

PH4KCXP Series Line Scan Camera User Manual

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Hefei I-TEK Optoelectronics Co., LTD.

<http://www.i-tek.cn/>



Revision History

Revision	Date	Description
0.1	2023/08/09	● Initial version
0.2	2024/06/07	● Add infrared and ultraviolet camera information



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1 Precautions

● General

- ① Do not drop, damage, disassemble the camera.
- ② Do not let children touch the camera without supervision.
- ③ Do not use the camera for other purposes than those specified herein.
- ④ If there is any problem with the camera, please contact us in time for technical support.

● Installation and Maintenance

- ① Do not install the camera in an environment with direct sunlight, high humidity or heavy dust.
- ② Keep the camera away from an environment with strong electromagnetic interference.
- ③ Keep the camera away from heat sources.
- ④ Be careful not to let the camera soak in liquid, such as water and drinks.
- ⑤ Clean dust on the surface of the camera as often as possible to avoid dust entering the camera, otherwise it may cause fault to the camera.
- ⑥ When cleaning camera dust, do not wash with water. Please use a soft object dipped in a small amount of 70% alcohol to wipe it off.

● Power Supply

- ① The recommended voltage is +12~24V ($\pm 10\%$), and the current must be 1.0A.
- ② Hefei I-TEK Optoelectronics Co., LTD. does not provide external power supply. Users need to connect power supply by themselves.

● Document

- ① Hefei I-TEK Optoelectronics Co., LTD. does not warrant that the document is the final version. The document may be updated after product upgrade. Please contact market@i-tek.cn for the latest version, which is provided for the authorized users.



2 Camera Models

● Camera Product Model

Abbreviation	Name	Description
Line Scan Camera:		
PA	Panther	Panther (Single line industrial line scan camera)
PL	Plasma	Plasma (Multi-line industrial line scan camera)
PH	Phoenix	Phoenix (TDI industrial line scan camera)
TPH	TEC-Phoenix	TEC-Phoenix (TEC-TDI industrial line scan camera)
PN	Pneuma	Pneuma (Basic industrial line scan camera)
PR	Prometheus	Prometheus (High resolution industrial line scan camera)
PU	PupMaya	PupMaya (High width industrial line scan camera)
PT	Ptepare	Ptepare (Special custom industrial line scan camera)
PM	Prism	Prism line scan camera
Area Scan Camera:		
TM	Taurus-Prism	Prism area scan camera
HS	Hercules	Hercules (CCD industrial area scan camera)
TS	Taurus	Taurus (CMOS industrial area scan camera)
THS	TEC-Hercules	TEC-Hercules (CCD TEC industrial area scan camera)
TTS	TEC-Taurus	TEC-Taurus (CMOS industrial area scan camera)
XS	XStream	XStream (Super high speed camera)

● Interface Specification

Abbreviation	Interface Type
GV	GigE Vision
CL	Camera Link
CXP/CXP10/CXP12	CoaXPress
U30	USB3.0
XGV	10 GigE Vision
PCIe	PCI-Express
SFP	Small Form Pluggable

● Color Form

Abbreviation	Image Mode
M	Monochrome
C	Color
F	Full Color
T	Monochrome TDI (Time Delay Integration)
X	Time Division Camera
U	UV (Ultraviolet)
N	NIR (Near Infrared)



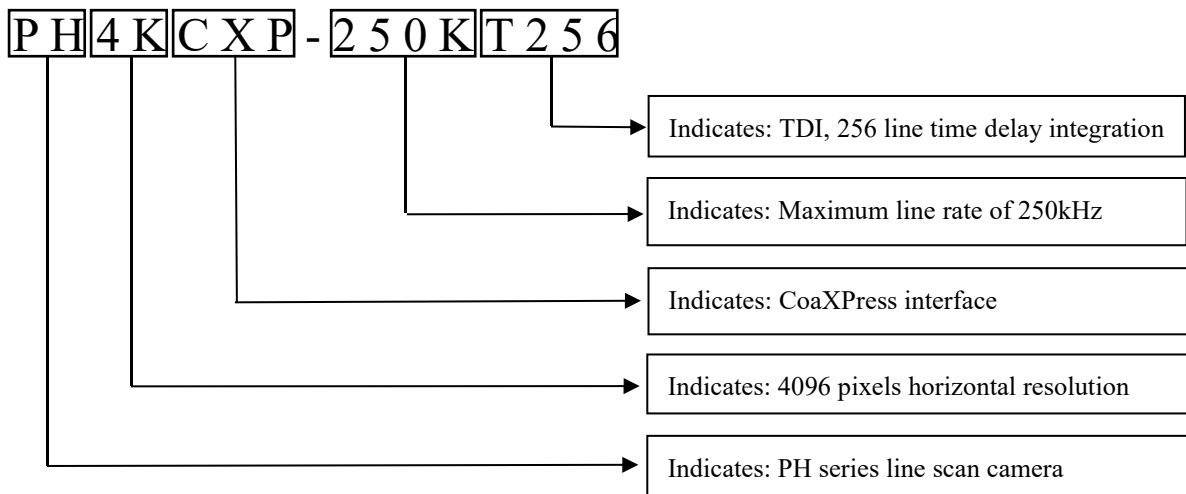
S	SWIR (Short Wave Infrared)
W	MWIR (Middle Wave Infrared)
L	LWIR (Long Wave Infrared)

- **Line Rate or Frame Rate**

Camera Type	Description
Line Scan Camera	Maximum line rate, e.g. 30kHz
Area Scan Camera	Maximum frame rate, e.g. 4000fps

e.g.

Indicates: 4K 256-line monochrome TDI line scan camera



3 Product Appearance



Fig. 1 Product Appearance

Note:

- ① The front and the side of camera provide threaded holes for mounting camera.
- ② Please refer to “Mechanical Dimensions and Interfaces” below for detailed camera dimensions.



4 Product Specifications

PH4KCXP series camera is designed for high-speed line scan applications in the field of industrial automation inspection, and is independently developed and produced by Hefei I-TEK Optoelectronics Co., LTD. Camera integrates internationally leading high-speed line scan image sensors, a large-scale on-site programmable logic gate array parallel processor, and outputs data to the outside through the CoaXPress interface. It also has the characteristics of high speed, high sensitivity, and low noise.

4.1 Main Features

- Backshot CCD Sensor
- Line Resolution 4096 Pixels
- Maximum Line Rate 250kHz
- High Sensitivity and Low Noise
- Minimum Exposure Time: 4us; Exposure Time Step: 0.01us
- Data Format: 8/10/12bit
- Binning
- Analog Gain / Digital Gain / Offset Control
- User-configurable Scanning Direction
- Trigger Rescale
- Area Mode
- LUT
- Flat Field Correction
- Real-time Temperature Monitor

4.2 Camera Specifications

Table 1 PH4KCXP Series Product Specifications

Model	PH4KCXP-250KT256	PH4KCXP-250KN256	PH4KCXP-250KU256
Product Description	4K 256-line monochrome TDI line scan camera	4K 256-line infrared TDI line scan camera	4K 256-line ultraviolet TDI line scan camera
Resolution	4096 x 256		
Pixel Size	5um x 5um		
Sensor Type	Backshot CCD		
Image Type	Monochrome		
Sensor Size	20.48mm		
Dynamic Range	≥ 62.3dB	≥54.2dB	≥63.5dB
SNR	42.7dB	42.6dB	43.4dB
Lens Mount	M42		
Max Line Rate	250kHz@8bit, 237kHz@10bit, 198kHz@12bit		
Analog Gain	X1/X2/X4/X8		
Digital Gain	0.004~7.998		

Digital Offset	-4095~4095
Trigger Mode	Free-Run, External Trigger
External Trigger	External IO / CXP
Exposure Control	Timed; Line Rate Control
Exposure Time	4us ~ 1s (step: 0.01us)
Data Format	8/10/12bit
Operation Temperature	0~55°C
Data Interface	CoaXPress
Data Rate	1216MB/s
Power Supply	DC 12~24V ($\pm 10\%$) 1.0A
Power Consumption	6.0W
Mechanical	60mm x 60mm x 39mm

Note: This table is for 1.10-3.7 version of PH4KCXP series camera specifications, which may vary slightly from version to version.

