BOPIXEL JAPAN ボゾンジャパン株式会社

CoaXPress Camera

Monochrome / Color CMOS 8.9Mpixel

BC-SM9M6X1 (9M, Monochrome)
BC-SC9M6X1 (9M, Color)
BC-SM9M10X1 (9M, Monochrome)
BC-SC9M10X1 (9M, Color)

Product Specifications

BOPIXEL Corporation

Safety precautions

- This product is not designed and manufactured for applications that may cause damage to the human body, so do not use it for that purpose.
- This product is not waterproof. Do not use this product in an environment where it will be directly exposed to liquid or in a humid place.
- Do not use the camera in an environment with flammable liquids or gases. It may cause a fire or an explosion.
- In environments where the temperature changes drastically, use the camera and lens after taking measures to prevent condensation. Condensation inside the camera may cause a malfunction.
- Use the camera in the environment described in the specifications. It may cause malfunction or malfunction.
- The housing temperature is high while the camera is in use. In particular, the camera labeled  may have a housing temperature of more than 60°C depending on the environment in which it is used. Do not touch the camera during use or immediately after use. Doing so may cause burns or injuries.
- Use the supply voltage and the I/O signal to the camera within the range described in the specifications. It may cause malfunction or malfunction.
- When wiring to the camera connector, follow the pin assignments described in the specifications and be careful not to stress the wiring or camera connection. It may cause malfunction or malfunction.
- Do not disassemble the camera.

Precautions for use

- Do not subject the camera to shock or static electricity.
- When not using the camera, use a lens mount cap or protective sheet to prevent dust from adhering to the CMOS sensor imaging surface.
- Blow off any dirt on the glass surface with an air duster or similar tool, and be careful not to scratch the glass surface.
- If there is a noise source such as a motor near the camera or wiring cable, the image may be distorted or communication failure may occur. Keep the camera and wiring cables away from noise sources.
- Due to the inherent characteristics of CMOS sensors, pixel defects may occur during transportation and storage.

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1 Specifications

1.1 Models

・BC-SM9M6X1 (9M, Monochrome)

・BC-SC9M6X1 (9M, Color)

CXP3-1 / CXP6-1 Support Model
DIN Connector

・BC-SM9M6X1-AN (9M, Monochrome)

・BC-SC9M6X1-AN (9M, Color)

CXP3-1 / CXP6-1 Support Model
DIN Connector Angle Type

・BC-SM9M10X1 (9M, Monochrome)

・BC-SC9M10X1 (9M, Color)

CXP3-1 / CXP6-1 / CXP10-1 Support Model
MicroBNC Connector

・BC-SM9M10X1-AN (9M, Monochrome) : under development

・BC-SC9M10X1-AN (9M, Color) : under development

CXP3-1 / CXP6-1 / CXP10-1 Support Model
MicroBNC Connector Angle Type

1.2 Electronic Specifications

Model Number		BC-SM9M6X1	BC-SC9M6X1
Image Sensor		1" 8.95 Mega pixels Monochrome CMOS (Sony: IMX255)	1" 8.95 Mega pixels Color CMOS (Sony: IMX255)
Shutter Type		Global	
Active Pixel		4,096 (H) x 2,160 (V) : 8.95MPixel	
Pixel Size		3.45 (H) x 3.45 (V) μm	
Sync System		Free run / External trigger (Hardware / Software) / LinkTrigger(use of coax cable)	
Maximum Frame Rate		67.01 fps (8bit CXP6_X1) / 53.69 fps (10bit CXP6_X1) 33.50 fps (8bit CXP3_X1) / 26.84 fps (10bit CXP3_X1) 93.59 fps (8bit CXP10_X1) / 88.64 fps (10bit CXP10_X1) (*3)	
Video Output Format		CXP6_X1 , CXP3_X1 / 1Lane CXP10_X1 / 1Lane(*3)	
Video Format		8 bits (Mono8) / 10bit (Mono10)	8 bit (BayerRG8) / 10 bit (BayerRG10)
Noise Level		Less than 2.4 LSBs (Gain 0 dB, 8bit, CIS_10BIT, 200[DN])	
Sensitivity (*1)		510Lux	1040Lux
Exposure time(*2)		1μ sec to 2 sec (ExposureMode:Timed) 15μ sec to 2 sec (ExposureMode:TriggerWidth)	
Gain	Analog Gain	0 to 18dB	
	Digital Gain	0 to 24dB	
Black Level		0 to 80 DN 8bit	
White Balance Gain		N/A	Formula1 : 1 to 5 Times Formula2 : 1 to 8 Times
ROI		Width(Horizontal): 64 to 4096 / Height(Vertical): 4 to 2160 Adjustable Steps for size: 16 pixels in width direction / 4 lines in height direction Adjustable Steps for offset: 2 pixels in width direction / 4 lines in height direction	
Image Flip		ReverseX / ReverseY (Default: OFF)	
Pixel Defect Correction		Up to 256 points	
Operational Mode		Free-run(TriggerMode:Off) / Edge-preset Trigger(TriggerMode:On , ExposureMode:Timed) / Pulse width Trigger (TriggerMode:On , ExposureMode:TriggerWidth)	
User Setting Storage		Support	
Communication		CoaXPress Standard Ver1.1	
Protocol		GenICam Standard Version (SFNC 2.5) compliant	
Input / Output		GPIO x 2	
Power	Input Voltage	PoCXP	
	Consumption	Maximum: 3.0 W, Typical: 2.8 W CXP6-1 Maximum: 3.4 W, Typical: 3.2 W CXP10-1(*3)	

*1 Sensitivity is measured under below conditions.
F5.6 of Lens, Gain:0dB, Exposure time:1/30sec., Light source: Light box(5100K)
*2 Refer to [Horizontal Period depending on camera settings]
*3 Supported by BC-S ** M10X1. (BC-S ** M10X1 also supports CXP3-1 and CXP6-1.)

