CIS

CoaXPress I/F
25M CMOS B/W Camera

VCC-25CXP1M

Product Specifications & Operational Manual

CIS Corporation

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1. Handling Precautions

1.1. Camera Handling Precautions

- ☐ Do not use or store the camera in the extremely dusty or humid places.
- ☐ Do not apply excessive force or static electricity that could damage the camera. Handle the camera with care.
- ☐ Do not shoot direct images that are extremely bright (e.g., strong light source, sun, etc.). When strong light such as spot light was shot, blooming or smear may occur. Put the lens cap on when camera is not in use.
- ☐ Follow the instructions in Chapter 3.3, "External Connector Pin Assignment" for connecting the camera module. Improper connection may cause damages not only to the camera module but also to the connected devices.
- ☐ Confirm the mutual ground potential carefully before connecting the camera to monitors or computers. Any AC leaks or coupling noises from the connected devices may cause damages or destroy the camera.
- ☐ Do not apply excessive voltage. (Use only the specified voltage.) Unstable or improper power supply voltage may cause damages or malfunction of the camera assembly.
- ☐ The voltage ripple of camera power DC+12~24V±10% shall be within ±50mV. Improper power supply voltage may cause noises on the video signals.
- ☐ Please be careful when using external power to the camera since the voltage depression may be bigger depending on the thickness and the length of the cable. Please refer below for the external power specifications.
  [Recommended value for power voltage]
  1. Power voltage: V 2. Cable length: ℓ(m) 3. Resistance value of cable per 1m: r(Ω)
  [Formula to calculate the output voltage of external power]
  $V[V] = 12[V] + r[\Omega/m] \times \ell[m] \times 1[A]$ V
  The [V] value from the formula above shall regard as within the range of power voltage specifications.
- ☐ The rising time of camera power supply voltage shall be less than +10V, Max. 60ms. Please avoid noises like chattering when rising.
- ☐ Our warranty does not apply to damages or defects caused by irregular and/or abnormal use of the product.

1.2. Restrictions on Applications

- ☐ The camera must not be used for any nuclear equipment or aerospace equipment with which mechanical failure or malfunction could result in serious bodily injury or loss of human life.
- ☐ The camera must not be used under conditions or environments other than specified in this manual.

1.3. Disclaimers (Exception Clause)

CIS shall be exempted from taking responsibility and held harmless for damages or losses incurred by the following cases.

- ☐ In case damages or losses are caused by earthquake, lightning strike, fire, flood, or other acts of God.
- ☐ In case damages or losses are caused by deliberate or accidental misuse by the user, or failure to observe the information contained in the instructions in this Product Specification and Operational Manual.
- ☐ In case damages or losses are caused by repair or modification conducted by the customer or any unauthorized party.

2. Product Outline

VCC-25CXP1M is a CoaXPress interfaced B/W camera utilizing a APS-H type, 25M pixels CMOS image sensor.

2.1. Features

- ☐ 65mm x 65mm x 65mm cubic in size
- ☐ Global shutter type CMOS (Monochrome)
- ☐ CoaXPress CXP-1, CXP-2, CXP-3, CXP-5, and CXP-6
- ☐ 4 Lanes
- ☐ PoCXP
- ☐ The maximum cable length: Approx. 100m at CXP-1, and approx. 40m at CXP-6.
- ☐ ROI
- ☐ Sub-sampling
- ☐ Exposure time, Gain settings
- ☐ External trigger mode (Fixed trigger shutter mode / Pulse width trigger shutter mode)
- ☐ GenICam complied
- ☐ M48 lens mount

2.2. Bundled Items

- ☐ Standard Bundled Items
  - Camera module, VCC-25CXP1M
- ☐ Optional Items
  - M48 to F lens mount conversion adaptor
- ☐ Packaging
  - Individual carton
  - Master carton (TBD pcs/carton)

    Note) Q'ty per master carton may vary depends on the shipping q'ty.

3. Specifications

3.1. General Specifications

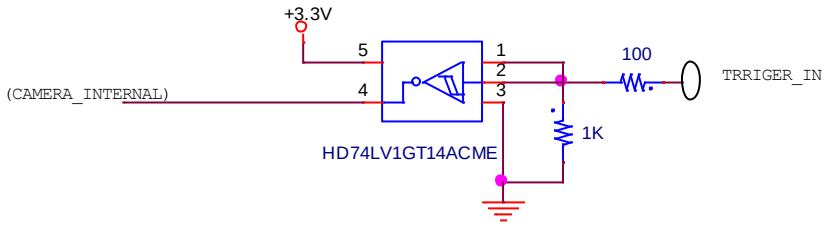
Electrical Specifications			
Pick Up Device	Device type	APS-H type, Global shutter type CMOS sensor	
	Effective pixel number	5120(H) × 5120(V)	
	Unit cell size	4.5μm(H) × 4.5μm(V)	
Video Output Mode		Ver.1.1.1 complied CXP6 / CXP5 / CXP3 / CXP2 / CXP1 ×4 each	
Video Output Frequency	Pixel clock frequency	72MHz	
Video Output Format		Mono 8 / Mono 10	
Frame Rate	CXP1 8bit/10bit	17.17fps/13.73fps	
	CXP2 8bit/10bit	30.52fps/24.41fps	
	CXP3 8bit/10bit	40.13fps/33.80fps	
	CXP5 8bit/10bit	68.40fps/54.72fps	
	CXP6 8bit/10bit	81.83fps/65.10fps	
Video Output Pixel Size (Max. Pixel Size)		5120 (H) × 5120(V)	
Video Signals	White clip level	FFh	At Mono 8
	Set up level	02h±02h	At Mono 8, and at factory setting
	Dark shading	0~2(H), 0~5(V)	At Mono 8, and at factory setting
Sensitivity		F8 400lx (Shutter speed 1/30s, Gain 0dB)	
Minimum Illumination		F1.4 5.2lx (Gain +18dB, Shutter OFF, level=50%)	
Gain Variable Range		x1~x8 (0dB~18dB)	
Shutter Speed		Preset: 1/30000, 1/10000, 1/5000, 1/2000, 1/1000, 1/500, 1/200, 1/100, 1/60, 1/50, 1/30 [s] Manual: 30[μs]~72590[μs]	
Gamma Correction		None (γ=1)	
Trigger Mode		Free run mode (Camera internal trigger) Trigger mode (Host, external terminal) ・Fixed trigger shutter ・Pulse width trigger shutter	
Partial Scan		10 Preset patterns (4096x4096, 4096x3072, 3840x2896, 3840x2160, 2560x2048, 2048x2048, 2048x1440, 1920x1200, 1920x1080, 1280x1024)	
Sequence Function		For each 16 parameter set, Start (X,Y) coordinate, Horizontal size, Vertical size, Exposure, and Gain settings Control mode: Trigger mode, Burst mode, and Index mode	
Power Requirements		12pins circular connector or PoCXP 12pin: 12V~24V	
Power Consumption		7.8W(CXP-1), 10.6 W (CXP-6), [At free run]	
Mechanical Specifications			
Dimensions		H:65mm W:65mm D:65mm (Without protruding portion)	
Weight		Approx. 290g	
Lens Mount		M48 mount	

Environmental Specifications			
Safety/Quality Standard		UL: Conform to UL for all the materials. CE: EMC: 2014/30/EU Conform to EN61000-6-4:2007+A1:2011 for Emission Conform to EN61000-6-2:2005 for Immunity RoHS: 2011/65/EU Conform to EN50581(RoHS2)	
Durability	Vibration	Acceleration	: 98m/s^2 (10G)
		Frequency	: 20~200Hz
		Direction	: X,Y, and Z 3directions
		Testing time	: 120 min for each direction
	Shock	No malfunction shall occur with the maximum 980m/s^2(100)G for ±X, ±Y, and ±Z 6 directions without packaging.	
Operation Guaranteed Environment		Temperature: -5~+45℃ Humidity: 20~80% RH with no condensation	
Storage Environment		Temperature: -25~60℃ Humidity: 20~80%RH with no condensation	

3.2. Input and Output

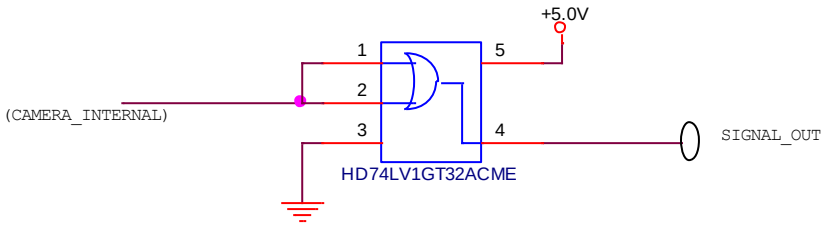
3.2.1 Trigger Input (12pins circular connector, No. 11 pin)

- ☐ 5.0V, 3.3V CMOSL level input (TTL level)
- ☐ Input voltage Low: 0.5Vdc (Max.), High: 2.1Vdc (Min.)
- ☐ To use this terminal, please set Trigger Source of AcquisitionControl to Line0.



3.2.2 Exposure Output (12pins circular connector, No. 9 pin)

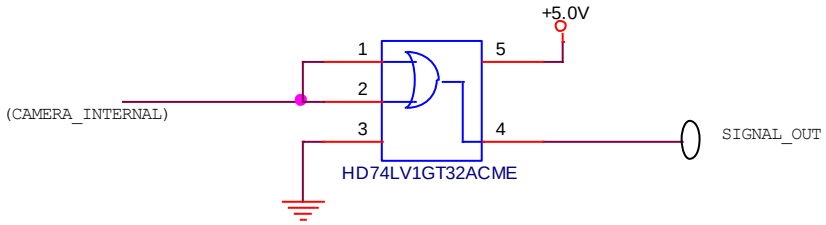
- ☐ 5.0V, CMOS Logic level output
- ☐ Output voltage Low: 0.55Vdc (Max.), High: 3.8Vdc (Min.)



3.2.3 FVALL_OUT/LVAL_OUT/ UplinkTrigger_OUT (12pins circular connector, No. 6, 7, and 10 pin)

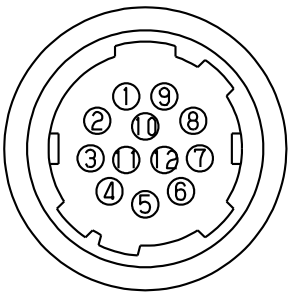
☐ 5.0V, CMOS Logic level output

☐ Output voltage Low: 0.55Vdc (Max.), High: 3.8Vdc (Min.)



