


# CoaXPress TDI Line Scan Camera Monochrome CMOS 9K x 256Lines

## BL-GM9K12X4

### Product Specifications

## 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 Electronic Specifications

<b>Model Number</b>	<b>BL-GM9K12X4</b>	
Image Sensor	Gpixel : GLT5009BSI Monochrome CMOS TDI (Backside Illuminated Sensor)	
Shutter Type	Global	
Active Pixel	Arrey1: 9072 pixels x 256TDI Lines TBD (Arrey2: 9072 pixels x 32TDI Lines)	
Pixel Size	5.0 (H) x 5.0 (V) $\mu$ m	
Sync System	Free run / External trigger (Hardware / Software) / LinkTrigger (use of coax cable)	
Line Rate	344KHz (Normal Mode@CXP12X4(8bit)),526KHz (Frame Mode@CXP12X4(8bit))	
Video Output Format	CXP12, CXP10, CXP6, CXP3 (X4, X2, X1Lane)	
Output Bit Number	8 /10 /12bits	
Noise Level	Less than 42dB (@Analog Gain X2)	
Exposure time	(1 / Line Rate) x (TDI Stages Number.)	
Gain	Analog	X2 to X8
	Digital	0 to 24dB
Black Level	0 to 80 DN 8bit	
Image Flip	Reverse X (Default: OFF)	
TDI Direction	Forward / Reverse	
Shading Correction	Support	
Look Up Table	Programmable 12bit	
Area Mode	Arrey1: 9072 pixels x 256 Lines TBD (Arre2: 9072 pixels x 32 Lines)	
Pixel Defect Correction	TBD points	
Operational Mode	Free-run (Trigger Mode: Off) / External Trigger	
User Setting Storage	Support	
Communication	CoaXPress Standard Ver1.1	
Protocol	GenICam Standard Version (SFNC 2.5) compliant	
Input / Output	GPIO×4, RS422×2	
Cooling System	Heatsink	
Power	Input	External 24V±10%, Minimum two PoCXP cables required.
	Consumption	Typical 16W

## 1.2 Mechanical Specifications

Model Number	BL-GM9K12X4
Dimensions	66 (W) x 109 (H) x 38.5 (D) mm , M58 Mount (*1)
Material	Aluminum alloy
Lens Mount	M58 Mount/M72 Mount/F Mount
Interface Connectors	HD-BNC Connector I/O Connector: HR10A-10R-12PB (Hirose) or equivalent
Camera Mounting	M5 screws holes (Four on front. Two on top, bottom and both side plate)
Weight	Approximately 810g

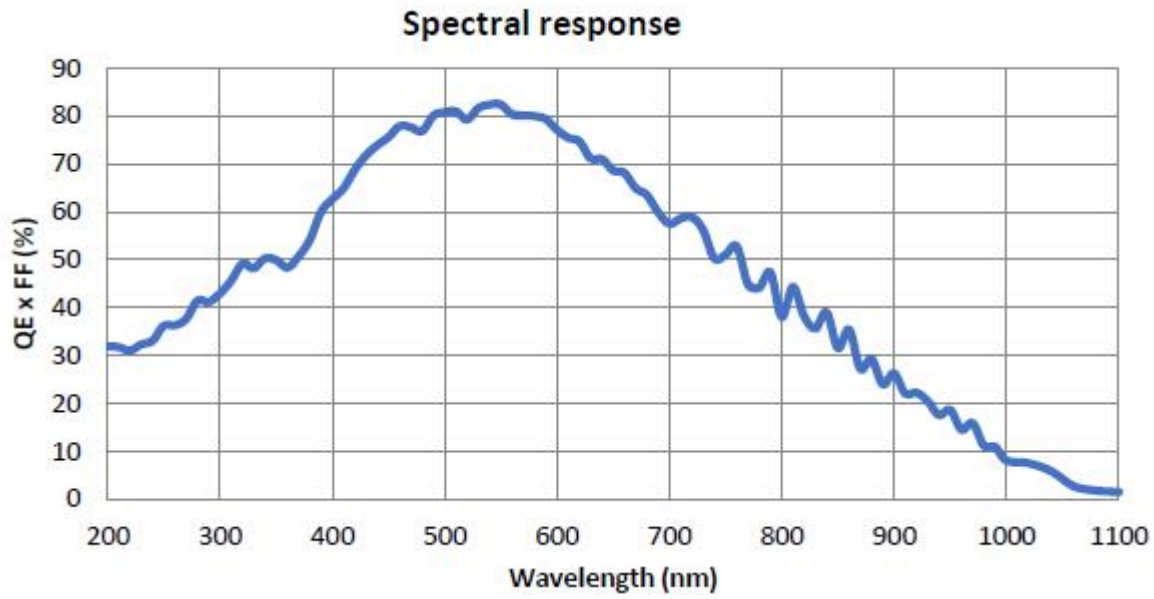
(\*1) excluding the connectors

## 1.3 Environmental Specifications

Model Number	BL-GM9K12X4
Operational Temperature / Humidity	a). Environmental Temperature: TBD b). Device Temperature: 70deg.C or less 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	The following certifications are planned. EMI: EN55032:2015,EN61000-3-2:2014,EN61000-3-3:2013 EMS: EN55035:2017,EN61000-4-2:2009,EN61000-4-3:2006+A1:2008+A2:2010,EN61000-4-4:2012
RoHS	RoHS Compliant

