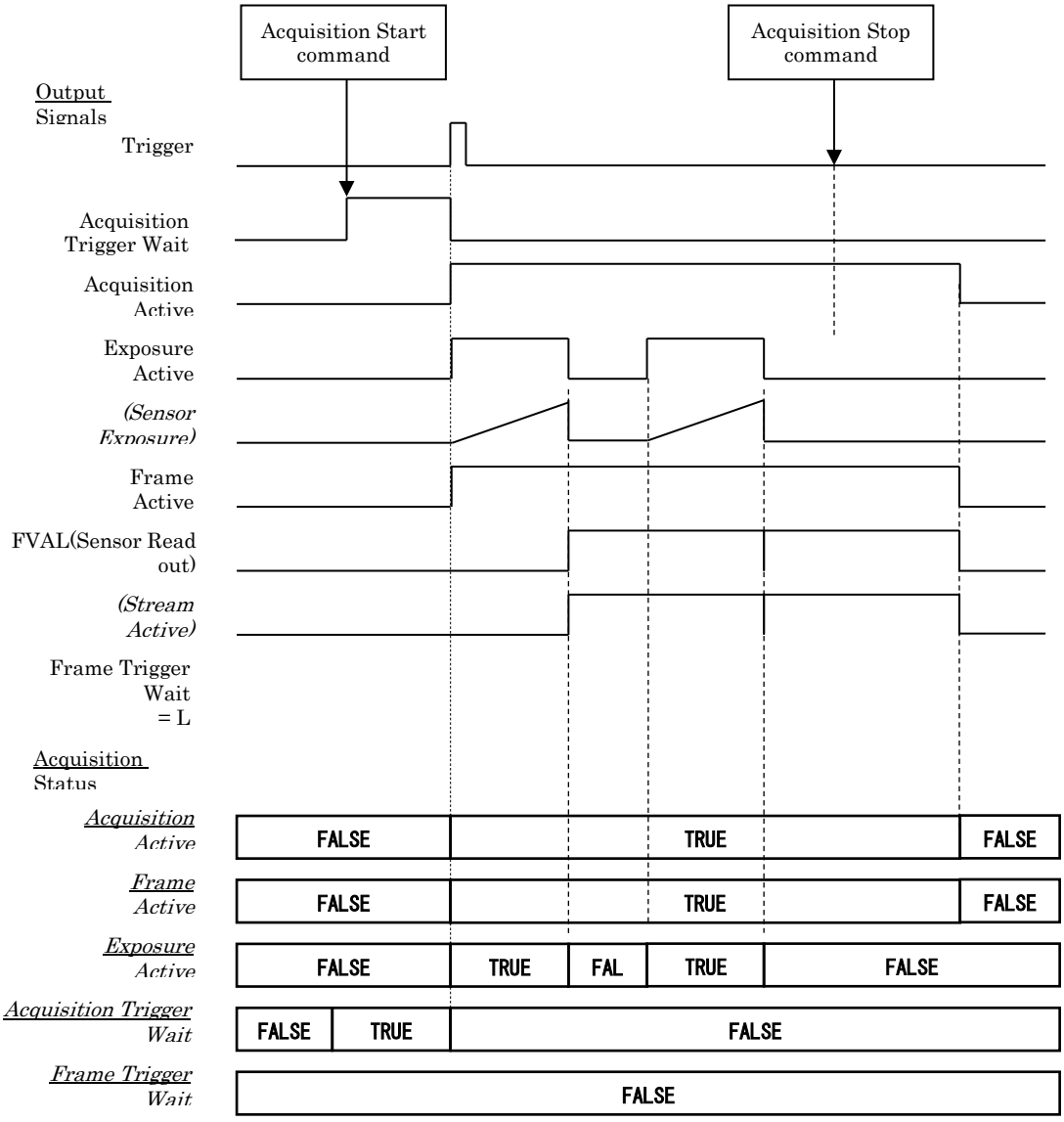


Fig. 37 Continuous Timing (Acquisition Start ON)

Conditions:
Acquisition mode: Continuous
Trigger selector: Frame Start
Trigger mode: ON

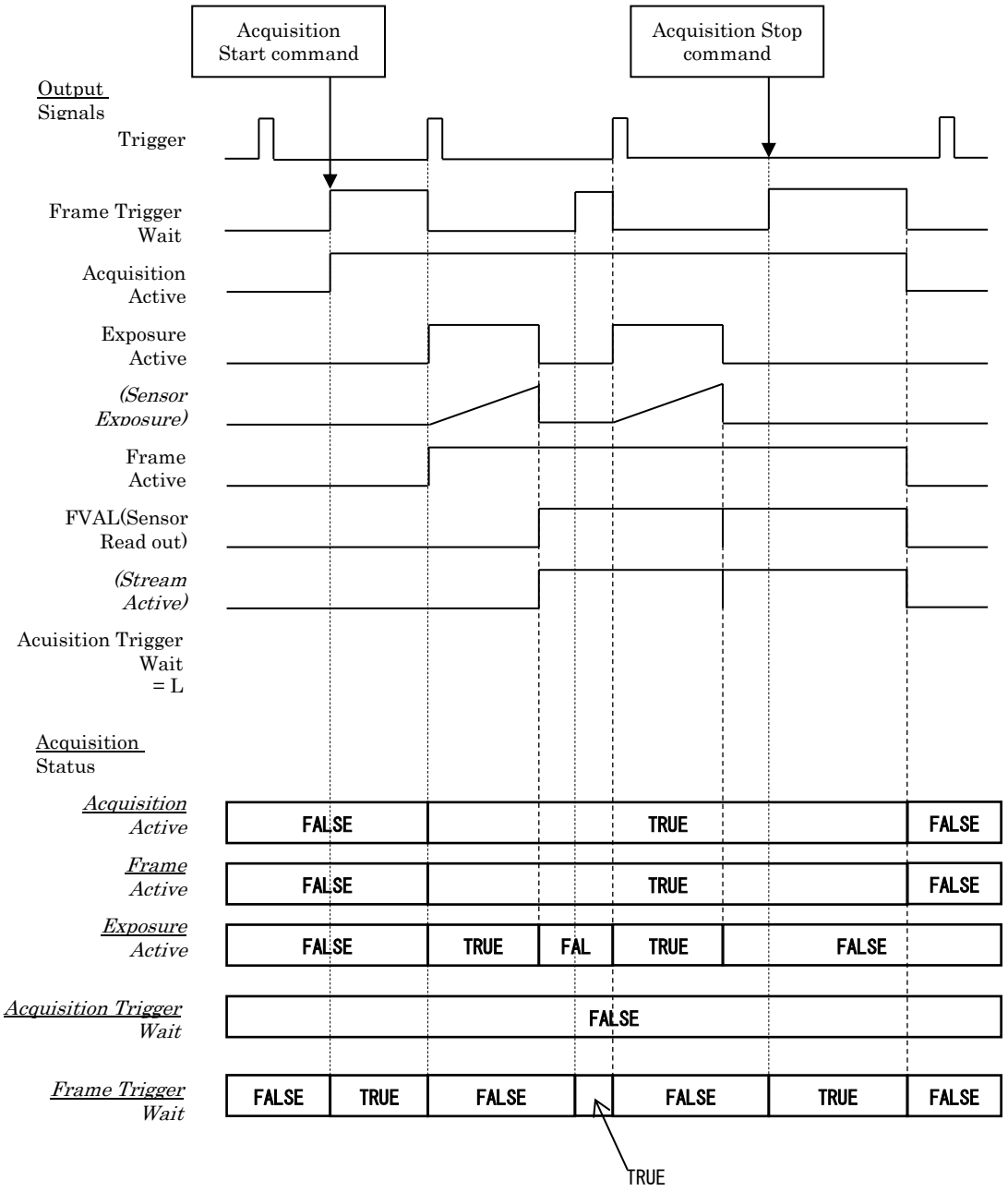


Fig.38 Continuous Timing (Frame Start ON)

7.1.2 Acquisition frame count

If Acquisition mode is set at Multi, the capturing frame number can be set.
The setting range is 1 frame to 65535 frames but in PIV mode, it is 2 frames to 65535 frames with 2 frames step.

7.1.3 Acquisition frame rate

With Trigger OFF, which is self-running operation, it is possible to set a longer acquisition period than the time required to read out all pixels in the area set by the ROI command.
The setting is done in the acquisition control. In this case, the setting period is the number of lines in 1 frame.

The setting range is:

Shortest	to	Longest
Time required to read out all pixels in the area set by AOI command	to	8 seconds

Note:
1. If the trigger is set to ON, this function is not available.
2. The value for setting is microseconds.
3. If the setting value is less than the minimum period, this setting is ignored and camera operates at the minimum period.

Self-running (Trigger OFF) works under the following conditions.
Exposure Mode : OFF
Exposure Mode : Timed and Frame Start OFF
Exposure Mode : Trigger Width and Frame Start OFF.

7.1.4 Calculation of frame rate

In the following formula, the result of underline should be rounded up.

7.1.4.1 V Binning Off

<Sensor Tap Geometry 1X2-2YE>

1X-2YE(fps) = 1/〔[Height/2 + {((720-(Height/2)-1)/4} + 25] x 24.574us 〕

<Sensor Tap Geometry 2XE-1Y>

1X-1Y(fps) = 1/【〔 Height + {(OffsetY-1)/4} + [{1440-(OffestY + Height)}/9] + 46 〕 x 24.574us】

<Sensor Tap Geometry 1X-1Y>

1X-1Y(fps) = 1/【〔 Height + {(OffsetY-1)/7} + [{1440-(OffestY + Height)}/15] + 46 〕 x 42.519us】

7.1.4.2 V Binning On

<Sensor Tap Geometry 1X2-2YE>

1X-2YE(fps) = 1/〔[(Height/4) + {((360-(Height/4)-1)/2} + 16] x 29.296us 〕

<Sensor Tap Geometry 2XE-1Y>

1X-1Y(fps) = 1/【〔 (Height/2)+ {(OffsetY-1)/2} + [{720-(OffsetY + (Height/2))}/4.5] + 28 〕 x 29.296us】

<Sensor Tap Geometry 1X-1Y>

1X-1Y(fps) = 1/【〔 (Height/2)+ {(OffsetY-1)/4} + [{720-(OffsetY + (Height/2))}/8] + 33 〕 x 47.259us】

7.2. Exposure setting

7.2.1 Exposure Mode

Exposure Mode sets which exposure mode is to be used.
If the trigger is used, Frame Start must also be used.
When Exposure Mode is set to Timed or Trigger Width, the combination of Exposure Mode and Frame Start can set various operations.