3.3. External Connector Pin Assignment

3.3.1 12pins Circular Connector



HR10-10R-12PA (73)

(HIROSE or equivalent)

Pin No.	Signals	Note
1	GND	GND
2	Power	External power input
3	NC	
4	NC	
5	GND	GND
6	LVAL_OUT	Line read out signals output
7	FVAL_OUT	Frame read out signals output
8	GND	GND
9	EXPOSURE_OUT	Sensor exposure signals output
10	LinkTrigger_OUT	External trigger signals output from the Host Device (LinkTrigger0)
11	TRIGGER_IN	External trigger input (Line0)
12	GND	GND

※NC=Non-Connection. Do not connect anything to the terminal.

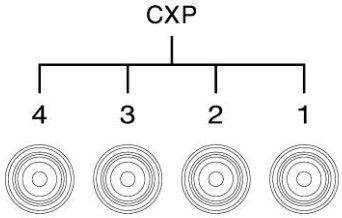
※LinkTrigger_OUT is the signal to monitor the external trigger signals from the Host Device.

※Reference: HR10-10R-12PA can connect Max. AWG26.

3.3.2 75ΩDIN Connector (Quad-type)

☐ CoaXPress Video output signals (4 lines need to be connected).

☐ No. 1 pin is the connector for PoCXP.



(Cambridge Connector)

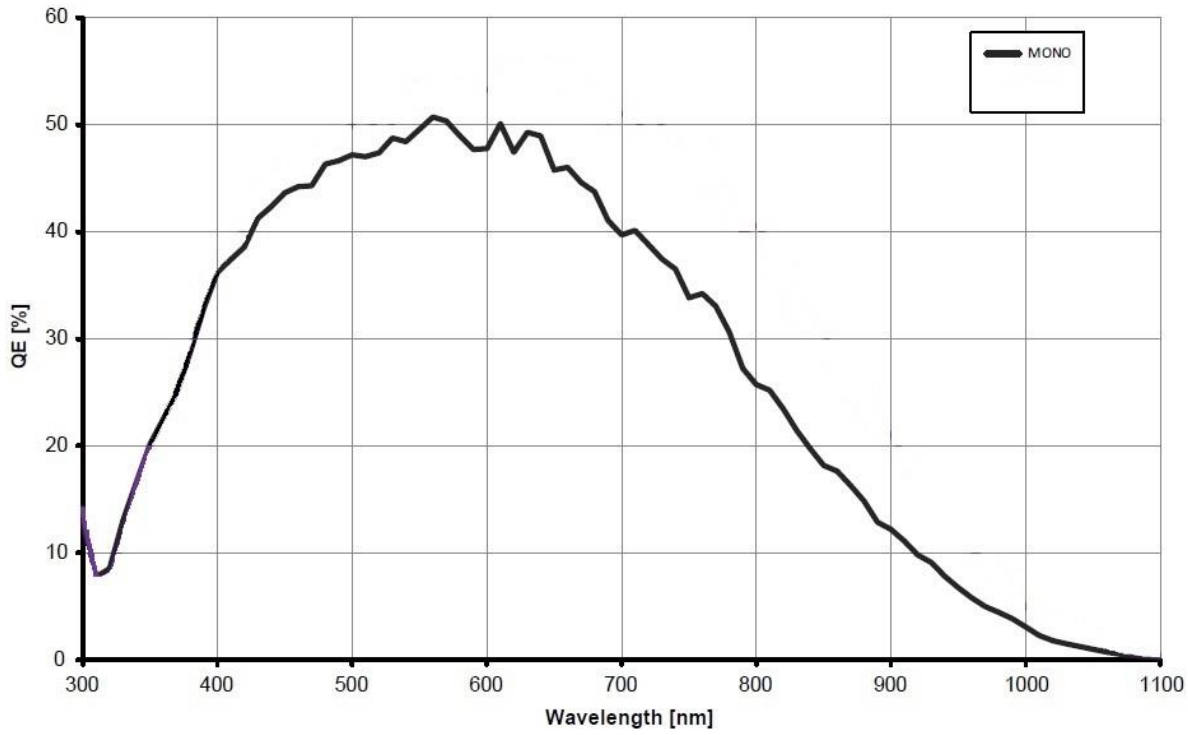
3.3.3 LED Indicator

☐ When it is ON, Lighting patterns of LED shows the camera status by the way of its lighting.

OFF	No Power supplied
Green/Orange Fast Blinking [12.5Hz]	4 cable lines are not connected.
Green Lighting	Confirmed connection of the device and the host.
Green Fast Blinking [12.5Hz]	Transmitting video data.
Orange Slow Blinking [1Hz]	Waiting for the trigger input
Red Slow Blinking [0.5Hz]	System error occurred or inappropriate trigger input.

3.4. Spectral Response

※The lens characteristic and the illuminant characteristics are excluded.



4. Camera Operational Function

4.1. Control System

☐ Complies with CoaXPress standard.

[Note] The indication of the parameter name for the commands may vary depend on the software you use.

4.2. Device Information

☐ This is to indicate the camera status.

DeviceControl	
DeviceModelName	(ReadOnly)
DeviceVersion	(ReadOnly)
DeviceFirmwareVersion	(ReadOnly)
DeviceSerialNumber	(ReadOnly)

・DeviceModelName : Model name of the camera
・DeviceVersion : Circuit Version
・DeviceFirmwareVersion : Firmware Version
・DeviceSerialNumber : Serial number of the camera

☐ A letter string consisting of the maximum 16 characters, including the terminal NUL letter (□0), can be set to the camera. To save it into the volatile memory of the camera, execute "UserSetSave". Execute "UserSetDefault" to restore it to the factory setting.

DeviceControl	
DeviceUserID	[User Definition]

4.3. LED Operational Mode

☐ This is to change LED operation of the camera rear. For the lighting patterns, please refer to the LED Indicator.

DeviceControl	
DeviceIndicatorMode	Active ErrorStatus Inactive

・Active : Indicate the communication status of CoaXPress
・ErrorStatus : OFF at normal operation.
Lights only when video transmitting error occurs or when an inappropriate trigger is input.
・Inactive : ALL LED OFF

4.4. Temperature Indication

☐ This is to indicate the temperature register value of the camera sensor.

DeviceControl	
DeviceTemperature	(ReadOnly)

[Note]

- The register value is not calibrated.

Temperature register value (Referenced values)

Sensor Temperature [°C]	30	40	50
DeviceTemperature value	94	108	122

4.5. Partial Scan (ROI)

☐ This is to increase its frame rate by cutting out and reducing the read out area.

☐ This function cannot be used with sub-sampling function.

ImageFormatControl	
Width	
Height	
OffsetX	X coordinate
OffsetY	Y coordinate
ROIQuickChange*	(Execute)

☐ Preset ROI

- "Width", "Height", "OffsetX", and "OffsetY" shall be updated when "ROIQuickChange(Xsize)x(Ysize)" is executed.
- 10 patterns of ROI are prepared as preset ROI.
- When "ROIQuickChange(Xsize)x(Ysize)" is executed, ROI is to be cut out from the center.
- Execute "ROIQuickChangeOff" to get back to the Full size of 5120x5120.
- The frame rates for each "ROIQuickChange(Xsize)x(Ysize)" shall be as the chart below, "Preset ROI frame rate",depending on their image size, pixel format, and link rate.

☐ Custom ROI

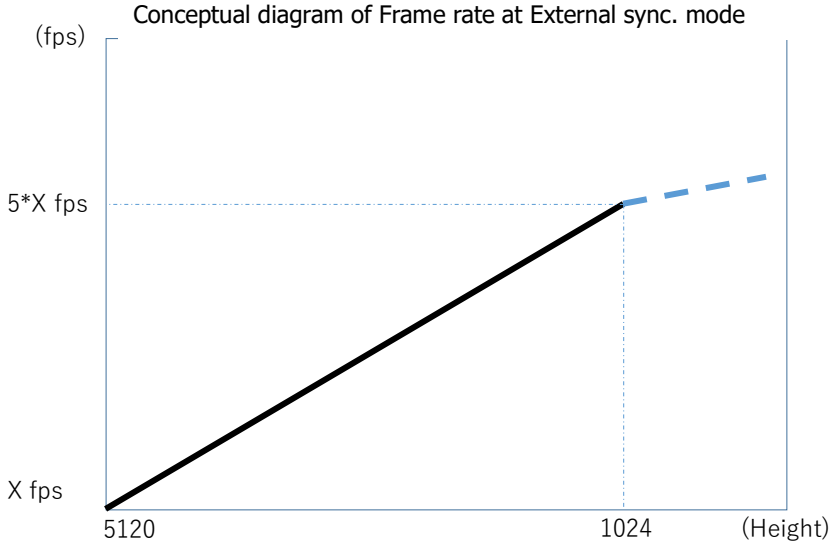
- With Width, ROI size of X direction can be specified per 64 pixels.
- With Height, ROI size of Y direction can be specified per 2 pixels.
- With OffsetX, the offset from the left side in X direction of ROI can be specified per 64 pixels.
- With OffsetY, the offset from the top side in Y direction of ROI can be specified per 2 pixels.
- OffsetX and OffsetY shall be set as follows.

  OffsetX+Width≦ 5120, OffsetY+Height≦ 5120
- The frame rates for the customized ROI shall be limited by the frame rates defined in the "Preset ROI frame rate" as shown in the chart in the next page "Custom ROI frame rate" depending on its Width and Height.

[Note]

- Frame rate shall be limited only at internal sync. mode. At external sync. mode, the frame rate shall operate with external trigger cycle.
- In case of external sync. mode and the Height is 1024 or more, frame rate shall be changed to line shape with Height. In case of Height is less than 1024, frame rate shall not be changed to line shape with Height. Please refer to Section 4.11.2.1 and note that there are restrictions on trigger pulse input timing.

