CIS

CoaXPress I/F

127M pixels CMOS (B/W) Camera

VCC-127CXP6MHS

Product Specifications & Operational Manual

CIS Corporation

Table of Contents

1. Handling Precautions

1.1. Camera Handling Precautions

- ☐ To protect the camera, do not use it in dusty or humid places.
- ☐ Please handle the camera with care to avoid strong shocks and static electricity. Failure to do so may result in malfunction.
- ☐ To protect the CMOS image sensor, please do not expose it to direct sunlight or high-intensity lights, etc. directly. Also, please put on the protective cap when the camera is not in use.
- ☐ Connect to the camera in accordance with Section 3.3. External Connector Specifications. Please note that incorrect connection may not only damage the camera itself, but also cause irrecoverable damage to the connected equipment.
- ☐ If there is an AC leak from the equipment (monitor/computer, etc.) connected to the camera, the camera may be damaged. Check the ground potential between the devices and make sure that there is no problem before connecting them.
- ☐ Use the correct power supply voltage for the camera within the specifications. Use of a power supply that does not meet the specifications or an unstable power supply may result in camera malfunction or failure.
- ☐ The ripple of the camera input power supply should be supplied within ±50mV. It may appear as noise in the image signal. Make sure to supply ripple within ±50mV when the camera input power supply is DC+24V±10%
- ☐ Any malfunction or failure of the camera due to misuse without observing the above precautions is not covered by the product warranty.

Our warranty does not apply to damages or defects caused by neglecting the instructions and precautions explained in this manual.

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 those specified in this manual.

1.3. Disclaimers (Exception Clause)

CIS should not be liable for any damages or losses if;

- ☐ damages or losses are caused by earthquake, lightning strike, fire, flood, or other acts of God.
- ☐ damages or losses are caused by deliberate or accidental misuse by user, or failure to observe information and instructions explained in this manual.
- ☐ damages or losses are caused by repair or modification conducted by user or any unauthorized party.

2. Prodct Overview

VCC-127CXP6MHS is B/W camera with CoaXPress interface. Using 3.6", global shutter type 127M pixels CMOS image sensor. Complies with CoaXPress Version 1.1.1. Must have function ready for Machine Vision applications such as trigger shutter, ROI, Gain, black level adjustment, FFC (flat field correction), defective pixel correction, and PoCXP. Suitable for various FA/Machine vision applications.

2.1. Features

- ☐ Global shutter type CMOS sensor
- ☐ Complies with CoaXPress CXP-6/CXP-12
- ☐ 2 lanes or 1 lane
- ☐ PoCXP
- ☐ Maximum cable length 24m (CXP-12), 40m (CXP-6)
- ☐ ROI
- ☐ Exposure and gain settings
- ☐ Binning (average and sum)
- ☐ FFC (Flat Field Correction)
- ☐ External trigger sync. mode (Fixed trigger shutter mode / Pulse width trigger shutter mode)
- ☐ Compliant with the CoaXPress standard and supports GenICam
- ☐ M72 lens mount

3. Specifications

3.1. General Specifications

Electrical Specifications			
Image sensor	Sensor type	3.6”, Global shutter type CMOS sensor	
	Effective pixels	13408(H) × 9528(V)	
	Unit cell size	3.45µm(H) × 3.45µm(V)	
Interface		Complies with CoaXPress ver, 1.1.1 Supports CXP12/CXP6	
Pixel clock frequency		74.25MHz	
Video output format		Mono8 / Mono10 / Mono12 / Mono14	
Frame rate	CXP12_X2	17.5fps@8bit / 13.1fps@10bit / 11.1fps@12bit / 9.1fps@14bit	
	CXP12_X1 / CXP6_X2	8.7fps@8bit / 6.5fps@10bit / 5.6fps@12bit / 4.6fps@14bit	
	CXP6_X1	4.4fps@8bit / 3.3fps@10bit / 2.8fps@12bit / 2.2fps@14bit	
Resolution (The maximum pixel size)		13408(H) x 9528(V)	
Video signals	White clip level	FFh	at Mono8 and factory setting (Defective pixel correction ON)
	Set up level	0~2h	at Mono8 and factory setting (Defective pixel correction ON)
	Dark shading	0~2h	at Mono8 and factory setting (Defective pixel correction ON)
Sensitivity		F11 (400lx, Mono14, 100000µs at factory settings)	
Minimum illumination		F3.5 0.5lx (Mono14, Gain x64, ExposureTime 100000µs, level=50%)	
Gain variable range		x1~x64 (0dB~36dB)	
Shutter speed		7.24[µs]~15[s] ※Use trigger mode when long time exposure is required.	
Gamma correction		Valid (Gamma 0.3~3.0)	
Trigger mode		Free-run mode (Camera internal trigger) External trigger sync. mode (Host, External terminal)	
Partial scan		Manual ROI	
Power requirements		12-pin circular connector: +24V±10% or PoCXP: +18.5V~26V (Use a power cable length of 10m or less for circular connectors.)	
Power consumption		21.0W max (CXP12_X2), [with free-run]	
Mechanical Specifications			
Dimensions		H:100mm W:100mm D:57.5mm excluding protrusion.	
Weight		730 g	
Lens mount		M72 mount	

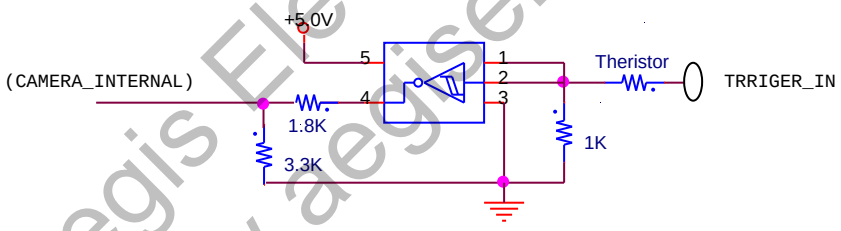
Environmental Specifications			
Safety/Quality Standards		CE: EMC: 2014/30/EU Emission: EN61000-6-4:2019 Immunity: EN61000-6-2:2019	
		RoHS: 2011/65/EU (EU)2015/863	
Durability	Vibration	Acceleration	: 98m/s^2 (10G)
		Frequency	: 20 ~ 200Hz
		Direction	: X, Y, and Z 3 directions
		Testing time	: 120min for each direction
	Shock	No malfunction with 980m/s^2 (100)G for ±X, ±Y, and ±Z, 6 directions without packaging.	
Operational temperature		0°C ~ +40°C Humidity: 20 ~ 80%RH with no condensation.	
Storage temperature		-25°C ~ +60°C Humidity: 20 ~ 80%RH with no condensation.	

※Operational temperature: Temperature range within which all the various functions of the camera operate normally

3.2. Input/Output Specifications

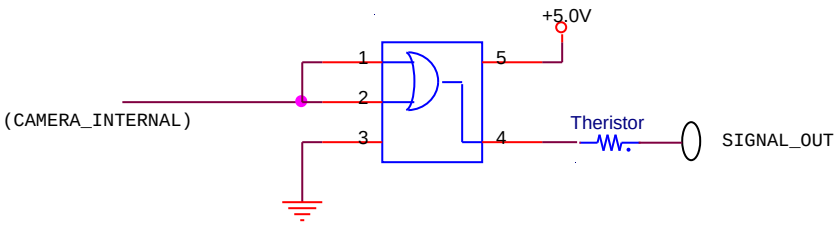
3.2.1 12-pin Connector External Input (Trigger No.11 pin)

- ☐ 5.0V, 3.3V CMOS level/TTL level
- ☐ Input voltage Low: 0.5Vdc (Max), High: 2.1Vdc (Min)
- ☐ To use this terminal, set TriggerSource of AcquisitionControl to Line0.