1.3 Mechanical Specifications

Model Number	BC-SM9M6X1(-AN) / BC-SC9M6X1(-AN)	BC-SC9M10X1(-AN) / BC-SC9M10X(-AN)
Dimensions	40 (W) x 40 (H) x 32.5 (D) mm: Straight Type (*1) 40 (W) x 40 (H) x 39 (D) mm: Angle Type(-AN) (*1)	
Material	Aluminum alloy	
Lens Mount	C Mount	
Interface Connectors	DIN1.0/2.3 Connector	MicroBNC Connector
	I/O Connector: HR10A-7R-6PB (Hirose) or equivalent	
Camera Mounting	M4 screws holes (Four on front. Two on top, bottom and both side plate)	
Weight	Approximately 74g : Straight Type Approximately 90g : Angle Type(-AN)	

(*1) excluding the connectors

1.4 Environmental Specifications

Model Number	BC-SM9M6X1(-AN) / BC-SC9M6X1(-AN)
Operational Temperature / Humidity	a).Environmental Temperature: 0 to +45 deg. C (with C MOUNT LENS) LENS SIZE: ϕ 35 x L45 mm Camera housing temperature when the environmental temperature is 45deg.C : 64 deg.C (*2) (Camera housing measuring point : Fig1.2-1) b). [DeviceTemperature] : 68 deg.C (*3) Environmental Humidity: 0 to 85%RH (No condensation)
Storage Temperature / Humidity	Environmental Temperature: -25 to +70 deg. C Environmental Humidity: 0 to 85%RH (No condensation)
Vibration	20 Hz to 200 Hz to 20 Hz (5 min. / cycle), acceleration 10 G, XYZ 3 directions 30 min. each
Shock	Acceleration 38 G, half amplitude 6ms, XYZ 3 directions 3 times each
Standard Compliancy	EMI: EN55032:2015+A11:2020, EN61000-3-2:2019, EN61000-3-3:2013+A1:2019 EMS: EN55035:2017+A11:2020 LVD: EN62368-1:2014+A11:2017
RoHS	RoHS Compliant

(*2) If use in an environment that exceeds 45deg.C, or if attach a small lens, take measures to dissipate heat so that the camera housing temperature will be less than 64deg.C.

(*3) If the camera has a heat dissipation effect, it may be possible to use it in an environment that exceeds 45deg.C. It can be used if the [Device Temperature] (value of the temperature sensor inside the camera) read by communication is within 68deg.C.

Camera housing measuring point

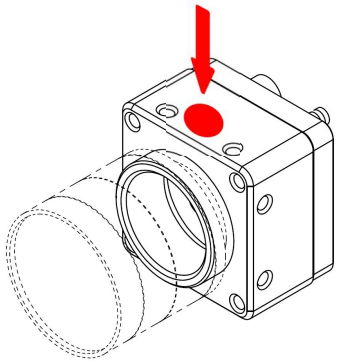
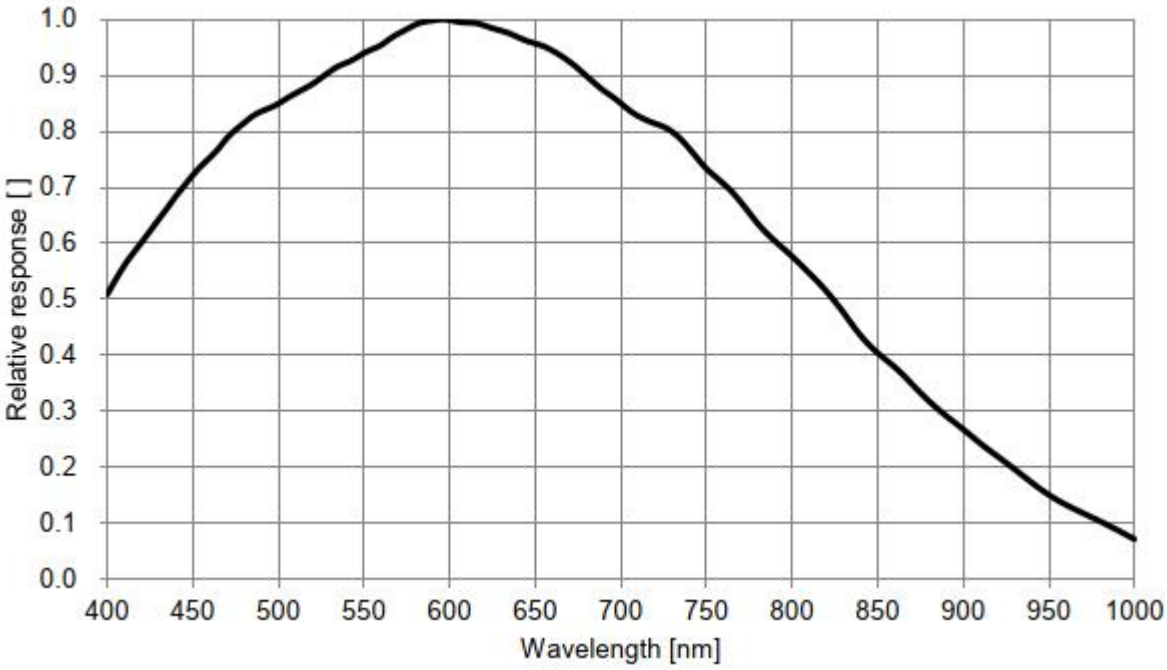
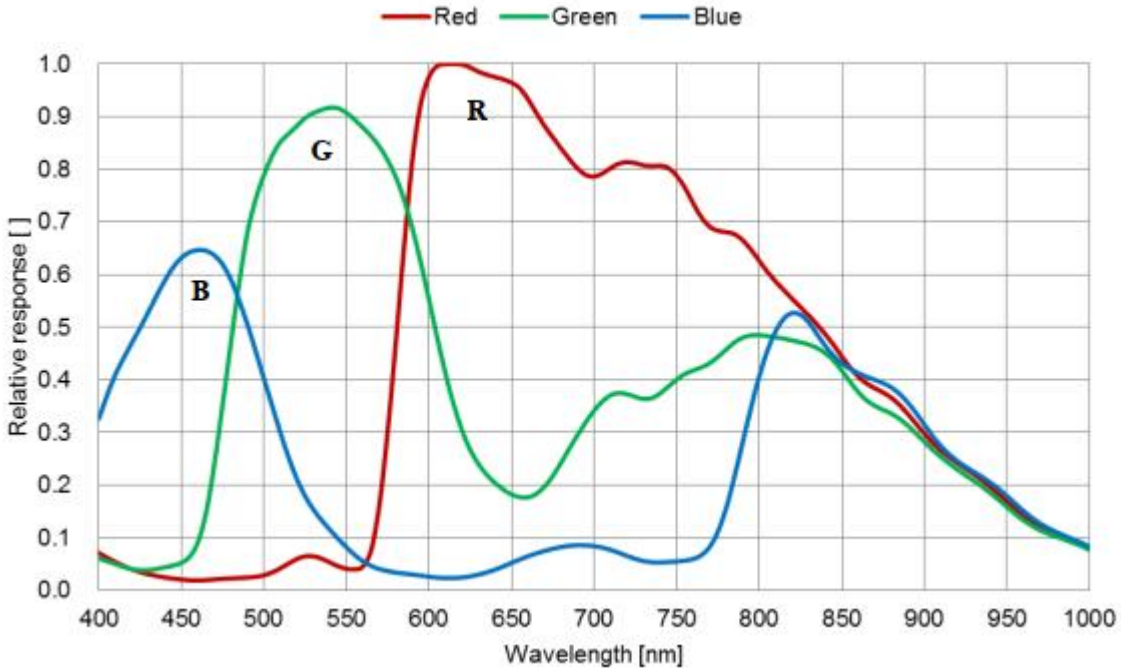