Conceptual diagram of Frame rate at External sync. mode



Preset ROI frame rate [fps]

ROI Setting mode (WidthxHeight,OffsetX,OffsetY)	Known as	PixelFormat	Link rate				
			CXP1_X4	CXP2_X4	CXP3_X4	CXP5_X4	CXP6_X4
ROIQuickChangeOff (5120x5120,0,0)	25M	Mono8	17.17	30.52	40.13	68.40	81.38
		Mono10	13.73	24.41	33.80	54.72	65.10
ROIQuickChange4096x4096 (4096x4096,512,512)	16M	Mono8	23.88	43.95	61.04	87.90	124.67
		Mono10	18.62	39.24	49.94	79.18	99.74
ROIQuickChange4096x3072 (4096x3072,512,1024)	12M	Mono8	30.52	57.82	78.47	115.65	162.76
		Mono10	24.97	52.32	68.67	102.21	130.21
ROIQuickChange3840x2896 (3840x2896,640,1112)	10M	Mono8	34.33	64.75	87.03	125.57	175.81
		Mono10	26.80	58.21	75.77	114.16	140.63
ROIQuickChange3840x2160 (3840x2160,640,1480)	4K QFHD	Mono8	45.78	82.92	118.78	154.20	231.32
		Mono10	34.88	75.77	102.21	137.34	185.05
ROIQuickChange2560x2048 (2560x2048,1280,1536)	5M	Mono8	54.93	114.16	122.07	175.69	244.14
		Mono10	40.69	94.51	122.07	175.69	195.31
ROIQuickChange2048x2048 (2048x2048,1536,1536)	4M	Mono8	57.82	122.07	122.93	189.04	244.14
		Mono10	42.26	109.87	122.93	189.04	195.31
ROIQuickChange1920x1440 (1920x1440,1600,1840)		Mono8	78.47	169.03	169.03	244.14	351.12
		Mono10	61.04	156.96	169.03	244.14	281.29
ROIQuickChange1920x1200 (1920x1200,1600,1960)	WUXGA	Mono8	91.56	199.76	199.76	288.18	399.52
		Mono10	73.24	187.02	199.76	288.18	319.69
ROIQuickChange1920x1080 (1920x1080,1600,2020)	FullHD	Mono8	109.87	222.52	222.52	313.97	462.75
		Mono10	78.47	204.42	222.52	313.97	370.10
ROIQuickChange1280x1024 (1280x1024,1920,2048)	SXGA	Mono8	122.07	244.14	244.14	374.11	487.57
		Mono10	84.52	219.73	244.14	374.11	390.63

Custom ROI frame rate [fps] (In case of CXP6_X4 at Mono8)

Width / Height	5120≧	4096≧	3840≧	2560≧	2048≧	1920≧	1280≧
5120≧	81.38	81.38	81.38	81.38	81.38	81.38	81.38
4096≧	81.38	124.67	124.67	124.67	124.67	124.67	124.67
3072≧	81.38	162.76	162.76	162.76	162.76	162.76	162.76
2896≧	81.38	162.76	175.81	175.81	175.81	175.81	175.81
2160≧	81.38	162.76	231.32	231.32	231.32	231.32	231.32
2048≧	81.38	162.76	231.32	244.14	244.14	244.14	244.14
1440≧	81.38	162.76	231.32	244.14	244.14	351.12	351.12
1200≧	81.38	162.76	231.32	244.14	244.14	399.52	399.52
1080≧	81.38	162.76	231.32	244.14	244.14	462.75	462.75
1024≧	81.38	162.76	231.32	244.14	244.14	462.75	487.57

Note 1) ▭ in the above chart is the frame rate defined by ROIQuickChange(Width)x(Height).

Note 2) ▭ is defined by "Preset ROI frame rate" in case of when link rate is other than link rate=CXP6_X4, and in case of when PixelFormat=mono10. The value shall be limited to the smaller value in each Width and Height.

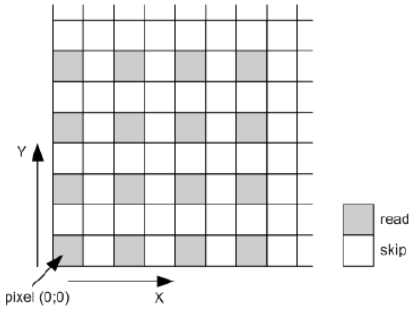
4.6. Sub-Sampling

ImageFormatControl	
Subsampling	Subsampling_Off Subsampling_On

☐ This is to increase its frame rate by reducing the pixel numbers to read out, reducing both horizontal and vertical pixel number in half, that is, 1/4 of the entire pixels. The field of angle remains the same as the one for full resolution.

☐ This function cannot be used with ROI function.

☐ When sub-sampling is in use, pixel defective correction function cannot be used.



Frame rate of Sub-sampling mode [fps]

Subsampling mode (Pixel number)	Pixel Format	Link rate				
		CXP1_X4	CXP2_X4	CXP3_X4	CXP5_X4	CXP6_X4
Sub-sampling (2560x2560)	Mono8	49.94	85.33	85.33	137.33	199.75
	Mono10	46.75	79.90	85.33	137.33	159.80

4.7. Flip

ImageFormatControl	
ReverseX	True/False
ReverseY	True/False

- ReverseX : Flip the image of X direction
- ReverseY : Flip the image of Y direction

4.8. Pixel Format

ImageFormatControl	
PixelFormat	Mono8 Mono10

- Mono8 : Monochrome 8bit
- Mono10 : Monochrome 10bit

4.9. Cursor Indication

☐ Cursor can be shown on the screen.

ImageFormatControl	
ShowCursor	On/Off
CursorX	X coordinate
CursorY	Y coordinate
CursorColor	White/Black

・ShowCursor : Specify if the cursor shall be indicated or not. (On/Off)
・CursorX : Specify the X coordinate of the vertical cursor.
・CursorY : Specify the Y coordinate of the vertical cursor.
・CursorColor : Specify the color of the cursor (Black or White).

[Note]

- When Reverse or ROI are shown, cursor coordinates shall be as follows.
  ReverseX=False, ReverseY=False: The top left of ROI screen is the origin of (0,0)
  ReverseX=True, ReverseY=False: The top right of ROI screen is the origin of (0,0)
  ReverseX=False, ReverseY=True: The bottom left of ROI screen is the origin of (0,0)
  ReverseX=True, ReverseY=True: The bottom right of ROI screen is the origin of (0,0)
- Cursor may not be shown when the screen size is scaled down.

[Note]

- Cursor indication cannot be set when test pattern indication is ON.

4.10. Test Pattern Indication

☐ Test pattern can be output from the camera. It is useful to check if your system is operating properly.

ImageFormatControl	
TestImageMode	ON/OFF

[Note]

- Test pattern indication function cannot be set when cursor indication is ON.

4.11. Trigger Mode

Acquisition Control	
TriggerSelectorAndActivation	AcquisitionMode FrameStartRisingEdge FrameStartFallingEdge FrameStartLevelHigh FrameStartLevelLow FrameBurstStart
TriggerSource	LinkTrigger0 Line0
TriggerSoftware	(Execute)
AcquisitionFrameRate	(ReadOnly)

- TriggerSelectorAndActivation : Trigger selector
  This is to select how to start capturing video or its polarity out of the followings.
  - AcquisitionMode : Free run mode [Internal sync. mode]
  - FrameStartRisingEdge : Fixed trigger shutter mode: Rising edge [External sync. mode]
  - FrameStartFallingEdge : Fixed trigger shutter mode: Falling edge [External sync. mode]
  - FrameStartLevelHigh : Pulse width trigger shutter mode: High active [External sync. mode]
  - FrameStartLevelLow : Pulse width trigger shutter mode: Low active [External sync. mode]
  - FrameBurstStart : Burst mode of Sequence function [Internal sync. mode]

- TriggerSource : Trigger source
  This is to select where to input the external trigger.
  - LinkTrigger0 : External trigger input from the CoaXPress Host Device
    Please refer to the specification manuals of the Host Device such as frame grabber board to know how to generate triggers.
  - Line0 : External trigger input from the 12pins circular connector.

- TriggerSoftware : Software trigger
  A trigger is generated in the camera and capture images for 1 frame when this command is executed.
  This command is valid when TriggerSelectorAndActivation is at FrameStartRisingEdge or FrameBurstStart.

- AcquisitionFrameRate : Frame rate of internal sync. mode
  It shows frame rate of internal sync. mode.

4.11.1 Internal Sync. Mode (Free Run Mode)

☐ This is a mode to use triggers continuously made in the camera. No external trigger shall be used.

☐ Set TriggerSelectorAndActivation to AcquisitionMode.

☐ Frame rates [fps] when ROI is invalid are as follows.

PixelFormat	CXP1_X4	CXP2_X4	CXP3_X4	CXP5_X4	CXP6_X4
Mono8	17.17	30.52	40.13	68.40	81.38
Mono10	13.73	24.41	33.80	54.72	65.10

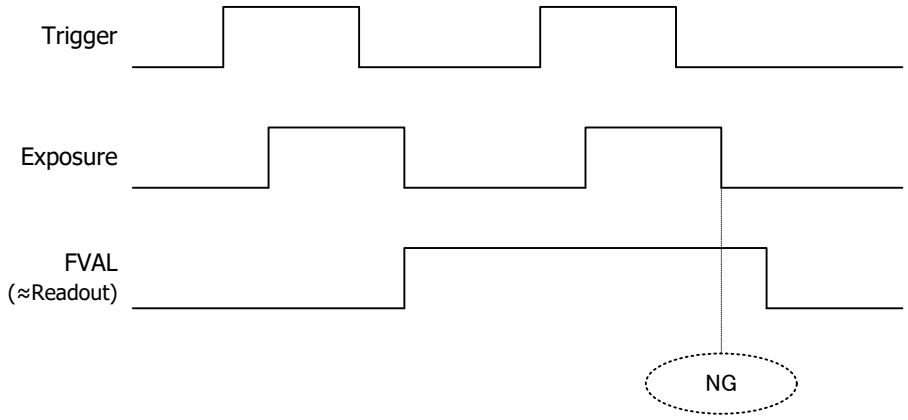
4.11.2 External Trigger Sync. Mode

☐ This is a mode to input external trigger signals to capture images by any preferred timings.

☐ Set "TriggerSelectorAndActivation" to other than "AcquisitionMode".

4.11.2.1 Restrictions on Trigger Pulse Input Timing

☐ The next trigger pulse can be input while reading out signals. However, please do not input a trigger pulse which ends its exposure while reading out the prior signals. In other words, a trigger pulse, while reading out signals for the prior frame and starts reading out signals for the next frame, cannot be input.