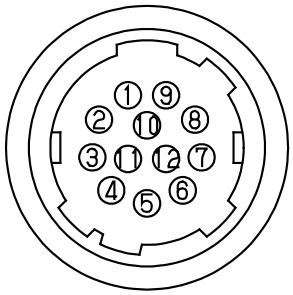
3.2.2 12-pin Connector External Output (No.7, 9, and 10 pin)

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



3.3. External Connector Specifications

3.3.112-pin Circular Connector HR10-10R-12PA(73) (Hirose) or equivalent

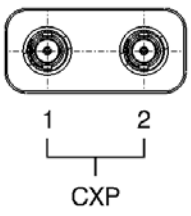


Pin	Signal Name	Explanation
1	GND	GND
2	Power input	External power input +24V±10%
3	USB D+	For FFC writing
4	USB D-	For FFC writing
5	GND	GND
6	USB VBUS	For FFC writing
7	GPO1	General-purpose output (Default: Low)
8	GND	GND
9	GPO2	General-purpose output (Default: Low)
10	GPO3	General-purpose output (Default: Low)
11	TRIGGER_IN	External trigger input
12	GND	GND

※Please refer to the separate Application Note for USB+/- FFC writing
※The output signals for general-purpose output are selectable from Section 4.24 Digital IO Control.
※Recommended power supply voltage
1. Power supply voltage: E[V]
2. Length of cable to use: ℓ[m]
3. Resistance per meter of cable used: r[Ω/m]
Equation for determining the output voltage of an external supply:
E[V]=24[V]+r[Ω/m]×ℓ[m]×0.6[A]
Camera connector input must be within the range of specified power voltage.
Supply E[V] to the camera from an external power supply..
※To avoid malfunction of the camera, please stop power supply from CoaXPress cable when supply the power from the circular connecter for external power supply.

3.3.2 75Ω MicroBNC Connector

☐ CoaXPress image output signals.
☐ Both No.1 pin and No.2 pin are connecters for PoCXP.
☐ This model “VCC-127CXP6MHS” requires 2 cables when using PoCXP for power supply. Therefore, make sure to feed power from the grabber board at the same time. If there is a time delay in the cable connection while supplying power from the grabber board, initialization will fail and the camera will not display images.



(Amphenol)

3.3.3 LED Indicator

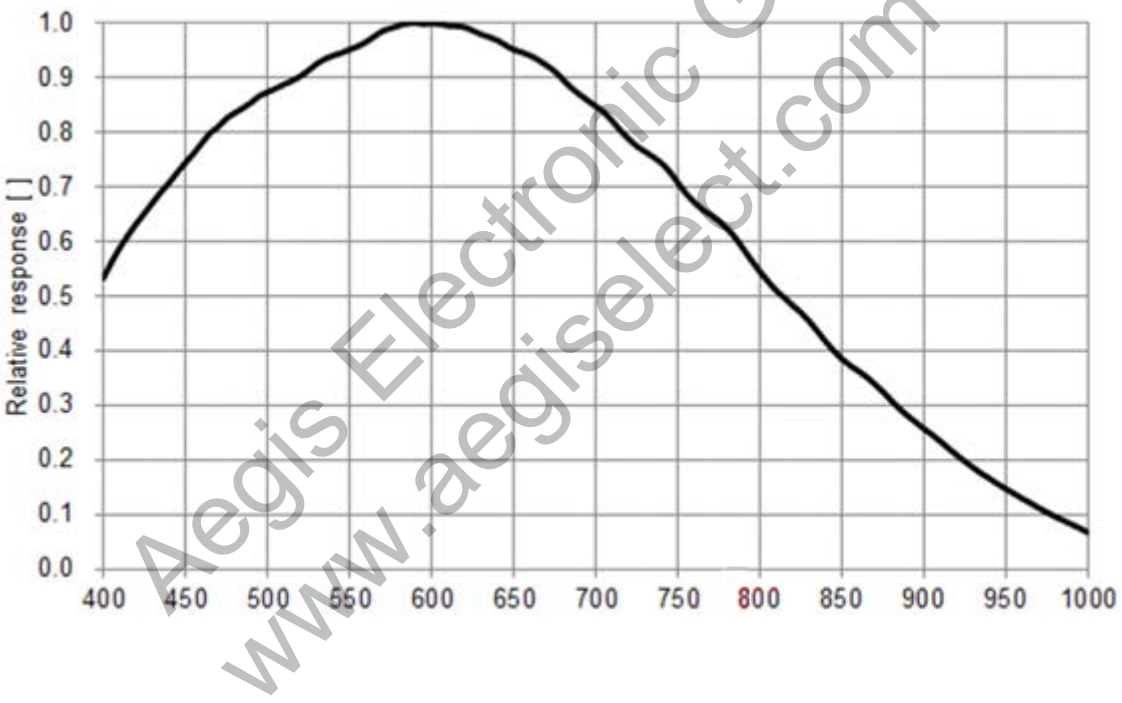
☐ When DeviceIndicatorMode is Active, the LED indicator shows the status of the camera by its way of light emitting.

OFF	No power supply
Green/Orange High-speed blinking [12.5Hz]	2 cables not connected.
Green lighting	Device and host connection established
Green High-speed blinking [12.5Hz]	Transmitting video data
Orange slow blinking [1Hz]	Waiting for trigger input
Red High-speed blinking [12.5Hz]	Video data transmitting error occurred/trigger error occurred [Error]

※Error status will occur when camera detects an illegal trigger while using external trigger sync. mode.

3.4. Spectral Response Characteristics

※Excluding characteristics of lens, IR cut filter, and light source.



4. Camera Functions

4.1. Camera Interface

☐ Complies with CoaXPress standard.

Each setting features comply with GenICam SFNC(Standard Features Naming Convention).

The corresponding SFNC version is available from DeviceSFNCVersionMajor, DeviceSFNCVersionMinor and DeviceSFNCVersionSubMinor.

4.2. Device Information

☐ This is to indicate device information.

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

☐ DeviceUserID: Set a letter string as DeviceUserID with up to 16 characters including terminal NUL letter (\0).

☐ DeviceUserString: Set a letter string as DeviceUserString with up to 256 characters including terminal NUL letter (\0).

Execute UserSetSave to save these letter strings into camera non-volatile memory.

After setting to Default in "UserSetDefault" and rebooting, the system will not return to the factory settings.

DeviceControl	
DeviceUserID	Manual
DeviceUserString	Manual

☐ Tap Geometry

TransportLayerControl		
DeviceTapGeometry	[1] : Geometry_1X_2YE	ReadOnly

[Note]
Depending on the FrameGrabberBoard to use, user may need to set DeviceTapGeometry to Geometry_1X_2YE to successfully acquire images.

4.3. LED Operation Mode

☐ This is to change operational mode of LED at the rear of camera. For information on lighting patterns, refer to Section 3.3.3. LED Indicator.

DeviceControl	
DeviceIndicatorMode	Active ErrorStatus Inactive

・DeviceIndicatorMode

Active : Displays CoaXPress communication status.
ErrorStatus : OFF with normal operation. Lights only when an error or illegal trigger occurs.
Inactive : ALL LED OFF.

4.4. Region Of Interest (ROI)

This is to increase the frame rate by cropping and reducing the read out area.

☐ User can change X direction freely, but Y direction is fixed at the center.
☐ User cannot set OffsetY.
☐ 1/2 of the Height is the center of the image.

ImageFormatControl	
RegionSelector	Region0
RegionMode	On/Off
Width	1920~13408
Height	1080~9528
OffsetX	0~(13408-Width)
OffsetY	[ReadOnly]

☐ ROI
- "RegionSeletor : Fixed to Region0.
- RegionMode : Turn Off to change "Width", "Height", and "OffsetX".
  Turn On to enable the value of “Width”, “Height”, “OffsetX”, and “OffsetY” are On.
  Make sure to start acquiring images when On.
- Width : User can specify the size of ROI in the X direction in 32-pixel increment.
- Height : User can specify the size of ROI in the Y direction in 8-pixel increment.
- OffsetX : User can specify the position of Offset in the X direction in 32-pixel increment.
- OffsetY : Read Only. The Offset position changes as the Height value changes.

[Note]
- User cannot change ROI when ShadingCorrection is True.
- User cannot use ROI and 2x2 binning together.
- When the image is not full scale (13408x9528), the DetectShading function of the shading correction is disabled.
- User cannot use FlatFieldCorrectionDataTransfer together.

Calculation formula at ROI

- The frame rate does not change from 13408 horizontal pixels even if the user changes the horizontal size.
- For the vertical size, the frame rate depends on the position and size of ROI.

PixelFormat	Time per frame		
	CXP12_X2	CXP6_X2 CXP12_X1	CXP6_X1
Mono8	(L+384)*11.1us	(L+384)*2*11.1us	(L+384)*4*11.1us
Mono10	(L+384)*14.8us	(L+384)*2*14.8us	(L+384)*4*14.8us
Mono12	(L+364)*17.5us	(L+364)*2*17.5us	(L+364)*4*17.5us
Mono14	(L+300)*21.5us	(L+300)*2*21.5us	(L+300)*4*21.5us

The frame rate at ROI is 1/(time per frame) fps.
L= Height/2.