The following table shows the operation depending on the combination.

Table - 15 Operation matrix

Exposure Mode	Trigger Control	Trigger OFF	Trigger ON
	Frame Start	Behavior	
OFF	OFF or ON	Self running No exposure control	–
Timed (EPS) Timed(RCT) Timed (PIV)	OFF	Self running Exposure control available	–
	ON	–	Operate in EPS, RCT or PIV
Trigger Width	OFF	Self running No exposure control	–
	ON	–	Exposure control by trigger width

Frame Start trigger: Sets whether the start of the frame is controlled externally or not.

Trigger Mode ON: If Acquisition Active is active and Exposure Mode is set to Timed or Trigger Width, the exposure will be started by using the signal set in Frame Trigger as the trigger.
Trigger Mode OFF: If Acquisition Active is active, the camera operates in self-running mode.

Exposure Mode can be selected from the following.
OFF : No shutter control
Timed : The exposure will be done in the preset period. The setting can be done in μsec units.
Frame Start OFF : Self-running mode and exposure control is available.
Frame Start ON : EPS operation mode

In this status, if JAI_RCT or JAI_PIV is selected in Trigger option, the camera will operate in RCT or PIV mode.

Trigger Width : The exposure will be controlled by the width of the trigger pulse.
Frame Start OFF : Not active. No exposure control
Frame Start ON : PWC operation mode

7.2.2 Exposure Time

This command is effective only when Exposure Mode is set to Timed. It is for setting exposure time.
The setting step for exposure time is 1 μsec per step.

Minimum: 10 μsec
Maximum: 8 seconds

7.2.3 Exposure Auto

This is a function to control the exposure automatically. It is effective only for Timed.
ALC Reference controls the brightness.
There are three modes: OFF, Once, and Continuous.

OFF:	No exposure control
Once:	Exposure adjusts when the function is set, then remains at that setting
Continuous:	Exposure continues to be adjusted automatically

In this mode, the following settings are available.

ALC Speed:	Rate of adjustment can be set
Exposure Auto Max:	The maximum value for the exposure range can be set
Exposure Auto Min:	The minimum value for the exposure range can be set
ALC Reference:	The reference level of the exposure control can be set
ALC Channel area:	The measurement area of the exposure control can be set

7.3. Trigger Mode

7.3.1 Trigger Source

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

OFF
Line 5 (Input to Opt IN1 and output from Digital IO
Line 7 (Input to TTL IN1 and output from Digital IO)
User Out 0

7.3.2 Trigger activation

This command can select how to activate the trigger.

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

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

Table - 16 Trigger activation

	RisingEdge	FallingEdge	LevelHigh	LevelLow
Timed	○	○	×	×
TriggerWidth	×	×	○	○
Trigger Option PIV	○	○	×	×
Trigger Option RCT	○	○	×	×

7.3.3 Trigger Overlap

This function defines whether or not a trigger pulse can be accepted while data is being read out.

OFF :	The trigger pulse is not accepted during CCD readout.
Read Out :	The trigger pulse can be accepted during CCD readout

7.3.4 Trigger Delay

This function delays trigger signal against trigger input signal.
The step is 1μs and the range for setting is 16bit, from 0 to 65,535μs.

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

This is used for applications which do not require triggering. In this mode, the video signal for the auto-iris lens is available.
For the video timing, refer to chapter 6.3.
The frame rate of full pixels readout is 54.7 fps for 1X2-2YE output format.

Primary settings to use this mode

Trigger control
Trigger Mode: OFF

Table - 17 Minimum interval of the image(1X-2YE, 8-bit)

1X- 2YE output	FULL	2/3 AOI	1/2 AOI	1/4 AOI	1/8 AOI	1/2V Binning (Note1)
Minimum frame line	744	564	474	339	272	375

Note 1) Only for EL-2800M-CXP
Note 2) Readout mode in trigger overlap is not available.

7.5. Timed mode (EPS)

This mode allows a single image frame to be captured with a preset exposure time by using the external trigger. Additional settings determine if the trigger pulse can be accepted during the exposure period.
The frame rate of full pixels readout is 54.7 fps for 1X2-2YE output format.

Primary settings to use this mode

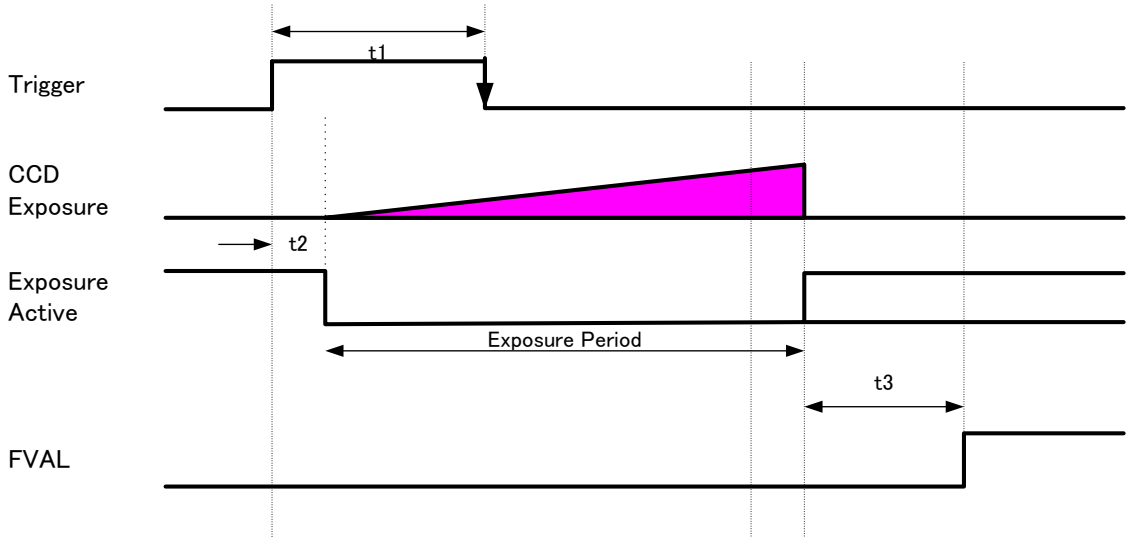
Exposure mode: Timed
Trigger mode: ON
Frame Start : ON

Table - 18 Minimum interval of the trigger pulse(1X-2YE, 8-bit)

1X-2YE output	**FULL**	**2/3 AOI**	**1/2 AOI**	**1/4 AOI**	**1/8 AOI**	**1/2V Binning (Note1)**
Minimum frame line	745	565	475	340	273	376

Note 1) EL-2800M only
Note 2) This table shows in case of Trigger option being set to Readout. If Trigger option is set to OFF, this period is longer than the figures in this table.

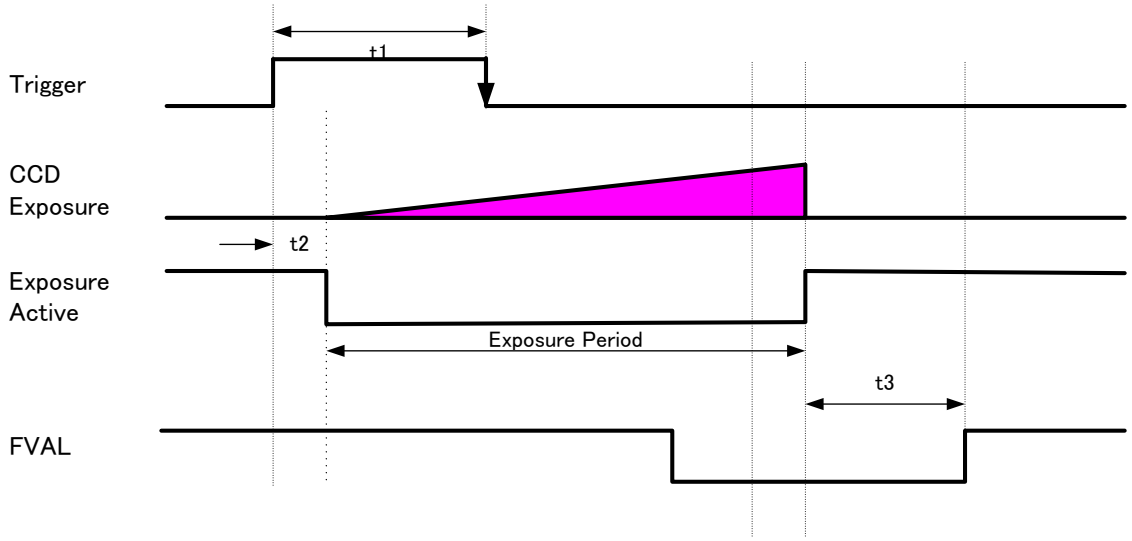
7.5.1 If the overlap setting is “OFF”



t1	t2	t3
8.1us (Typical)	2L (Min)	4.5 ～ 5.5L

Fig.39 Overlap OFF

7.5.2 If the overlap setting is “Readout”



t1	t2	t3
1L	2L (min)	4L

Fig.40 Readout

7.6. Trigger width mode

In this mode, the exposure time is equal to the trigger pulse width. Accordingly, longer exposure times are supported. Additional settings determine if the trigger pulse can be accepted during the exposure period.
The frame rate of full pixels readout is 54.7 fps for 1X2-2YE output format.