☐ When a trigger is input with the restricted timing explained the above, or with the timing to end exposure right after FVAL becomes "L", video output from the camera might be stopped or the image turns to be all black.

☐ In case of when the camera stopped operation while normal operation, or when proper video image were not output, stop the trigger input and execute "SensorReset" command to re-start camera operation.

☐ In case of when the camera stopped operation while sequence mode, or when proper video image were not output, turn OFF SequencerActivation, and execute "SensorReset" command to re-start camera operation.

Device Control	
SensorReset	(Execute)

4.11.2.2 Trigger Input Timing and Delay Time to Start Exposure

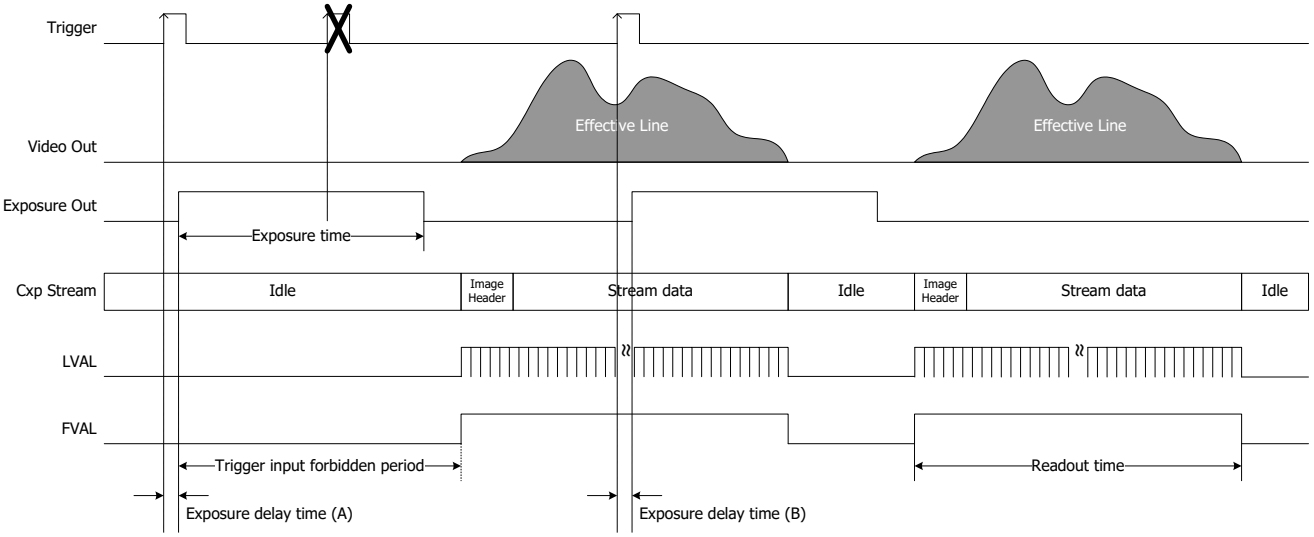
☐ Due to image sensor's own characteristics, the timing, for standard operation and overlapped operation, from when a trigger is input to the image sensor to when the actual exposure starts, would be different.

Trigger Input Timing and Delay Time to Start Exposure [μs]

	Link rate				
	CXP1_X4	CXP2_X4	CXP3_X4	CXP5_X4	CXP6_X4
Exposure Delay [μs] to start exposure for Standard operation ※Timing chart: Exposure delay time (A)	9.6	9.5	9.5	9.5	9.5
Exposure Delay [μs] to start exposure for overlapped operation ※Timing chart: Exposure delay time (B)	9.6~27	9.5~18	9.5~18	9.5~14	9.5~12

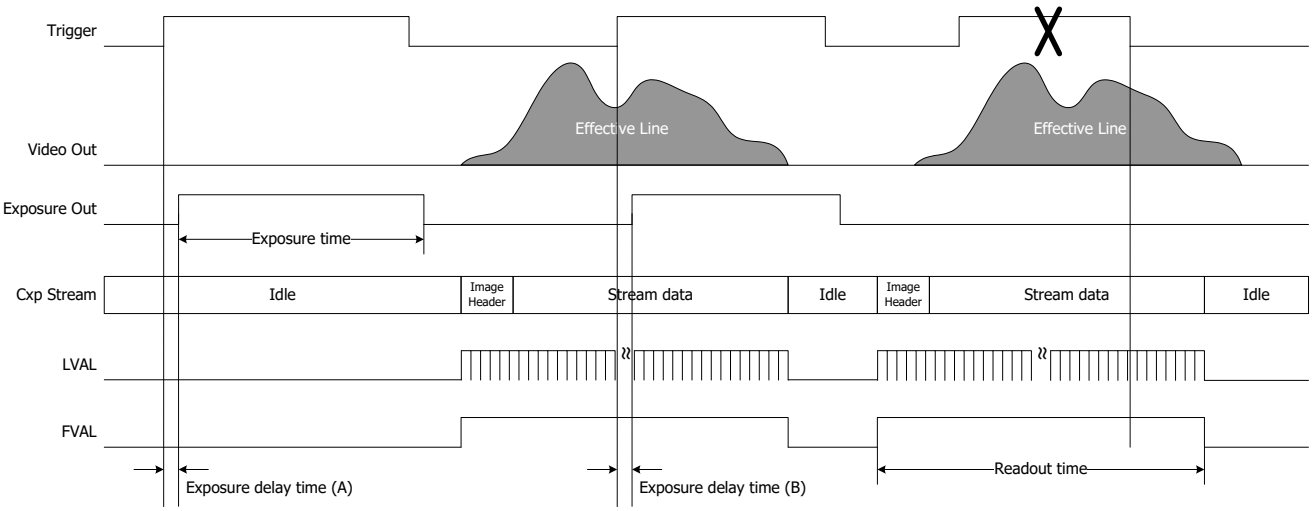
4.11.2.3 Fixed Trigger Shutter Mode

- ☐ This is the mode to start exposure by the input trigger signals. Exposure time is the set time with "Exposure Time".
- ☐ Set "TriggerSelectorAndActivation" to "FrameStartRisingEdge" or "FrameStartFallingEdge".
- ☐ Trigger cycle needs to be longer than FVAL period (Frame data reading out period).
- ☐ Trigger cycle needs to be longer than the exposure time.
- ☐ Trigger operation is CLK Sync. H-V Sync. Reset.
- ☐ The trigger pulse width to be input is 30us ~ Max. Exposure time.
- ☐ The maximum exposure time depends on ROI setting, PixelFormat, and Link rate (Please refer to the Section 4.12, Exposure Time).



4.11.2.4 Pulse Width Trigger Shutter Mode

- ☐ This is the mode to start exposure by the input trigger signals. The exposure time is its trigger pulse width.
- ☐ Set "TriggerSelectorAndActivation" to "FrameStartLevelHigh" or "FrameStartLevelLow".
- ☐ Trigger cycle needs to be longer than FVAL period (Frame data reading out period).
- ☐ Trigger operation is CLK Sync. H-V Sync. Reset.
- ☐ The minimum trigger pulse width to be input shall be 30μs. (Please refer to the restrictions on trigger pulse input).
- ☐ Functionally, there is no upper limitation. However, at long exposure, some noises, lines, pixel-wise FPN, and shading might be noticeable.



4.12. Exposure Time

Acquisition Control	
ExposureTime (us)	30~Max. Exposure time
ExposureTimeMax	(ReadOnly)
PresetShutter1_Xs	(Execute)

- ExposureTime

  Exposure time can be set per 1μs. The minimum exposure time is 30μs.

  The maximum exposure time depends on ROI settings, PixelFormat, and Link rate. The smaller values than the chart in the next page shall be set.

ROI setting mode (Video image size)	Known as	Pixel format	Link rate				
			CXP1_X4	CXP2_X4	CXP3_X4	CXP5_X4	CXP6_X4
ROIQuickChangeOff (5120x5120)	25M	Mono8	58026	32540	24689	14392	12060
		Mono10	72590	36181	29354	18033	15132
ROIQuickChange4096x4096 (4096x4096)	16M	Mono8	41642	22528	16156	11150	7793
		Mono10	53475	25258	19797	12401	9784
ROIQuickChange4096x3072 (4096x3072)	12M	Mono8	32540	17066	12515	8419	5916
		Mono10	39822	18887	14336	9557	7452
ROIQuickChange3840x2896 (3840x2896)	10M	Mono8	28899	15160	11320	7736	5461
		Mono10	37091	16952	12999	8590	6883
ROIQuickChange3840x2160 (3840x2160)	4K QFHD	Mono8	21617	11832	8192	6257	4096
		Mono10	28444	12970	9557	7054	5176
ROIQuickChange2560x2048 (2560x2048)	5M	Mono8	17976	8533	7964	5461	3868
		Mono10	24348	10410	7964	5461	4949
ROIQuickChange2048x2048 (2048x2048)	4M	Mono8	17066	7964	7907	5063	3868
		Mono10	23438	8874	7907	5063	4949
ROIQuickChange1920x1440 (1920x1440)		Mono8	12515	5688	5688	3868	2616
		Mono10	16156	6144	5688	3868	3356
ROIQuickChange1920x1200 (1920x1200)	WUXGA	Mono8	10695	4778	4778	3299	2275
		Mono10	13425	5120	4778	3299	2958
ROIQuickChange1920x1080 (1920x1080)	FullHD	Mono8	8874	4266	4266	2958	1934
		Mono10	12515	4664	4266	2958	2503
ROIQuickChange1280x1024 (1280x1024)	SXGA	Mono8	7964	3868	3868	2446	1820
		Mono10	11605	4323	3868	2474	2446
Subsampling (2560x2560)		Mono8	19569	11548	11548	6144	3868
		Mono10	21162	12401	11548	6144	5120

- ExposureTimeMax : The maximum exposure time

  The settable maximum exposure time is indicated corresponding to ROI setting, PixelFormat, and Link rate.

- PresetShutter1_Xs : Preset shutter time

  When the preset shutter value is set, it shall be reflected to the long time exposure setting value.