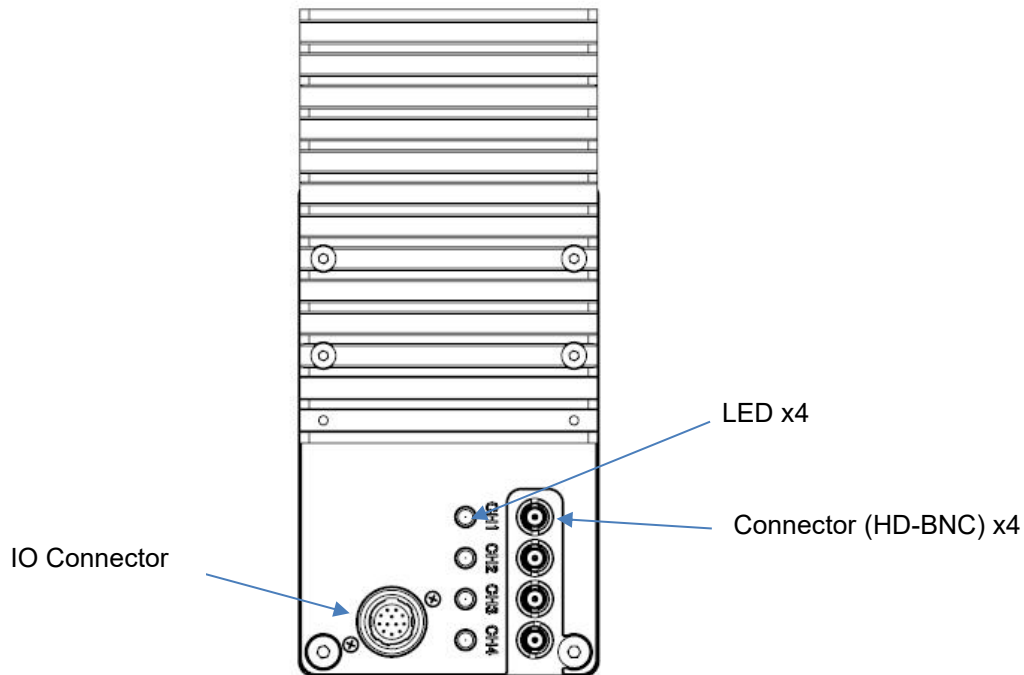
## 2 CMOS information

### 2.1 Spectral Sensitivity Characteristics



### 3 Camera Hardware Information

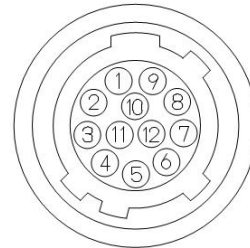
#### 3.1 Interface



#### 3.2 IO Connector

- HR10A-10R-12PB (Hirose) or equivalent can be used.
- GPIO can select input and output by camera setting.

#### Pin assignment And DC characteristics

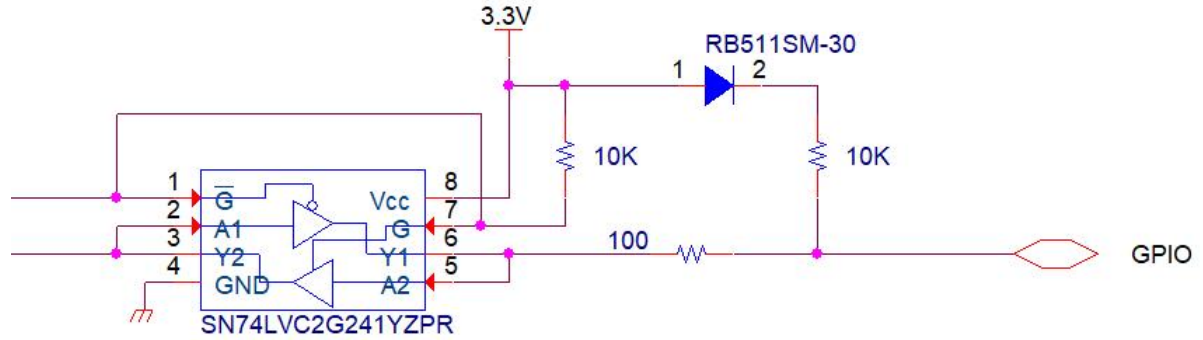


Pin No	Signal Name	DIR	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>OL</sub>	V <sub>OH</sub>
1	GND	GND	-	-	-	-
2	DC24V	POWER	-	-	-	-
3	Line0	IN/OUT	≤0.8V	2~5V	0.55	2.3
4	Line1	IN/OUT	≤0.8V	2~5V	0.55	2.3
5	Line2	IN/OUT	≤0.8V	2~5V	0.55	2.3
6	Line3	IN/OUT	≤0.8V	2~5V	0.55	2.3
7	RS422_0(-)	IN/OUT	-0.2V	0.2V	2.4	0.4
8	RS422_0(+)	IN/OUT			0.4	2.4
9	GND	IN/OUT	-	-	-	-
10	DC24V	POWER	-	-	-	-
11	RS422_1(-)	IN/OUT	-0.2V	0.2V	2.4	0.4
12	RS422_1(+)	IN/OUT			0.4	2.4