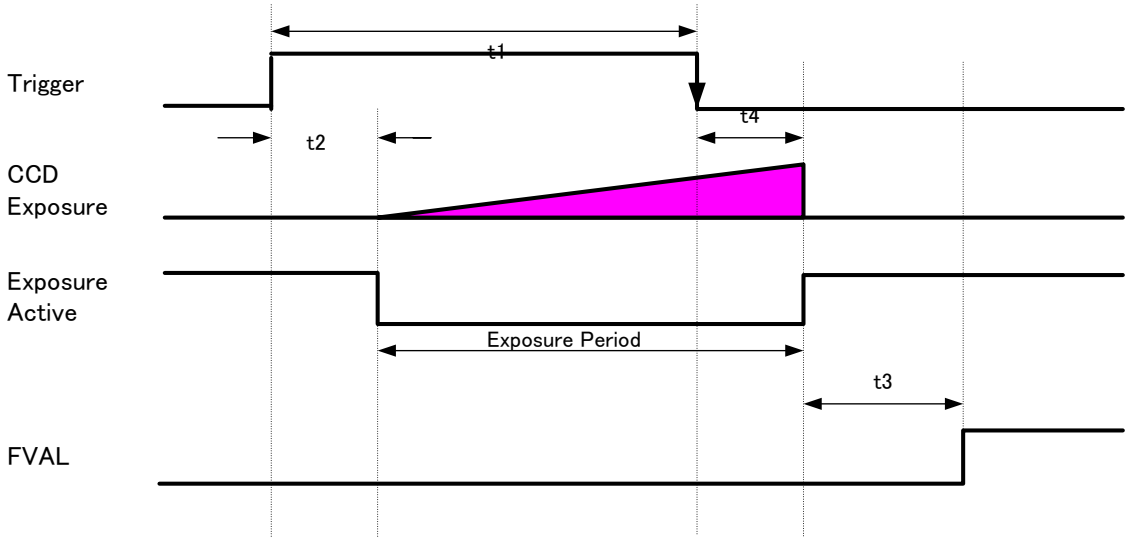
Primary settings to use this mode
Exposure mode: Trigger width
Trigger mode: ON
Frame Start : ON

Table – 19 Minimum interval of the trigger pulse (1X-2YE, 8-bit)

1X-2YE output	FULL	2/3 AOI	1/2 AOI	1/4 AOI	1/8 AOI	1/2V Binning (Note1)
Minimum frame line	745	565	475	340	273	376

Note 1) EL-2800M only
Note 2) This table shows in case of Trigger option being set to Readout. If Trigger option is set to OFF, this period is longer than the figures in this table.

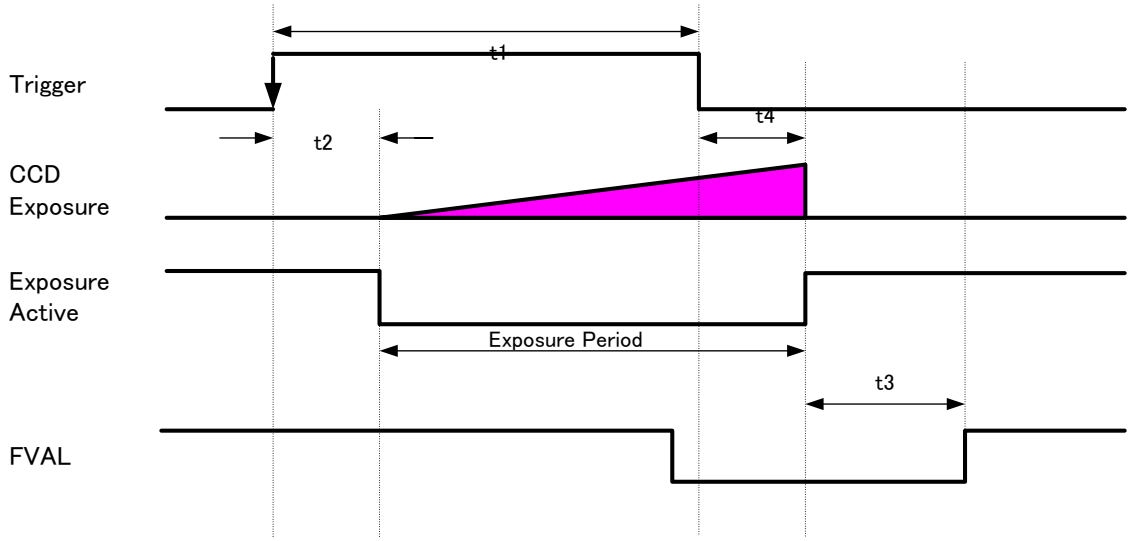
7.6.1 If the overlap setting is "OFF"



t1	t2	t3	t4
1L (Min)	8.1 us (Typical)	4.5L ～5.5L	8 μs

Fig41 Overlap = OFF

7.6.2 If the overlap setting is “Readout”



t1	t2	t3	t4
1L(Min)	1L	4L	1L + 8 μs

Fig.42 Readout

7.7. RCT mode

Until the trigger is input, the camera operates continuously and the video signal for the auto-iris lens is output. At this moment, the video signal, FVAL and LVAL are output but DVAL is not output. When the trigger is input, the fast dump is activated to read out the electronic charge very quickly, after which the accumulation and the readout are performed. When the accumulated signal against the trigger is read out, FVAL, LVAL and DVAL are output too.

Primary settings to use this mode

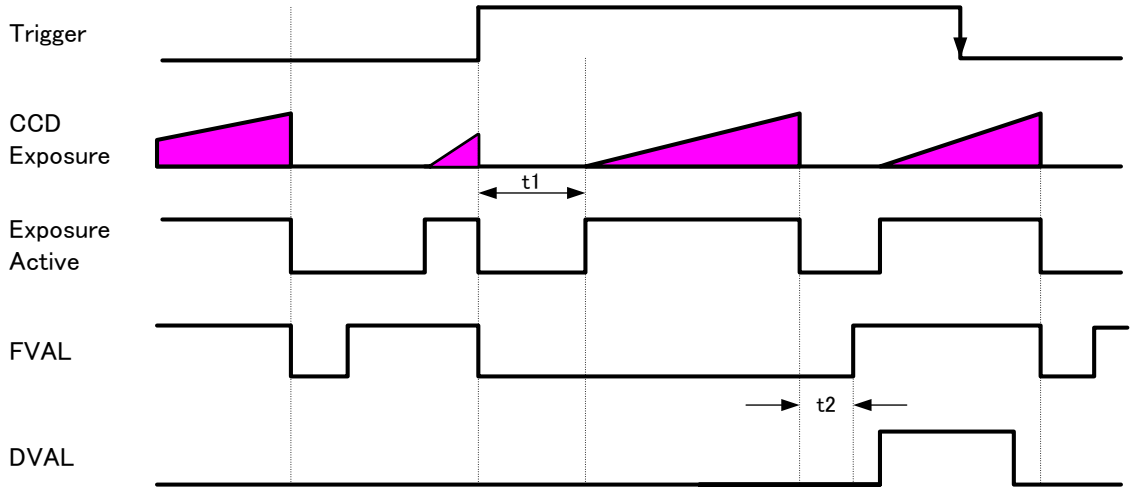
Exposure mode: Timed(RCT)
Trigger mode: ON
Frame Start : ON
Trigger option : RCT

In this mode, the setting of Trigger Overlap is invalid.

Table – 20 Minimum interval of the trigger pulse (1X-2YE, 8-bit, Exposure time = 10 us)

1X-2YE output	**FULL**	**2/3 AOI**	**1/2 AOI**	**1/4 AOI**	**1/8 AOI**	**1/2V Binning (Note1)**
Minimum frame line	Timed Exposure Mode/Trigger Mode OFF + Exposure Time + 195					

Note 1) Only for EL-2800M-CXP
Note 2) Readout mode in trigger overlap is not available.



Output format	t1	t2
1X-2YE	194L	4.5L ～5.5L
1X-1Y	384L	4.5L ～5.5L

Fig.43 RCT mode timing

7.8. PIV (Particle Image Velocimetry)

The Particle Image Velocimetry mode can be used in applications where 2 images need to be taken with a very short time interval. It can only be used with strobe flash as illumination. The first accumulation time is 10 μsec to 2 sec. Then, the second exposure will be taken. The accumulation is LVAL asynchronous. The first strobe is activated during the first exposure duration and the second strobe is pulsed while the first frame is being read out. In this way, two strobe flashes generate two video outputs.

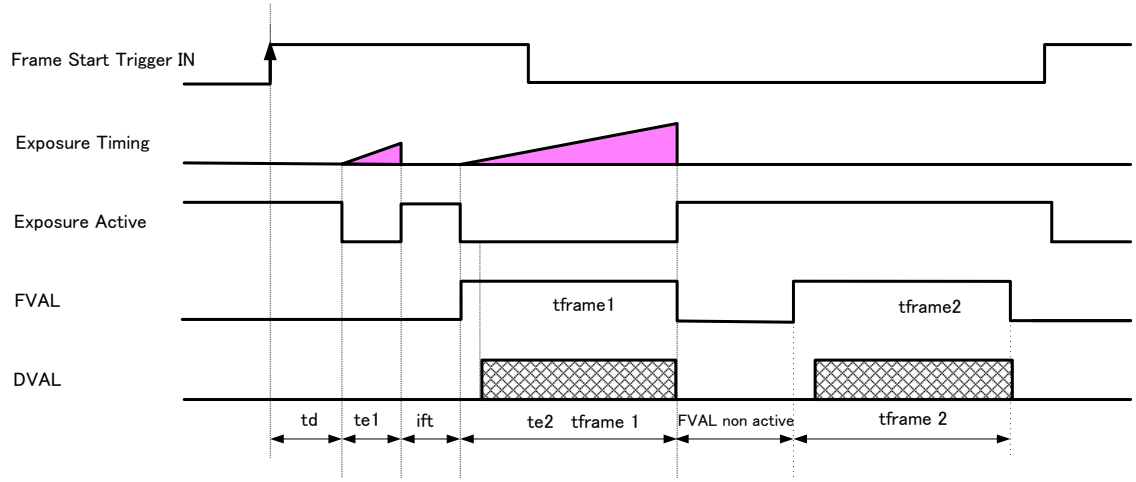
Primary Settings
Exposure mode: Timed(PIV)
Trigger mode: ON
Frame Start : ON
Trigger option : PIV

In this mode, the setting of Trigger Overlap is invalid.

Table – 21 Minimum interval of the trigger pulse (1X-2YE, 8-bit)

1X – 2YE output	FULL	2/3 AOI	1/2 AOI	1/4 AOI	1/8 AOI	1/2V Binning (Note1)
Minimum frame line	(Timed Trigger Mode/Trigger Mode OFF x 2) + Exposure Time + 1					

Note 1) Only for EL-2800M-CXP
Note 2) Readout mode in trigger overlap is not available.



Time name	Description	Time
td	Exposure beginning delay	8.1us
te1	First exposure time period	10 μs ～ 2 s
te2	Second exposure time	1 frame
itf	Inter framing time	3.4 us
FVAL non active	FVAL non active	4LVAL
tframe1	First Frame read out	1 frame
tframe2	Second Frame read out	1 frame

Fig.44 PIV mode

7.9. Sequential Timed Exposure Mode

7.9.1 Video send mode

The sequential trigger mode has the following modes and it is selected in the video send mode.

Video send mode:	How to select the index
Trigger Sequence:	Select the index by the frame start trigger signal. (The setting index can be determined by the next index setting.)
Command Sequence:	Select the index number to assign directly by the command sequence index command.