Fig 1.2-1

2 CMOS Informaiton

Relative response

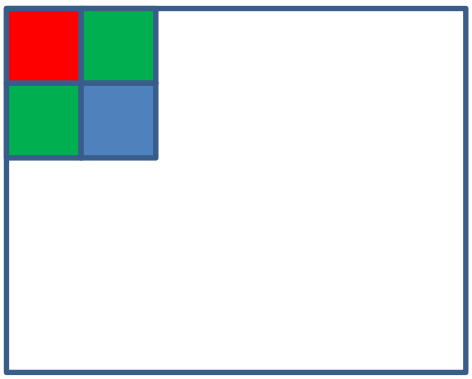




Color Filter Array

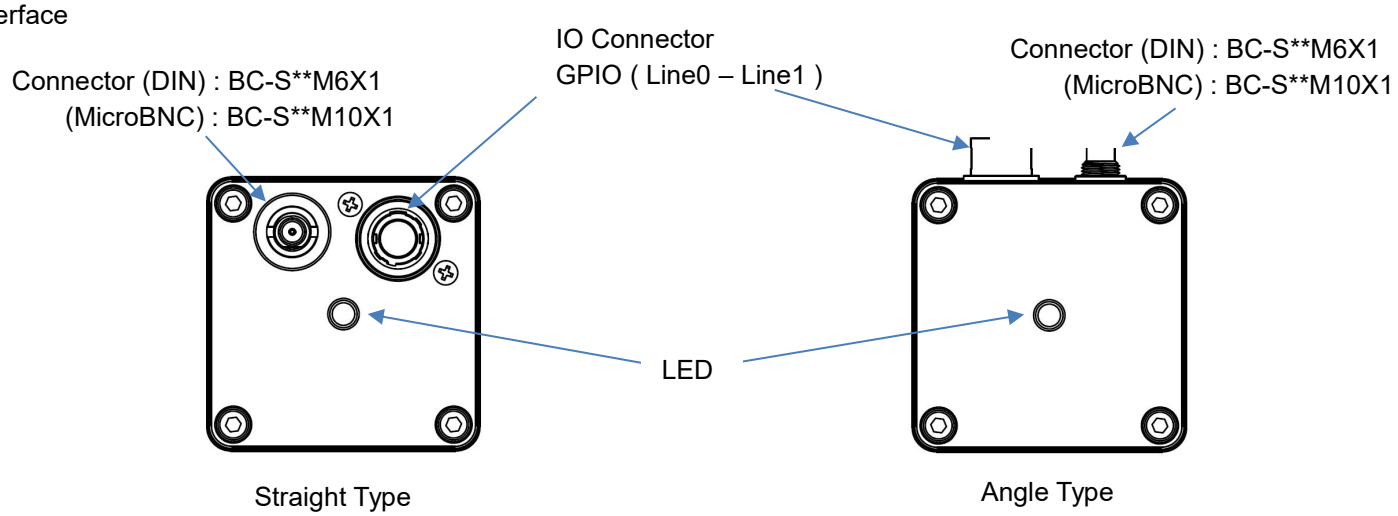
BC-SC9M6X1 (Color) / BC-SC9M10X1 (Color)

(0,0)



3 Camera Hardware Information

Interface



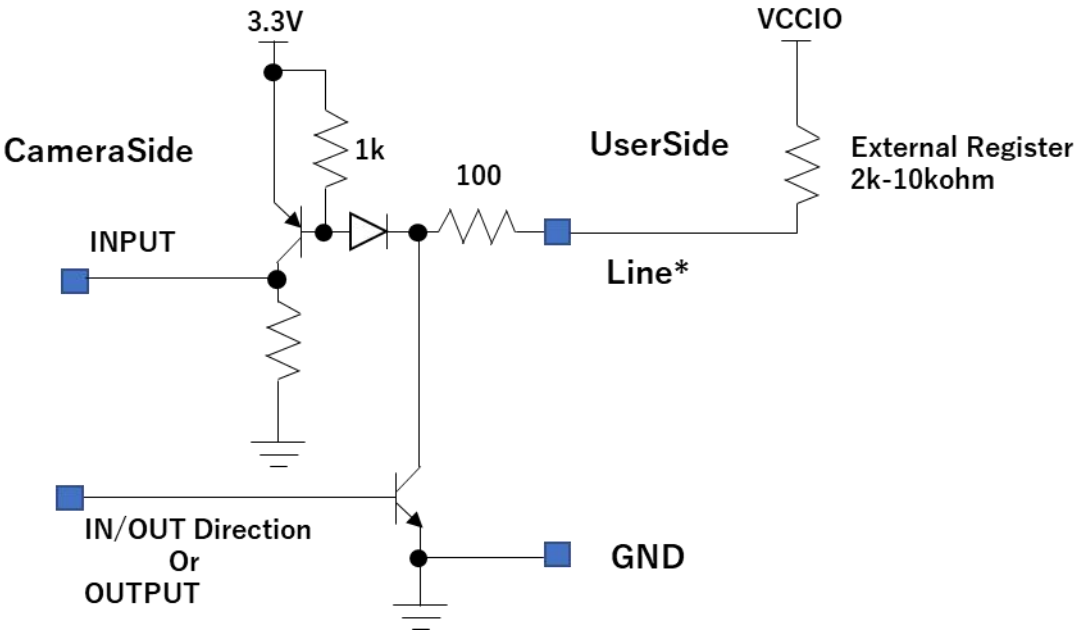
IO Connector

HR10A-7P-6S (Hirose) or equivalent can be used.
GPIO can select input and output by camera setting.