4.3 Camera Structure

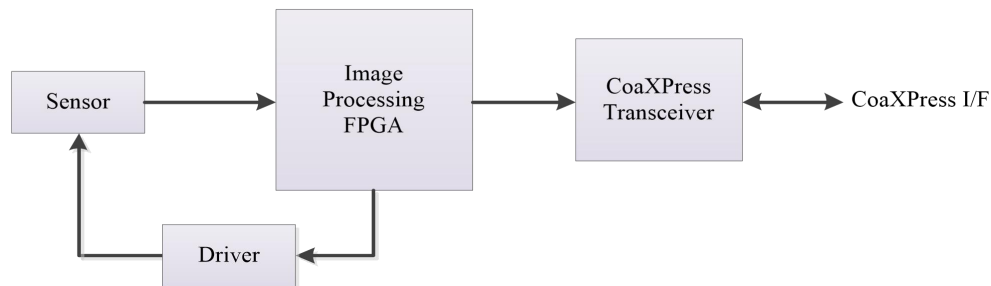


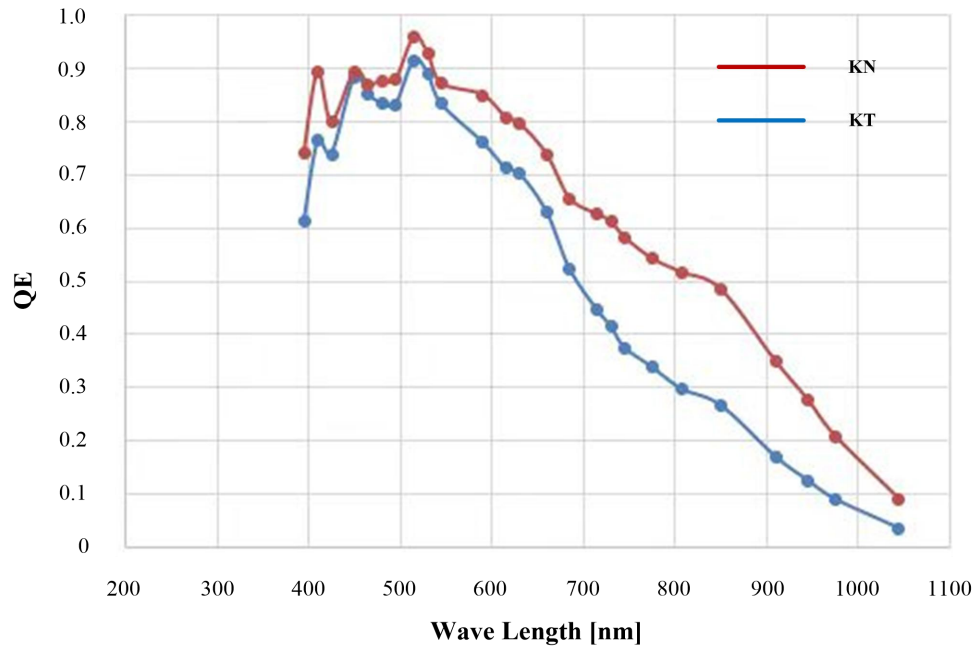
Fig. 2 Internal Implementation Structure of Camera

PH4KCXP series cameras are designed based on high-speed line scanning image sensors. The pixel array is uniformly sampled and maintained by a backshot control system, converted from analog front-end to digital signal, processed by FPGA algorithms, and transmitted to the PC acquisition card through the CoaXPress interface.

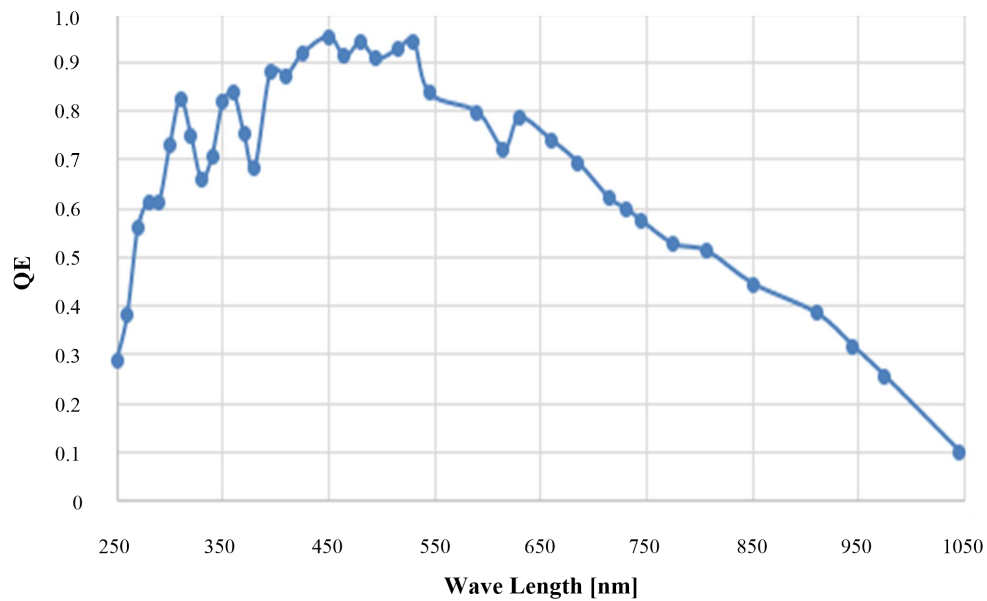
PH4KCXP series cameras can accept external signal triggered acquisition, sourced from 4-pin interface signals or CXP signals from the CoaXPress interface.

4.4 Spectral Response

The spectral response of PH4KCXP series camera is shown in figure below.



(a) PH4KCXP-250KT256/250KN256



(b) PH4KCXP-250KU256

Fig. 3 Spectral Response of Camera

4.5 Environmental Requirements

- (1) Operating temperature: 0°C~55°C, humidity: 10% ~ 80%; Storage temperature: -20°C~75°C.
- (2) The sensor in the camera has dust proof sealing setting, which can effectively prevent dust from entering sensor surface. If lens cap is open, dust may enter. Therefore, tighten the lens cap when the camera is not in use.

4.6 RoHS Certification

All camera components (including electronic components, PCB, and shell) are RoHS compliant.

5 Mechanical Dimensions and Interfaces

5.1 Mechanical Dimensions

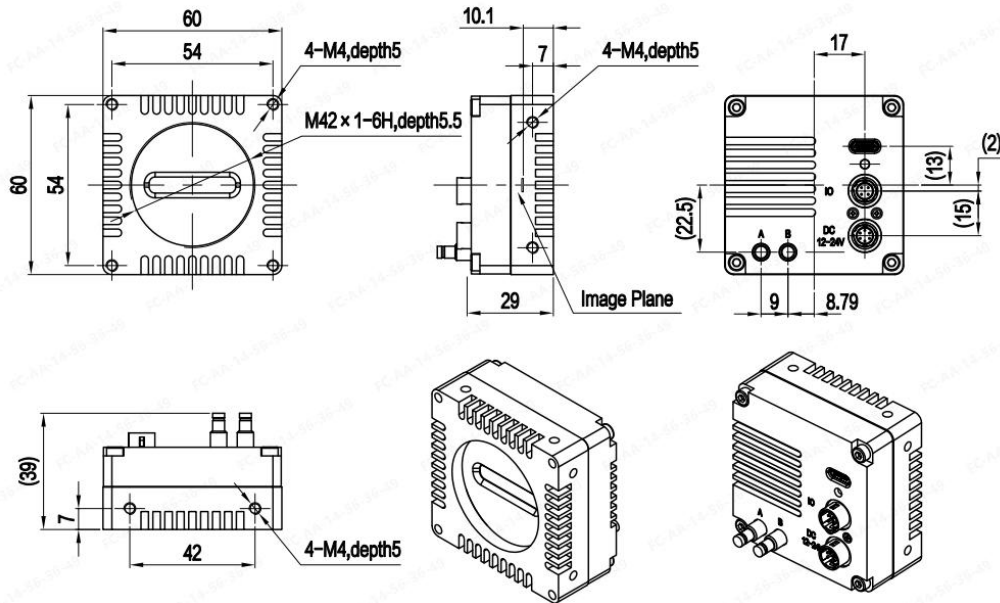


Fig. 4 Camera Mechanical Dimensions

5.2 Camera Interface

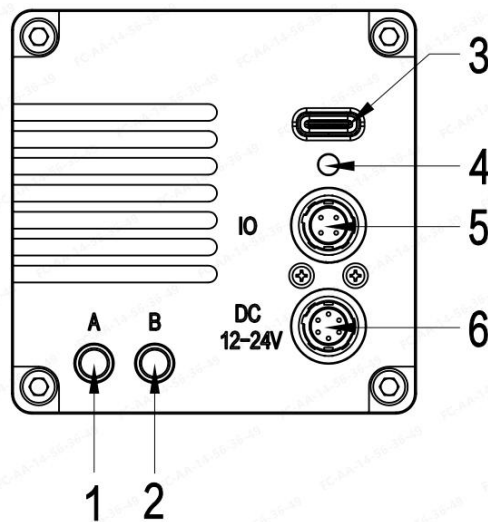


Fig. 5 Interfaces of Camera

- ① CoaXPress Connection A (**Master**)
- ② CoaXPress Connection B
- ③ Type-C Interface
- ④ Camera Status Indicator
- ⑤ 4-pin Control Interface
- ⑥ 6-pin Power Input



5.2.1 Camera Status Indicator

The camera status indicator is used to indicate real-time status of camera, as shown in the table below:

Table 2 Camera Status Indicators

LED Status Indicators	Camera Status
Solid Green	Normal
Blinking Green	No trigger input within three seconds in external trigger mode
Solid Red	Processor is starting or in error
Blinking Red	Camera fatal error (need contact technical support)
Solid Yellow	Camera is initializing or executing command

5.2.2 Power Interface

The power input interface adopts a 6-pin connector with the model:
Hirose HR10A-7R-6PB(Male).

Corresponding connector on the cable model:
Hirose HR10A-7P-6S(Female).