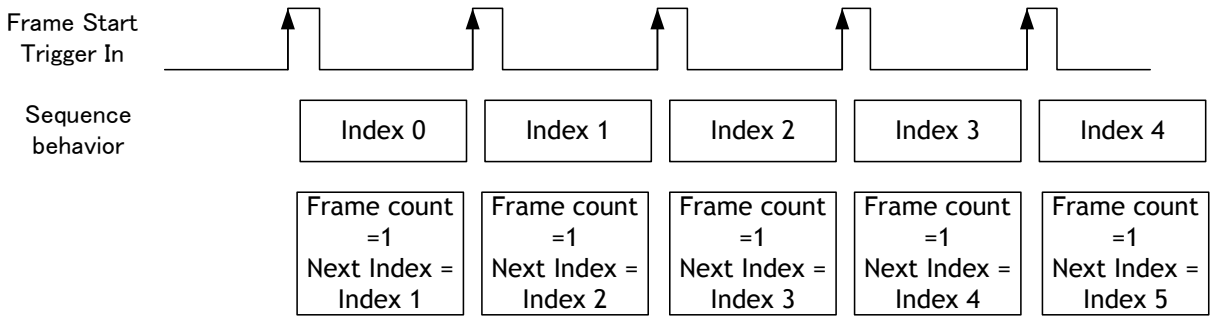


Fig. 45 Behavior of Sequence trigger

Table - 22 Minimum trigger interval (1X-2YE, 8-bit, Exposure time = 10 μs)

1X - 2YEoutput	FULL	2/3 ROI	1/2 ROI	1/4 ROI	1/8 ROI	1/2V Binning
Minimum frame line	Timed Exposure Mode/Trigger Mode OFF + Exposure Time + 1					

Note 1. Overlap mode=Readout is not available
Note 2. The minimum interval calculation assumes that the exposure times for all sequences are equal. If there are differences, it is necessary to add the differences to the calculation. If the exposure times are different, it is recommended to organize the exposure times from the shortest exposure to the longest one.
Note 3. The sequence must start with Index 0. After Index 0 is executed, the Sequence proceeds to the next setting index.

Table – 23 Sequence Index table (Default)

Sequence ROI Index	Sequence ROI													
	Width	Height	Offset		Gain Selector			Exposure Time	Black Level	Binning		LUT Enable	Frame Count	Next Index
			X	Y	Gain (ALL)	Red	Blue			Horizontal	Vertical			
- Index 0		1440	0	0	0	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 1		1440	0	0	0	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 2		1440	0	0	0	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 3		1440	0	0	0	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 4		1440	0	0	0	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 5		1440	0	0	0	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 6		1440	0	0	0	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 7		1440	0	0	0	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 8		1440	0	0	0	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0
- Index 9		1440	0	0	0	0	0	180000	0	1 (Off)	1 (Off)	Off	1	Index 0

7.9.2 Sequence ROI setting parameters

Setting parameters for Sequence ROI is as follows.

(1) Sequence ROI Index Selector
In Sequence ROI Index Selector, Index 0 to 9 can be selected.
Sequence ROI – Width, Height, Offset X, Offset Y, Gain Selector - Gain/Red/Blue, Exposure Time, Black Level, Binning Horizontal, Binning Vertical, LUT Enable, Frame Count, Next Index for the selected index are displayed.

(2) Sequence ROI Width
Width is fixed at 1920. No setting is necessary for this parameter.

(3) Sequence ROI Height
Set the height of sequence ROI. The setting range is 8 to 1440 lines.
Rules for setting area and step number are the same as the normal ROI mode set by [Video Send Mode] = “Normal”.

(4) Sequence ROI Offset X
This parameter is fixed at 0.

(5) Sequence ROI Offset Y
Set Offset Y of sequence ROI.
Sequence ROI Binning Vertical = 1 (Off):
Setting range is 0 to (1432 - [Sequence ROI Height])
Sequence ROI Binning Vertical = 2 (On):
Setting range is 0 to (712 - [Sequence ROI Height])
The limitations of step number and other factors are the same as the normal ROI mode set by [Video Send Mode] = “Normal”.
In 1X2-2YE and 1X-2YE, as only Height is set at the center of upper and lower taps, OFFSET Y setting is not enabled.

(6) Sequence ROI Gain Selector
In Sequence ROI Gain Selector, the gain settings for each index are available.
EL-2800C-PMCL: Gain(ALL), Red and Blue can be set.
EL-2800M-PMCL: Only Gain is displayed and can be set.

(7) Sequence ROI Black Level
Black Level setting is available for each index.

(8) Sequence ROI Exposure Time
Exposure Time setting is available for each index.
(9) Sequence ROI Binning Horizontal
ON or OFF of Horizontal Binning for each index can be set.

(10) Sequence ROI Binning Vertical
ON or OFF of Vertical Binning for each index can be set.

(11) Sequence ROI LUT Enable
Enable or disable of LUT function for each index 0 to 9 can be set.

(12) Sequence ROI Frame Count
This can set how many times the selected index is repeated. This is applied to each index. Triggers are input according to numbers set in Frame Count and index is repeated and moves to the next index. Therefore, the same number of triggers as Frame Count must be input.

(13) Sequence ROI Next Index
The number of the index that will follow the current index can be set.
If [Video Send Mode] is set to "Trigger Sequence" and the trigger pulse is input in EPS trigger, the sequence is executed from index 0.
Accordingly, after the number of frame count of index 0 is set, the next index setting after index 0 will be executed.

(14) Sequence ROI Reset Command
This command resets the current index pointer and reverts to index 0 in the table. Frame Count is also re-initialized.

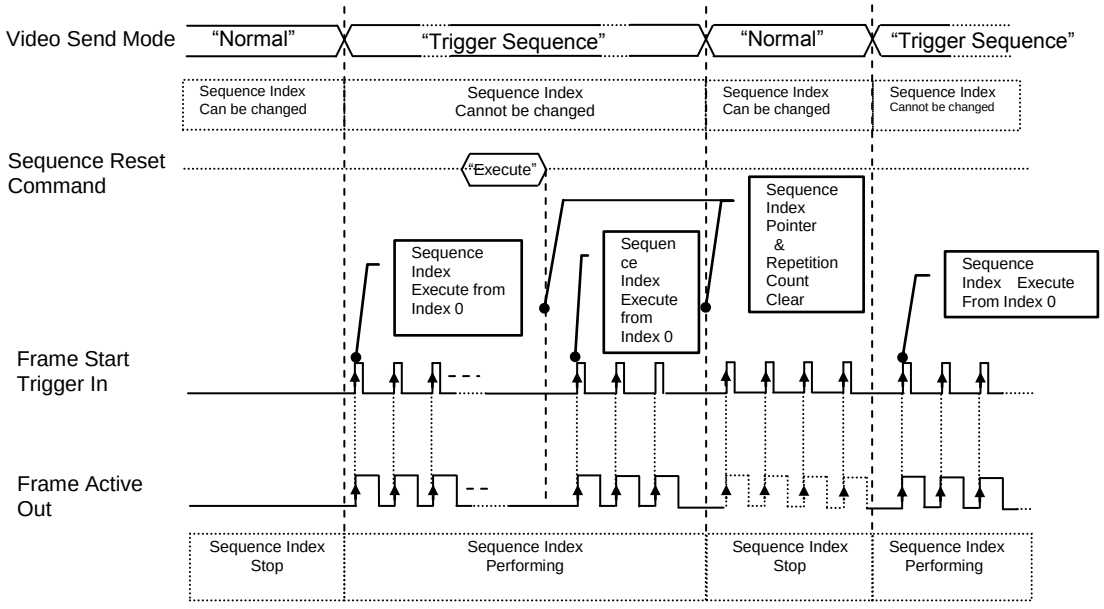


Fig. 46 Sequence trigger timing

7.10. Operation and function matrix

Table - 24 Operation and function matrix

Exposure operation	Trigger mode	Timed option	V. Binning (Note1)	H. Binning (Note1)	Exposure Time	ROI (Partial scan)	Auto White Balance (Note2)	Auto Tap Balance	Auto Iris Output	Auto gain	Auto Exposure	Over Lap
OFF	OFF	OFF	1	1	×	○	○	○	○	○	×	×
			2	2	×	○	○	○	○	○	×	×
Timed	OFF	OFF	1	1	○	○	×	×	○	○	○	×
			2	2	○	○	×	×	○	○	○	×
Timed	ON	OFF	1	1	○	○	×	×	×	×	×	○
			2	2	○	○	×	×	×	×	×	○
Trigger Width	ON	OFF	1	1	×	○	×	×	×	×	×	○
			2	2	×	○	×	×	×	×	×	○
Timed Option	ON	RCT	1	1	○	○	○	○	○	○	○	×
			2	2	×	×	○	○	×	×	×	×
Timed Option	ON	PIV	1	1	×	○	×	×	×	×	×	×
			2	2	×	×	×	×	×	×	×	×
Sequence Trigger	ON	Sequence trigger	1	1	○	○	×	×	×	×	×	×
			2	2	○	○	×	×	×	×	×	×

Note 1. Only EL-2800M-CXP
Note 2: Only EL-2800C-CXP

8. Other functions

8.1 Black level control

This function adjusts the setup level.

Variable range: -256 to 255 LSB (at 10-bit output)

8.1.1 Black Level Selector

The following factors can be set.

EL-2800M: DigitalAll/Tap1All/Tap2All/Tap3All/Tap4All
EL-2800C: DigitalAll/
Tap1All/Tap1Red/Tap1Blue
Tap2All/Tap2Red/Tap2Blue
Tap3All/Tap3Red/Tap3Blue
Tap4All/Tap4Red/Tap4Blue

8.1.2 Black Level

The black level can be set in the following range.

EL-2800M: DigitalAll : -256～255
Tap2All : -512～ +511
Tap3All : -512～ +511
Tap4All : -512～ +511

EL-2800C: DigitalAll : -256～255
DigitalRed All/DigitalBlue : -512～ +511
Tap2All/Tap2Red/Tap2Blue : -512～ +511
Tap3All/Tap3Red/Tap3Blue : -512～ +511
Tap4All/Tap4Red/Tap4Blue : -512～ +511

8.1.3 Black Level Auto

The tap balance of black level can be adjusted.
It is required to close the lens iris or cap the lens in order to cut the incident light.
OFF: Adjust manually
Once: Adjust only one time when this command is set.