PresetShutter1_Xs	Shutter (s)	Exposure time (μs)
Shutter_1_30s	1/30	33333 us
Shutter_1_50s	1/50	20000 us
Shutter_1_60s	1/60	16667 us
Shutter_1_100s	1/100	10000 us
Shutter_1_200s	1/200	5000 us
Shutter_1_500s	1/500	2000 us
Shutter_1_1000s	1/1000	1000 us
Shutter_1_2000s	1/2000	500 us
Shutter_1_5000s	1/5000	200 us
Shutter_1_10000s	1/10000	100 us
Shutter_1_30000s	1/30000	30 us

[Note]

・Shutter lines

The next exposure can be started while outputting video for the prior exposure (overlap).

However, please note that there are some cases that shutter lines become noticeable depending on camera operational mode or gain settings used.

4.13. Gain

AnalogControl	
Gain	1.0~8.0
PresetGainX	(Execute)

- Gain : x1 to x8 preferred Gain can be set per x0.25.

  [Note]

  Functionally, gain up function is up to +8 times. However, the image quality will be reduced when gain setting is increased. We recommend you to evaluate it first.

- PresetGainX : Preset Gain

  When the preset gain is set, it shall be reflected to manual gain.

  Manual gain setting values would never be reflected to the preset values.

  Preset values cannot be data saved.

PresetGainX	Magnification	Decibel equivalent
Gain_x1	x1	0dB
Gain_x2	x2	6.0dB
Gain_x3	x3	9.5dB
Gain_x4	x4	12.0dB
Gain_x5	x5	14.0dB
Gain_x6	x6	15.6dB
Gain_x7	x7	16.9dB
Gain_x8	x8	18.0dB

4.14. Black Level Adjustment

☐ This is the function to adjust black level.

AnalogControl	
BlackOffset	0~255

[Note]

- Black level is adjustable with relative values. When it is increased or decreased by 1, its luminance level changes by approx. 0.3 at 8 bit output, and it changes by approx. 1.2 at 10 bit output.
- When the lower values than the initial value are set, saturation level would not achieve to the maximum value for output range.
- At sequence control mode, black level shall be adjusted to the deepest black.

4.15. Shading Correction

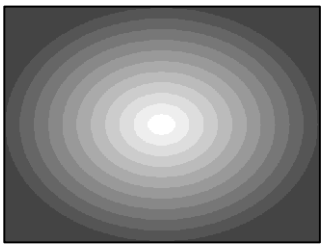
☐ This is a function to correct the peripheral brightness lowering caused by the lens and others used.

AnalogControl	
ShadingCorrection	True/False
DetectShading	(Execute)

- ShadingCorrection

  Turn ShadingCorrection "True" to start shading correction according to the shading correction data prepared by shading detection.

Before shading correction



After shading correction

- DetectShading : Shading detection

Shoot a uniform object such as a pattern box, to full screen, then execute DetectShading, to calculate the correction data automatically in the camera.

[Note]

- Turn ShadingCorrection "False" to detect shading.
- When detecting shading, make sure to turn OFF partial scan mode (ROI) and sub-sampling mode. The image size shall be set to 5120×5120 to execute.
- When changing ReverseY, please re-execute shading detection.
- Acquire correction data only when the camera is in operation. (Shading correction data cannot be acquired if the camera is not outputting anything).
- Execute UserSetSave to save the correction data.

4.16. Defective Pixels Correction

☐ CIS compensates the noticeable CMOS pixel defects found at the shipping inspection prior to our shipment.

This function can be OFF.

AnalogControl	
DefectivePixelCorrection	True/False

4.17. Link Speed and Link Count

Transfer Control	
ConnectionConfig	CXP1_X4 CXP2_X4 CXP3_X4 CXP5_X4 CXP6_X4

- CXP1_X4 : Link speed=1.250Gbps, Link count=4
- CXP2_X4 : Link speed=2.500Gbps, Link count=4
- CXP3_X4 : Link speed=3.125Gbps, Link count=4
- CXP5_X4 : Link speed=5.000Gbps, Link count=4
- CXP6_X4 : Link speed=6.250Gbps, Link count=4

4.18. How to Save and Initialize the Settings

☐ If you wish to save the setting values, execute UserSetSave. Doing so, the setting values shall be saved in the camera non-volatile memory and the saved settings data shall be reflected when the camera is turned on next time.

UserSets	
UserSetSave	(Execute)
UserSetDefault	(Execute)

- UserSetSave : This is to save the setting values of the camera.
- UserSetDefault : This is to restore the camera setting values to the ex-factory settings.

☐ When executing "UserSetDefault", set ConnectionConfig to "CXP3_X4" to execute.

☐ Camera settings shall be restored to the factory settings right after completion of UserSetDefault. However, there would be some cases that command indications are not updated depending on its indication software used. Please make sure to update the command.

4.19. Sequence Control Function

☐ This is the function to select one set of parameter out of the several preset parameter sets per every trigger input, and apply it to the camera.

☐ The maximum 16 kinds of parameter sets can be preset. The following parameters can be set per parameter.

Settable parameter: Shutter, Gain, Start X coordinate, Start Y coordinate, X size, and Y size.

☐ Operation sequence is specified as "Index". This is to specify the parameter set number to be applied for the maximum 16 indexes.

☐ There are three control modes; trigger mode, burst mode, and index mode.

4.19.1 Basic Operation for Sequence Control Function

☐ Please follow the below steps to use sequence control function.

(1) Trigger shutter mode

AquisitionControl – According to TriggerSelectorAndActivation, select trigger type and polarity out of the followings, corresponding to the sequence operation.
FrameStartRisingEdge/ FrameStartFallingEdge/ FrameStartLevelHigh/ FrameStartLevelLow/ FrameBurstStart

(2) Defective pixels correction, Sub-sampling, and ROI settings

Turn "False" DefectivePixelCorrection, and turn "OFF" SubsamplingMode. These functions cannot be used with Sequence control function. Set the ROI of ImageFormatControl to ROIQuickChangeOff.

(3) Selection of the maximum ROI size

Select SequenserMaxROIsize bigger than the maximum X and Y size of the one for the parameter set to be used for sequence control.

(4) Set the maximum 16 sets of parameter table for sequence to be used.

(5) Make sure to turn OFF sequence operational mode (SequencerControl – SequencerActivation), and select the following settings.

In case of Trigger mode and Burst mode: Select OFF → FrameStartPredefined
In case of Index mode: Select OFF → FrameStartIndexSelector

(6) Input a trigger pulse to start sequence control operation.
In case of burst mode, it stops at the last image screen of sequence when sequence control is completed.

(7) Turn OFF SequenceActivation to get back to the status before sequence control.

☐ Restriction on trigger input timing

Restrictions on trigger input timing for sequence control are the same as the one for normal mode. In case of Index mode, input trigger signals when Ack is returned after IndexSelectorModeIndexNumber setting is completed.

[Note]

- SequencerActivation shall be turned OFF once, before setting settings for sequence control.
- With SequencerActivation, UserSetSave is not valid, therefore, set them manually after turning power ON.
- Sequence starts when SequencerActivation was set to other than OFF, if a trigger had been input in the camera. Make sure not to input any triggers when changing SequencerActivation.
- Exposure time to input for each parameter shall be smaller values than the specified values in Section 4.12. The Maximum Exposure Time, according to SequenserMaxROIsize and link rate to be used.
- Sequence may stop with unstable status if operation for normal mode were performed while sequence control is in operation. Please make sure to turn OFF Sequence operation to proceed.

4.19.2 Trigger Mode and Burst Mode Operational Outline

☐ This is the mode to specify Index transition flow in advance.

The repeating count for each Index, the number of the Index to be used, and Loop count can be set.

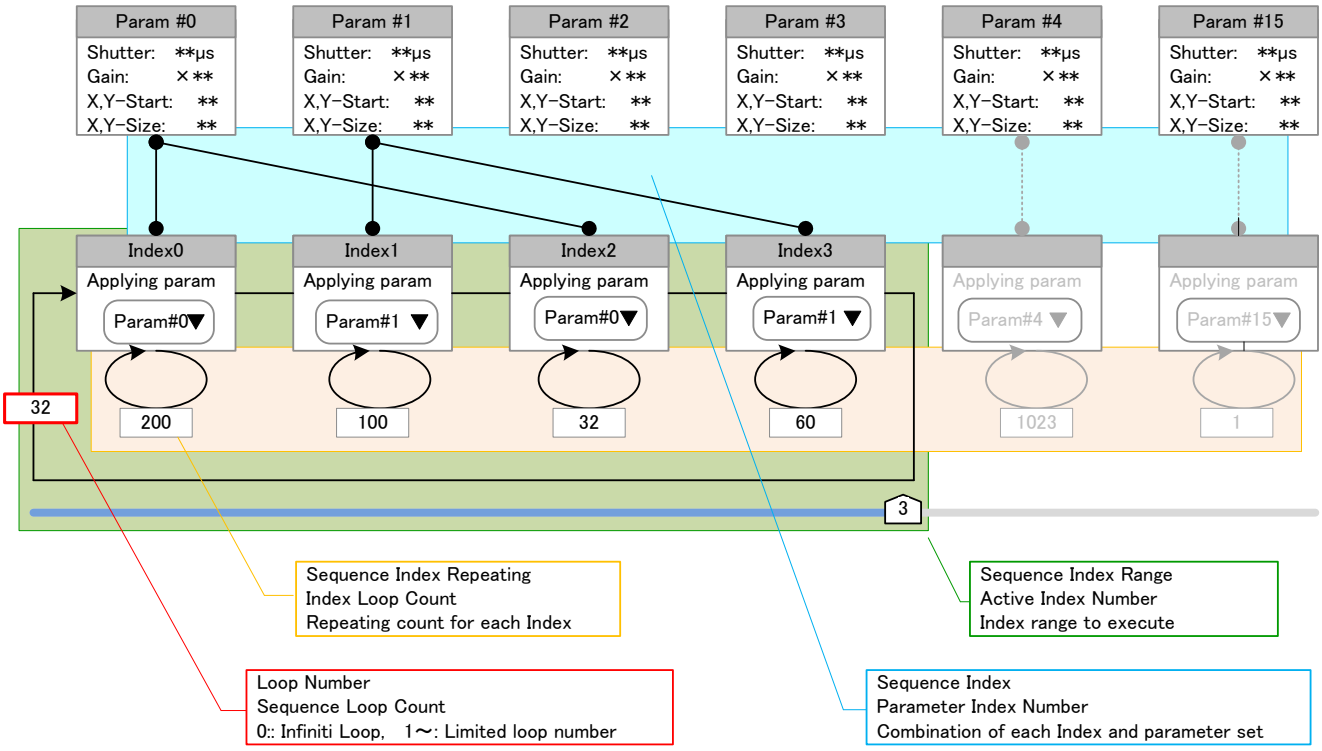
☐ Trigger mode

Index shifts every time an external trigger is input, and its parameter is applied to the camera.