Pin assignment And DC characteristics

Pin No.	Signal Name	Function	DIR	Voltage	
				Low Voltage	High Voltage
1	NC	NC			
2	Line0	GPIO	IN	Less than+1.0V	+3.0 to +26.4V
			OUT	0 to +2.20V	+3.0 to +26.4V
3	Line1	GPIO	IN	Less than+1.0V	+3.0 to +26.4V
			OUT	0 to +2.20V	+3.0 to +26.4V
4	NC	NC			
5	NC	NC			
6	GND	GND		-	

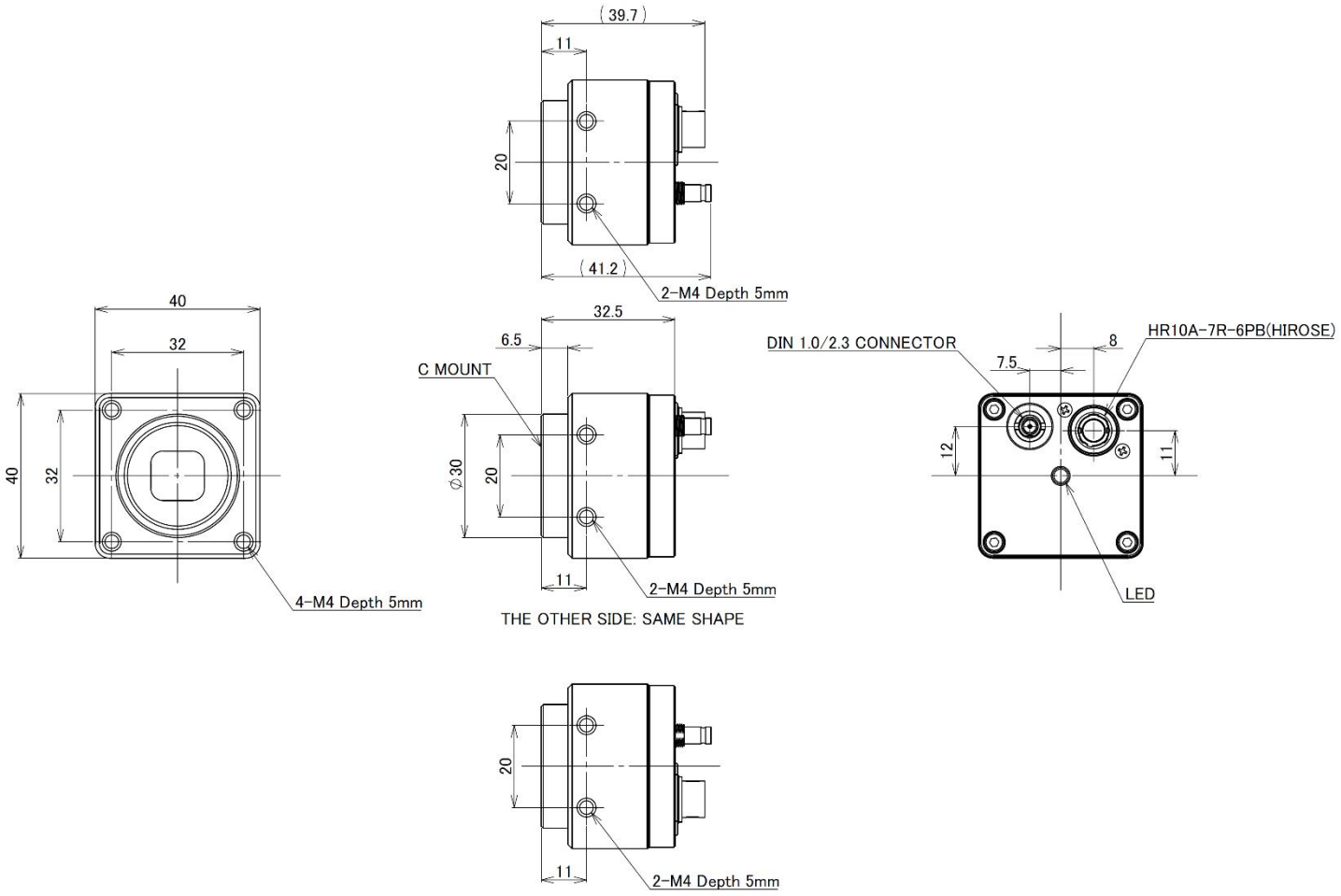
GPIO Line Circuit



Camera Dimensions

Unit: mm

【STRAIGHT TYPE】



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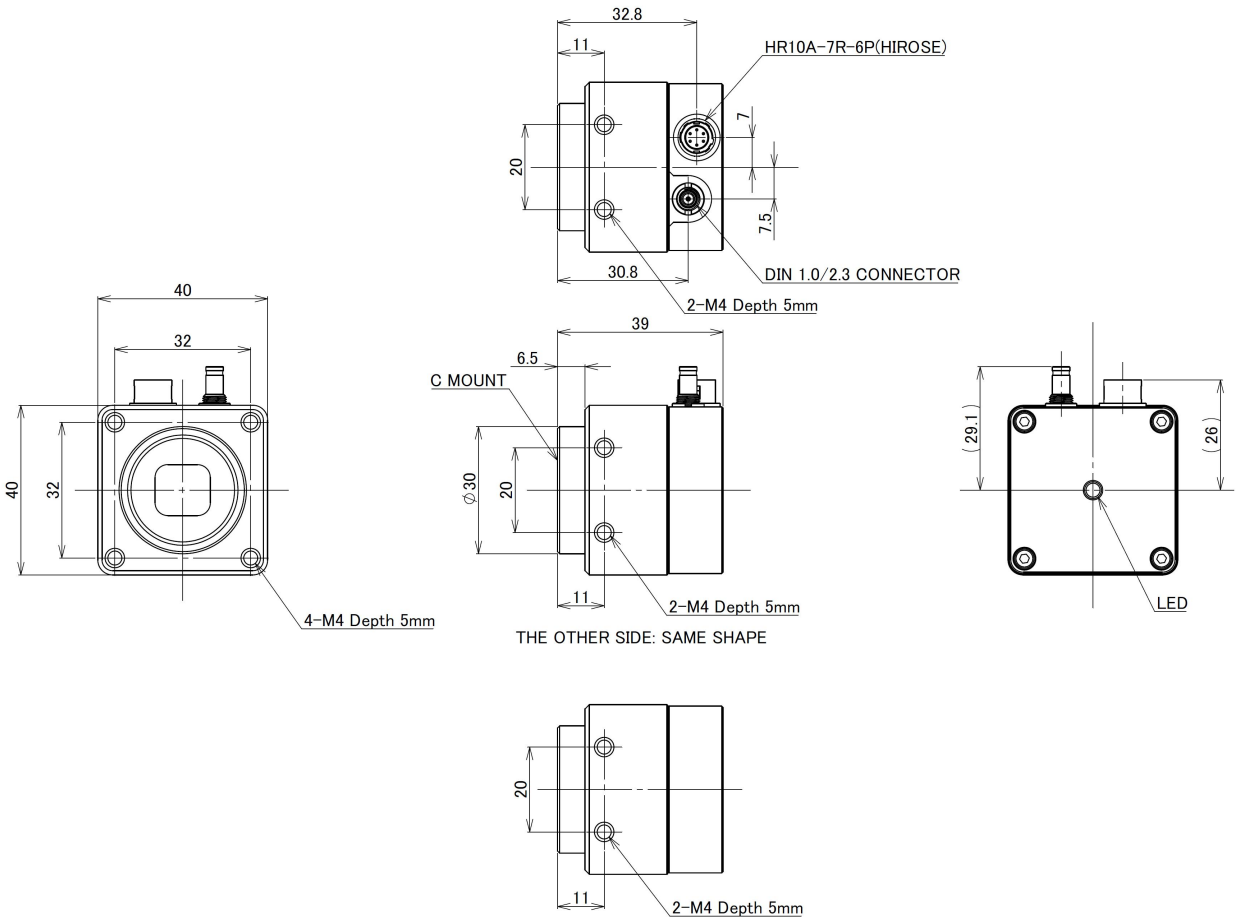
【ANGLE TYPE】 Unit: mm



4 Camera Operation

4.1 GenICam Command Reference Table

The setting items of the camera conform to SNFC of GenICam Standard Version.
The items implemented in the camera are as follows.
Please refer to SNFC of GenICam for details of the function except the original functions of BOPIXEL.

4.1.1 Standard functions

GenICam command	Default
DeviceVendorName	BOPIXEL Corporation
DeviceModelName	BC-SM9M6X1 / BC-SC9M6X1
DeviceManufacturerInfo	www.BOPIXELjapan.com
DeviceVersion	-
DeviceSerialNumber	-
DeviceUserID	00000000
DeviceTemperature	-
DeviceClockFrequency	-
SensorWidth	4096
SensorHeight	2160
WidthMax	4096
HeightMax	2160
Width	4096
Height	2160
OffsetX	0
OffsetY	0
ReverseX	False
ReverseY	False
PixelFormat	MonochromeModel: Mono8 / ColorMode : BayerRG8
TestPatternGeneratorSelector	FPGA
TestPattern	Off
BinningVerticalMode	Sum (MonochromeModel Only)
BinningVertical	1 (MonochromeModel Only)
AcquisitionFrameRate	Refer to [FrameRate calcurate]
TriggerMode	Off
TriggerSource	Software
TriggerSoftware	-
TriggerDelay	0

GenICam command	Default
ExposureMode	Off
ExposureTime	0
GainSelector	AnalogAll
Gain[AnalogAll] (*1)	0
Gain[DigitalAll] (*1)	0
BlackLevelSelector	All