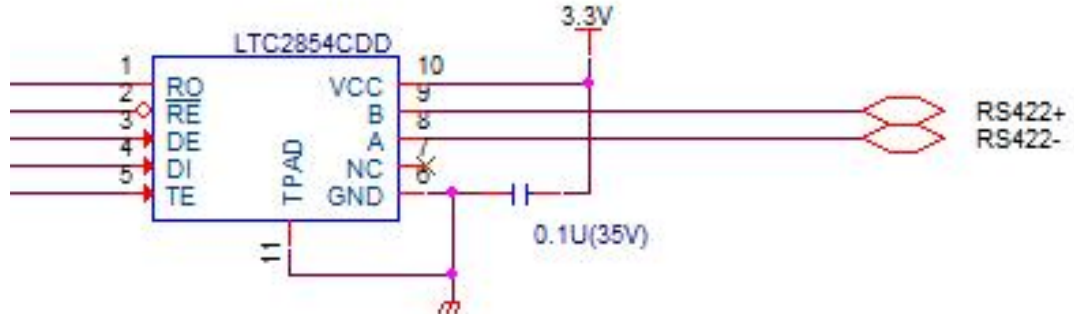


## 3.3 GPIO Line Circuit

## 3.3.1 Line0, Line1, Line2, Line3



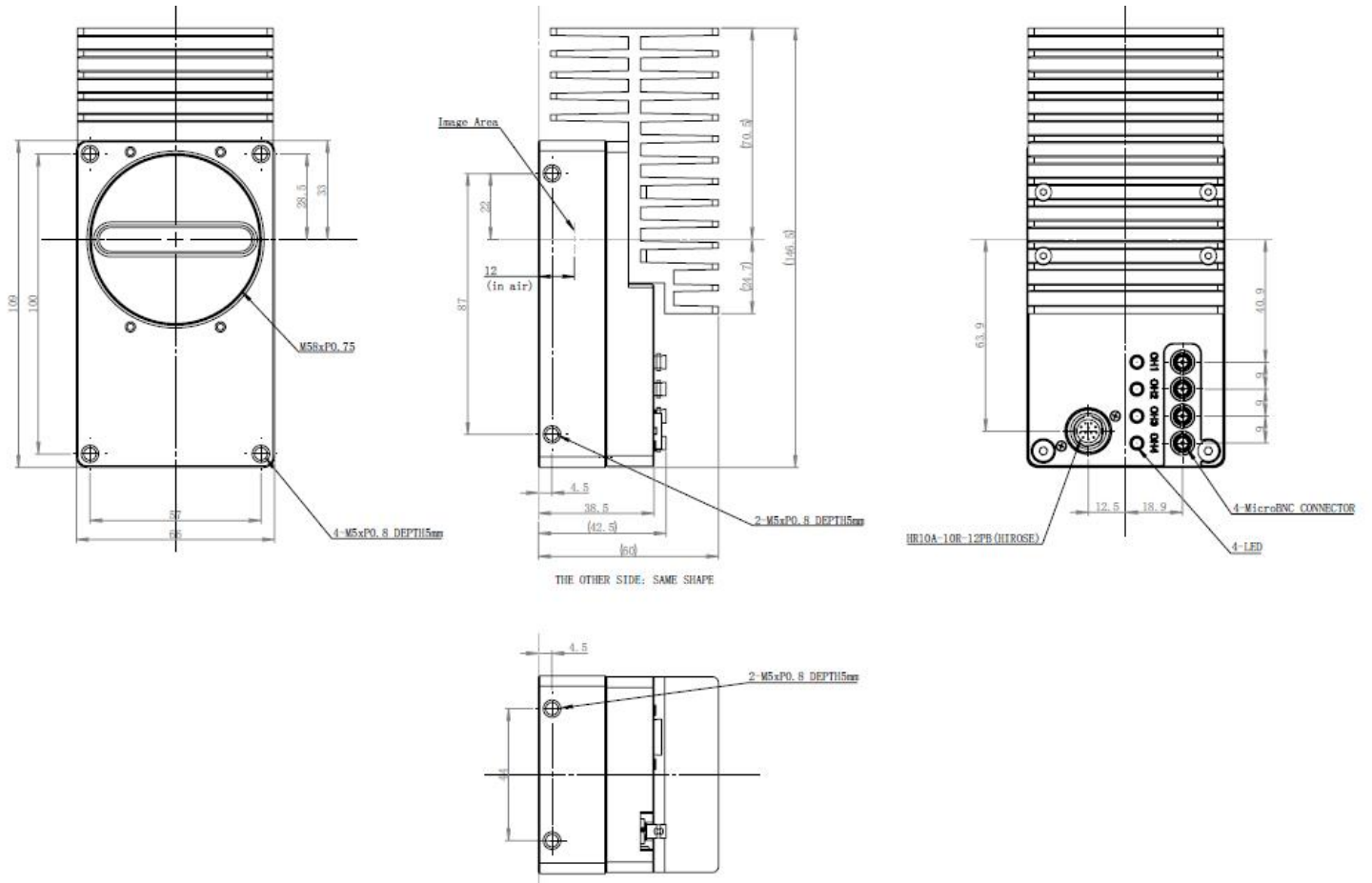
## 3.3.2 RS422\_0, RS422\_1



**4 CAMERA DIMENSIONS**

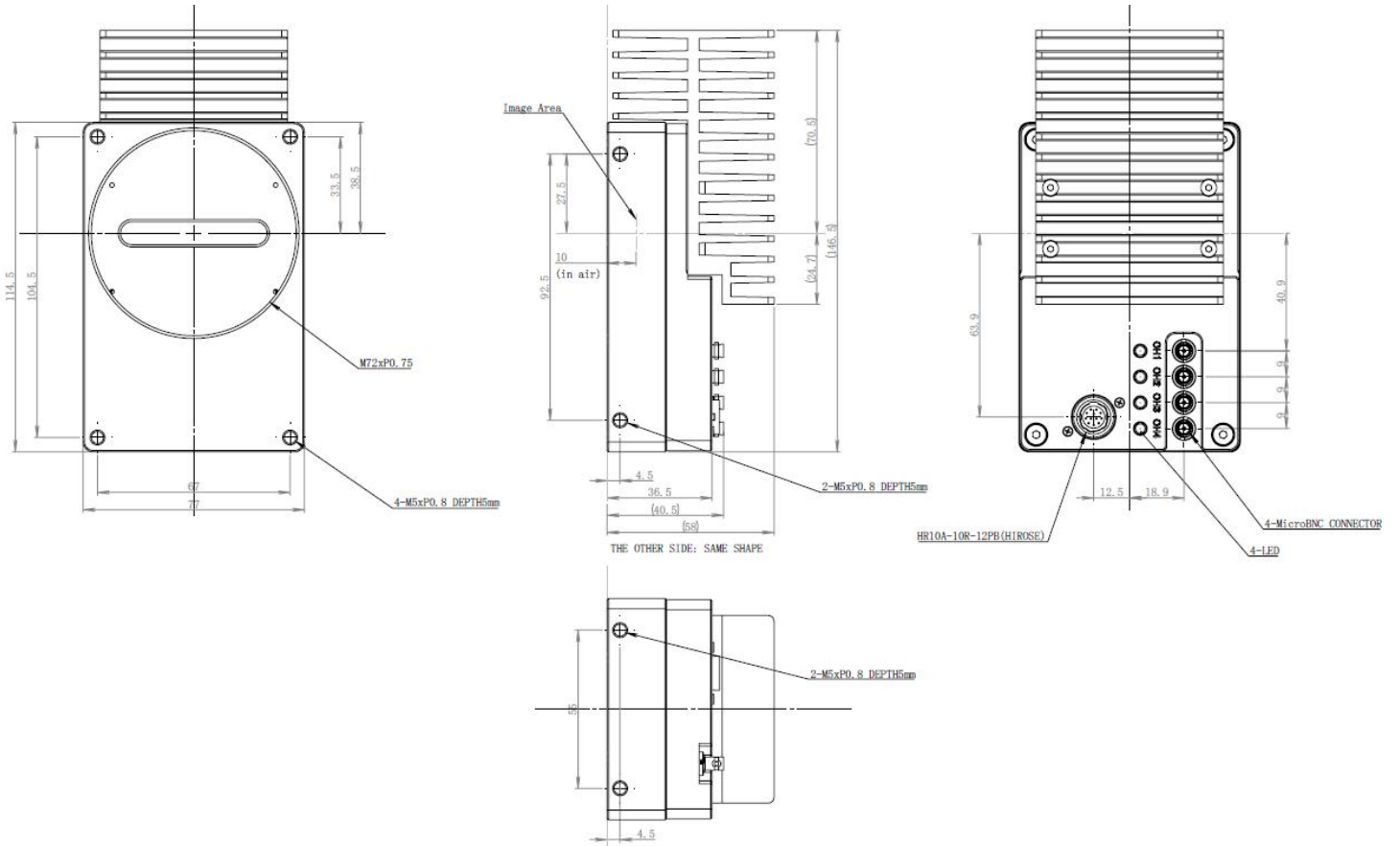