The detection area can be selected by BalanceWhiteChannelArea. The detection area is selected individually from the following areas or the entire screen.

High Left	High Mid-left	High Mid-right	High Right
Mid-High Left	Mid-High Mid-left	Mid-High Mid-right	Mid-High Right
Mid-Low Left	Mid-Low Mid-left	Mid-Low Mid-right	Mid-Low Right
Low Left	Low Mid-left	Low Mid-right	Low Right

Fig.47 Detection area

8.2 Gain control

The EL-2800M-CXP can adjust the gain level from 0dB to +30dB using 0dB as the reference (Factory default). In the EL-2800C-CXP, the master gain can be adjusted from 0dB to +27dB and R and B gains can be adjusted in the range of -7dB to + 12.99dB using the master gain as the reference.

Resolution:
Master Gain: 0.035dB/Step
Blue/Red Gain: x0.00012 /Step

The master gain uses an analog gain and digital gain internally. All digital gain has the resolution of x0.00012/Step and provides more precise gain setting.

The magnification of digital gain is calculated in the following formula.

$$\text{Digital Gain Magnification} = \frac{\text{Gain Value} + 8192}{8192}$$

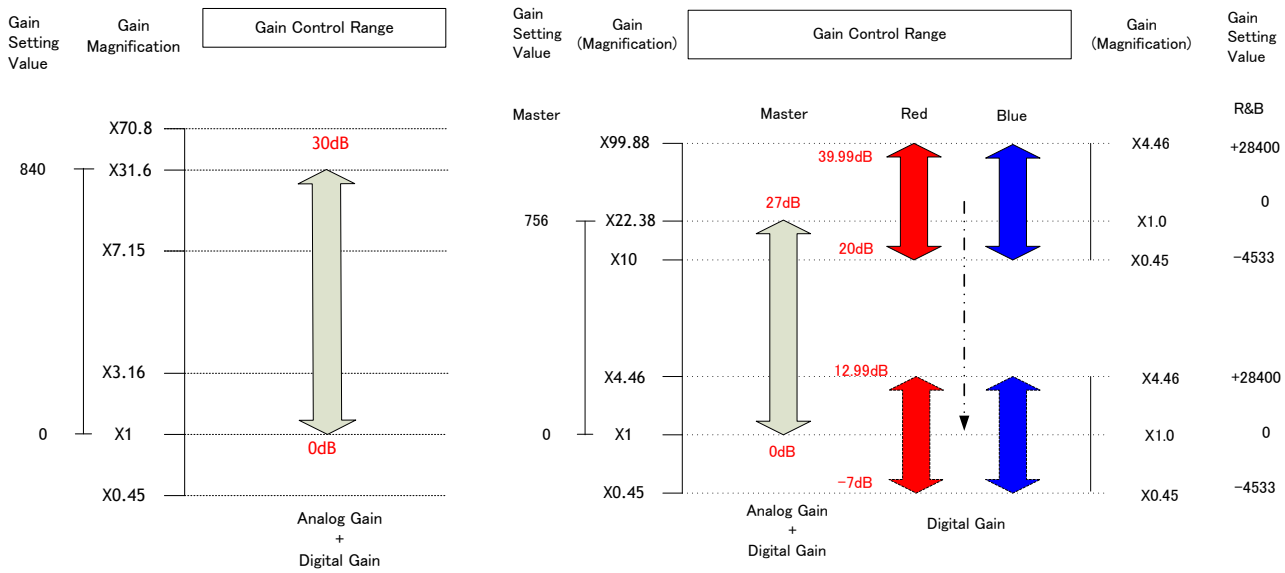


Fig. 48 Gain control

8.2.1 Gain Selector

The following parameters can be set.

EL-2800M: AnalogAll/DigitalAll/Digital Tap2/Digital Tap3/Digital Tap4

EL-2800C: AnalogAll/DigitalAll/Digital Red All/Digital Blue All
/DigitalTap2All/DigitalTap3All/DigitalTap4All
/DigitalTap2Red/DigitalTap2Blue
/DigitalTap3Red/DigitalTap3Blue
/DigitalTap4Red/DigitalTap4Blue

8.2.2 Gain

The gain can be adjusted in the following range.

EL-2800M: AnalogAll : 0.7079～32.1
DigitalAll : 0.7079～1.4125
Digital Tap2All : 0.8912～1.1220
Digital Tap3All : 0.8912～1.1220
Digital Tap4All : 0.8912～1.1220
EL-2800C: AnalogAll : 1.0～22.7
DigitalAll : 0.7079～1.4125
Digital Red All : 0.4466～4.4668
Digital Blue All : 0.4466～4.4668

Digital Tap2All : 0.8912～1.1220/
Digital Tap2Red : 0.8912～1.1220/
Digital Tap2Blue : 0.8912～1.1220

Digital Tap3All : 0.8912～1.1220/
Digital Tap3Red : 0.8912～1.1220/
Digital Tap3Blue : 0.8912～1.1220

Digital Tap4All : 0.8912～1.1220/
Digital Tap4Red : 0.8912～1.1220/
Digital Tap4Blue : 0.8912～1.1220

8.2.3 Gain Raw

The gain raw can be adjusted in the following range.

EL-2800M:
AnalogAll : 0 ～ 840
DigitalAll : -2393～+3379
Digital Tap2All/ Digital Tap3All/ Digital Tap4All : -891～+1000

EL-2800C:
AnalogAll : 0 ～ 756
DigitalAll : -2393～+3379
Digital Tap2All/Digital Tap3All/Digital Tap4All : -891～+1000/
Digital Red All/Digital Blue All : -4533～28400
Digital Tap2Red/Digital Tap2Blue : -891～+1000
Digital Tap3Red/Digital Tap3Blue : -891～+1000
Digital Tap4Red/Digital Tap4Blue : -891～+1000

8.2.4 Gain Auto

This function automatically controls the gain level. This function is effective only for Frame trigger OFF and RCT modes.
This is controlled by the command ALC Reference.

There are three modes.

OFF:	Adjust manually.
Once:	Operate only one time when this command is set
Continuous:	Operate the auto gain continuously

The following detailed settings are also available.

ALC Speed:	The rate of adjustment of GainAuto can be set.(Common with Exposure Auto)
Gain Auto Max:	The maximum value of GainAuto control range can be set
Gain Auto Min:	The minimum value of GainAuto control range can be set
ALC Reference:	The reference level of Gain Auto control can be set (Common with Exposure Auto)
ALC channel area:	The area of GainAuto control can be set, either entire area or individual section

High Left	High Mid-left	High Mid-right	High Right
Mid-High Left	Mid-High Mid-left	Mid-High Mid-right	Mid-High Right
Mid-Low Left	Mid-Low Mid-left	Mid-Low Mid-right	Mid-Low Right
Low Left	Low Mid-left	Low Mid-right	Low Right

Fig.49 ALC channel area

8.2.5 Balance White Auto

This is the auto white balance control function.
The operation can be selected from the following:

OFF:	Adjust manually.
Once:	Operate only one time when this command is set
Continuous:	Operate the white balance control continuously

AWB channel area is the same as the gain and black level controls.

8.3. LUT

This function can be used to convert the input to the desired output characteristics.
The Look-Up Table (LUT) has 256 points for setup. The output level can be created by multiplying the gain data by the input level. In the EL-2800C-CXP, the same LUT characteristic is applied independent of the color value

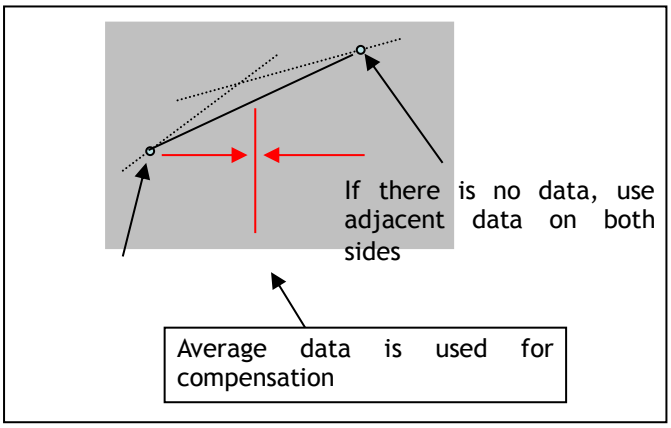
8.3.1 LUT Mode

Can be set to OFF, gamma (see section 8.4), or Lookup Table.8.3.2 LUT Index

The number of LUT data elements is 256. The lowest level is Index 0 and the highest level is Index 255.

8.3.3 LUT value

There are 256 LUT data elements to which a value can be assigned. The minimum LUT value is 0 and the maximum LUT value is 255.
The data between LUT data elements is calculated from adjacent data elements.
In the color camera, LUT characteristics for R, G and B are the same.



Output Data = Video IN x LUT data

8.4. Gamma

This command is used set gamma between gamma 0.45 and gamma 1.0 (OFF).
The gamma can be changed in 8 steps. The gamma value is an approximate value.

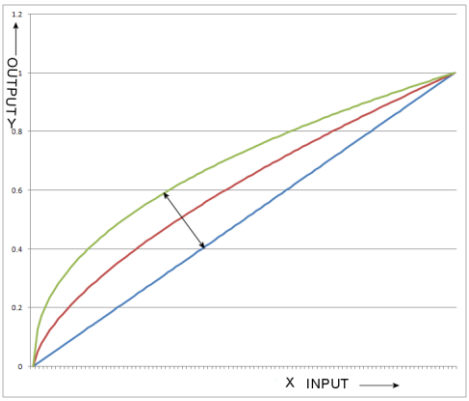


Fig. 50 Gamma compensation

8.5. Shading Correction

This function compensates for shading (non-uniformity) caused by the lens or the light source used. This compensation can be performed even if shading issues are not symmetrical in horizontal and/or vertical directions.

There are two methods of correction.

Flat shading correction:
The method to compensate the shading is to measure the highest luminance level in the image and use that data as the reference. Luminance levels of other areas are then adjusted so that the level of the entire area is equal. The block grid for compensation is 15 (H) x 12(V) blocks with 128 pixels x 128 pixels for each block .The complementary process is applied to produce the compensation data with less error.