The power interface on the back of the camera is shown as follows:

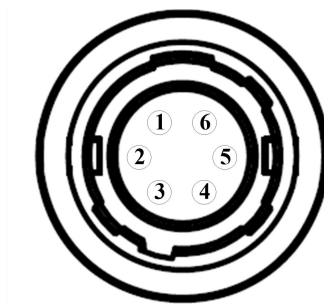


Fig. 6 Pin Assignments for Interface

Table 3 Interface Pin Definition

Signal	Pin	Signal	Pin
VCC	1	GND	4
VCC	2	GND	5
VCC	3	GND	6

5.2.3 Control Interface

The control interface adopts a 4-pin connector with the model:
Hirose HR10A-7R-4PB(Male).

Corresponding connector on the cable model:

Hirose HR10A-7P-4S(Female).

The control interface on the back of the camera is shown as follows:

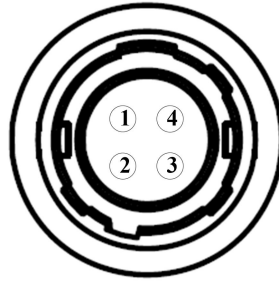


Fig. 7 Control Interface Plugin

Table 4 Control Interface Plugin Pin Definition

Signal	Pin	Signal	Pin
Line1+	1	Line2_GND	3
Line1 -	2	Line2_IN	4

The external trigger circuit is shown as follows:

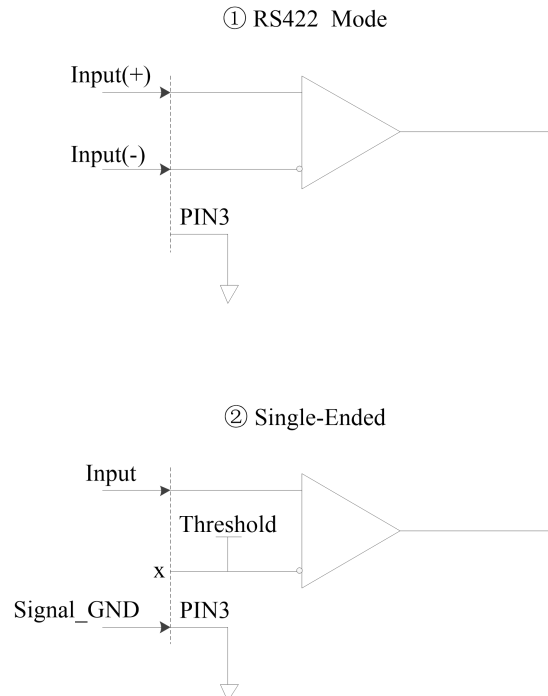


Fig. 8 Diagram of Trig Input Circuit

- Input voltage range: 3.3~24V

5.2.4 Data Interface

PH4KCXP series camera implements standard Quad CoaXPress protocol, and data interface is two DIN 1.0/2.3 sockets on the back of camera. The data interface on the back of camera is shown in the red box below:

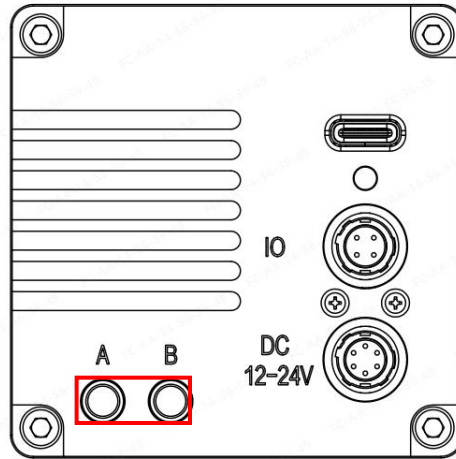


Fig. 9 Data Interface

The mechanical drawing of DIN 1.0/2.3 socket is as follows:

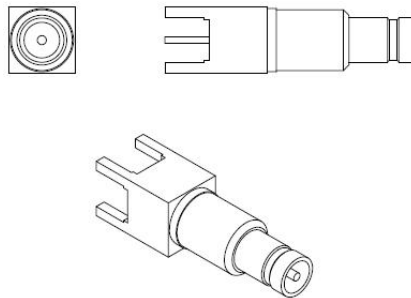


Fig. 10 DIN 1.0/2.3 Socket

6 Camera Features

This chapter introduces the main features of PH4KCXP series camera.

6.1 Trigger Mode

PH4KCXP series camera supports two trigger modes: Free-Run mode, External Pulse mode.

6.1.1 Free-Run Mode

In Free-Run mode, camera's internal logic automatically generates camera control timing, so that it can produce normal image output without external trigger signal.

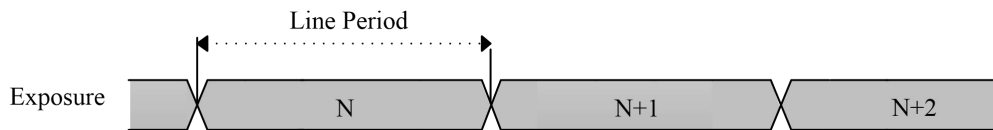


Fig. 11 Free-Run Mode

In Free-Run mode, exposure time can be controlled by line rate (reciprocal of line period). The internal running sequence of camera is shown in the figure above.

6.1.2 External Pulse Mode

In External Pulse mode, camera starts exposure at the rising edge of the external trigger signal, and the line period at this time is determined by the interval between the rising edges of the external trigger pulse.

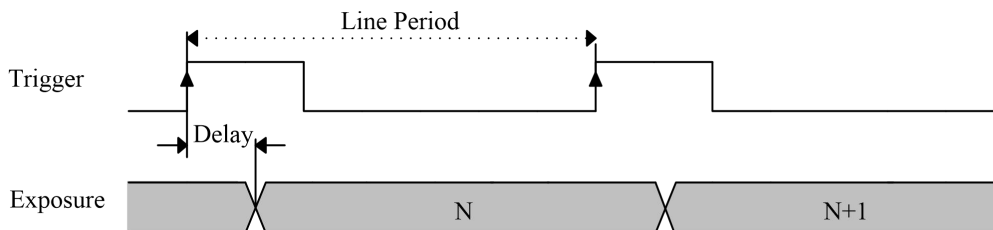


Fig. 12 External Pulse Mode

6.2 Trigger Rescale

In an ideal situation, when camera images objects in uniform motion, the image quality obtained can meet the user's needs. In fact, due to the non-uniform motion of objects and the imprecise matching of motion speed and image taking speed, users need to adjust the trigger rate to achieve ideal shooting conditions.

PH4KCXP series camera can select a specified number of trigger signals through a smooth window for rate averaging processing to obtain rate stable trigger signals. At the same time, the trigger signal rate can be precisely adjusted through functions such as rate division, doubling, and smoothing coefficient, so that the object's motion speed matches the camera's image acquisition speed perfectly, thus meeting the user's demand for high-quality acquisition.

6.3 Area Mode

PH4KCXP series camera has a resolution of 4096 x 256, which can be used as both a TDI line scan camera and an area scan camera. When used as area scan camera, image height is fixed at 256. In area mode, the exposure time and frame period can be independently set.

6.4 Camera Scanning Direction

The scanning direction of PH4KCXP series camera is divided into horizontal scanning direction and vertical scanning direction, as shown in the following figure.

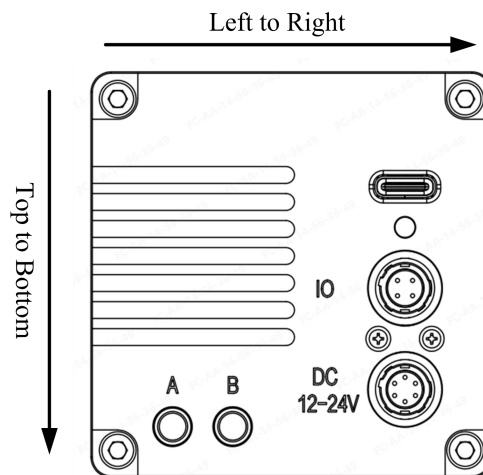
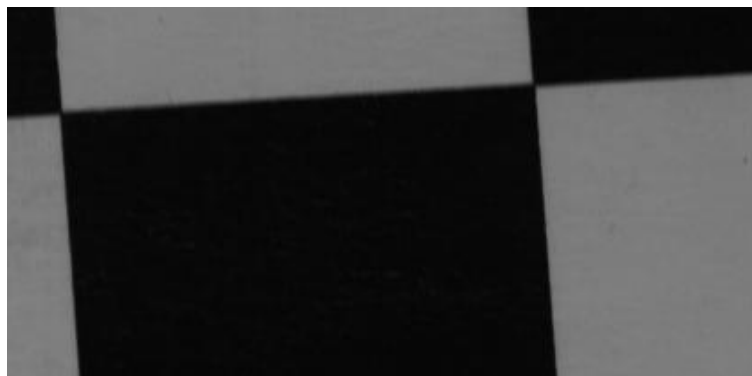


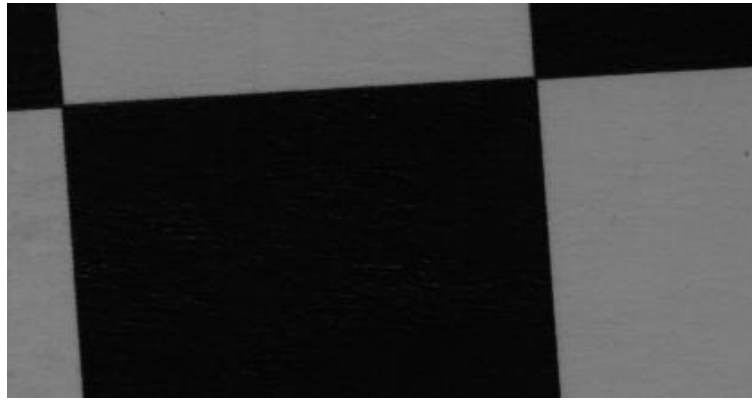
Fig.13 Camera Scanning Direction

Horizontal scanning direction supports two scanning directions: left to right and right to left.