M58 Mount

Unit: mm



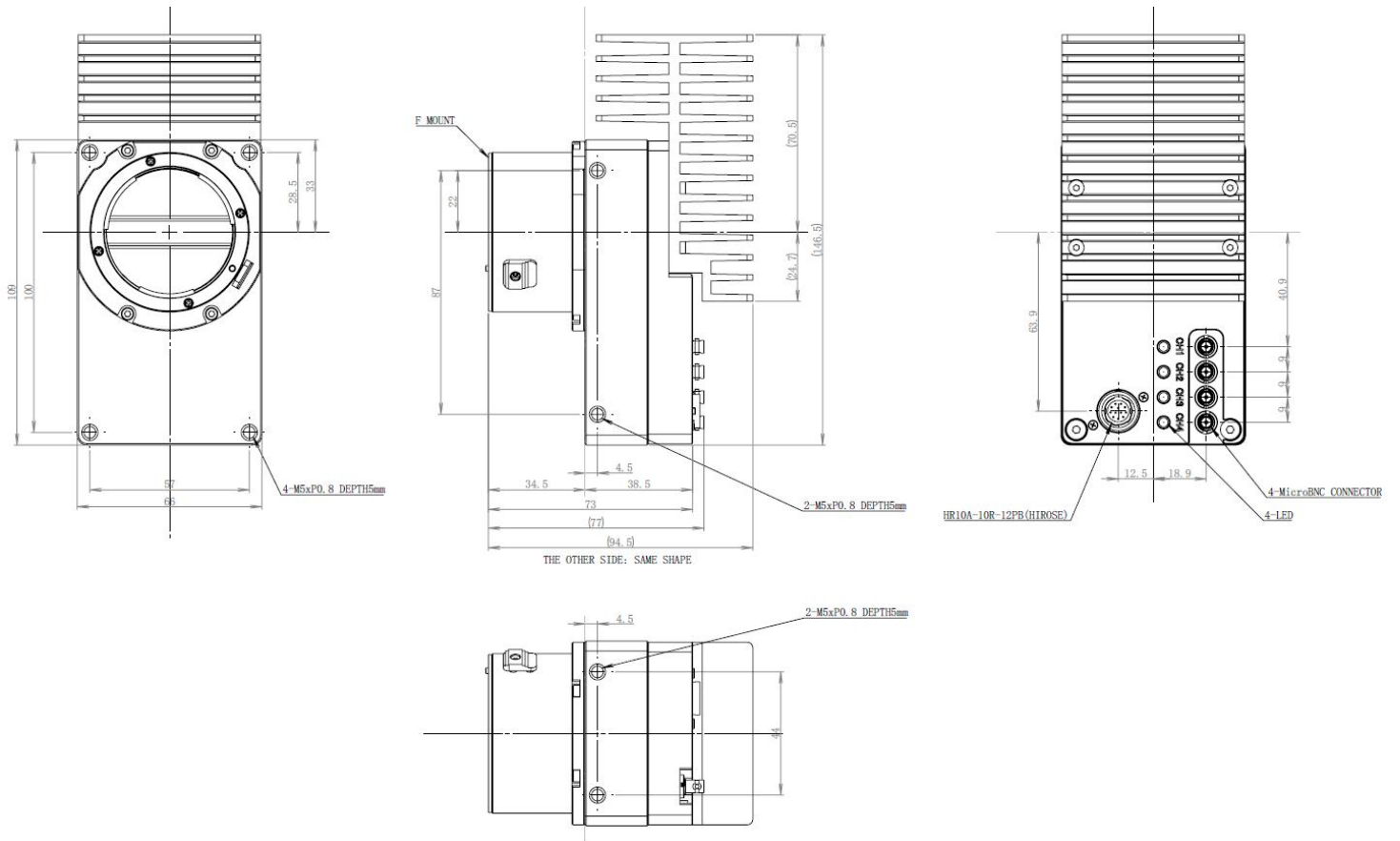
M72 Mount

Unit: mm



F Mount

Unit: mm



## 5 Operation Mode

This camera has two main operation modes: Normal Mode and Frame Mode.