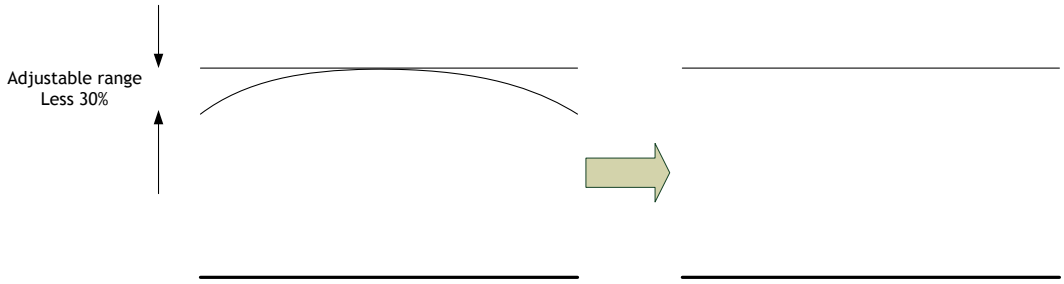


Fig. 51 Flat shading correction concept drawing

Color shading correction (For EL-2800C only):
In this case, R channel and B channel are adjusted to match with G channel characteristics. The block grid for compensation is 15(H) x 12(V) blocks and the complementary process is applied to produce the compensation data with less error.

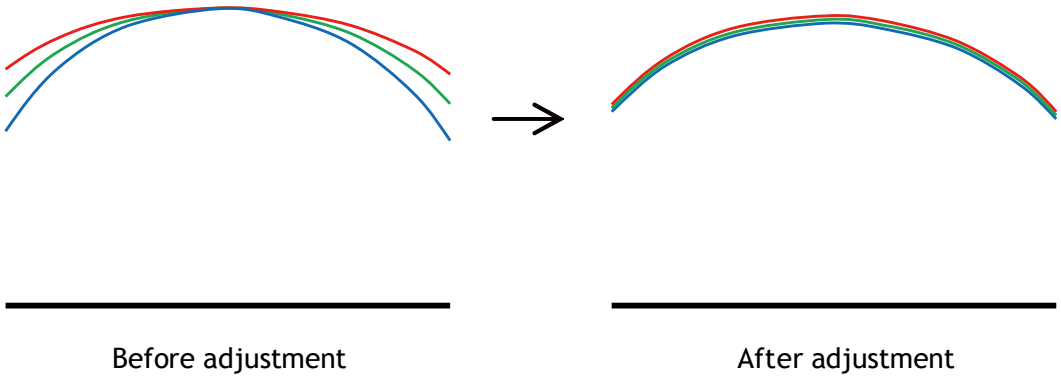


Fig.52 Color shading correction concept drawing

Note: Under the following conditions, the shading correction circuit may not work properly.

- If there is some area in the image with a video level less than 70%
- If part of the image or the entire image is saturated
- If the highest video level in the image is less than 300LSB (at 10-bit output)

8.6. Blemish compensation

The EL-2800M-CXP and EL-2800C-CXP have a blemish compensation circuit. This function compensates blemishes on the CCD sensor (typically pixels with extremely high response or extremely low response). This applies to both monochrome and color versions. Pixels that fulfill the blemish criteria can be compensated by adjacent pixels in both columns and, in the case of the EL-2800C-CXP, the defective pixels can be compensated by the same Bayer color pixels in both adjacent columns. The number of pixels that can be compensated is up to 300 pixels.

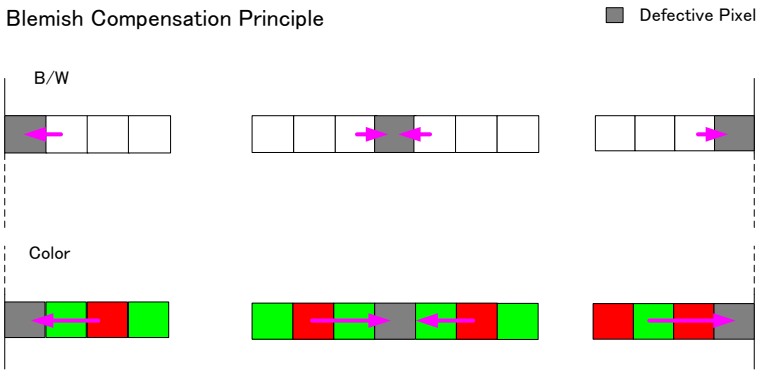


Fig. 53 Blemish compensation

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

8.7. Bayer color interpolation (Only for EL-2800C)

This function is available only for EL-2800C-CXP. The EL-2800C-CXP uses a CCD with an RGB Bayer pattern. If in-camera Bayer color interpolation is not used, the following RAW data can be output.

B	Gb	B	Gb	B	Gb	B	Gb	B	Gb
Gr	R	Gr	R	Gr	R	Gr	R	Gr	R
B	Gb	B	Gb	B	Gb	B	Gb	B	Gb
Gr	R	Gr	R	Gr	R	Gr	R	Gr	R

Fig.54 Bayer pattern

The RAW data contains only luminance information for each color and outputs as a monochrome signal. The Bayer color interpolation function can complement lacking color information on each pixel and output RGB color data as the result. Color interpolation compensates for the lack of color information by using information from adjacent pixels. The following is the concept drawing for the color interpolation process.

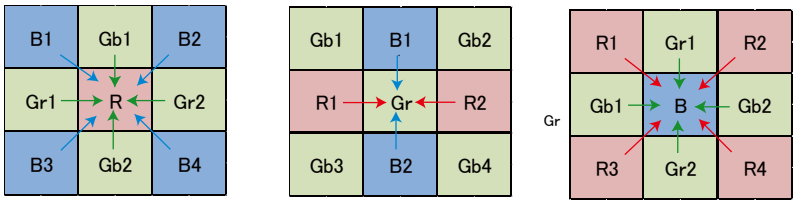


Fig.55 Color interpolation concept drawing

8.8 Lens

The EL-2800-CXP can be used with 4 different types of auto iris lenses, in addition to standard lenses with manual iris control. If an auto iris function is to be utilized, the lens type used must be selected in Lens Select.

Table -25 Lens selector

Lens Select	Description (Control with camera)	Note
P-Iris Lens	1) Iris position can be remotely controlled manually 2) Auto iris control is also available	If P-iris lens is used, the specific model name should be selected in lens select.
Motor controlled lens	1) Iris position can be remotely controlled manually 2) Auto iris control is also available	
Video iris lens	Only auto iris control is available	Factory Option (Use AUX Type 2)
DC iris lens	Only auto iris control is available	Factory Option (Use AUX Type 2)

8.8.1 About P-Iris

New Elite Series EL-2800M-PMCL and EL-2800C-PMCL come equipped with P-Iris control as part of the standard lens control function. The P-Iris system is a newly developed lens control method designed to control the iris more precisely. Especially for video cameras in surveillance applications utilizing megapixel CCD or CMOS imagers, it becomes a very important factor to control an iris in order to achieve the maximum camera performance. In surveillance applications, depending on shooting conditions, resolution and depth of field are important factors. The iris is deeply related with these factors. If the iris diaphragm is smaller, but not too small, resolution gets better and the depth of field is also deeper. The P-Iris system controls the iris diaphragm precisely and maintains the best image with the highest resolution and depth of field. P-Iris can also combine with gain and electronic shutter to keep the appropriate iris position under changing lighting conditions (ALC function).

8.8.2 Setting for P-iris lens being used

P-iris lenses use an absolute setting value control system and therefore, if the following parameters are input, precise iris position control is possible.

8.8.2.1 P-Iris lens select

Select the lens used. At present time, the following two lenses are available for these cameras.

P-Iris lens select	Description	Control step number	Open F value
LM16JC5MM	KOWA 16mm 2/3-inch	74	F1.4
LM35JC5MM	KOWA 35mm 2/3-inch	73	F2.0

8.8.2.2 Step max.

The iris control step depends on the lens. The setting value uses the value stored in the camera. Refer to the table above for the control step number.

8.8.2.3 Position

The iris position can be set between 0 to Step Max. 0 means to open the iris and Step Max means to close the iris. The camera initializes P-iris control and acquires iris position under the following conditions:

1) When the camera is powered
2) When the lens is selected in P-Iris lens select
3) If the lens is changed in P-iris lens select

8.8.2.4 Current F value

The current F value is indicated by using iris position information. This can be indicated during auto iris operation. The relation between iris position and F value depends on the lens used.

8.8.2.5 P-Iris Auto min. / P-Iris Auto max.

This function can set the control range when the iris is operated automatically. Auto max. sets the limit when the iris goes open and Auto min. sets the limit when the iris goes closed. Auto max. can be set to fully open but Auto min. is stopped at F5.6 as lens performance typically degrades if the iris is closed beyond this point.

8.8.2.6 Auto Iris Lens Control Signal Output

If the auto iris lens is used, this parameter should be ON. This is common for all types of auto iris lens.

8.8.3 Motorized lenses

The EL-2800-CXP can use the 3-axis motorized lens control for zoom, focus and iris. The following functions are available via the motorized lens commands.

8.8.3.1 Iris

Open: While this command is supplied, the iris will continue to open.
Close: While this command is supplied, the iris will continue to close.
Stop: When this command is supplied, the iris operation stops.

8.8.3.2 Zoom

Wide: While this command is supplied, the zoom will continue to move towards wide angle.
Tele: While this command is supplied, the zoom will continue to mode towards telephoto.
Stop: When this command is supplied, the zoom operation stops.

8.8.3.3 Focus+

Near: While this command is supplied, the focus will continue to shift closer to the camera.
Far: While this command is supplied, the focus will continue to move towards infinity.
Stop: When this command is supplied, the focus operation stops.

8.8.4 Exclusive video output signal for iris control

This signal can be used for automatic lens iris control in Continuous and RCT modes.
This signal is available if AUX Type 2 connector is used for AUX (Factory option).
The iris video signal is composed to average the video level in the center area of each frame and can be output as a composite signal with H-sync.

The following drawing shows the waveform of the iris control video signal. This signal is output with the same video level within the same frame and the average is recalculated with each new frame.