Vertical scanning direction supports two scanning directions: bottom to top and top to bottom. Note that when the vertical scanning direction does not match the direction of object movement, it can cause image edges to blur.



(a) Opposite to the Direction of Object Movement



(b) Same as the Direction of Object Movement

Fig.14 Vertical Scanning Direction

6.5 LUT

The LUT uses a 12bit input and 12bit output LUT to map and convert the values of the original image. Users can use this function to implement gamma correction.

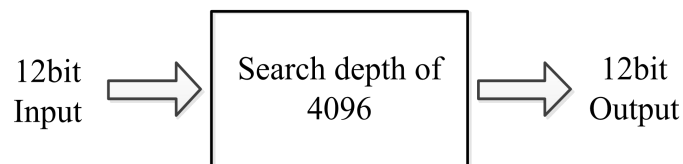


Fig. 15 LUT Structure

The following figure is the LUT mapping curve with Gamma = 0.5:

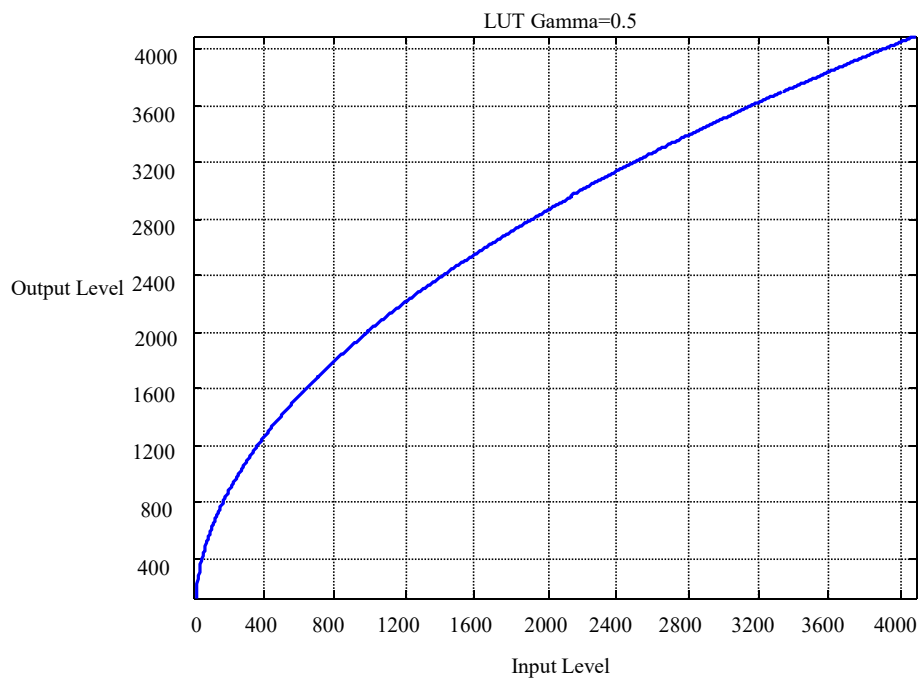


Fig. 16 LUT: Gamma=0.5

6.6 Binning

PH4KCXP series camera performs a sum operation on the values of adjacent two, four, or eight pixels after normal exposure acquisition, and then outputs them as a separate pixel value. Note that in area mode, modifying vertical Binning has no effect.

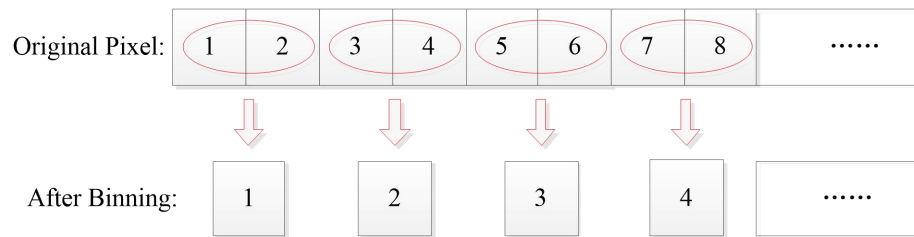


Fig. 17 Horizontal Binningx2

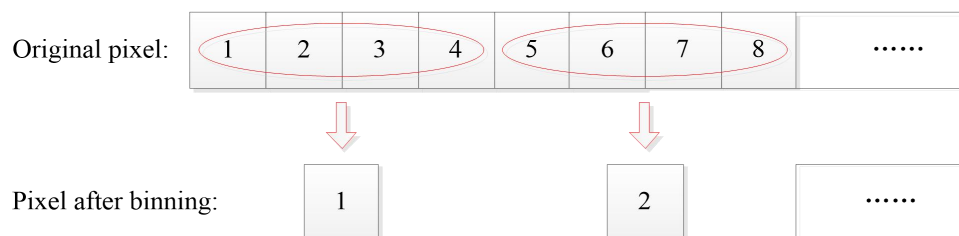


Fig. 18 Horizontal Binningx4

Original Pixel: After Binning:

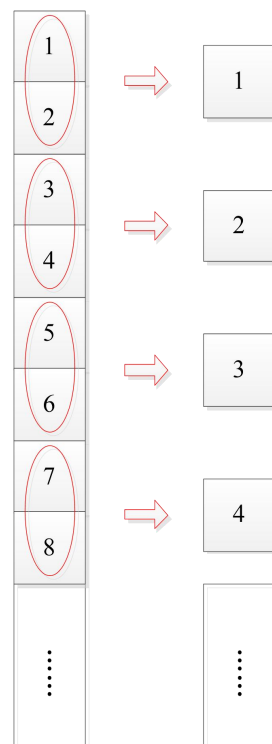


Fig. 19 Vertical Binningx2

Original Pixel: After Binning

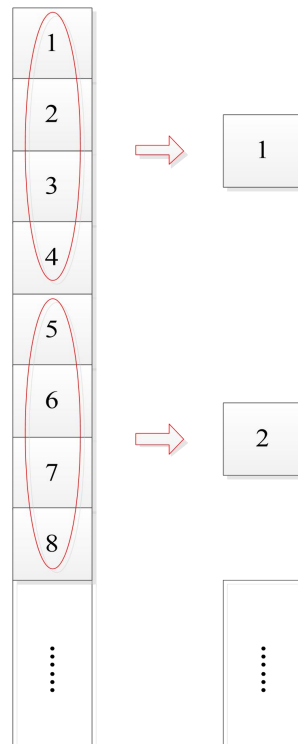


Fig. 20 Vertical Binningx4

Original Pixel: After Binning:

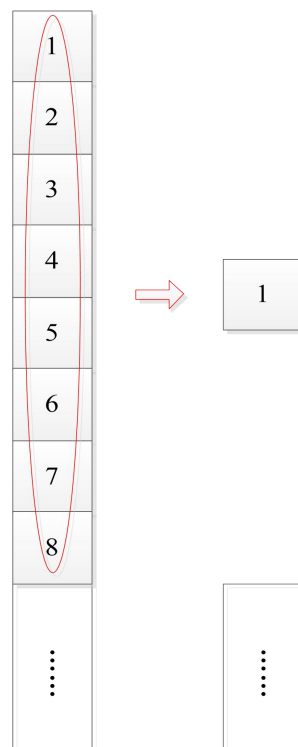
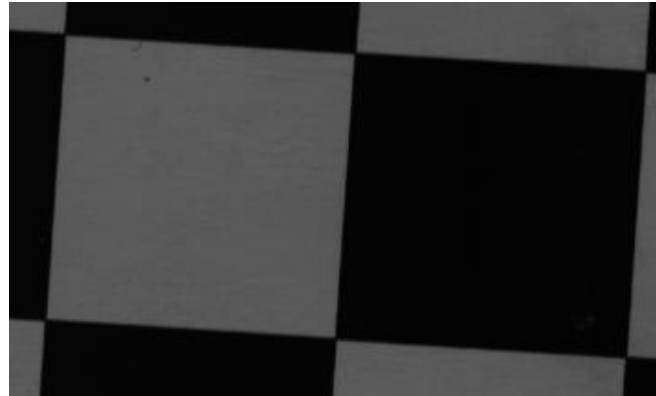


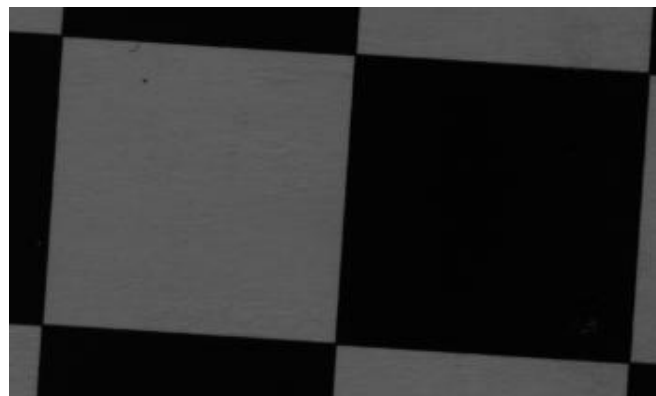
Fig. 21 Vertical Binningx8

6.7 Time Delay Integration

For camera adopts multi line sensor, two adjacent exposures can make multi lines of pixels in the same position, and the response of pixels can be increased by adding their values, while SNR of images can be improved. In order to make two adjacent lines of pixels in the same position, the image length to width ratio should be 1:1, and the vertical scanning direction should be set correctly, otherwise the image edge will be blurred.