4.5. 2x2 Binning Mode

ImageFormatControl	
BinningHorizontal	1~2
BinningHorizontalMode	Sum / Average
BinningVertical	1~2
BinningVerticalMode	Sum / Average

☐ BinningHorizontal and BinningVertical settings are linked. Therefore, changing either of them to 2 will set 2x2 binning mode. BinningHorizontalMode and BinningVerticalMode settings are also linked.

※When Region0 is full scale (13408x9528) and RegionMode is not On, the user cannot change BinningHorizontal and BinningVertical.

☐ The frame rate is the same with binning as with full scale.

☐ This mode is mutually exclusive with ROI. Valid only at full scale.

☐ User can use this mode in combination with defective pixel correction, FFC and shading correction.

☐ User cannot use this mode with FlatFieldCorrectionDataTransfer.

4.6. Pixel Format

ImageFormatControl	
PixelFormat	Mono8 Mono10 Mono12 Mono14

・Mono8 : Monochrome 8bit
・Mono10 : Monochrome 10bit
・Mono12 : Monochrome 12bit
・Mono14 : Monochrome 14bit

4.7. Flip

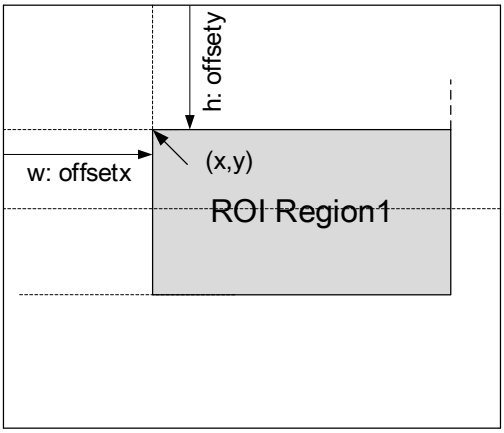
ImageFormatControl	
ReverseX	True/False
ReverseY	True/False

ReverseX : Flip the image in X direction.
ReverseY : Flip the image in Y direction.

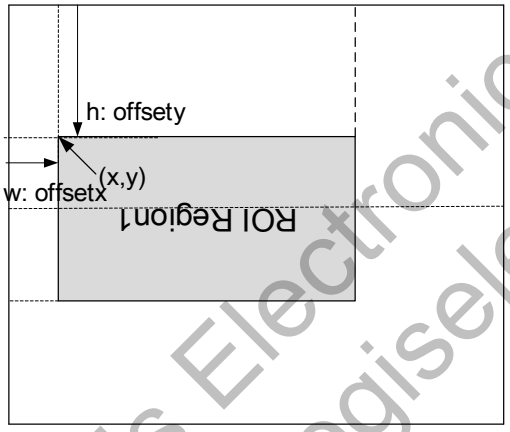
[Note]

・ Flipping the image vertically or horizontally at ROI will also flip OffsetX and OffsetY values.

[When both ReverseX and ReverseY are False]



[When both ReverseX and ReverseY are True]



4.8. Cursor Indication

☐ This is to show cursor on your display screen.

ImageFormatControl	
CursorPattern	On/Off
CursorOffsetX	X coordinate
CursorOffsetY	Y coordinate
CursorColor	White/Black

- CursorPattern : Cursor display On/Off
- CursorOffsetX : Specify X coordinate of vertical cursor.
- CursorOffsetY : Specify Y coordinate of horizontal cursor.
- CursorColor : Specify the cursor color. (black or white)

[Note]

- With zooming out, cursor may be out of view.
- Test pattern indication and cursor indication are mutually exclusive.
- At ROI and 2x2 binning mode, enter the coordinate position for the output image in CursorOffsetX and CursorOffsetY at ROI and 2x2 binning mode.

4.9. Test Pattern Indication

☐ This is to display test pattern from the camera. This is useful to check if your system is operating properly.

ImageFormatControl	
TestPattern	OFF GreyHorizontalRamp GreyHorizontalRampMoving GreyScale

[Note]

- Cursor indication and test pattern indication are mutually exclusive.

4.10. Trigger Mode

Acquisition Control	
TriggerSelector	AcquisitionStart FrameStart
TriggerMode	Off/On
TriggerActivation	RisingEdge FallingEdge LevelHigh LevelLow
TriggerSource	LinkTrigger0 Line0 Software
TriggerSoftware	Execute
IllegalTriggerFlag	0 or 1
AcquisitionFrameRate	[ReadOnly]

・TriggerSelector

Select how to start capturing images from the following options.

・AcquisitionStart : Free-run mode [Internal sync. mode]

・FrameStart : External trigger sync. mode [External sync. mode]

・TriggerMode

Select disable/enable of triggers in external trigger sync. mode.

・Off : Disable triggers.

・On : Enable triggers.

・TriggerActivation

Select the trigger polarity from the following.

Select "FrameStart" of TriggerSelector to start operation

・RisingEdge [External sync. mode]

・FallingEdge [External sync. mode]

・LevelHigh : High active [External sync. mode]

・LevelLow : Low active [External sync. mode]

・TriggerSource

Select where to send external triggers.

・ LinkTrigger0 : External trigger input from CoaXPress Host Device

Please refer to the specification manuals of the Host Device (e.g., frame grabber board) for the trigger generation method.

・Line0 : External trigger input from 12-pin circular connector.
・Software : Enables TriggerSoftware command.

※FallingEdge and LevelLow of TriggerActivation are not recommended while selecting LinkTrigger0.
Depending on the grabber board, the first frame may not be displayed.

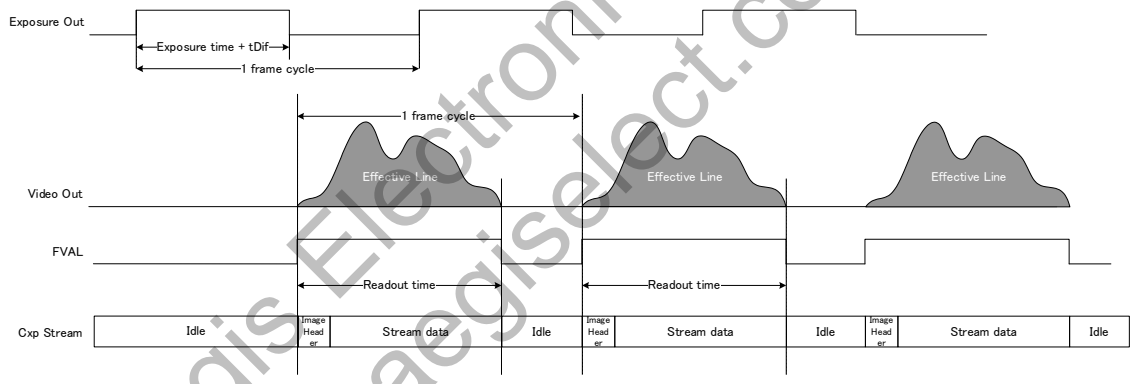
・TriggerSoftware : Software trigger
Camera generates a trigger to capture one frame image by executing this command.
This command is valid when TriggerSelector is in FrameStart (External sync. mode).
※Make sure to set TriggerActivation to RisingEdge.

・IllegalTriggerFlag :
If there is a trigger input with restricted timing, “IllegalTriggerFlag” becomes “1”. For illegal triggers, please refer to Section 4.10.2 External Sync. Mode (Fixed Trigger Shutter Mode) and Section 4.10.3 External Sync. Mode (Pulse Width Trigger Shutter Mode) for restrictions on trigger cycle.
To reset this flag, execute ErrorFlagReset of DeviceControl.

・AcquisitionFrameRate :
Display the frame rate in decimal format during operation, and update the value every 3 seconds.
The slowest frame rate is 1.0fps. Frame rates below 1.0fps are displayed as 0.0fps.