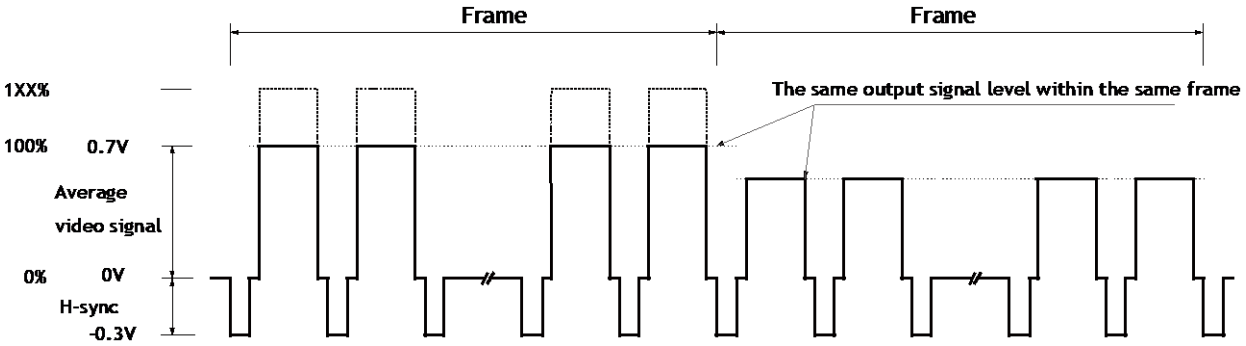


Fig. 56 Iris video output signal

The following parameters of this auto iris control signal output can be changed.

Auto Iris Control Signal Output:
ON: The auto iris control can be connected with AGC and ASC as ALC function
OFF: The auto iris control is not connected with AGC and ASC.

Iris State Control:
Video: Use the iris control in auto mode.
Close: Force the iris to close.
Open: Force the iris to open.

8.8 ALC

In the EL-2800M-CXP and EL-2800C-CXP, auto gain, auto shutter and auto iris functions can be combined to provide a wide ranging automatic exposure control from dark to bright or vice versa. The functions are applied in the sequence shown below and if one function is disabled, the linkage between the other two is maintained.

In order to make the ALC function effective, set the Auto Iris Lens Control Signal Output to “ON”. The auto iris function works together with AGC and Exposure Auto.

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

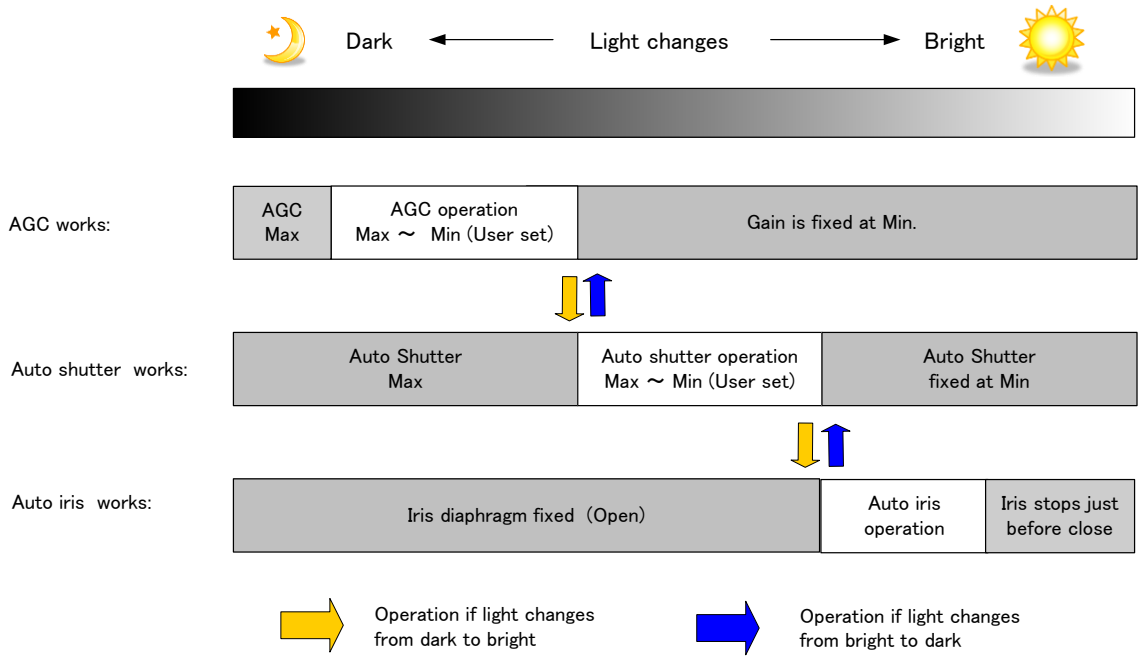


Fig.57 ALC function concept

ALC Reference will determine the target video level for AGC, Auto Shutter and/or Auto iris. For instance, if ALC Reference is set to 100% video level, AGC, Auto Shutter and/or Auto iris will function to maintain 100% video level.

■ Please note that ALC function is available only in continuous mode, as well as RCT mode.

9. Camera setting

In the EL-2800M-CXP and EL-2800C-CXP, control of all camera functions is done by the JAI SDK and Control Tool software. All controllable camera functions are stored in an XML file inside of the camera. The JAI SDK and Control Tool software can be downloaded from www.jai.com.

10. External appearance and dimensions

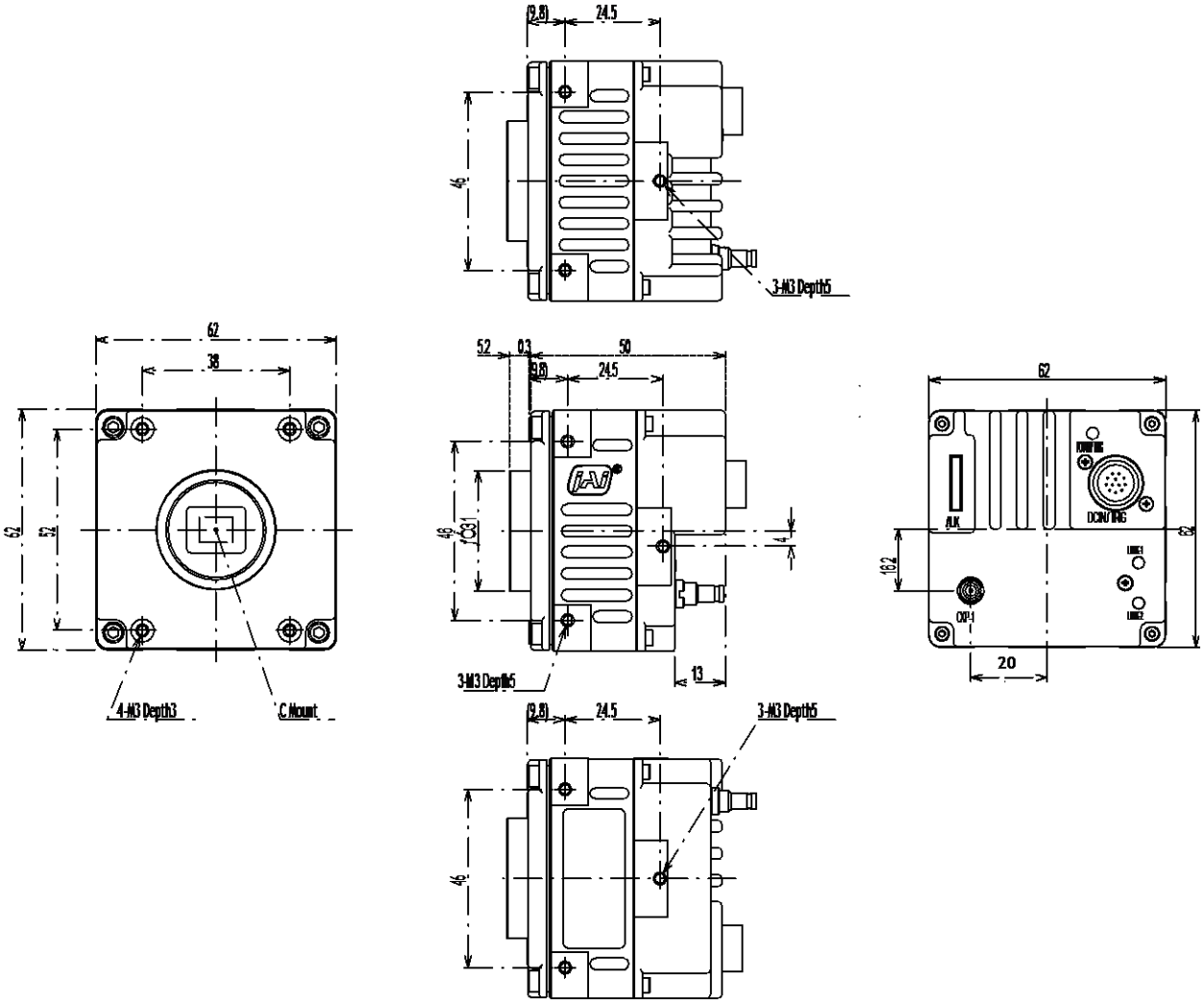


Fig. 58 Outside dimensions (C mount)

11. Specifications

11.1 Spectral response

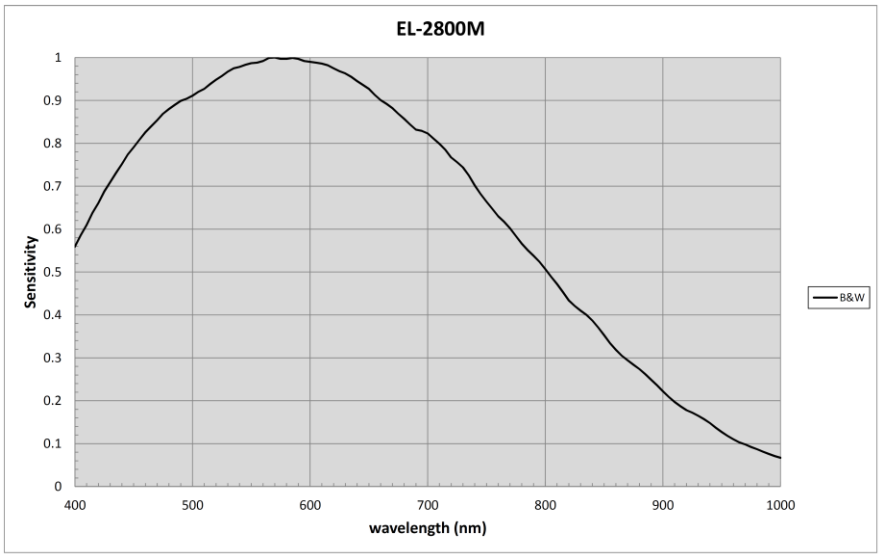


Fig. 59 Spectral response (EL-2800M-CXP)