☐ Burst mode

It operates as the same way as free run at internal sync. mode. Sequence starts with the trigger, and Index shifts with the camera internal trigger automatically, then its parameter is applied to the camera

☐ Operational flow



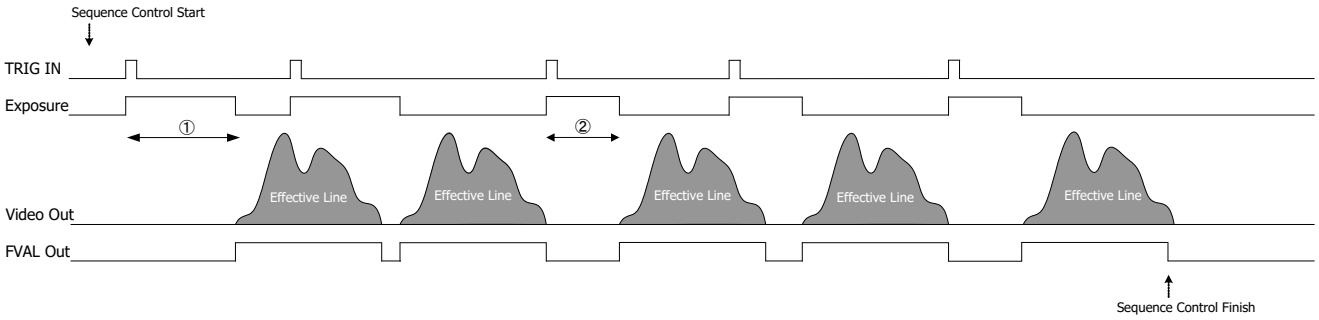
4.19.3 Trigger Mode

☐ The start and stop of sequence operation can be controlled by the edge control or pulse width control of trigger input signals.

☐ Select and set TriggerSelectorAndActivation to the one out of FrameStartRisingEdge/ FrameStartFallingEdge/ FrameStartLevelHigh/ FrameStartLevelLow to be used. Repeat count, Index number, and Loop count to be used can be set.

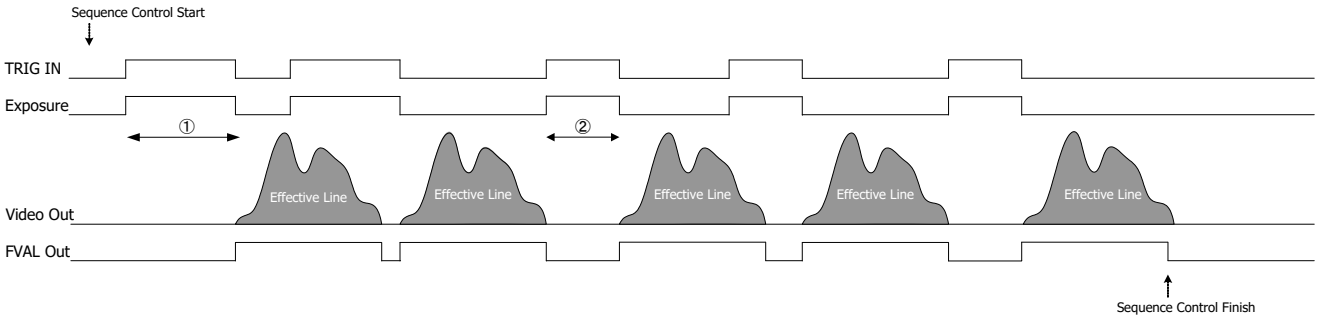
(1) Edge Control

- Sequence starts with a trigger input when TriggerSelectorandActivation is FrameStartRisingEdge or FrameStartFallingEdge.
- Exposure time (① and ②) for each frame shall be controlled by the preset sequence parameter set.
- When the image output for the sequence Loop count is completed, sequence operation ends.



(2) Pulse Width Control

- Sequence starts with a trigger input when TriggerSelectorandActivation is FrameStartLevelHigh or FrameStartLevelLow.
- Exposure time (① and ②) for each frame is the pulse width of the trigger.
- When the image output for the sequence loop count is completed, sequence operation ends.



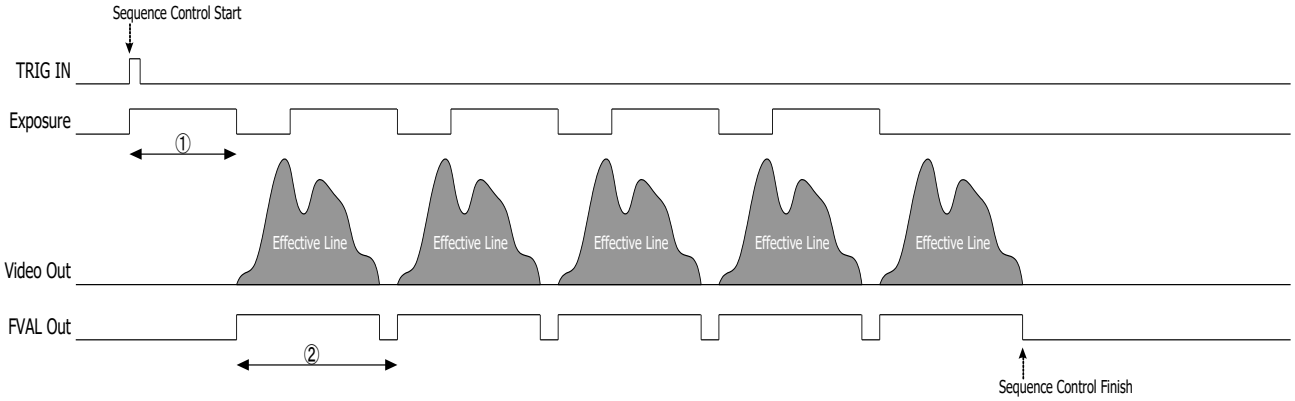
4.19.4 Burst Mode

☐ The start and stop of sequence operation can be controlled by the edge control or level control of trigger input signals, and register start.

☐ Set TriggerSelectorAndActivation to FrameBurstStart.

(1) Edge Control

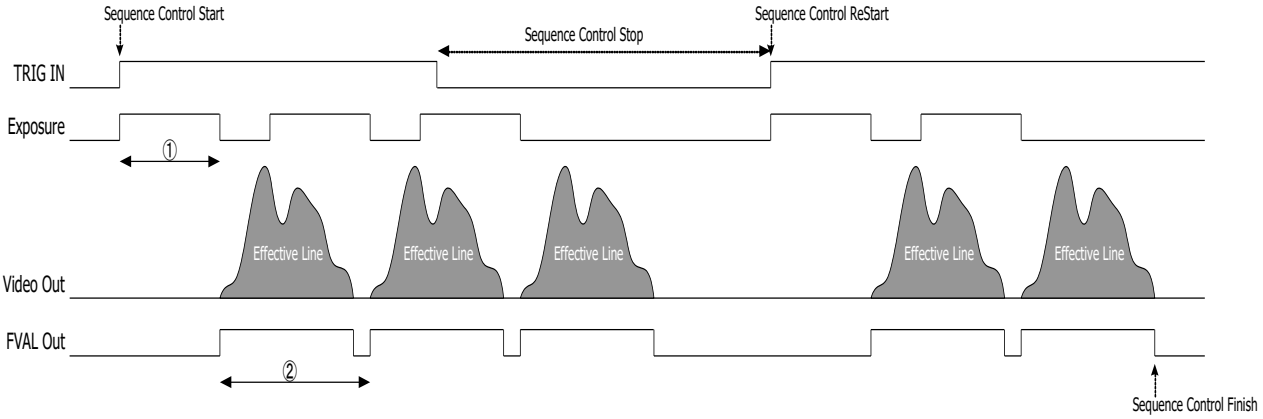
- Sequence starts with a trigger input when SequencerActivation is FrameBurstStartEdge.
- Exposure time for each frame (①) and frame output time (②) shall be controlled by the preset sequence parameter set and its image size setting.
- When the image output for the sequence loop count is completed, sequence operation ends.



(2) Level Control

- When SequencerActivation is FrameBurstStartLevel, sequence operation is performed while the trigger input is High level.
- Change the trigger input to Low level to stop operation in the middle.

  If you wish to completely end the operation, turn OFF TriggerSelectorAndActivation.
- Change the trigger input level to High Level again to re-start sequence operation.
- When the image output for the sequence Loop count is completed, sequence operation ends.



(3) Register Start

- Right after selecting FrameBurstStartSoftware of SequencerActivation, sequence operation is executed as the same way as edge control.