4.10.1 Internal Sync. Mode (Free-run Mode)

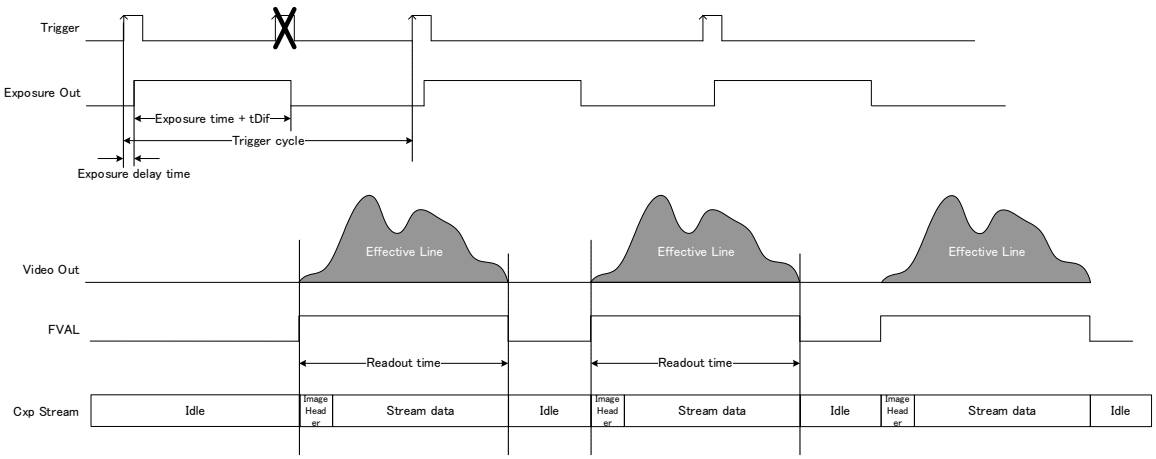
☐ This mode is to use internal triggers continuously generated in the camera.
☐ Set TriggerSelector to AcquisitionStart.



※User can check the actual exposure time from ExposureOut signal. Please refer to Section 4.11 Exposure Time for the formula to calculate the actual exposure time.

4.10.2 External Sync. Mode (Fixed Trigger Shutter Mode)

☐ This is a mode to capture images at any timing by inputting a trigger signal.
☐ Set "TriggerSelector" to "FrameStart".
☐ This is a mode to start exposure for the time set by "ExposureTime" when a trigger signal is input.
☐ Set "TriggerActivation" to "RisingEdge" or "FallingEdge".
☐ Trigger period must be longer than the period in internal sync. mode (free-run).
☐ Trigger period must be longer than exposure time.
☐ Trigger operation is H-V sync reset method with H-sync.
☐ Trigger pulse width must be 1µs or more to input.
☐ The first frame after changing the settings for CXP link speed and link count, pixel format, 2x2 binning, ROI, and trigger mode is an invalid frame. Input a dummy trigger once, and use the second and subsequent trigger signals as the regular imaging signal.



In NormalMode

※Exposure delay time depends on the PixelFormat and ConnectionConfig settings. 4~6 are jitter.

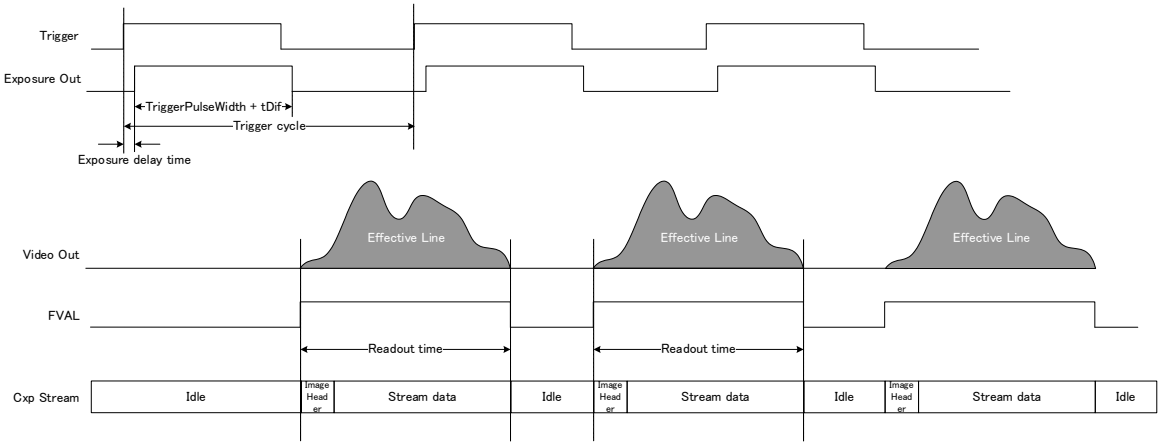
PixelFormat	Exposure delay time		
	CXP12_X2	CXP6_X2 CXP12_X1	CXP6_X1
Mono8	11.1µs*(4to6)	11.1µs*(4to6)*2	11.1µs*(4to6)*4
Mono10	14.8µs*(4to6)	14.8µs*(4to6)*2	14.8µs*(4to6)*4
Mono12	17.5µs*(4to6)	17.5µs*(4to6)*2	17.5µs*(4to6)*4
Mono14	21.5µs*(4to6)	21.5µs*(4to6)*2	21.5µs*(4to6)*4

In ShortExposureMode, the exposure delay time jitter from 0ms to 4ms depending on the PixelFormat, ConnectionConfig or ExposureTime.

※User can check the actual exposure time from ExposureOut signal. Please refer to Section 4.11 Exposure Time for the formula to calculate the actual exposure time.

4.10.3 External Sync. Mode (Pulse Width Trigger Shutter Mode)

- ☐ This mode starts exposure by the input trigger signal and sets the exposure time by the trigger pulse width.
- ☐ Set "TriggerSelector" to "FrameStart".
- ☐ Set "TriggerActivation" to "LevelHigh" or "LevelLow".
- ☐ Trigger period must be longer than the period in internal sync. mode (free-run).
- ☐ Trigger operation is H-V sync reset method with H-sync.
- ☐ Trigger pulse width must be 86.2µs or more to input.
- ☐ The first frame after changing the settings for CXP link speed and link count, pixel format, 2x2 binning, ROI, and trigger mode is an invalid frame. Input a dummy trigger once, and use the second and subsequent trigger signals as the regular imaging signal.



※Exposure delay time depends on the PixelFormat and ConnectionConfig settings. 4~6 are jitter.

PixelFormat	Exposure delay time		
	CXP12_X2	CXP6_X2 CXP12_X1	CXP6_X1
Mono8	11.1μs*(4to6)	11.1μs*(4to6)*2	11.1μs*(4to6)*4
Mono10	14.8μs*(4to6)	14.8μs*(4to6)*2	14.8μs*(4to6)*4
Mono12	17.5μs*(4to6)	17.5μs*(4to6)*2	17.5μs*(4to6)*4
Mono14	21.5μs*(4to6)	21.5μs*(4to6)*2	21.5μs*(4to6)*4

※User can check the actual exposure time from ExposureOut signal. Please refer to Section 4.11 Exposure Time for the formula to calculate the actual exposure time.

[Note]

ShortExposureMode and external sync. mode (pulse width trigger shutter mode) are mutually exclusive.

4.11. Exposure Time

There are two exposure modes, NormalMode and ShortExposureMode.

Please use ShortExposureMode to operate with short exposure times.

[Note]

ShortExposureMode and external sync. mode (pulse width trigger shutter mode) are mutually exclusive.

Set trigger mode to internal sync. mode (free-run mode) or external trigger sync. mode (fixed trigger shutter mode) to use ShortExposureMode.

Acquisition Control		
ExposureTime (μs)	At NormalMode	87~15000000
	At ShortExposureMode	7.24~3158
SensorExposureMode	NormalMode ShortExposureMode	

ExposureTime : This is to display the exposure time. The range of exposure time that can be set varies depending on the SensorExposureMode.

※The actual exposure time in Normal Mode is the value set here plus tDif.

※The exposure time in ShortExposureMode is the same as the set value and the actual exposure time.

In Normal Mode, the following tDif exposure time is automatically added to the value set in ExposureTime.

PixelFormat	tDif		
	CXP12_X2	CXP6_X2 CXP12_X1	CXP6_X1
Mono8	11.1μs*(47to49)+6.95μs	11.1μs*(47to49)*2+6.95μs	11.1μs*(47to49)*4+6.95μs
Mono10	14.8μs*(47to49)+6.95μs	14.8μs*(47to49)*2+6.95μs	14.8μs*(47to49)*4+6.95μs
Mono12	17.5μs*(43to45)+6.95μs	17.5μs*(43to45)*2+6.95μs	17.5μs*(43to45)*4+6.95μs
Mono14	21.5μs*(31to33)+6.95μs	21.5μs*(31to33)*2+6.95μs	21.5μs*(31to33)*4+6.95μs

In ShortExposureMode, user can set the exposure time within the following range.