(a) Edge Blur



(b) Edge Clear

Fig.22 Time Delay Integration Effect

6.8 Flat Field Correction

Ideally, when camera imitates a uniform target, gray value of all pixels in resulting image should theoretically be the same. However, values of each pixel in image often vary considerably. These differences may result from uneven illumination, inconsistent light transmittance between lens center and lens edge, and inconsistent response of camera sensor pixels. The difference of sensor pixel response has been corrected before delivery. In general, it is mainly to correct dark brightness between two sides of image caused by lens. The camera calculates correction parameters of each pixel and stores them in camera for image correction. In some cases, lens and lighting conditions are better and better images can be obtained without flat field correction.

Flat field correction effect is shown in the figure below:

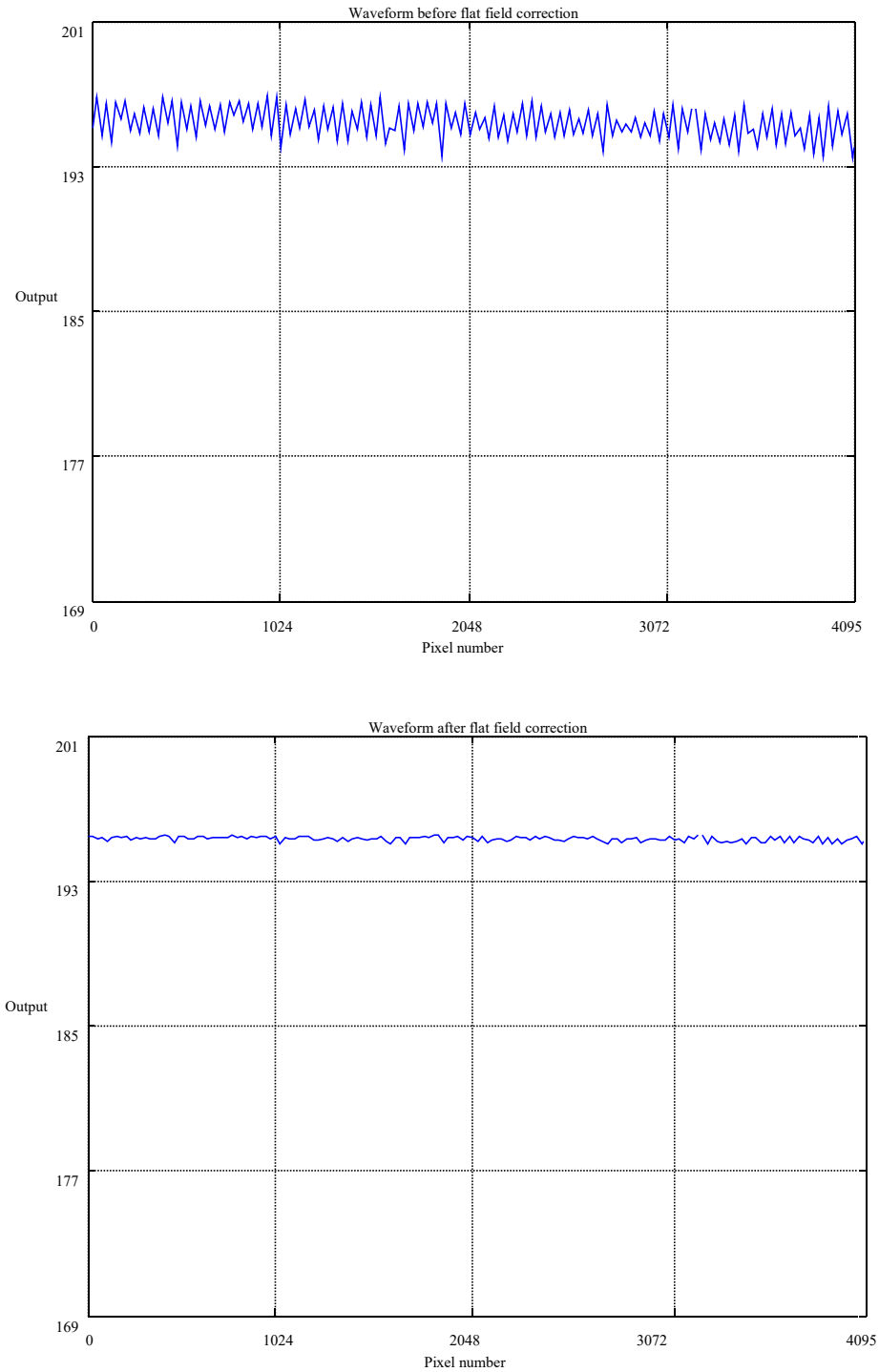


Fig. 23 Flat Field Correction Schematic

6.9 Test Image

Unlike images obtained from sensors, test images are fixed style images pre-edited and stored inside the camera. Test images can be used to test whether the data link is unobstructed.

The following figure shows the scrolling diagonal stripe mode, where the horizontal data of the output image continuously increases and starts counting again from 0 after reaching the maximum value,

repeating the cycle.

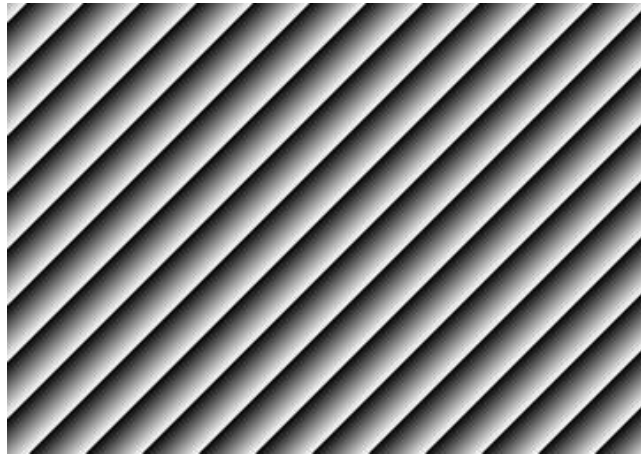


Fig. 24 Test Image

6.10 Data Format

PH4KCXP series camera processes data in 12bit data format, but provides 8bit, 10bit and 12bit output. When camera outputs 8bit data, the lowest 4bit data will be deleted. When the camera outputs 10bit of data, the lowest 2bit will be deleted.



Fig. 25 Data Format

6.11 Gain and Offset

Camera gain is divided into the analog gain and digital gain.

Analog gain acts on the analog signal. By increasing analog gain, a stronger response can be generally obtained under weak illumination, thus realizing a higher SNR. Users can configure camera's analog gain.

Digital gain amplifies or reduces the data of the photoelectric conversion signal after AD, which is usually used to increase the dynamic range of the output image. Digital gain can also be used to adjust the brightness of the image. Digital bias is commonly used to adjust the overall background brightness of an image.

The effect of digital gain can be summarized by the following equation:

$$\text{Data value (Output)} = \text{Data value (digital gain=1 \& digital offset=0)} \times \text{Digital gain value}$$



The effect of digital gain can be summarized by the following equation (Data values less than 0 will be output as 0) :

$$\text{Data value (Output)} = \text{Data value (digital offset=0)} + \text{Digital offset value}$$

Digital offset is set for 12bit data. If the image data is 8bit or 10bit, the actual digital offset will be divided by 16 or 4.

6.12 Camera Temperature

PH4KCXP series camera supports real-time acquisition of camera temperature. Users can read camera temperature value to monitor the current temperature value of sensor or make some responses according to temperature value.

The recommended operating environment temperature of the camera is 0~55°C. If users detect an abnormal internal temperature (such as over 65°C), it is recommended to stop the camera immediately to avoid component damage. Power off and contact our technical support in time.

6.13 Load/Save Configuration

PH4KCXP series camera supports multiple sets of working parameter sets, including one set of factory default parameter sets and multiple sets of user parameter sets. Factory default parameter set can be used in most occasions. Users can also configure parameters based on actual requirements and save in user parameter set for self-loading after power on. The camera will automatically load the last saved parameter set each time.