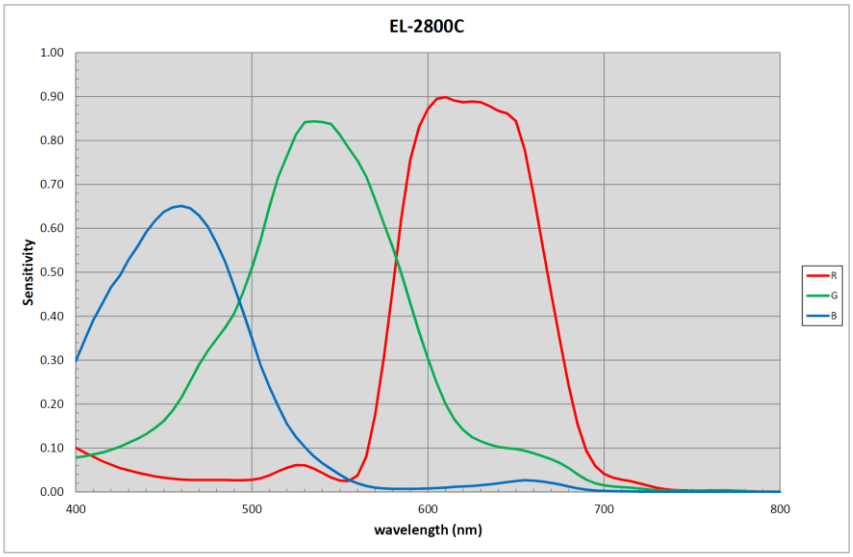


Fig.60 Spectral response (EL-2800C-CXP) （With IR Cut Filter）

11.2 Specifications table

Table - 26 Specifications table

Specifications				EL-2800M-CXP		EL-2800C-CXP	
Scanning system				Progressive scan, 4-tap			
Synchronization				Internal			
Interface				CoaxPress (JIIA NIF-001-2010 CoaxPress Standard First Edition) EL-2800M-CXP: 3.125 Gbps , 1 link, Comply with PoCXP EL-2800C-CXP: Bayer 3.125 Gbps, RGB 6.25 Gbps, 1 Link, Comply with PoCXP			
Image sensor				2/3 inch Monochrome CCD		2/3 inch Bayer color CCD	
Aspect Ratio				4:3			
Image size(Effective Image)				8.72 (h) x 6.54 (v) mm 10.9 mm diagonal			
Pixel size				4.54 (h) x 4.54 (v) μm			
Effective Image output Pixels				1920 (h) x 1440 (v)		1920 (h) x 1440 (v)	
Pixel Clock				Sensor Pixel Clock	54 MHz		
				Camera Out Pixel clock	108 MHz		
Acquisition frame rate	1X-2YE			54.7 fps ～ 0.125 fps		54.7 fps ～ 0.125 fps	
	1X-1Y			15.8 fps ～ 0.125 fps		15.8 fps ～ 0.125 fps	
	RGB (1X-1Y)			–		15.8 fps ～ 0.125 fps	
Acquisition mode				Single frame / Multi frame (1 to 255) / Continuous			
EMVA 1288 Parameters Absolute sensitivity Maximum SNR				at 12-bit output 15.94 p (λ = 525 nm) 41.39dB		at 12-bit output 23.71 p (λ = 525 nm) 41.52dB	
SN ratio				61dB (Typical) (0dB gain, Black))		58.5dB (Typical) (0dB gain, Green Pixel Black Level)	
Image Output format Digital	Full image			1920 (h) x 1440 (v)		Bayer 1920 (h) x 1440 (v)	
	ROI	Height		8 ～1440 lines, 1line/step		8 ～1440 lines, 2lines/step	
		OFFSET Y		0 ～1430 lines, 1 line/step		0 ～1430 lines, 2 lines / step	
	Binning	H	1	1920 (H)		1920 (H)	
			2	960 (H)		–	
		V	1	1440 (V)		1440 (V)	
			2	720 (V)		–	
	Bit assignment			8-bit, 10-bit ,12-bit		8-bit , 10-bit ,12-bit, 24-bit_RGB	
Horizontal Frequency	Binning Vertical			Tap Geometry	Frequency (KHz)	Interval (μs)	Clock
	1			1X-2YE	40.693	24.574	2654
	1			1X-1Y	40.693	24.574	2654
	1			1X-1Y	23.519	42.519	2296
	2			1X-2YE	34.134	29.296	3164
	2			1X-1Y	34.134	29.296	3164
	2			1X-1Y	21.160	47.259	2552
Vertical Frequency	Binning Vertical			Tap Geometry	Frequency(Hz)	Total line number	Effective line number
	1			1X-2YE	54.7	744	720
	1			1X-1Y	27.4	1485	1440
	1			1X-1Y	15.8	1485	1440
	2			1X-2YE	91.0	375	360
	2			1X-1Y	45.3	752	720
	2			1X-1Y	28.1	752	720

Trigger Selector		Acquisition	Acquisition Start / Acquisition End
		Exposure	Frame Start
Trigger option		Acquisition Start / Acquisition End	Overlap: OFF
		Frame Start	Overlap: OFF / READOUT Except “Timed option : OFF”, only “Overlap: OFF” is available
Trigger Input Signal		Line 1, Line 2, PG1, PG2, CXP Trigger packet	
Exposure Mode	OFF (Frame Start disable)	Minimum frame rate ～ 8 sec. (Max.) Variable unit: 1 μs	
	Timed	10 μs (Min.) ～ 8 sec (Max.)、 Variable unit:1 μs	
	Timed option	OFF: Timed, JAI_RCT: Timed (RCT) with ALC, JAI_PIV: PIV	
	Trigger Width	1 line + 8 μs (Min.) ～ ∞ (Max.)	
Auto Exposure		OFF / Once / Continuous	
Exposure Auto Speed		1 ～ 8	
Digital I/O: Line selector		12P: GPIO IN / GPIO OUT	
Black Level Adjust.	Ref. level	33.5LSB 10-bit (Average value of 100*100)	
	Adj. range	-256 ～ 255LSB 10-bit	
	Resolution	1 STEP = 0.25LSB	
Gain Level Adjust.	Manual Adj. range	0dB ～+30dB, Less 0.01dB/Step	0dB ～+27dB, Less 0.01dB / step
	WB Gain		R / B : -7dB to +13dB, Less 0.01dB/ step
	WB Area		4 x 4
	WB Range		3000K ～ 9000K
	White Balance		OFF, Once, Continuous
Blemish Comp.	Detection	Detect white blemish above the threshold value (Black blemish is detected only by factory)	
	Compensation	Complement by adjacent pixels in horizontal (Continuous blemishes are not compensated)	
	Numbers	512 pixels	
ALC		AGC, auto exposure, iris control can be combined and automatically controlled	
Gamma		0.45 ～ 1.0 (8 steps are available)	
LUT		OFF: γ=1.0, ON= 256 points can be set	
Shading Compensation		Flat Field Block (128 x 128 pixels) comp.	Flat Field, Color shading Block (128 x 128 pixels) comp.
Bayer Color interpolation		—	3 x 3 Linear compensation
Power	Input range	DC+12V to +24V ± 10% (At the input terminal)	
	Current Consumption	620mA (At 12V input, Full/Bayer image, Lens drive OFF) 645mA (At 12V input, ROI, Lens drive OFF)	
	Power consumption	7.44W (At 12V input, Full/Bayer image, Lens drive OFF) 6.48W (At 12V input, ROI, Lens drive OFF)	
Lens mount		C mount Rear protrusion of the lens is less than10 mm	
Flange back		C mount: 17.526 mm, Tolerance: 0 to -0.05 mm	
Optical filter		Protection glass: Not provided	Optical Low Pass filter ＋ IR cut filter (Half value is 670nm)
Operating temperature (Performance guaranteed)		-5°C to +45°C	
Humidity (Performance guaranteed)		20 – 80% (non-condensing)	

Operating temperature	-45°C to +70°C
Humidity	20 – 80% (non-condensing)
Storage Temp. / Humidity	-45°C to +70°C/20% to 80 % (non-condensing)
Regulation	CE (EN61000-6-2 and EN61000-6-3), FCC part 15 class B, RoHS, WEEE
Housing Dimensions	62 x 62 x 55.5 mm (W x H x D) (excluding protrusion)
Weight	245 g

Note1): Approximately 5 minutes pre-heating is required to achieve these specifications.
Note2): The above specifications are subject to change without notice.

Appendix

1. Precautions

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

2. Typical Sensor Characteristics

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

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

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

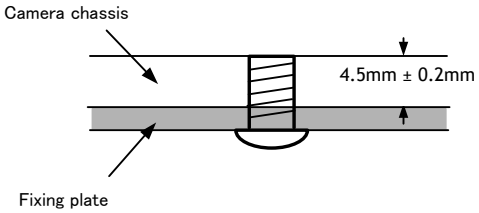
Patterned Noise
When the sensor captures a dark object at high temperature or is used for long time integration, fixed pattern noise may appear on the video monitor screen.

3. Caution when mounting a lens on the camera

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

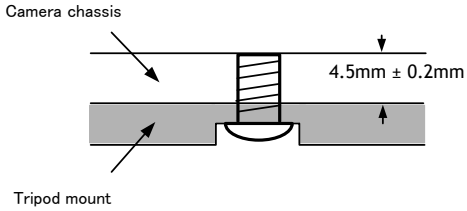
4. Caution when mounting the camera

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



Mounting the camera to fixing plate

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



Attaching the tripod mount

5. Exportation

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

6. References

1. This manual can and datasheet for EL-2800M-CXP / EL-2800C-CXP can be downloaded from www.jai.com
2. Camera control software can be downloaded from www.jai.com

Manual change history

Date	Revision	Changes
Nov. 2013	1.0	New release
Nov. 2013	1.1	Add chapter 6.4 The relations between tap Geometry and Frame rate. Correct TYPO.
Nov. 2013	1.2	Add the description for 54.6fps for RGB output at Quad Tap in Section 1 and 3 and also correct TYPO
Jan. 2014	1.3	Correct TYPO
Feb. 2014	1.4	Correct typo (S/N 58dB to 58.5dB for Bayer) Correct pin assignment of P-Iris.
May 2014	1.5	Change LUT Enable to LUT Mode、Revise Spectral Response
Oct. 2014	1.6	Revised B/W spectral response with wider wave length range
May 2015	1.7	Add the description of the optical interface

User's Record

Camera type: **EL-2800M-CXP / EL-2800C-CXP**

Revision: **……..**

Serial No. **……..**

Firmware version. **……..**

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

User's Mode Settings.

User's Modifications.

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

Visit our web site at www.jai.com

See the possibilities