PixelFormat	tDif		
	CXP12_X2	CXP6_X2 CXP12_X1	CXP6_X1
Mono8	7.24μs to 550μs	7.24μs to 1094μs	7.24μs to 2182μs
Mono10	7.24μs to 732μs	7.24μs to 1458μs	7.24μs to 2910μs
Mono12	7.24μs to 794μs	7.24μs to 1582μs	7.24μs to 3158μs
Mono14	7.24μs to 718μs	7.24μs to 1429μs	7.24μs to 2851μs

The maximum value of ExposureTime that can be set varies depending on the settings of trigger mode, ROI, PixelFormat, and ConnectionConfig.

4.12. Gain

AnalogControl	
Gain	1.0~64.0
RegistersControl	
BaseGainSelector	UpperLeft UpperRight BottomLeft BottomRight
BaseGain	1024~16383 : 0x400 (x1)
BaseOffset	-16384~16383 : 0x0

- Gain : User can set the preferred gain value in the range of x1.0~x64.0 per 0.01 step.
- BaseGainSelector : This is to specify the position of the image sensor when setting BaseGain.
- BaseGain : The values adjusted at factory are stored here to suppress sensitivity variations and uneven saturation in each area of the image sensor selected by BaseGainSelector. Make sure that all items are set to 1024 (x1) when calculating FPN and PRNU correction coefficients.
- BaseOffset : The values adjusted at factory are stored here to suppress sensitivity variations and uneven saturation of each image sensor.
  Specify the input value in 14bit range (-16384~16383).

[Note]

- User can set the preferred gain value in the range of x1.0~x64.0 per 0.01 step. However, with high gain settings (x64.0 or more), degradation of image quality and increase of noise is unavoidable. Please evaluate it first.
- In BaseGain, 1024 is x1, but due to image sensor specifications, the output image does not reach saturation level at 1024.
- When gain is x16 or more, the gain may not be linear.

4.13. Black Level Adjustment

☐ This function adjusts black levels at a later stage of image processing in the camera.

AnalogControl	
BlackLevel	0~16

BlackLevel	8bit	10bit	12bit	14bit
0	0	0	0	0
1	1	4	16	64
2	2	8	32	128
3	3	12	48	192
4	4	16	64	256
5	5	20	80	320
6	6	24	96	384
7	7	28	112	448
8	8	32	128	512
9	9	36	144	576
10	10	40	160	640
11	11	44	176	704
12	12	48	192	768
13	13	52	208	832
14	14	56	224	896
15	15	60	240	960
16	16	64	256	1024

※This function is for adjustment in the + direction only.

4.14. Flat Field Correction

☐ This function execute correction using FPN and PRNU coefficients for all pixels stored in memory.

FlatFieldCorrectionControl	
FFCCoefficientWidth	NormalMode PRNUExtensionMode
FPNCorrectionEnable	True/False
FPNShiftPosition	10~14
GlobalFPN	-4096~4095
PRNUCorrectionEnable	True/False
PRNUShiftPosition	8~14

・FFCCoefficientWidth : This is to set the bit width of FFC coefficient.
In NormalMode, FFC correction coefficients are assigned to 8bit for FPN and PRNU.
In PRNUExtensionMode, FFC correction coefficients are assigned to 7bit for FPN and 9bit for PRNU.

※This selection depends on whether the format of the correction coefficients obtained is NormalMode or PRNUExtensionMode. To perform FPN and PRNU corrections using the FFC coefficients adjusted at factory, use the Default setting.

・FPNCorrection : FPN correction
When set to True, the camera corrects FPN from FPN(Offset)+Global_FPN at light shielding.

・FPNShiftPosition : The decimal position of FPN correction coefficient.

※Depends on the decimal point position of the obtained FPN correction coefficient. To perform FPN correction using FFC coefficient of factory setting, make sure to set to Default.

・GlobalFPN : When FPN correction is True, correction will be made from FPN(Offset)+Global_FPN. When FPN correction is True, the black level becomes lower due to the correction. Therefore, use Global_FPN to adjust the black level appropriately.

・PRNUCorrection : PRNU correction. PRNU (Gain) correction is performed when PRNUCorrection is True.

・PRNUShiftPosition : PRNU correction coefficient decimal point.

※Depends on the decimal point position of the obtained PRNU correction coefficient. To perform PRNU correction using FFC coefficient of factory setting, make sure to set to Default.

※When user switches FPNCorrection or PRNUCorrection between False and True, the position of the black level may change. When switching, make sure to adjust GlobalFPN by entering an appropriate value so that the black level does not drop to 0 or below.

※For details on this item, please refer to the Application Note.

4.15. Shading Correction

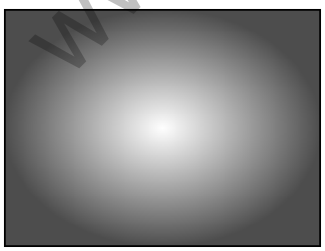
☐ This is a function to correct the drop in the amount of peripheral light caused by lens and others.

AnalogControl	
ShadingCorrection	True/False
DetectShading	Execute
ShadingCorrectionDataSelector	Table1 Table2 Table3 Table4
ShadingDataIndex	0~8131
ShadingDataValue	0x0~0x7fff
ShadingDataLoad	Execute
ShadingDataSave	Execute

・ShadingCorrection

When ShadingCorrection is set to True, shading correction is performed using shading correction data created by shading detection.

Before shading correction



After shading correction

・User must obtain shading correction data in advance from DetectShading before shading correction.

・DetectShading

Shoot an object with stable brightness such as pattern box to full screen to execute DetectShading so that function automatically calculates shading correction data.

[Note]

・ When performing shading detection, use partial scan mode (ROI) and set the size to 13408x9528. If the size is not 13408x9528 or the camera is in 2x2 binning mode, this function cannot be performed.

・Execute shading operation when camera is in operation. During long exposure operation or in external sync. mode, the camera may not update shading detection data if camera operation is not completed 1 second after DetectShading. In this case, execute DetectShading again when camera is in operation.
(To detect proper shading correction data, make sure that the camera is outputting images.

・ShadingCorrectionDataSelector : This is to select shading correction data.
User can select shading correction data from 4 tables. Data from Table1~4 selected here will be the correction data to be operated for each function.

・ShadingDataIndex : Shading correction data index No.
Shading correction data for each table have 8132 indices. Set a value from 0~8131 for the index.

・ShadingDataValue : Shading correction data value
User can set and readout shading correction data value for each shading correction data index number.
※Shading correction data value is not subject to UserSetSave.

・ShadingDataLoad : Shading correction data readout
This is to readout only table data selected by ShadingCorrectionDataSelector from the camera non-volatile memory.
※At camera startup, the camera reads shading correction data of all tables from the camera non-volatile memory.

・ShadingDataSave : This is to save shading correction data.
This is to save only table data selected by ShadingCorrectionDataSelector to the camera non-volatile memory.

4.16. Gamma Correction

☐ This is to correct gamma. This mode is mutually exclusive with LUT function.

AnalogControl	
Gamma	0.30~3.00 gamma coefficients

Gamma : This is to set gamma correction value from 0.30 to 3.00 per 0.01 step.
Do not change values while capturing images.

[Note]
・Gamma correction is not valid when LUTEnable is True.
・When PixelFormat is Mono14, gamma correction is applied to the upper 12 bits of data and the lower 2 bits becomes 0. When the gamma correction value is 1.0, camera outputs 14-bit data size as usual even with Mono14. However, this is not the case for Mono8, Mono10, and Mono12.

4.17. LUT Function

☐ This is to use LUT function. This mode is mutually exclusive with gamma correction.

LUTControl	
LUTEnable	True/False
LUTIndex	0~4095
LUTValue	0~4095
LUTSave	Execute

・ LUTEnable : Set to False to enable gamma correction, or set to True to enable LUT function.
When set to True, the camera loads True LUTIndex and LUTValue stored in nonvolatile memory. If nothing is stored in non-volatile memory, the camera loads the initial value.
Do not change these settings while capturing images.

・ LUTIndex : Specify input value in 12-bit range (0 to 4095). If user specifies input value here, output value for that input value is displayed in LUTValue.
※This function is valid only when LUTEnable is True.

・ LUTValue : Specify output value in 12-bit range (0 to 4095).

User cans set LUTValue for the input value specified with LUTIndex.
※This function is valid only when LUTEnable is True.
※LUTValue is not subject to UserSetSave.

- LUTSave : This is to save data set with LUTIndex and LUTValue.
※This function is valid only when LUTEnable is True.

[Note]

- The camera processes LUT function and gamma correction using the same register inside the camera. Therefore, LUTIndex, LUTValue, and LUTSave can be changed only when LUTEnable is True.
- When PixelFormat is Mono14, the camera performs LUT correction on the upper 12 bits of data and the lower 2 bits becomes 0. However, this is not the case for Mono8, Mono10, and Mono12.