Due to the correlation between parameters of camera, if camera does not work properly after modifying parameters, users can restore the factory default parameter set, and then reset parameters and save settings.

7 Camera Control

7.1 GenICam Standard

GenICam standard, promulgated by European Machine Vision Association (EMVA), provides a unified programming interface for all types of industrial cameras. The programming interface (API) is the same regardless of which transmission protocol the camera uses or which functions it implements. It mainly contains the following three modules:

- GenAPI: Responsible for parsing XML files and solving problem of how to configure camera
- GenTL: Transport layer, for device enumeration, attribute control, and image acquisition
- SFNC: Standard for naming camera features

Camera XML description file is stored locally on the PC, and collection software will select the most appropriate XML file according to camera model. Application and camera communicate with each other through SFNC, GenAPI, and GigEVision, as shown in the figure.

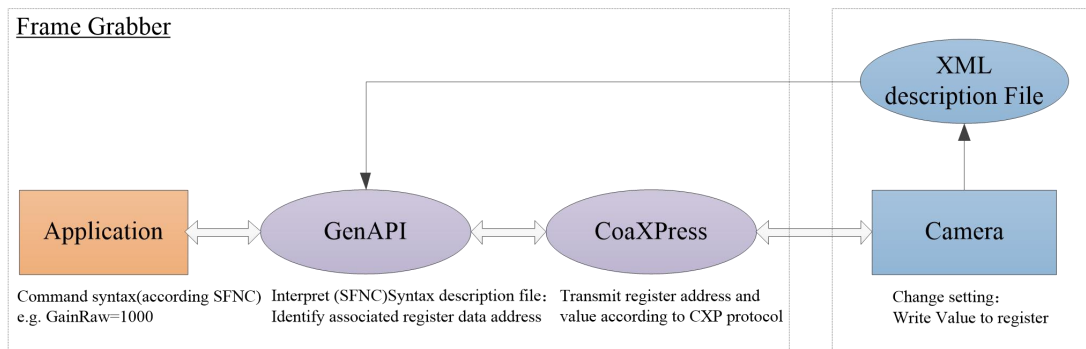


Fig. 21 Communication Principle Diagram Between Application and Camera

In fact, if users want to change camera settings, such as gain, GenICam (SFNC) specifies a standardized syntax:

```

if( IsAvailable(Camera.GainRaw) )
    Camera.GainRaw = 1000;
  
```

GenAPI can parse these commands through the description file. For example, to set the gain to 1000, the value of 0x3E8 (HEX) must be written to the register at address 0x0815 (HEX). Other tasks involved may be to check whether the camera has gain characteristics in advance and check whether the new value are consistent with the allowable gain range. This register message is transmitted and parsed by protocol and applied to camera.

7.2 GenAPI Parameter Attributes

The actual method of controlling camera is related to software implementation of frame grabber and SDK. Most frame grabber software provides a graphical user interface (GUI) that is automatically generated from XML files. This manual focuses on functions of camera, detailing the specific commands and their impact on operation of camera, listing the name, interface, access, description, range and default value of each GenAPI parameter.



(1) Register name

Each parameter is identified by a unique name. Most names are part of SFNC, and use camera custom names for non-standard parameters.

(2) Register address

This parameter represents the address value of the register (hexadecimal format).

(3) Register size

This parameter represents the size of the register value (in byte).

(4) Register interface

The parameter interface represents the type of parameter, which is mainly used for GUI of frame grabber to assign a display type to parameter.

Table 5 Overview of Parameter Interface

Interface	Interface Name	Description
Integer	I	Integer with value, minimum, maximum, and increment
Float	F	Float with value, minimum, maximum, and physical unit
String	S	String
Enumeration	E	Enumerate type
Command	C	Command type
Boolean	B	Boolean type

(5) Parameter access

This parameter represents whether users can read (RO), write (WO) or read/write (RW) parameters.

(6) Default parameter value and range

When setting the parameter, it will check whether the input value is within the valid range of parameter.

7.3 Register Classification

7.3.1 Bootstrap CoaXPress Registers

Table 6 Bootstrap CoaXPress Registers

Name	Address	Size	Interface	Access	Visibility
Standard	0x0	4	I	RO	Beginner
Revision	0x4	4	I	RO	Beginner
XmlManifestSize	0x8	4	I	RO	Guru
XmlManifestSelector	0xc	4	I	RW	Guru
XmlVersion	0x10	4	I	RO	Guru
XmlSchemeVersion	0x14	4	I	RO	Guru



XmlUrlAddress	0x18	4	I	RO	Guru
Idc2Address	0x1c	4	I	RO	Guru
ConnectionReset	0x4000	4	I	RW	Guru
DeviceConnectionID	0x4004	4	I	RO	Guru
MasterHostConnectionID	0x4008	4	I	RW	Guru
ControlPacketSizeMax	0x400c	4	I	RO	Guru
StreamPacketSizeMax	0x4010	4	I	RW	Guru
ConnectionConfig	0x4014	4	E	RW	Beginner
ConnectionConfigDefault	0x4018	4	E	RO	Beginner
TestMode	0x401c	4	E	RW	Guru
TestErrorCountSelector	0x4020	4	I	RW	Guru
TestErrorCount	0x4024	4	I	RW	Guru
TestPacketCountTx	0x4028	8	I	RW	Guru
TestPacketCountRx	0x4030	8	I	RW	Guru
ElectricalComplianceTest	0x4038	4	E	RW	Guru
WidthAddress	0x3000	4	I	RO	Guru
HeightAddress	0x3004	4	I	RO	Guru
AcquisitionModeAddress	0x3008	4	I	RO	Guru
AcquisitionStartAddress	0x300c	4	I	RO	Guru
AcquisitionStopAddress	0x3010	4	I	RO	Guru
PixelFormatAddress	0x3014	4	I	RO	Guru
DeviceTapGeometryAddress	0x3018	4	I	RO	Guru
Image1StreamIDAddress	0x301c	4	I	RO	Guru
HsUpconnection	0x403c	4	I	RO	Guru

- **Standard**
Unique identification of CoaXPress standard.
- **Revision**
CoaXPress protocol version number.
- **XmlManifestSize**
The number of XML files available.
- **XmlManifestSelector**
Select XML manifest entry.
- **XmlVersion**
The version of XML file referenced by XmlManifestSelector.
- **XmlSchemeVersion**
The version of XML file format scheme referenced by XmlManifestSelector.



- **XmlUrlAddress**
The URL address of XML file referenced by XmlManifestSelector.
- **Iidc2Address**
If device supports IIDC 2 protocol, this register should provide start address of IIDC 2 register space.
- **ConnectionReset**
Reset all connections to device.
- **DeviceConnectionID**
Provide ID of device connection from which this register is read.
- **MasterHostConnectionID**
ID of host device.
- **ControlPacketSizeMax**
Provide maximum control packet data size, which is defined in bytes and should be multiples of 4 bytes.
- **StreamPacketSizeMax**
Provide maximum flow packet data size that host can accept. The size is defined in bytes and should be a multiple of 4 bytes.
- **ConnectionConfig**
Current device link speed and number of link channels. The enumeration names and values are as follows:
 - CXP3_X2 (0x00020038)
 - CXP6_X2 (0x00020048)
- **ConnectionConfigDefault**
Default link speed and number of link channels. The enumeration names and values are as follows:
 - CXP3_X1 (65592)
 - CXP5_X1 (65600)
 - CXP6_X1 (65608)
 - CXP3_X2 (131128)
 - CXP5_X2 (131136)
 - CXP6_X2 (131144)
 - CXP3_X4 (262200)
 - CXP5_X4 (262208)
 - CXP6_X4 (262216)
 - CXP10_X4 (0x00040050)
 - CXP12_X4 (0x00040058)



- **TestMode**

Enable test packet transmission from device to host. The enumeration names and values are as follows:

- Off (0)
- Model (1)

- **TestErrorCountSelector**

Test mode selection. The parameter range is as follows:

- Maximum: 3
- Minimum: 0
- Increment: 1

- **TestErrorCount**

Number of test errors.

- **TestPacketCountTx**

Number of test error frames.

- **TestPacketCountRx**

Test the number of data frames read.

- **ElectricalComplianceTest**

Electrical compatibility testing. The enumeration names and values are as follows:

- NormalOperatingMode (0)
- CXP3_X1 (65592)
- CXP5_X1 (6560)
- CXP6_X1 (65608)
- CXP3_X2 (131128)
- CXP5_X2 (131136)
- CXP6_X2 (131144)
- CXP3_X4 (262200)
- CXP5_X4 (262208)
- CXP6_X4 (262216)

- **WidthAddress**

Address of camera width register.

- **HeightAddress**

Address of camera height register.

- **AcquisitionModeAddress**

The address of camera acquisition mode register.



- **AcquisitionStartAddress**
The camera start grabbing address of register.
- **AcquisitionStopAddress**
The camera stops grabbing address of register.
- **PixelFormatAddress**
The address of camera pixel format register.
- **DeviceTapGeometryAddress**
The address of camera Tap arrangement register.
- **Image1StreamIDAddress**
Address of data stream register.
- **HsUpconnection**
Whether camera supports address of uplink channel register.