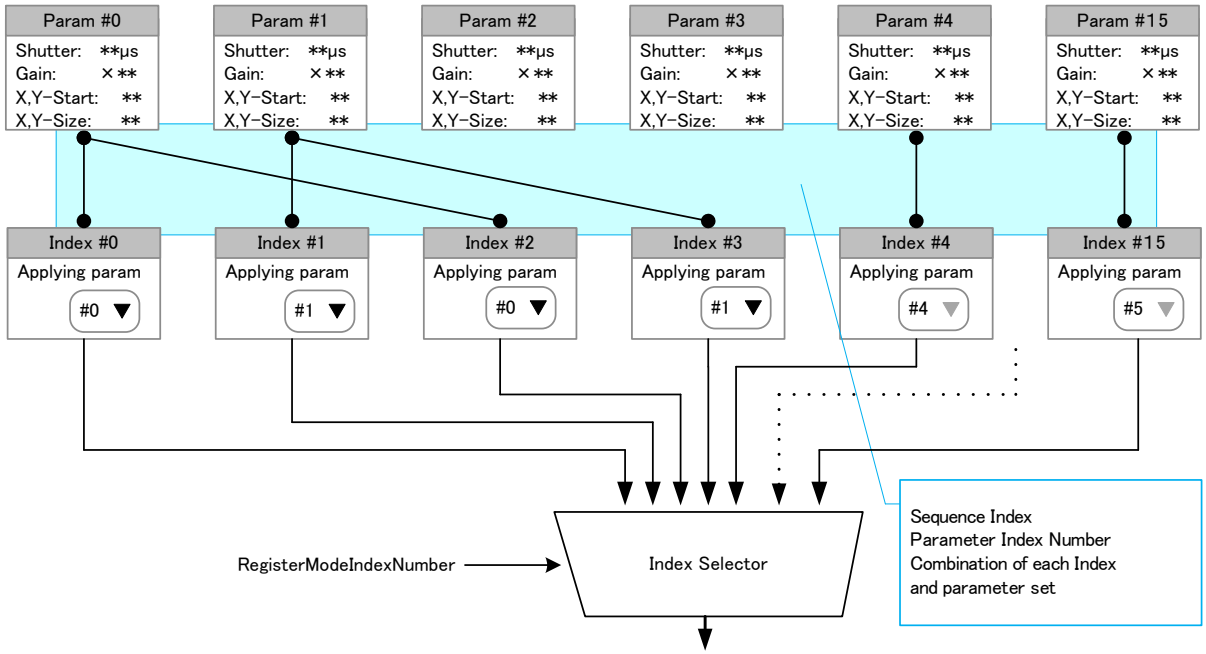
4.19.5 Index Mode

☐ This is the mode to directly specify the Index number to apply by IndexSelectorModeIndexNumber.

☐ Every time when a trigger is input, the Index parameter set specified by IndexSelectorModeIndexNumber is applied to the camera.

☐ Select and set TriggerSelectorAndActivation to the one out of FrameStartRisingEdge/ FrameStartFallingEdge/ FrameStartLevelHigh/ FrameStartLevelLow to be used.

☐ Operational flow



(1) Edge Control

- Exposure time for each frame shall be controlled by the preset sequence parameter set.

(2) Pulse Width Control

- Exposure time is the pulse width of the trigger. Exposure time of parameter set is not referred.

4.19.6 Setting Items for Sequence Control

☐ To save the settings, execute UserSetSave. Please note that SequencerActivation cannot be saved and will be OFF when power is turned ON next time. When using sequence mode, please set them every time.

☐ Settings for How to set Sequence Control

Acquisition Control	
TriggerSelectorAndActivation	AquisitionMode FrameStartRisingEdge FrameStartFallingEdge FrameStartLevelHigh FrameStartLevelLow FrameBurstStart

・FrameStartRisingEdge : Sequence control is set to trigger pulse rising edge control
・FrameStartFallingEdge : Sequence control is set to trigger pulse falling edge control
・FrameStartLevelHigh : Sequence control is set to high level control
・FrameStartLevelLow : Sequence control is set to low level control
・FrameBurstStart : Set to use Sequence control with Burst mode

☐ Settings for How to Start Sequence Control

SequencerControl	
SequencerActivation	OFF FrameStartPredefined FrameStartIndexSelector FrameBurstStartEdge FrameBurstStartLevel FrameBurstStartSoftware

・SequencerActivation : Set the mode for sequence control
・FrameStartPredefined : Set the sequence control to start trigger mode
・FrameStartIndexSelector : Set the sequence control to start index mode
・FrameBurstStartEdge : Set the sequence control to start burst mode with edge control
(Selectable at FrameBurstStart)
・FrameBurstStartLevel : Set the sequence control to start burst mode with level control
(Selectable at FrameBurstStart)
・FrameBurstStartSoftware : Set the sequence control to start burst mode with register start
(Selectable at FrameBurstStart)

☐ Settings for Sequence Count and Range

SequencerControl	
ActiveIndexNumber	0~15

・ActiveIndexNumber : This is to specify the Index number to repeat at Trigger mode and Burst mode.

SequencerConfigurationParameter	
ParameterIndexNumber	
Index0	Parameter number of Index0
Index1	Parameter number of Index1
Index2	Parameter number of Index2
Index3	Parameter number of Index3
Index4	Parameter number of Index4
Index5	Parameter number of Index5
Index6	Parameter number of Index6
Index7	Parameter number of Index7
Index8	Parameter number of Index8
Index9	Parameter number of Index9
Index10	Parameter number of Index10
Index11	Parameter number of Index11
Index12	Parameter number of Index12
Index13	Parameter number of Index13
Index14	Parameter number of Index14
Index15	Parameter number of Index15

- This is to set the parameter number to execute at Index0 to Index 15.

SequencerConfigurationParameter	
IndexLoopCount	
IndexCount0	Repeating count of Index0
IndexCount1	Repeating count of Index1
IndexCount2	Repeating count of Index2
IndexCount3	Repeating count of Index3
IndexCount4	Repeating count of Index4
IndexCount5	Repeating count of Index5
IndexCount6	Repeating count of Index6
IndexCount7	Repeating count of Index7
IndexCount8	Repeating count of Index8
IndexCount9	Repeating count of Index9
IndexCount10	Repeating count of Index10
IndexCount11	Repeating count of Index11
IndexCount12	Repeating count of Index12
IndexCount13	Repeating count of Index13
IndexCount14	Repeating count of Index14
IndexCount15	Repeating count of Index15

- This is to set the repeating count of each Index. (1~1023)

SequencerConfigurationParameter	
SequencerLoopCount	Loop Count of Sequence
IndexSelectorModeIndexNumber	Index number to execute

・SequencerLoopCount : This is to set the loop count of Sequence (0～1023) at burst mode. When it is "0", the loop count is infinity loop.

・IndexSelectorModeIndexNumber : This is to infinity repeat the specified Index number at Index mode.

☐ Settings for Sequence Parameter Set

- There are 16 parameter sets. When the number of SequencerParameterSetSelector is changed, parameter set is exchanged. Even when the parameter number is changed, the setting data is kept.

SequencerControl	
PatameterSetSettingNumber	Parameter number
PatameterSetSettingNumber	
SequencerExposureTime	Exposure time
SequencerGain	Gain
SequencerWidth	Size of X direction
SequencerHeight	Size of Y direction
SequencerOffsetX	X direction Off set
SequencerOffsetY	Y direction Off set

・PatameterSetSettingNumber : Specify the parameter number and set the next parameter (0~15).
・SequencerExposureTime : This is to set exposure time for each parameter.
・SequencerGain : This is to set gain for each parameter.
・SequencerWidth : This is to set the X direction size for each parameter.
・SequencerHeight : This is to set the Y direction size for each parameter.
・SequencerOffsetX : This is to set the X direction Offset for each parameter.
・SequencerOffsetY : This is to set the Y direction Offset for each parameter.

[Note]
The input value of SequencerWidth, SequencerHeight, SequencerOffsetX, and SequencerOffsetY are limited by the size of SequencerMaxROISize. Input SequencerWidth, SequencerHeight, SequencerOffsetX, and SequencerOffsetY after setting SequencerMaxROISize.

SequencerControl	
SequencerMaxROISize	ROISize_5120x5120 ROISize_4096x4096 ROISize_4096x3072 ROISize_3840x2896 ROISize_3840x2160 ROISize_2560x2048 ROISize_2048x2048 ROISize_1920x1440 ROISize_1920x1200 ROISize_1920x1080 ROISize_1280x1024
SequencerMaxExposureTime	(ReadOnly)

・SequencerMaxROISize : Make sure to select SequenserMaxROIsize bigger than the maximum X size and Y size of the parameter set to be used at Sequence control.
・SequencerMaxExposureTime : This is to indicate the maximum exposure time useable with the selected SequencerMaxROISize. Exposure time for each parameter shall be set less than this value.

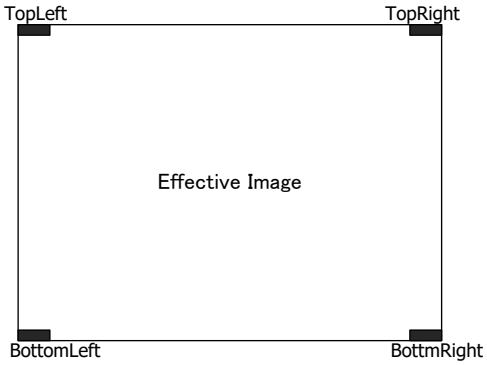
4.19.7 Sequence Status Information

☐ This is to indicate the status of sequence control.

SequencerStatus	
IndexNumberStatus	(ReadOnly)
RepeatNumberStatus	(ReadOnly)
LoopNumberStatus	(ReadOnly)
FrameBurstStatus	(ReadOnly)

・IndexNumberStatus : Indicate the Index number in execution.
・RepeatNumberStatus : Indicate the Index repeating number in execution.
・LoopNumberStatus : Indicate the sequence loop count in execution.
・FrameBurstStatus : Indicate the sequence status of Burst mode.

☐ Image Output of Sequence Status
While sequence operation, the sequence status information can be embedded in the effective image to output.



SequencerControl		
SequencerInformationLocation	Off	None
	TopLeft	Upper left 5pixels
	TopRight	Upper right 5pixels
	BottomLeft	Lower left 5pixels
	BottomRight	Lower right 5pixels

・SequencerInformationLocation ：Specify the pixel position to embed the sequence status information.

☐ For each pixel, index number, index repeating number, and loop count are output as follows.