4.18. Defective Pixel Correction

☐ Defective pixel correction at factory

CIS applies defective pixel correction to the pixel defects caused by the image sensor prior to shipment of the product. User can also add the defective pixel information. Please refer to the Application Note.
User can turn off the correction process.

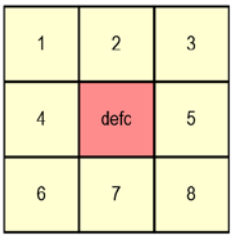
PixelCorrectionControl	
DefectPixelCorrectionEnable	True/False
DefectPixelCorrectionMode	Concealment Replacement
HorizontalReplacementDistance	1~48

- DefectPixelCorrectionEnable : Set DefectPixelCorrectionEnable to True to enable defective pixel correction, and set False to disable it. If PRNU coefficients of FFC coefficients are All 1, the camera defines them as pixel defects.
- DefectPixelCorrectionMode : Select the pixel defect correction method.
Please refer to Section 4.18.1 for Concealment, and Section 4.18.2 for Replacement.
- HorizontalReplacementDistance : Select Replacement to replace defective pixels with the pixel data for the horizontal distance specified here.

※Even with 2x2 binning, HorizontalReplacementDistance will apply the replacement position at full scale.

4.18.1 Concealment

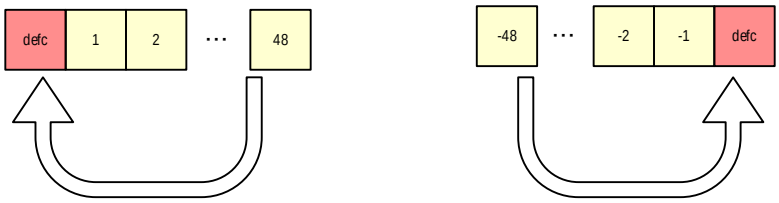
This is to interpolate the defective pixel from its 8 peripheral pixels as follows. If there is a defective pixel in the peripheral 8 pixels, the camera interpolates from the 8 pixels without the defect.



4.18.2 Replacement

This is to replace the pixel data at the horizontal distance specified by HorizontalReplacementDistance with defective pixels.

When the pixel defect position is smaller than 13408/2. When the pixel defect position is bigger than 13408/2.



4.19. FlatField Correction Control

☐ This is to access the FlatField correction data.

☐ FFC coefficients are divided into Area1 and Area2.

Area1(13408*9528*2Byte): 0x0000_0000~0x0F3A_A9FF of FlatFieldCorrectionDataAddress.
Area 1 stores the correction coefficients written at the factory. User cannot delete or overwrite.

Area2(13408*9528*2Byte): 0x1000_0000~0x1F3A_A9FF of FlatFieldCorrectionDataAddress.
User can delete and overwrite data stored in Area2.

Execute FlatFieldCorrectionDataSave and restart to shift to correction coefficients save mode. User can delete and overwrite data here. Please refer to the Application Note for the procedures.

FlatFieldCorrectionDataControl	
FlatFieldCorrectionDataAddress	0x1000_0000~0x1FFF_FFFC
FlatFieldCorrectionDataValue	0x0000_0000~0xFFFF_FFFF
FlatFieldCorrectionDataSector	16384~32767
FlatFieldCorrectionDataRead	Execute
FlatFieldCorrectionDataWrite	Execute
FlatFieldCorrectionDataSectorErase	Execute
FlatFieldCorrectionDataSelector	None Area1 Area2
FlatFieldCorrectionDataLoad	Execute
FlatFieldCorrectionDataSaveEnable	True/False
FlatFieldCorrectionDataSave	Execute
FlatFieldCorrectionDataTransfer	Off FPN PRNU [Not subject to Save]
FlatFieldCorrectionDataStatus	None Area1 Area2 Area1 and Area2 [ReadOnly]

- FlatFieldCorrectionDataAddress : Specify the address for FlatFieldCorrectionDataValue.
- FlatFieldCorrectionDataValue : Output data and set data to be input.
- FlatFieldCorrectionDataSector : Set the sector number to delete.
- FlatFieldCorrectionDataRead : Output data specified by FlatFieldCorrectionDataAddress to FlatFieldCorrectionDataValue.
- FlatFieldCorrectionDataWrite : Set the value of FlatFieldCorrectionDataValue to the address specified by FlatFieldCorrectionDataAddress.
- FlatFieldCorrectionDataSectorErase : Delete data in the sector specified by FlatFieldCorrectionDataSector.

※Even if the FFC coefficient is deleted with this process, the value of FlatFieldCorrectionDataStatus is not changed. This function is provided to partially modify the FFC coefficient.

・FlatFieldCorrectionDataSelector : Select the area of FlatFieldCorrectionData that the camera will use. Also, select data to be subject to FlatFieldCorrectionDataLoad/Save operation.
If None, camera does not readout any data at startup.
FlatFieldCorrectionDataLoad/Save will also become disable.

・FlatFieldCorrectionDataLoad :
Readout the FPN/PRNU correction coefficients of the area specified by FlatFieldCorrectionDataSelector. Readout takes approximately 4 seconds.
※FlatFieldCorrectionDataLoad is invalid during Load while capturing images.

・FlatFieldCoefficientDataSaveEnable :
To prevent accidental execution, user can only enable FlatFieldCoefficientDataSave if it is set to True. This command is not subject to UserSetSave.
※Do not use this command except when changing all FFC correction coefficients of Area2.

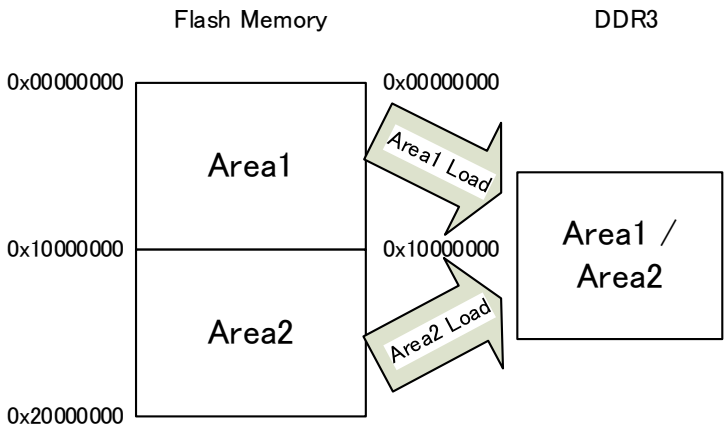
・FlatFieldCoefficientDataSave :
This command is valid only when FlatFieldCoefficientDataSaveEnable is True.
Execution of this command shifts to FPN/PRNU correction coefficients save mode in the area specified by FlatFieldCorrectionDataSelector.
After executing this command, the camera will not accept any commands. When restarting the camera, the next startup will be in correction coefficients save mode. This mode can delete and save correction coefficients. When the FlashMemoryUpdate.exe tool completes writing the coefficients while in correction coefficients save mode, the next restart will return to normal mode.
※Do not use this command except when changing all FFC correction coefficients of Area2.

・FlatFieldCorrectionDataTransfer :
Tranfers FlatFieldCorrectionData as images.
The camera transmits normal images when Off, FPN correction data when FPN, and PRNU correction data when PRNU.
Specify Mono8 to PixelFormat. (PixelFormat is also valid for other than Mono8, in which case the upper 8-bit display the correction data.)
※FlatFieldCorrectionDataTransfer register is mutually exclusive with ROI and 2×2 binning.
※FlatFieldCorrectionDataTransfer register is not subject to UserSetSave. It will be OFF at startup and during UserSetLoad.

・FlatFieldCorrectionDataStatus : Display the state of saving FFC coefficients.
None: No FFC coefficients saved.
Area1: FFC coefficients saved in Area1.
Area2: FFC coefficients saved in Area2.
Area1 and Area2: FFC coefficients saved in Area1 and Area2.

4.19.1 FlatField Correction Data

☐ Please refer to the following flowchart for FlatField correction data.



FlatFieldCorrectionData(FFCData) saved in FlashMemory is once loaded into DDR3 SDRAM and used as correction coefficients. FlashMemory is 4G bit.

FlatFieldCorrectionDataLoad command is the transfer command from FlashMemory to DDR3 SDRAM. Once transferred, the value of the data in DDR3 SDRAM will not change until the camera is turned off or loaded again. Also, when changing correction coefficient of FlashMemory by FlatFieldCorrectionDataWrite or FlatFieldCorrectionDataSectorErase, user needs to reload it to reflect it as a correction coefficient.