### 1) Normal Mode:

The camera operates in the same way as a normal line sensor camera, outputting data in 1-line units.

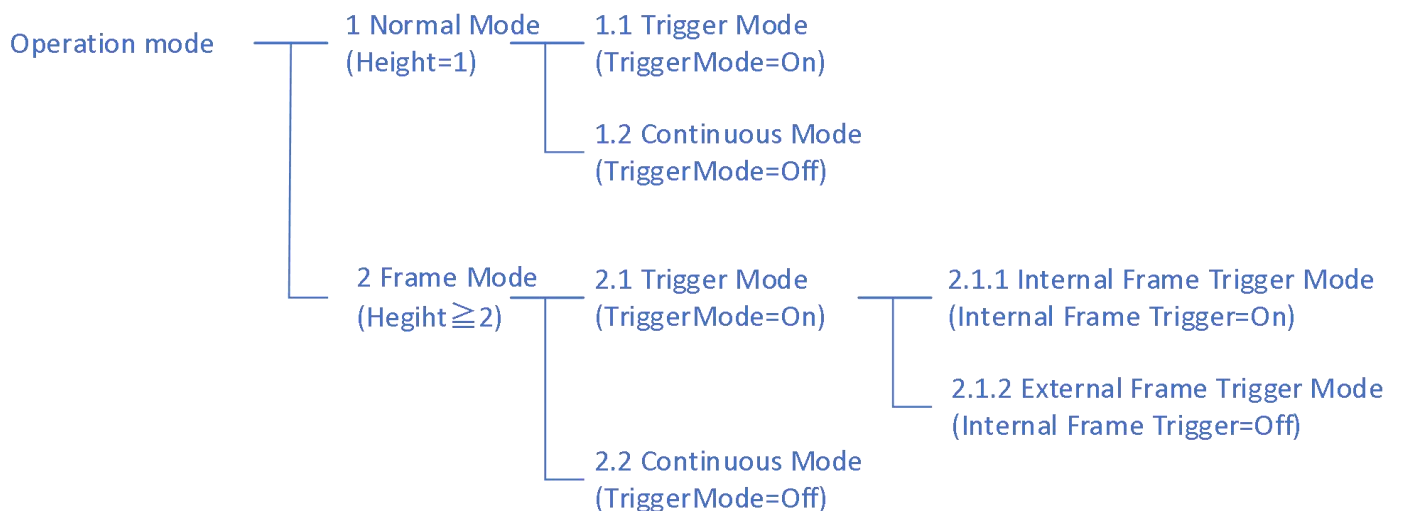
The CXP (CoaXPress) protocol Packet Overhead is not affected, and the maximum line rate is 344KHz@CXP.

### 2) Frame Mode: (This mode is specific to this camera.)

This mode is similar to the Area Sensor Camera, which outputs multiple lines (settable any number) at once. By treating multiple lines as an area, the Packet Overhead of the CXP (CoaXPress) protocol can be reduced, and the maximum line rate is reached 526 kHz @ CXP12X4.

*(Note) The image output format in this mode is the same as for area sensors, so the frame grabber settings must be compatible with area sensors (where Height is set to multiple lines).*

### ● Operation Mode Chart



The operation of each mode is described below.

## 5.1 Normal Mode (Height setting value: 1)

### 5.1.1 Trigger Mode (Trigger Mode=On)

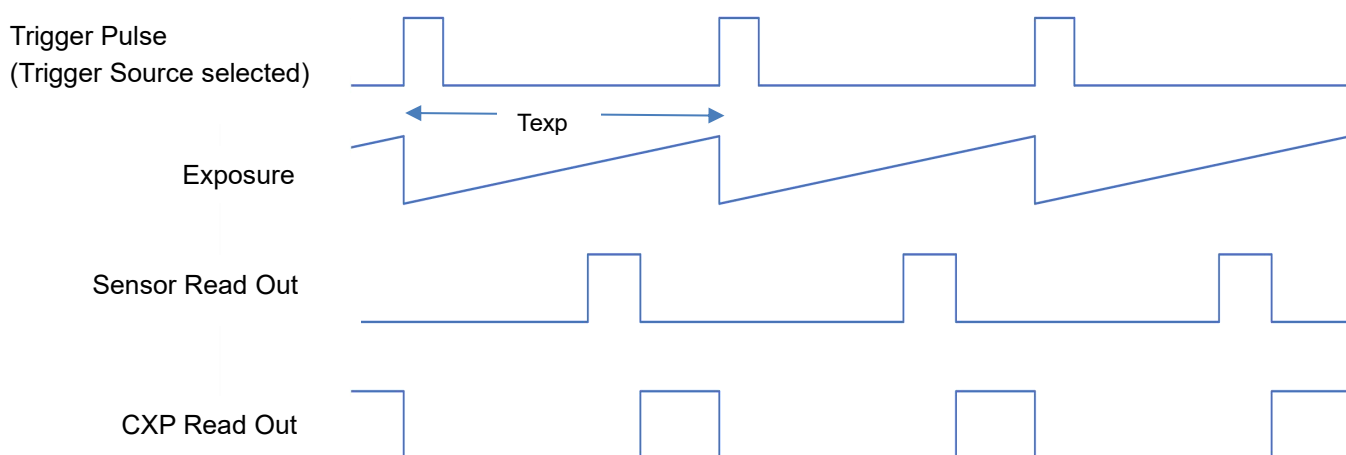
One line of pixels is output for each external trigger signal input.