In case of Mono10 MSB◄——— 10bit ———► LSB

In case of Mono8 MSB◄——— 8bit ———► LSB

pix0	Index number [3:0]	"0000"	"00"
pix1	Repeating number [7:0]		"00"
pix2	"000000"	Repeating number [9:8]	"00"
pix3	Loop count [7:0]		"00"
pix4	"000000"	Loop count [9:8]	"00"

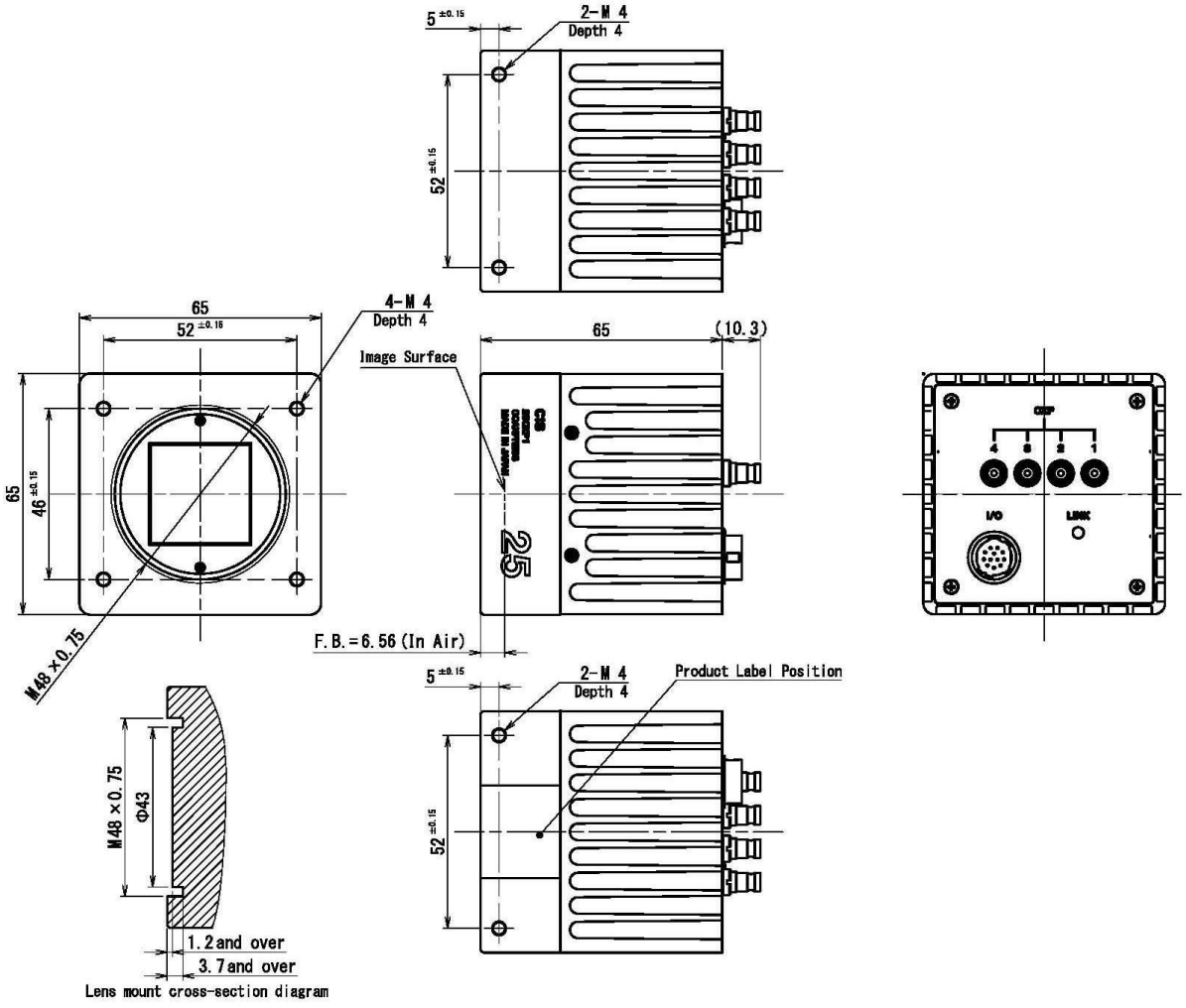
5. Factory Settings

Function	Data	Explanation
DeviceUserID	DeviceUserID	
DeviceIndicatorMode	Active	
Width	5120	
Height	5120	
OffsetX	0	
OffsetY	0	
SubsamplingMode	Subsumpling_Off	
ReverseX	False	
ReverseY	False	
PixelFormat	Mono8	
ShowCursor	Off	
CursorX	0	
CursorY	0	
CursorColor	White	
TestPattern	Off	
TriggerSelectorAndActivation	AcquisitionMode	
TriggerSource	LinkTrigger0	
ExposureTime	30.000	
Gain	1.000	
BlackOffset	10	
ShadingCorrection	False	
DefectivePixelCorrection	True	
DefectivePixelThreshold	0	
ConnectionConfig	CXP3_X4	
SequencerMaxROISize	ROISize_5120x5120	
SequencerInfomationLocation	Off	
ActiveIndexNumber	0	
SequencerActivation	Off	
Index0~Index15	0~15	The same value as the Index
Index0Count~Index15Count	1	All 1
SequencerLoopCount	0	
IndexSelectorModeIndexNumber	0	
ParameterSetSettingNumber	0	
SequencerExposureTime	30.000	
SequencerGain	1.000	
SequencerWidth	5120	
SequencerHeight	5120	
SequencerOffsetX	0	
SequencerOffsetY	0	

※ Factory setting values are the same as the one for UserSetDefault command.

6. Dimensions

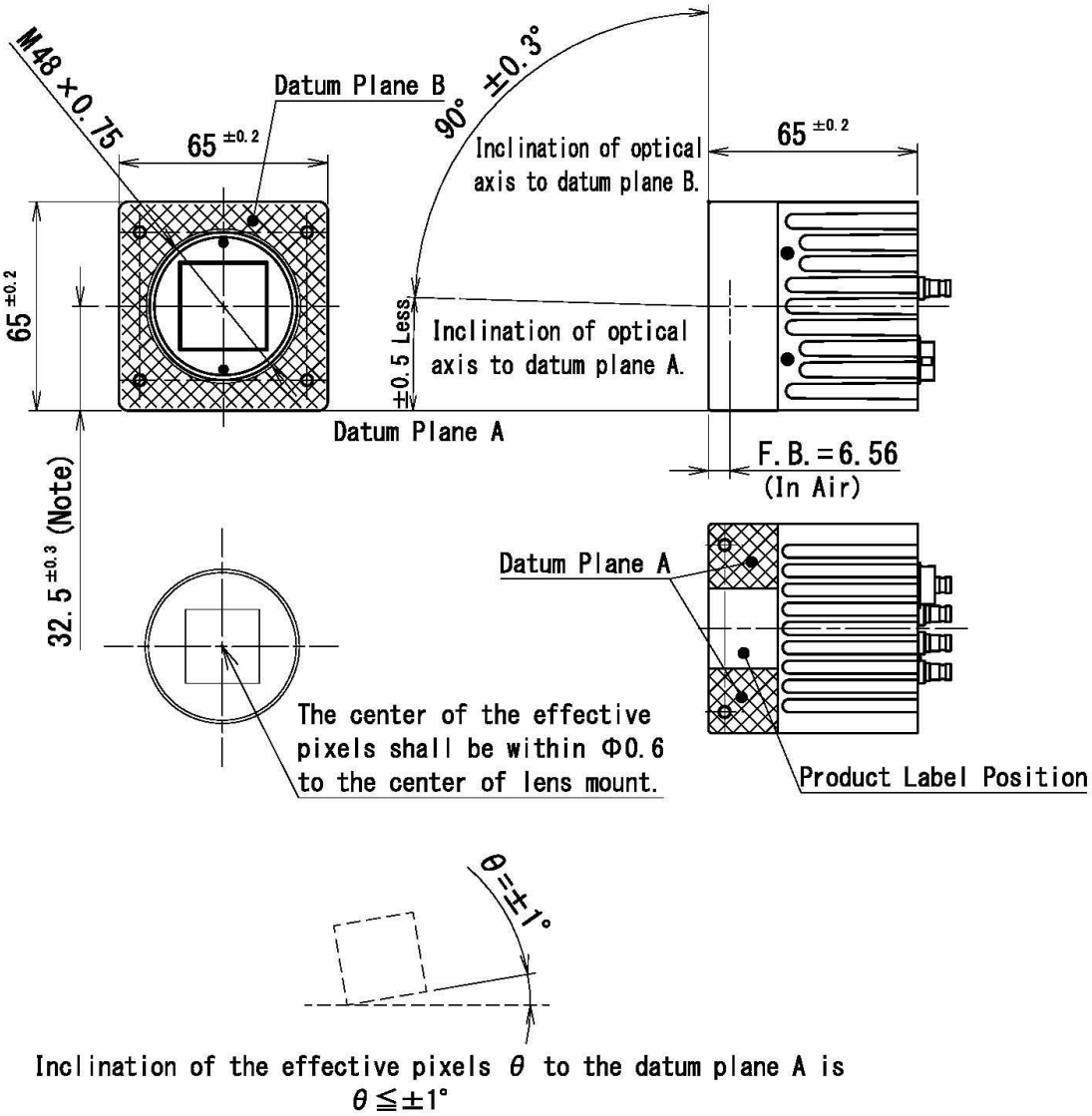
6.1. Camera Dimensions



Note2) Lens mount screw complies with M48×0.75-6H. Please refer to JIIA LE-004-2011.
Note1) Please make sure the protrusion portion does not interfer with the lens selected.
Refer to the lens mount cross-section diagram for the details.

935-0042-00
(Unit:mm)

6.2. Optical Axis Accuracy



Inclination of the effective pixels θ to the datum plane A is
$\theta \leqq \pm 1°$

Note : Dimensions from datum plane A to the center of the lens mount.

937-0013-00
(Unit : mm)

7. Case for Indemnity (Limited Warranty)

7.1. Product Warranty

The term of warranty of this product is within 3 years from the date of shipping out from our factory.
If you use the product properly and discover a defect during the warranty period, and if that was caused by designing or manufacturing, CIS Corporation, at its option, repairs or replaces it at no charge to you. Products out of warranty period will be subject to charge. CIS repairs the products as long as it is repairable.

CIS shall be exempted from taking responsibility and held harmless for damages or losses incurred by the following cases.

- In case damages or losses are caused by earthquake, lightning strike, fire, or other acts of God.
- In case damages or losses are caused by deliberate or accidental misuse by the user, or failure to observe the information contained in the instructions in this Product Specification and Operational Manual.
- In case damages or losses are caused by repair or modification conducted by the customer or any unauthorized party.

7.2. CMOS Pixel Defect

CIS compensates the noticeable CMOS pixel defects found at the shipping inspection prior to our shipment. On very rare occasions, however, CMOS pixel defects might be noted with time of usage of the products. Cause of the CMOS pixel defect is the characteristic phenomenon of CMOS sensor itself and CIS is exempted from taking any responsibilities for them. Should you have any questions on CMOS pixel defects compensation please contact us.

7.3. Product Support

Should you have any problems in function of the product you purchased, and if you need our further analysis and/or repair, please contact the dealer you purchased it from.