BlackLevel	10
BalanceRatioSelector	0 (ColorMode Only)
BalanceRatio[Red]	0 (ColorMode Only)
BalanceRatio[GreenR]	0 (ColorMode Only)
BalanceRatio[GreenB]	0 (ColorMode Only)
BalanceRatio[Blue]	0 (ColorMode Only)
WhiteBalanceFunctionMode(*2)	Formula1
LineSelector	Line0
LineMode	Input
LineInverter	False
LineStatus	-
LineSource	UserOutput0
UseroutputSelector	UserOutput0
UserOutputValue	False
	-
DeviceTapGeometry	Geometry_1X_1Y
PayLoadSize	8847360
CxpLinkConfigurationStatus	-
CxpLinkConfiguration	CXP6_X1
CxpLinkConfigurationPreferred	CXP6_X1
TestMode	Off
TestErrorCountSelector	0
TestErrorCount	0
UserSetSelector	Default
UserSetLoad	-
UserSetSave	-
UserSetDefault	Default

Original functions of BOPIXEL

GenICam command	Discription	Default
ImageSensorBitSize	Select the ADC bit size of the CMOS sensor. When set to CIS_8Bit, the image will be the image with the CMOS gain multiplied by 4.	CIS_10Bit
TriggerAcquisitionModeSelector	Selects the trigger acquisition mode. (Overlap / Fast) Refer to [TriggerAcquisitionMode]	Overlap
EnablePixelCorrection	When set to ON, Activates pixel correction.	True
PixelCorrectionHighlight	When set to ON, the pixel of the coordinate to be corrected is highlighted.	False
PixelCorrectionIndex	Index for Pixel Correction Data.This can be set for 256 points.	0
PixelCorrectionX	Set the X position.This can be set for 256 points. The pixel to be corrected is written at the factory. Users can be added.	65535
PixelCorrectionY	Set the Y position.This can be set for 256 points. The pixel to be corrected is written at the factory. Users can be added.	65535
LineDebounceTime	Specifies the delay in microseconds (us) to apply after receiving IO[Line*] signal and before activating it.	1