☐ At startup

This is to load FFCData selected by FlatFieldCorrectionDataSelector.
・If None, camera will not load FFCData.
・This is to load data in Area1 when selecting Area1 and saving FFC data in Area1 by FlatFieldCorrectionDataStatus. (It takes approximately 4 seconds to startup.)
・This is to load data in Area2 when selecting Area2 and saving FFC data in Area2 by FlatFieldCorrectionDataStatus. (It takes approximately 4 seconds to startup.)
・Camera does not load the areas without FFC data saved by FlatFieldCorrectionDataStatus at startup.

☐ FlatFieldCorrectionDataLoad

This is to load FFCData selected by FlatFieldCorrectionDataSelector.
・If None, camera will not load FFCData.
・This is to load data in Area1 when selecting Area1 (It takes approximately 4 seconds to startup.)
・This is to load data in Area2 when selecting Area2. (It takes approximately 4 seconds to startup.)
・This command does not affect information in FlatFieldCorrectionDataStatus.

☐ FlatFieldCorrectionDataSave

This is to write new FFCData by deleting data in the area selected by FlatFieldCorrectionDataSelector. When doing this, the area selected by FlatFieldCorrectionDataSelector and the area selected by FlashMemoryUpdate.exe must be the same.

☐ FlatFieldCorrectionDataTransfer

This is to display DDR3 SDRAM data in the area loaded by FlatFieldCorrectionDataSelector as image data.

4.20. Device Temperature Control Function

This is to control the temperature of the device.

DeviceControl	
DeviceTemperature	[ReadOnly]

- DeviceTemperature : Displays sensor temperature in degrees Celsius. The camera will update value every 3 seconds.

※Enable Polling function of the grabber board to update the DeviceTemperature value in 3 seconds.

※Use the camera in an environment where the camera displays a temperature below 55°C in Device Temperature. If the temperature exceeds 55°C, take sufficient measures to dissipate heat. Otherwise, CIS cannot guarantee the reliability and operating performance of the product.

4.21. Link Speed and Lin Count

TransportLayerControl	
ConnectionConfig	CXP12_X2 CXP12_X1 CXP6_X2 CXP6_X1

・CXP12 : Link speed=12.5Gbps, Link count=1 or 2

・CXP6 : Link speed=6.25Gbps, Link count=1 or 2

※Do not change ConnectionConfig while grabbing (acquiring images).

4.22. Save and Initialize Settings

☐ Execute "UserSetSave" to save settings into camera non-volatile memory. Camera loads the saved settings upon next rebooting.

UserSets	
UserSetSelector	Default UserSet0 UserSet1
UserSetLoad	Execute
UserSetSave	Execute
UserSetDefault	Default UserSet0 UserSet1

・UserSetSelector : This is to select the camera setting values.
User can execute UserSetLoad only with Default. UserSetSave is invalid with Default.
※This value corresponds to the UserSetLoad and UserSetSave operations.

・UserSetLoad : This is to load the camera setting value selected by UserSetSelector from non-volatile memory.
When UserSetSelector is Default, the camera displays the factory setting.

・UserSetSave : This is to save the camera setting values.
User can execute UserSetLoad only with Default. UserSetSave is not subject to save.

・UserSetDefault : This is to select the camera settings at startup. Load the selected settings and the camera will start its operation.
※This value does not correspond to UserSetSelector operation. The camera does not save the values with UserSetSave. It saves the values at the time when user changed the selection. Also, the value is not updated by UserSetLoad.

※ShadingData are LUTValue are not subject to UserSetSave. User can save these values in non-volatile memory via individual Save commands.

☐ The camera changes the set values to the loaded values after executing UserSetLoad. However, the command display may not be updated depending on the display software used.

4.23. Digital IO Control

☐ This is a function to output the following signals from No. 7, 9, and 10 pin of the 12-pin circular connector by setting LineSelector and LineSource.

Digital IO Control	
LineSelector	Line1 Line2 Line3
LineMode	Output
LineSource	Off ExposureActive FrameActive LineActive TriggerPacketActive

・LineSelector

Line1 : Select the output setting for No. 7 pin.

Line2 : Select the output setting for No. 9 pin.

Line3 : Select the output setting for No. 10 pin.

・ LineSource

This is to set the output for the 12-pin circular connector pin selected by LineSelector.

OFF : Fixed to 0.

ExposureActive : Display the exposure period of the image sensor in Hi active.

FrameActive : Display the effective period of frame with Hi active.

LineActive : Display the effective period of line with Hi active.

TriggerPacketActive: Decode and output packet signals of uplink trigger from frame grabber.

4.24. OpticalBlackControl

☐ This is to change the mode of OBClamp.

OpticalBlackControl	
OpticalBlackEnable	True/False
OpticalBlackFunction	AverageValue IndividualValue

・OpticalBlackEnable : User can select to perform OpticalBlackControl automatically or manually.
If False, user needs to adjust black level by BaseOffset for each ambient temperature, ROI, binning, and gain setting. If True, the black level is automatically adjusted appropriately according to its ambient temperature and settings.

・OpticalBlackFunction : This is to select the OpticalBlackClamp method when OpticalBlackEnable is True.
AverageValue makes the same adjustment to the OpticalBlack value in the upper left, upper right, lower left, and lower right regions.
The difference in output level per area is reduced even at high gain (recommended setting).
IndividualValue makes the individual adjustments to the OpticalBlack value in the upper left, upper right, lower left, and lower right regions.

5. Factory Settings

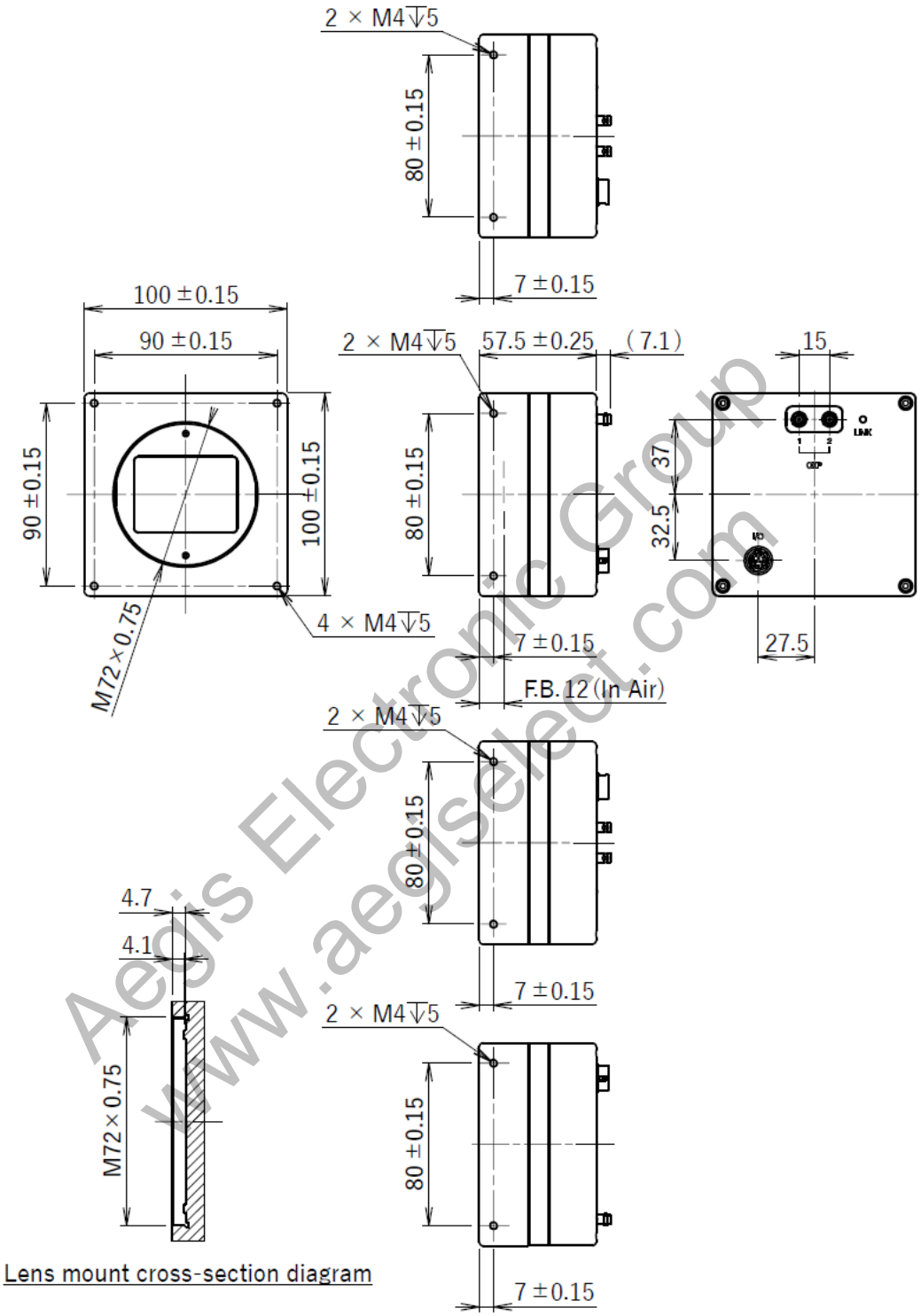
Function	Initial Data	Descriptions
DeviceControl		
DeviceUserID	“”	
DeviceUserString	“”	
DeviceIndicatorMode	Active	
ImageFormatControl		
RegionSelector	Region0	
RegionMode	On	
Width	13408	
Height	9528	
OffsetX	0	
BinningHorizontal	1	
BinningHorizontalMode	Sum	
BinningVertical	1	
BinningVerticalMode	Sum	
PixelFormat	Mono8	
ReverseX	False	
ReverseY	False	
TestPattern	Off	
CursorPattern	Off	
CursorOffsetX	6704	
CursorOffsetY	4764	
CursorColor	White	
AcquisitionControl		
TriggerSelector	AcquisitionStart	
TriggerMode	Off	
TriggerSource	LinkTrigger0	
TriggerActivation	RisingEdge	
ExposureTime	100000	
SensorExposureMode	NormalMode	
AnalogControl		
Gain	1.0	
Gamma	1.0	
ShadingCorrection	False	
ShadingCorrectionDataSelector	Table1	
BlackLevel	0	
LUTControl		
LUTEnable	False	