7.3.2 Device Control Registers

Table 7 Device Control Registers

Name	Address	Size	Interface	Access	Visibility
DeviceVendorName	0x2000	32	S	RO	Beginner
DeviceModelName	0x2020	32	S	RO	Beginner
DeviceManufacturerInfo	0x2040	48	S	RO	Beginner
DeviceVersion	0x2070	32	S	RO	Beginner
DeviceSerialNumber	0x20b0	16	S	RO	Expert
DeviceUserId	0x20c0	16	S	RW	Beginner
DeviceTemperature	0xa004	4	F	RO	Beginner
DeviceHumidity	0xa014	4	F	RO	Beginner
DeviceTapGeometry	0xa008	4	E	RO	Beginner
CoolingTargetTemperature	0xa00c	4	I	RW	Beginner
CoolingEnable	0xa010	4	B	RW	Beginner

- **DeviceVendorName**
Device vendor name.
- **DeviceModelName**
Device model name.
- **DeviceManufacturerInfo**
Device manufacturer information.



- **DeviceVersion**
Device version.
- **DeviceSerialNumber**
Device serial number.
- **DeviceUserId**
User-defined ID.
- **DeviceTemperature**
Device temperature.
- **DeviceHumidity**
Device humidity.
- **DeviceTapGeometry**
Tap arrangement. The enumeration names and values are as follows:
 - Geometry_1X_1Y (0)
- **CoolingTargetTemperature**
Device target temperature. PH4KCXP series camera has not yet achieved cooling function. The parameter range is as follows:
 - Maximum: 50
 - Minimum: -30
 - Increment: 1
- **CoolingEnable**
Enable cooling function. PH4KCXP series camera has not yet achieved cooling function.

7.3.3 Image Format Control Registers

Table 8 Image Format Control Registers

Name	Address	Size	Interface	Access	Visibility
Width	0xa800	4	I	RW	Beginner
Height	0xa804	4	I	RW	Beginner
SensorWidth	0xa808	4	I	RO	Expert
BinningHorizontal	0xa810	4	E	RW	Beginner
BinningVertical	0xa828	4	E	RW	Beginner
BinningAverage	0xa860	4	B	RW	Beginner
PixelFormat	0xa830	4	E	RW	Beginner
VideoMode	0xa834	4	E	RW	Beginner
HorizontalScanDirection	0xa838	4	E	RW	Beginner
OffsetX	0xa80c	4	I	RW	Beginner



TDIStage	0xa850	4	I	RW	Beginner
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- **Width**

Actual camera output width. The parameter range is as follows:

- Minimum: 256
- Increment: 16

- **Height**

Actual camera output height. The parameter range is as follows:

- Maximum: 65535
- Minimum: 1
- Increment: 1

- **SensorWidth**

Sensor width.

- **BinningHorizontal**

Horizontal binning. The enumeration names and values are as follows:

- Binning_X1 (1)
- Binning_X2 (2)
- Binning_X4 (4)
- Binning_X8 (8)

- **BinningVertical**

Vertical binning. The enumeration names and values are as follows:

- Binning_X1 (1)
- Binning_X2 (2)
- Binning_X4 (4)
- Binning_X8 (8)

- **BinningAverage**

Binning average, check this option to keep width and height of the image changing with binning, while keeping the grayscale value unchanged.

- **PixelFormat**

Pixel format. The enumeration names and values are as follows:

- Mono8 (17301505): Monochrome 8bit
- Mono10 (17825795): Monochrome 10bit
- Mono12 (0x1100005): Monochrome 12bit

- **VideoMode**

Output image format. The enumeration names and values are as follows:

- Original (0): Original image
- Corrected (1): Corrected image



- MonochromePattern (2): Monochrome test image
- **HorizontalScanDirection**
Horizontal scan direction. The enumeration names and values are as follows:
 - LeftToRight (0): Left to right
 - RightToLeft (1): Right to left
- **OffsetX**
Horizontal offset position. The parameter range is as follows:
 - Minimum: 0
 - Increment: 16
- **TDIStage**
Time delay integration stage, used to set image brightness in line mode. The parameter range is as follows:
 - Maximum: 256
 - Minimum: 1
 - Increment: 1

7.3.4 Acquisition Control Registers

Table 9 Acquisition Control Registers

Name	Address	Size	Interface	Access	Visibility
AcquisitionMode	0xb050	4	E	RO	Beginner
AcquisitionStart	0xb054	4	C	RW	Beginner
AcquisitionStop	0xb058	4	C	RW	Beginner
AcquisitionLineRate	/	/	F	/	Beginner
AcquisitionLinePeriod	0xb028	4	F	RW	Beginner
AcquisitionMaxLineRate	0xb02c	4	C	WO	Beginner
AreaMode	0xa854	4	B	RW	Beginner
AreaExposureTime	0xb05c	4	I	RW	Beginner
AreaFramePeriod	0xb060	4	I	RW	Beginner
AreaShadowCorrection	0xa858	4	B	RW	Beginner

- **AcquisitionMode**
Acquisition mode, usually default to continuous acquisition. The enumeration names and values are as follows:
 - Continuous (0): Continuous acquisition
- **AcquisitionStart**
Start acquisition.
- **AcquisitionStop**



Stop acquisition.

- **AcquisitionLineRate**

Acquisition line rate.

- Minimum: 1

- **AcquisitionLinePeriod**

Acquisition line period, unit is us. The parameter range is as follows:

- Maximum: 1000000

- Increment: 0.01

- **AcquisitionMaxLineRate**

Set acquisition line rate to the maximum value.

- **AreaMode**

Enable area mode, check this option to use the camera as a area scan type.

- **AreaExposureTime**

Area exposure time. The parameter range is as follows:

- Maximum: 50000

- Minimum: 1280

- Increment: 1

- **AreaFramePeriod**

Area frame period. The parameter range is as follows:

- Maximum: 262143

- Minimum: 3840

- Increment: 1

- **AreaShadowCorrection**

Area mode shadow correction.

7.3.5 IO Control Register

Table 10 IO Control Registers

Name	Address	Size	Interface	Access	Visibility
TriggerMode	0xb008	4	E	RW	Beginner
TriggerSource	0xb014	4	E	RW	Beginner
TriggerRescaleEnable	0xb034	4	B	RW	Expert
TriggerRescaleWindowSize	0xb038	4	E	RW	Expert
TriggerRescaleFactor	0xb048	4	F	RW	Expert
TriggerMultDivEnable	0xb03c	4	B	RW	Expert
TriggerMultiplier	0xb040	4	E	RW	Expert



TriggerDivider	0xb044	4	I	RW	Expert
FrameTriggerMode	0xf864	4	E	RW	Beginner
FrameTriggerSource	0xf85c	4	E	RW	Beginner
FrameTriggerHeight	0xf868	4	I	RW	Beginner
Line1Polarity	0xb030	4	E	RW	Beginner
Line2Polarity	0xf860	4	E	RW	Beginner
Line1DebouncingPeriod	0xf830	4	I	RW	Beginner
Line2DebouncingPeriod	0xf854	4	I	RW	Beginner
Line1TriggerInputFrequency	0xf83c	4	I	RO	Beginner
Line2TriggerInputFrequency	0xf858	4	I	RO	Beginner
LineDetectionLevel	0xf850	4	E	RW	Expert

- **TriggerMode**

Trigger mode on/off. The enumeration names and values are as follows:

- Off (0)
- On (1)

- **TriggerSource**

Trigger source selection. The enumeration names and values are as follows:

- CXPin (1): CXP signal
- Line1 (0): IO interface line 1 signal
- Line2 (2): IO interface line 2 signal

- **TriggerRescaleEnable**

Enable trigger rescale function.

- **TriggerRescaleWindowSize**

Trigger signal smoothing window size, selecting the number of samples of trigger signals that require frequency averaging processing through the smoothing window. The enumeration names and values are as follows:

- Window_1 (0)
- Window_2 (1)
- Window_4 (2)
- Window_8 (3)
- Window_16 (4)
- Window_32 (5)
- Window_64 (6)
- Window_128 (7)
- Window_256 (8)
- Window_512 (9)
- Window_1024 (10)

- **TriggerRescaleFactor**



Trigger signal smoothing coefficient, used to fine tune the rate of the trigger signal. The parameter range is as follows:

- Maximum: 1.3
- Minimum: 0.7

- **TriggerMultDivEnable**

Enable trigger signal rate doubling and division function.