(*1)Gain : AnalogAllGain / 10 + DigitalGainAll / 10 [dB]

(*2)White Balance Function Mode:
1) Formula1: OutValue = InValue + (InValue-BlackLevel)*BalanceRatio/64 (Set 0 for 0dBGain)
2) Formula2: OutValue = (InValue-BlackLevel)*BalanceRatio/2048+BlackLevel (Set 2048 for 0dBGain)

5 Image Acquisition and Camera Trigger Modes

TriggerMode：By setting it to ON, the user can input a trigger to the camera from the outside.
TriggerMode：When set to OFF, a trigger is generated inside the camera at the cycle of AcquisitionFrameRate.
TriggerMode：If OFF, the Trigger Acquisition Mode setting works in Overlap Mode.

5.1 Trigger Source

5.1.1 Software

A trigger is input by a communication command from the camera.
When software trigger is used, the timing of trigger input to the camera may not be guaranteed because it depends on the operating status of the host PC.

5.1.2 Line0-Line1

A trigger is input from the 6-pin connector (GPIO) of the camera.
When using the Line trigger, it is necessary to keep the voltage input range to the IO pin.

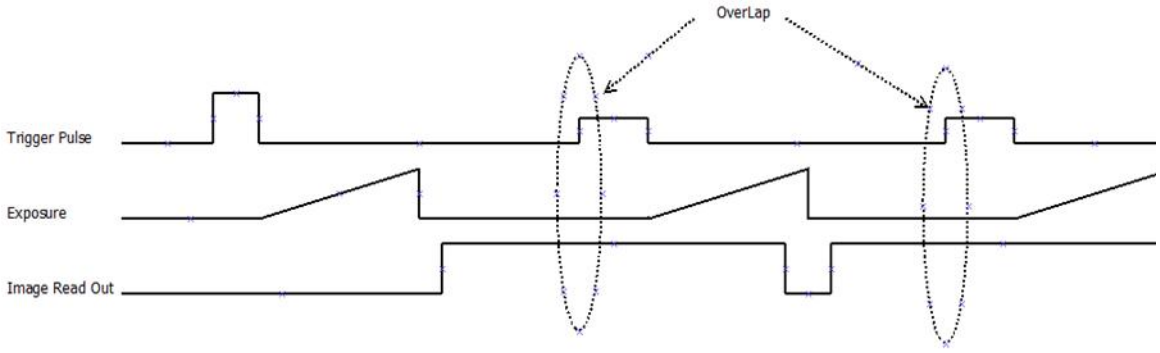
5.1.3 LinkTrigger

A trigger is input from the Cable line of the grabber board.
The trigger input method from LinkTrigger depends on the grabber board specifications.

5.2 Trigger Acquisition Mode

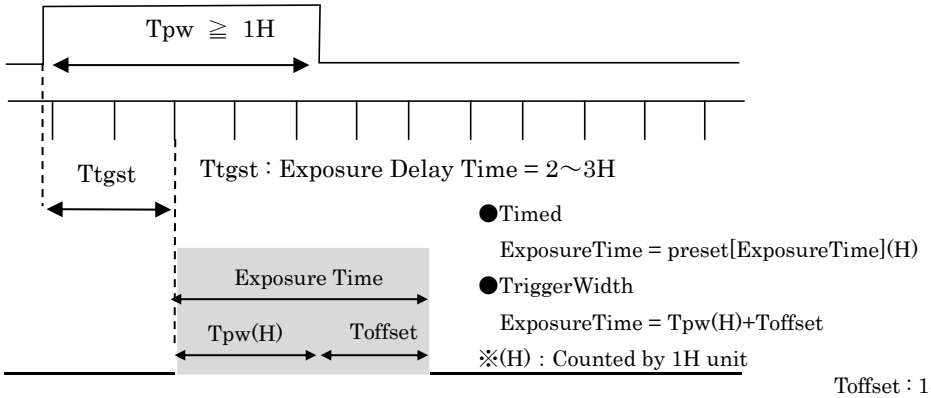
5.2.1 Overlap Mode

In this mode, Next trigger can be input during the sensor image read out.
However, exposure start timing is delayed 2 horizontal period and 1 jitter horizontal period sensor drive term.



- **The Detail Timing**

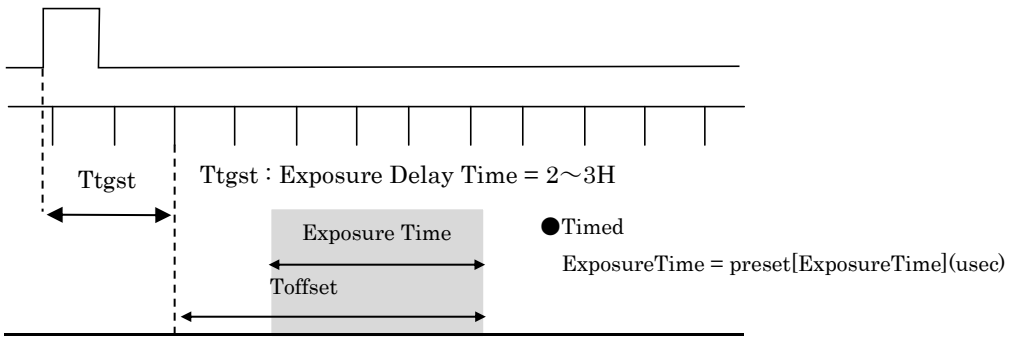
a) Exposure Time > 1Horizontal Period ＋ 17us



Toffset：14.26us

When used with TriggerWidth, Toffset is added inside the CMOS.

b) Exposure Time ≦ 1Horizontal Period ＋ 17us (Active : Exposure mode is Timed only.)