Function	Initial Data	Descriptions
FlatFieldCorrectionControl		
FFCCoefficientWidth	NormalMode	
FPNCorrectionEnable	False	
FPNShiftPosition	-	The value adjusted at factory.
GlobalFPN	-	The value adjusted at factory.
PRNUCorrectionEnable	False	
PRNUShiftPosition	-	The value adjusted at factory.
FlatFieldCorrectionDataControl		
FlatFieldCorrectionDataSelector	None	
FlatFieldCoefficientDataSaveEnable	False	
FlatFieldCorrectionDataTransfer	Off	
Digital IO Control		
LineSelector	Line1	
LineSource	Off	
PixelCorrectionControl		
DefectPixelCorrectionEnable	False	
DefectPixelCorrectionMode	Concealment	
HorizontalReplacementDistance	1	
RegistersControl		
BaseGain	-	BaseGain value adjusted at factory.
BaseOffset	-	BaseOffset value adjusted at factory.
OpticalBlackControl		
OpticalBlackEnable	True	
OpticalBlackFunction	AverageValue	
TransferControl		
ConnectionConfig	CXP6_X2	

※Factory settings are the same as Default in UserSetDefault.

6. Dimensions

6.1. Camera Dimensions



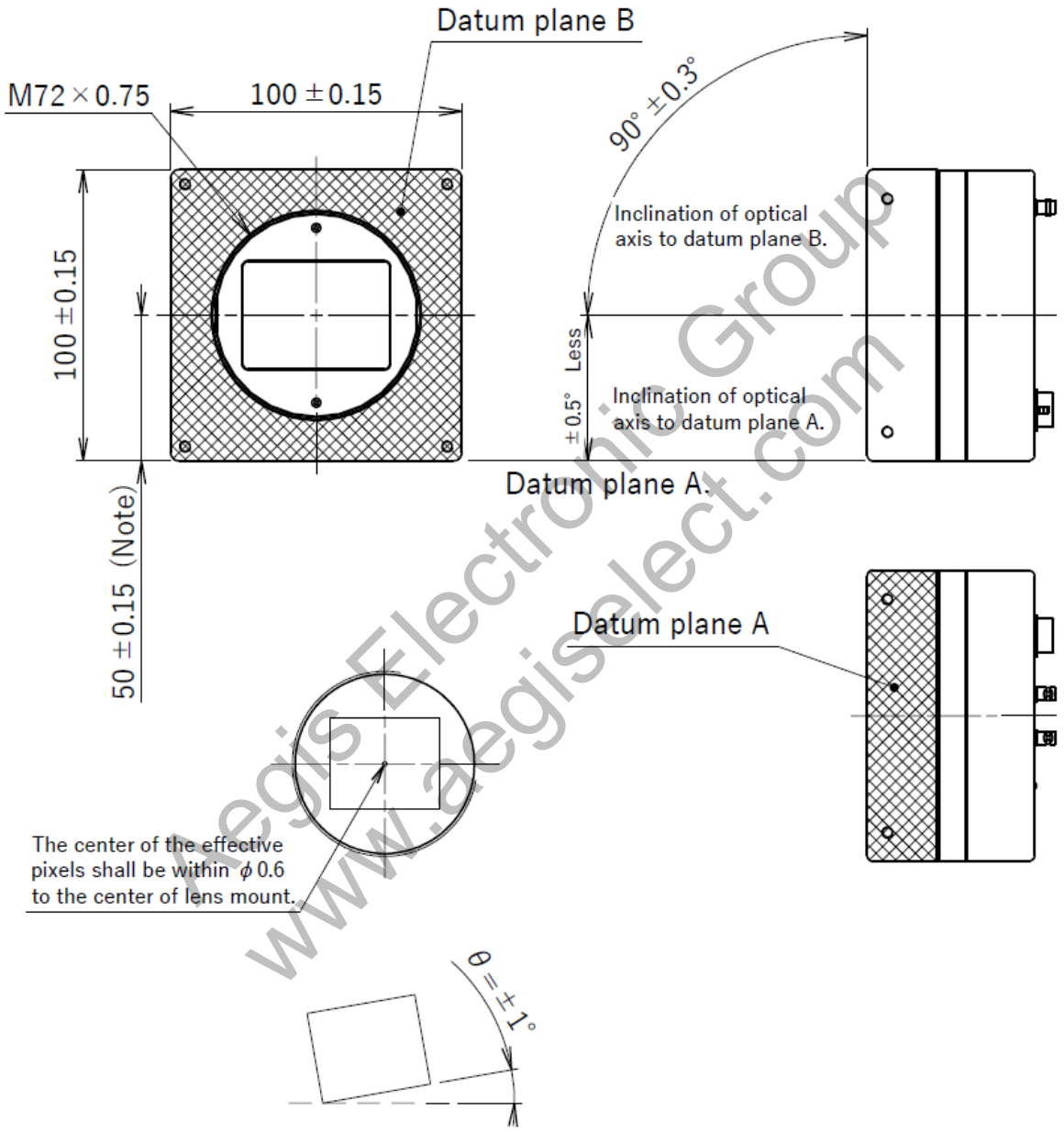
Note2) Lens mount screw complies with M72×0.75-6H.
Please refer to ISO 68-1,965-1 (or JIS B0205-1,B0209-1).
Note1) Please make sure the protrusion portion does not inter with the lens selected.
Pefer to the Lens mount cross-section diagram for the detailes.

(Unit : mm)
935-xxxx-00

☐ Note for camera installation and heat dissipation.

DeviceTemperature feature of the camera must be less than 55 degree. Ensure sufficient heat dissipation by mounting it on a metal surface of at least 200 mm × 200 mm × 10 mm. If adequate heat dissipation is not provided, reliability and operational performance cannot be guaranteed.

6.2. Optical Axis Accuracy



Inclination of effective pixels θ to datum plane A is $\theta \leqq \pm 1^{\circ}$.

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

Drawing Number : TBD
(Unit : mm)

7. Warranty Policy, etc.

7.1. Product Warranty

The warranty period for this product is 3 years from the date of shipment.
If a failure occurs during this period due to our design or manufacturing, we will repair the product free of charge in accordance with the product service described in Section 7.3. Product Services.
Repair after the warranty period will be charged if repair is possible.

CIS should not hold responsible for damages or losses if;

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

7.2. CMOS Pixel Defects

CIS applies defective pixel correction prior to shipment of the product. However, the number of defective pixels are subject to increase due primarily to the effect of cosmic rays. Due to this nature, CIS should not hold responsible for the natural increase of defective pixels.

7.3. Product Services

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