The exposure time is the trigger signal input interval time ( $T_{exp}$ ).

In this mode, each line includes Packet Overhead of CXP (CoaXPress) protocol.

During high-speed scanning operation, there is an issue that the ratio of Overhead to the total amount of transferred data becomes large, resulting in a loss of transfer rate.

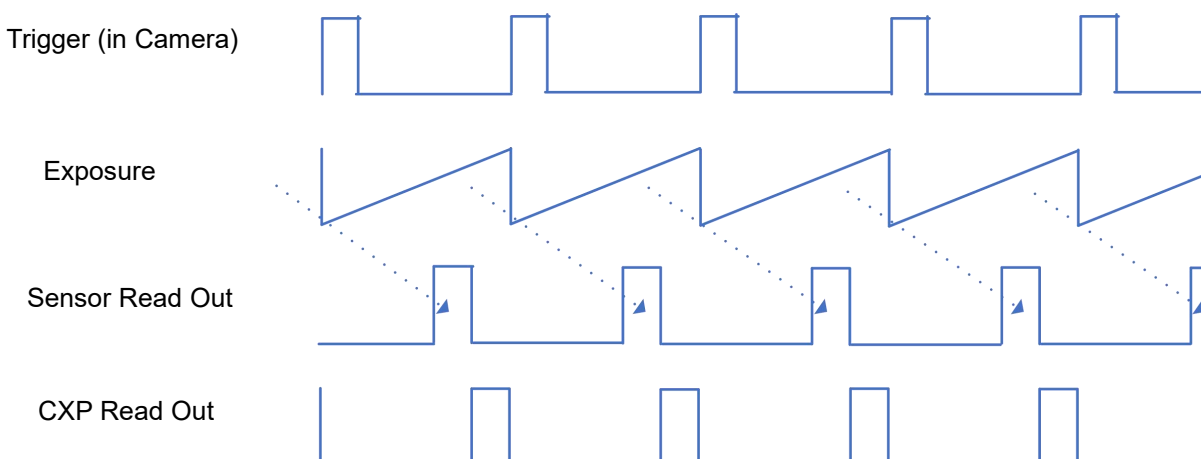
※Reference Table 6.1 Max. Line Scan Rate (kHz)



### 5.1.2 Continuous Mode (Trigger Mode=Off)

Each line is output continuously at the cycle set in Exposure Time.

In this mode, the header and footer sections of the CXP (CoaXPress) protocol are inserted for each line, resulting in a large overhead ratio to the transferred image data during high-speed scan operation.



## 5.2 Frame Mode (Height setting value: 2 or higher)

Frame Trigger combines multiple line outputs into a frame, like an area sensor. This solves the problem of low transmission efficiency due to the overhead of the CXP protocol in the [5.1 Height Setting value: 1](#) operation described above.

Width (number of pixels per line) X Height (number of output lines) is output as one frame like an area sensor.

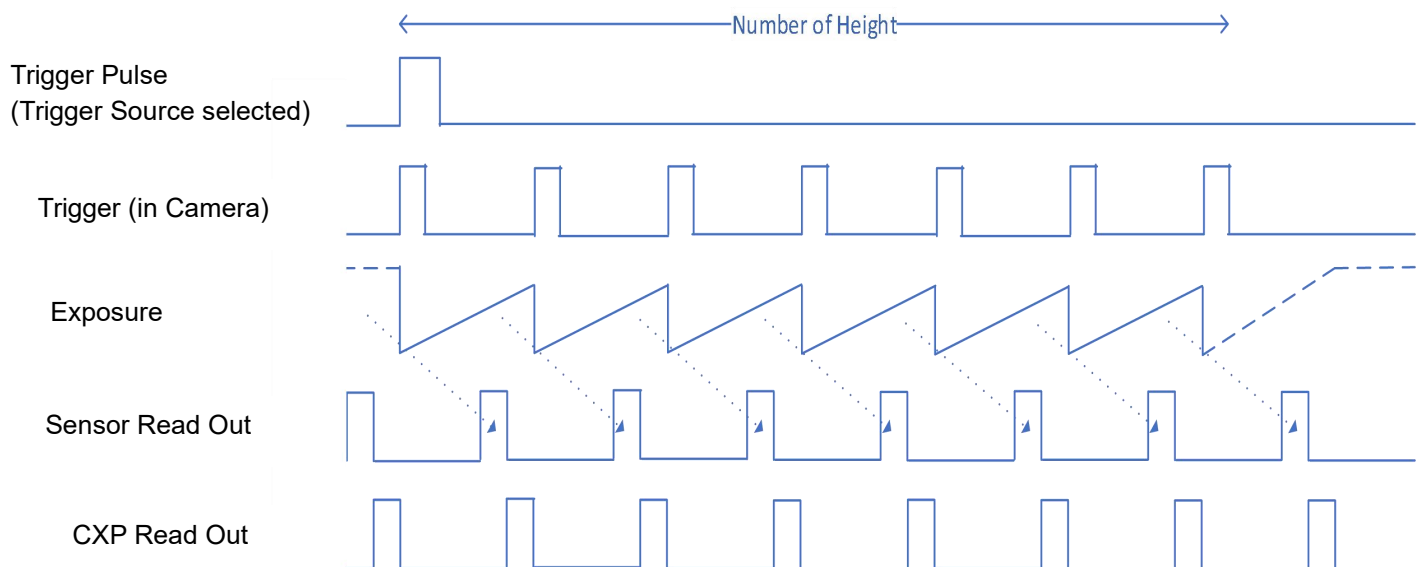
*(Note) The image output format in this mode is the same as for area sensors, so the frame grabber settings must be compatible with area sensors (where Height is set to multiple lines).*

### 5.2.1 Trigger Mode (Trigger Mode=On)

#### 5.2.1.1 Internal Frame Trigger (Internal Frame Trigger=On)

Starting from the trigger input, the camera takes pictures for the number of lines of the preset Height value with the set exposure time (cycle =  $1 \div$  exposure time).