Toffset：16.11us

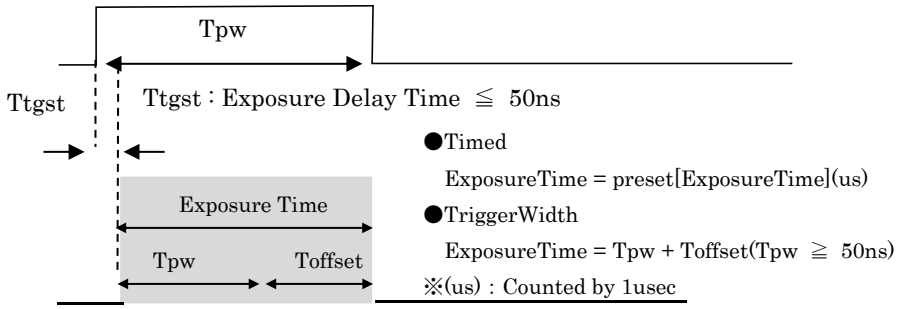
The Horizontal Period depends on the camera settings.
Refer to [Horizontal Period depending on camera settings]

5.2.2 Fast Trigger Mode

In this mode, exposure starts immediately (delayed < 50nsec.) against the trigger signal input without the jitter. However, when the next trigger is input during the sensor image read out, some noise may be appeared with trigger input timing.

- **The Detail Timing**

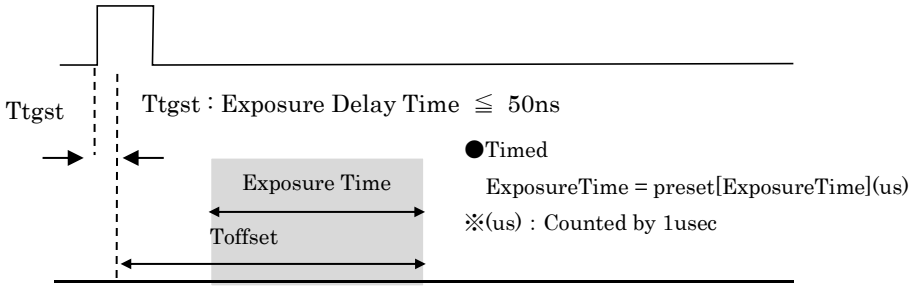
a) Exposure Time > 17usec



Toffset : 14.26us

When used with TriggerWidth, Toffset is added inside the CMOS.

b) Exposure Time ≦ 17usec (Active : Exposure mode is Timed only.)



Toffset : 16.11us

The Horizontal Period depends on the camera settings.
Refer to [Horizontal Period depending on camera settings]

5.2.3 Horizontal Period depending on camera settings

CXP Link Configuration	Pixel Format	ImageSensor BitSize	Horizontal Period(usec)
CXP3	Mono8/BayerRG8	CIS_8Bit	13.468
CXP3	Mono10/BayerRG10	CIS_8Bit / CIS_10Bit	16.808
CXP6	Mono8/BayerRG8	CIS_8Bit	6.7340
CXP6	Mono10/BayerRG10	CIS_8Bit / CIS_10Bit	8.4040
CXP10	Mono8/BayerRG8	CIS_8Bit	4.8215
CXP10	Mono10/BayerRG10	CIS_10Bit	5.2659
CXP10	Mono8/BayerRG8	CIS_10Bit	5.0909

5.2.3 Change time of Trigger Acquisition Mode and BinningVertical and ImageSensorBitSize

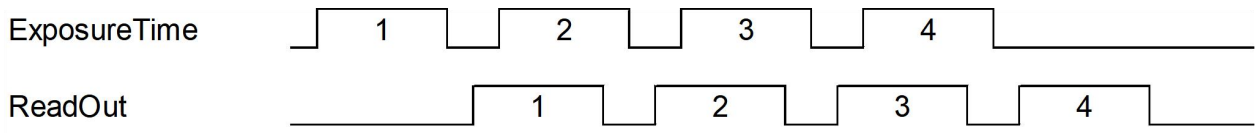
mmediately after changing the [Trigger Acquisition Mode] or [BinningVertical] or [ImageSensorBitSize], it takes time to change the mode inside the camera.

Do not enter a trigger to camera during that period.

Change time of [Trigger Acquisition Mode] or [BinningVertical] or [ImageSensorBitSize]
- CXP3-1 (Mono8 / BayerRG8) : 269[ms]
- CXP3-1(Mono10 / BayerRG10) : 336[ms]
- CXP6-1 (Mono8 / BayerRG8) : 134[ms]
- CXP6-1(Mono10 / BayerRG10) : 168[ms]
- CXP10-1 (Mono8 / BayerRG8) / CIS_8Bit : 97[ms]
- CXP10-1(Mono10 / BayerRG10) / CIS_8Bit : 106[ms]
- CXP10-1(Mono8 / BayerRG8) / CIS_10Bit : 102[ms]

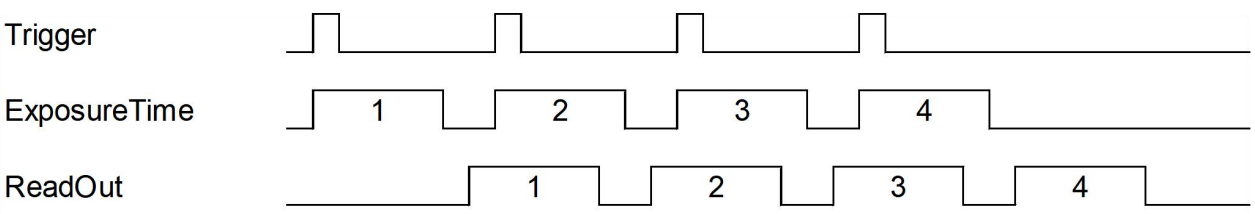
5.3 Exposure Mode

5.3.1 Exposure Mode : OFF(Free-Run)



When this mode is set, camera outputs video image continuously.
The camera is exposed and outputs video image at the set [Acquisition framerate].
The exposure time is set to a maximum value within a preset [Acquisition framerate].

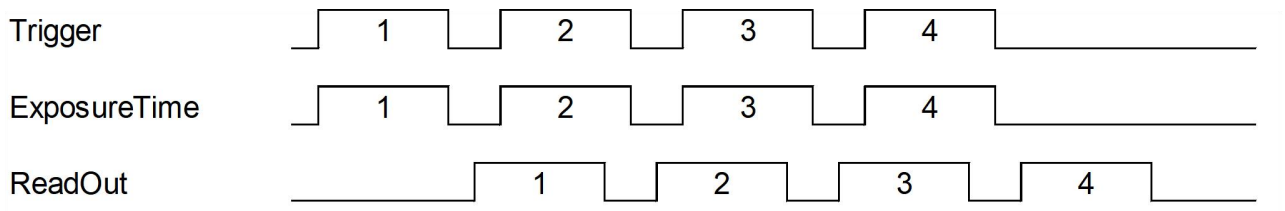
5.3.2 Exposure Mode : Timed



The camera is exposed within a preset [ExposureTime] and outputs video image from an external trigger.
There is an upper limit to the timing at which a trigger can be input.
Refer to [Trigger prohibition time] and [FrameRate calcurate].

When inputting a trigger from [LinkTrigger] , the camera recognizes at the rising edge of the trigger signal.
When inputting a trigger from [Line*], user can select whether the trigger signal is recognized as a rising or a falling edge using the [LineInverter] setting.

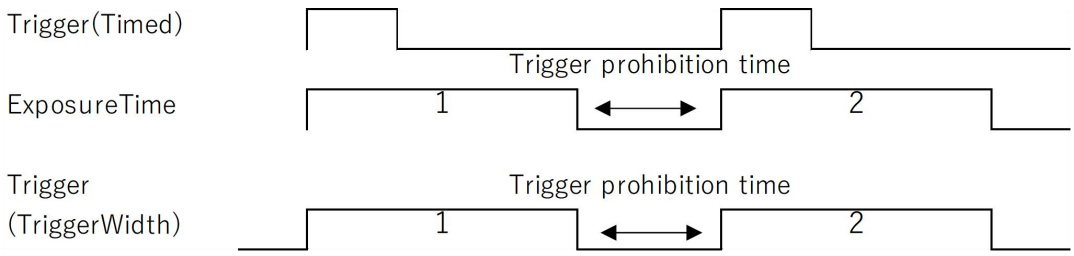
5.3.3 Exposure Mode : Trigger Width



The camera is exposed for the same period as the external trigger and outputs the video image.
There is an upper limit to the timing at which a trigger can be input.

5.3.4 Trigger prohibition Time

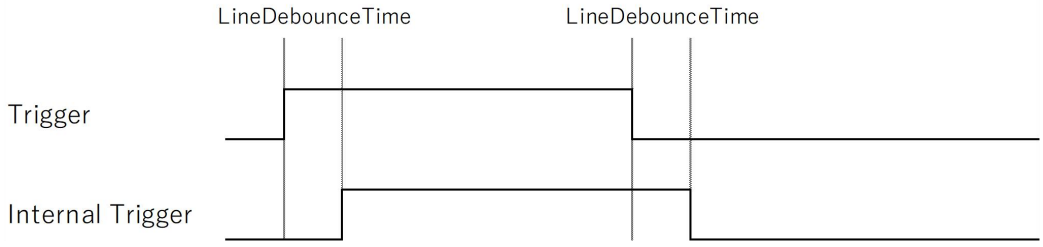
When inputting triggers with [Timed] or [TriggerWidth], there is a trigger prohibition time.
Do not enter the next trigger to camera during this period.



Trigger prohibition time

CXP3-1(Mono8 / BayerRG8) : 754.21[us]
CXP3-1(Mono10 / BayerRG10) : 941.26[us]
CXP6-1(Mono8 / BayerRG8) : 337.11[us]
CXP6-1(Mono10 / BayerRG10) : 470.63[us]
CXP10-1(Mono8 / BayerRG8)、(CIS_8Bit) : 270.01 [us]
CXP10-1(Mono10 / BayerRG10)、(CIS_10Bit) : 295.00 [us]
CXP10-1(Mono10 / BayerRG10)、(CIS_8Bit) : 285.10 [us]

5.3.5 Trigger LineDebounce Time



Generates an internal trigger after the time set in LineDebounceTime elapses after the trigger is detected.
LineDebounceTime is added to the internal trigger.
It can be used as a trigger signal filtering function.

6 FrameRate calcurate

Mono8 / BayerRG8

CXP3-1

74250000 / 1000 / (Height + 56) [fps] (*1)

CXP6-1

74250000 / 500 / (Height + 56) [fps] (*1)

CXP10-1 (CIS_8Bit)

74250000 / 358/ (Height + 56) [fps] (*1)

CXP10-1 (CIS_10Bit)

74250000 / 378/ (Height + 56) [fps] (*1) (*2)

Mono10 / BayerRG10

CXP3-1

74250000 / 1248 / (Height + 56) [fps] (*1)

CXP6-1

74250000 / 624 / (Height + 56) [fps] (*1)

CXP10-1 (CIS_10Bit)

74250000 / 391/ (Height + 56) [fps] (*1) (*2)

(*1)Round down to the 3rd decimal placel

(*2) Supported by BC-S ** M10X1. (BC-S ** M10X1 also supports CXP3-1 and CXP6-1.)

7 Revision Information

Rev	Date	Changes
0.0		Released
0.1	2021/05/25	Change Exposure Time. Change the setting change time of Trigger Acquisition Mode. Added Gain formula. Updated chapter on camera trigger mode. Updated Trigger prohibition time.
0.2	2021/10/06	Fixed an error in Maximum Frame Rate. Add measurement conditions to Sensitivity. Fixed an error in ColorGainmagncication and function. Change DeviceManufacturerInfo to www.BOPIXELjapan.com]. Added BinningVertical and ImageSensorBitSize to the setting change time condition of Trigger Acquisition Mode. Change Standard Compliancy. Added details of Trigger prohibition time.
0.3	2021/11/19	Added CXP10-1 support model.
0.4	2021/12/06	Fixed an error in FrameRate caluculate.
0.5	2022/02/10	Change Standard Compliancy Fixed an error in White Balance Gain Fixed an error in GPIO Line Circuit

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