※When Software is selected as Trigger Source, it is always On.



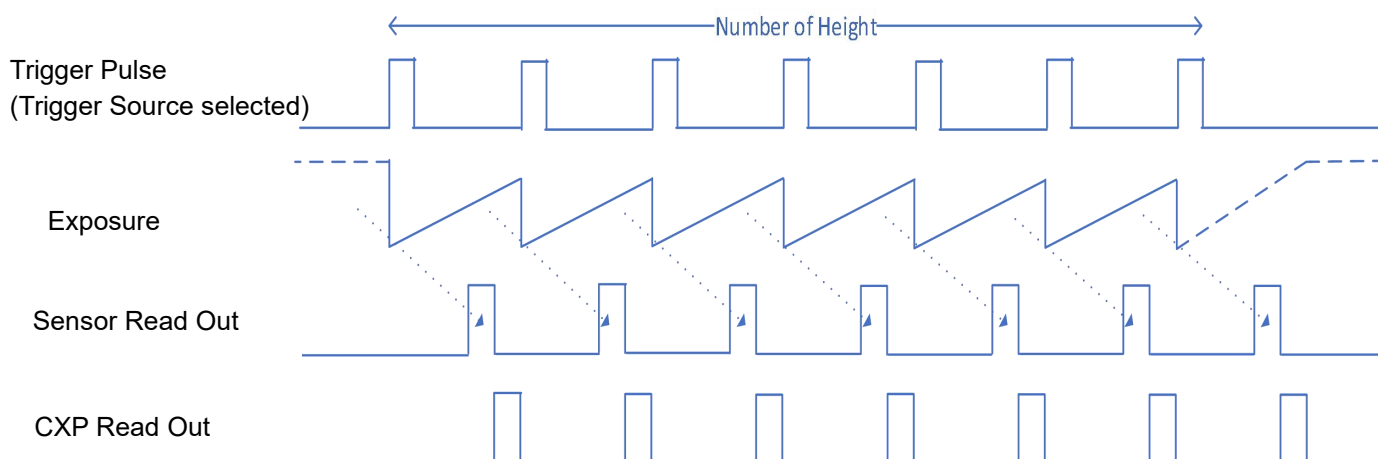
### 5.2.1.2 External Frame Trigger (Internal Frame Trigger=Off)

One line of pixels is output for each external trigger input, and the frame ends when a line equal to the Height setting value is output.

Exposure time is the trigger input interval.

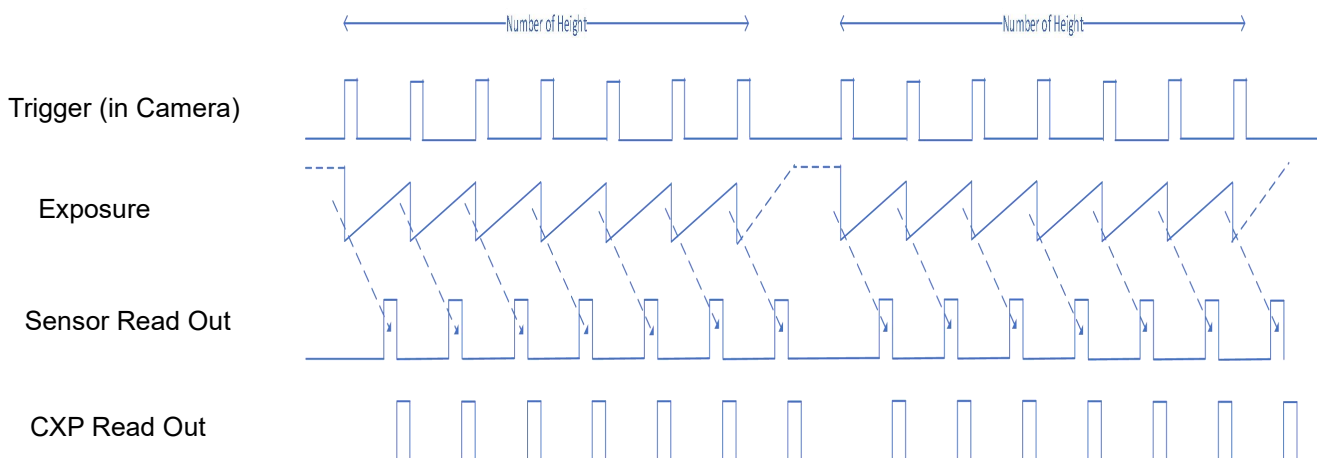
The line output by the next trigger input is the first line of the next frame.

If an Acquisition Stop command is issued during the end of a frame, the remaining lines are automatically output internally to complete the frame.



### 5.2.2 Continuous Mode (Trigger Mode=Off)

Multiple line outputs are combined and handled as a frame, just like an area sensor. This solves the problem of low transmission efficiency due to the overhead of the CXP protocol when operating with the above [5.1 Normal Mode](#).





## 6 Maximum Line Rate

The maximum value varies depending on the operation mode.  
The maximum line rate (kHz) is shown below.

Table 6.1

### Max. Line Scan Rate(kHz)

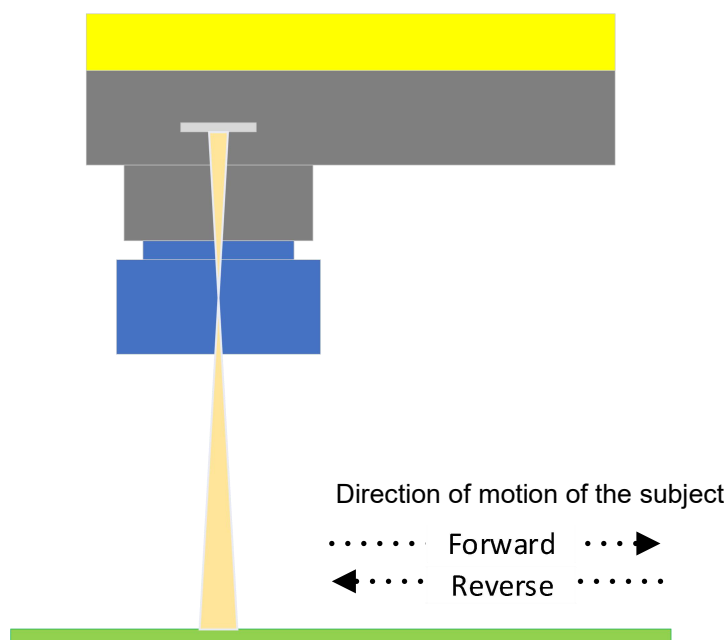
Link Configuration	Operation Mode	
	Normal Mode	Frame Mode
CXP-12X4	344.82	526.31
CXP-12X2	185.18	263.15
CXP-12X1	128.2	131.57
CXP-10X4	277.77	416.66
CXP-10X2	151.51	208.33
CXP-10X1	102.04	104.16
CXP-6X4	175.43	263.15
CXP-6X2	94.6	131.57
CXP-6X1	64.51	65.78
CXP-3X4	87.71	131.57
CXP-3X2	47.84	65.78
CXP-3X1	32.46	32.89

## 7 TDI(Time Delay Integration) 設定

### 7.1 TDI Stage Direction

Select the Pushing Scan Direction for TDI.

Node Name	Value
TDI Scan Stage Direction	Forward Reverse



### 7.2 TDI Stage Number

Specifies the number of TDI stage stages.

Node Name	Value	TDI 段数
TDI Stage Number A	s4	4
	s8	8
	s16	16
	s32	32
	s64	64
	s96	96
	s128	128
	s160	160
	s192	192
	s224	224
	s240	240
	s248	248
	s252	252
s256	256	

## 8 Camera Operation

### 8.1 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.

#### 8.1.1 Standard functions

GenICam command	Default
DeviceVendorName	BOPIXEL
DeviceModelName	BL-GM9K12X4
DeviceManufacturerInfo	www.BOPIXELjapan.com
DeviceVersion	-
DeviceSerialNumber	-
DeviceUserID	00000000
DeviceTemperature	-
SensorWidth	9072
SensorHeight	1
WidthMax	9072
HeightMax	9072
Width	9072
Height	1
ReverseX	False
PixelFormat	Mono8
TestPatternGeneratorSelector	FPGA
TestPattern	Off
AcquisitionFrameRate	1 / Exposure Time (KHz)
TriggerMode	Off
TriggerSource	Software
TriggerSoftware	-
TriggerDelay	0
ExposureMode	Off
ExposureTime	-
GainSelector	AnalogAll
Gain[AnalogAll]	0 (2 Times)
Gain[DigitalAll] (*1)	0
BlackLevelSelector	All
BlackLevel	10

GenICam command	Default
LUTSelector	Luminance
LUTEnable	False
LUTIndex	
LUTValue	
LineSelector	Line0
LineMode	Input
LineInverter	False
LineSource	UserOutput0
LineStatus	-
UseroutputSelector	UserOutput0
UserOutputValue	False
DeviceTapGeometry	Geometry_1X_1Y
PayLoadSize	9072
CxpLinkConfiguration (*3)	CXP6_X4
CxpLinkConfigurationPreferred	CXP6_X4
CxpLinkConfigurationStatus	-
TestMode	Off
TestErrorCountSelector	0
TestErrorCount	0
UserSetSelector	Default
UserSetLoad	-
UserSetSave	-
UserSetDefault	Default

(\*1) Gain[DigitalAll] :  $OutValue = InValue + (InValue - BlackLevel) * DigitalAllGain / 64$  (Set 0 for 0dBGain)

## Original functions of BOPIXEL

GenICam command	Description	Default
ImageSensorBitSize	Select the ADC bit size of the CMOS sensor.	CIS_10Bit
LineDebounceTime	Specifies the delay in microseconds (us) to apply after receiving IO[Line*] signal and before activating it.	1
ExecuteShadingCorrection	Execute shading correction automatically.	—
EnableShadingCorrection	When set to True, Activates shading correction.	Off
LoadShadingData	Load Saved Shading Data.	—
SaveShadingData	Save Present Shading Data.	—
DeviceSpecificSelect	Select Device-specific LUT.	
LUTSave	Save programable LUT.	
TDIStageDirection	Specifies TDI Scan Direction.	Forward
TDIStageNumerA	Specifies TDI Number of Stage.	s4

**9 Revision Information**

Rev	Date	Changes
0.1	2022/9/29	Released
0.2	2022/11/01	1.1 Electronic Specifications Add) Noise Level Change) Power Input
0.3	2022/11/24	1.1 Electronic Specifications Line Rate: Description in Normal Mode and Frame Mode. 5 Operation Mode Changed and added the description.