- **TriggerMultiplier**

Trigger signal rate doubling, used to coarsely adjust the increase in trigger signal rate size. The enumeration names and values are as follows:

- Multiplier_1 (0)
- Multiplier_2 (1)
- Multiplier_4 (2)
- Multiplier_8 (3)

- **TriggerDivider**

Trigger signal rate division, used to reduce and roughly adjust the rate of the trigger signal. The parameter range is as follows:

- Maximum: 256
- Minimum: 1
- Increment: 1

- **FrameTriggerMode**

Frame trigger mode. The enumeration names and values are as follows:

- FrameStart (1): Frame start
- Off (0): Off

- **FrameTriggerSource**

Frame trigger source. The enumeration names and values are as follows:

- CXPin (1): CXP signal
- Line1 (0): IO interface line1 signal
- Line2 (2): IO interface line2 signal

- **FrameTriggerHeight**

Frame trigger image height. The parameter range is as follows:

- Maximum: 65535
- Minimum: 1

- **Line1Polarity**

Line1 trigger polarity. The enumeration names and values are as follows:

- High (0): High level trigger acquisition
- Low (1): Low level trigger acquisition



- **Line2Polarity**

Line2 trigger polarity. The enumeration names and values are as follows:

- High (0): High level trigger acquisition
- Low (1): Low level trigger acquisition

- **Line1DebouncingPeriod**

Line 1 input signal jitter window length, signal below this pulse width will be considered as gross signals filtered out, unit is us. The parameter range is as follows:

- Maximum: 655
- Minimum: 0

- **Line2DebouncingPeriod**

Line 2 input signal jitter window length, signal below this pulse width will be considered as gross signals filtered out, unit is us. The parameter range is as follows:

- Maximum: 655
- Minimum: 0

- **Line1TriggerInputFrequency**

Line 1 trigger signal rate, unit is Hz.

- **Line2TriggerInputFrequency**

Line 2 trigger signal rate, unit is Hz.

- **LineDetectionLevel**

Input signal detection level, that is input voltage range. The enumeration names and values are as follows:

- Threshold_for_3V3_to_5V (0): Voltage range 3.3~5V
- Threshold_for_6V_to_24V (1): Voltage range 6~24V

7.3.6 Analog Control Registers

Table 11 Analog Control Register

Name	Address	Size	Interface	Access	Visibility
AnalogGain	0xb810	4	E	RW	Beginner

- **AnalogGain**

Analog gain. The enumeration names and values are as follows:

- Gain_x1 (0)
- Gain_x2 (1)
- Gain_x4 (2)
- Gain_x8 (3)

7.3.7 Digital Control Registers



Table 12 Digital Control Registers

Name	Address	Size	Interface	Access	Visibility
DigitalGain	/	/	F	/	Beginner
GainRaw	0xc028	4	I	RW	Beginner
DigitalOffset	0xc004	4	I	RW	Beginner
VerticalScanDirection	0xc02c	4	E	RW	Expert
VerticalScanControl	0xc038	4	E	RW	Beginner
TargetExposureEnable	0xc030	4	B	RW	Expert
TargetExposureTime	0xc034	4	I	RW	Expert
Denoise	0xc03c	4	I	RW	Expert

- **DigitalGain**

Digital gain. The parameter range is as follows:

- Maximum: 7.998
- Minimum: 0.004
- Increment: 0.002

- **GainRaw**

Digital gain raw data. The meaning and function of this parameter are consistent with the DigitalGain parameter, inherited from the old version of the camera, and only distinguished by naming.

The parameter range is as follows:

- Maximum: 4095
- Minimum: 0
- Increment: 1

- **DigitalOffset**

Digital offset. The parameter range is as follows:

- Maximum: 4095
- Minimum: -4095
- Increment: 1

- **VerticalScanDirection**

Vertical scanning direction. The enumeration names and values are as follows:

- Forward (0): Forward
- Backward (1): Backward

- **VerticalScanControl**

Vertical scanning direction control, signal used to select and control the vertical scanning direction. The enumeration names and values are as follows:

- Internal (0): Internal signal
- CXP_Positive (1): CXP positive signal
- CXP_Negative (2): CXP negative signal
- IO1_Positive (3): Line1 positive signal
- IO1_Negative (4): Line1 negative signal



- IO2_Positive (5): Line2 positive signal
- IO2_Negative (6): Line2 negative signal
- **TargetExposureEnable**
Enable the target exposure time function, check this option to allow users to set their own exposure time. Only effective under triggering conditions outside of line mode.
- **TargetExposureTime**
Target exposure time. The parameter range is as follows:
 - Maximum: 655
 - Minimum: 5
- **Denoise**
Denoise. The parameter range is as follows:
 - Maximum: 100
 - Minimum: 0

7.3.8 LUT Control Registers

Table 13 LUT Control Registers

Name	Address	Size	Interface	Access	Visibility
LUTEnable	0xd004	4	B	RW	Expert
LUTIndex	0xd008	4	I	RW	Expert
LUTValue	0xd00c	4	I	RW	Expert

- **LUTEnable**
Enable LUT function.
- **LUTIndex**
Lookup table data index, that is, the gray value of image before mapping lookup table. The parameter range is as follows:
 - Maximum: 4095
 - Minimum: 0
 - Increment: 1
- **LUTValue**
Lookup table data value, that is, the gray value of image after mapping lookup table. The parameter range is as follows:
 - Maximum: 4095
 - Minimum: 0
 - Increment: 1

7.3.9 Flat Field Correction Registers



Table 14 Flat Field Correction Registers

Name	Address	Size	Interface	Access	Visibility
PRNUCorrSelector	0xd838	4	I	RW	Expert
PRNUCorrEnable	0xd800	4	B	RW	Expert
PRNUCorrOffsetX	0xd804	4	I	RW	Expert
PRNUCorrWidth	0xd808	4	I	RW	Expert
PRNUCorrReferenceMode	0xd80c	4	B	RW	Expert
PRNUCorrReferenceTarget	0xd810	4	I	RW	Expert
PRNUCorrLowPassFilter	0xd834	4	I	RW	Expert
PRNUCorrStart	0xd814	4	C	WO	Expert
PRNUCorrReset	0xd818	4	C	WO	Expert

- **PRNUCorrSelector**

Selection of flat field correction parameter set. The parameter range is as follows:

- Maximum: 3
- Minimum: 0
- Increment: 1

- **PRNUCorrEnable**

Enable flat field correction.

- **PRNUCorrOffsetX**

Flat field correction horizontal offset, used to set the starting position of the flat field correction area. The parameter range is as follows:

- Minimum: 0
- Increment: 16

- **PRNUCorrWidth**

Width of flat field correction area. The parameter range is as follows:

- Minimum: 16
- Increment: 16

- **PRNUCorrReferenceMode**

Flat field correction reference mode, check this option to correct the grayscale value of the selected area to the target value.

- **PRNUCorrReferenceTarget**

Flat field correction target value. The parameter range is as follows:

- Maximum: 4095
- Minimum: 0

- **PRNUCorrLowPassFilter**

Flat field correction low-pass filtering. The parameter range is as follows:

- Maximum: 64



- Minimum: 0
- Increment: 2
- **PRNUCorrStart**
Start flat field correction.
- **PRNUCorrReset**
Restore flat field correction parameters to factory settings.

7.3.10 User Set Control Registers

Table 15 User Set Control Registers

Name	Address	Size	Interface	Access	Visibility
UserSetSelector	0xe800	4	E	RW	Beginner
UserSetLoad	0xe804	4	C	WO	Beginner
UserSetSave	0xe808	4	C	WO	Beginner

- **UserSetSelector**
User configuration selector. The enumeration names and values are as follows:
 - Default (0): Factory configuration
 - UserSet1(1): User configuration 1
 - UserSet2(2): User configuration 2
 - UserSet3 (3): User configuration 3
 - UserSet4 (4): User configuration 4
 - UserSet5 (5): User configuration 5
 - UserSet6 (6): User configuration 6
 - UserSet7 (7): User configuration 7
 - UserSet8 (8): User configuration 8
 - UserSet9 (9): User configuration 9
 - UserSet10 (10): User configuration 10
 - UserSet11 (11): User configuration 11
 - UserSet12 (12): User configuration 12
 - UserSet13 (13): User configuration 13
 - UserSet14 (14): User configuration 14
 - UserSet15 (15): User configuration 15
 - UserSet16 (16): User configuration 16
- **UserSetLoad**
Load selected camera configuration.
- **UserSetSave**
Save selected camera configuration.



8 FAQ

- **If the camera cannot be connected to computer,**

- ① Ensure that CoaXPress interface cable is OK
- ② Ensure that serial port channel parameters of CoaXPress interface are correctly set.

- **If CoaXPress interface cannot receive camera clock signal,**

- ① Ensure that the camera has been turned on properly (i.e. the status indicator should be normally green).
- ② If a third-party frame grabber is used to grab images, ensure that frame grabber and supporting software are operating properly, which can be checked by restarting computer.
- ③ Ensure that CoaXPress interface cable is OK.

- **If the camera has no image output in External Pulse mode,**

- ① Ensure that external input pulse is normal.
- ② Ensure that the camera has received trigger pulse correctly (it can be confirmed by status indicator display).
- ③ If CoaXPress interface signal is used as trigger input signal, ensure that frame grabber is configured correctly.

- **If temperature of camera casing is abnormal,**

- ① Ensure that voltage range of external connected power supply is normal.
- ② If the casing is hot or the camera emits smoke, immediately cut off power and stop using camera, then contact us for technical support.

- **If images are dark,**

- ① Ensure that sensor aperture on the casing is not blocked.
- ② Ensure that exposure time is set properly.

- **If the images are not clear,**

- ① Ensure that sensor glass is clean.
- ② Ensure that camera status indicator is normal.

- **If the camera cannot output images,**

- ① Check whether CoaXPress interface is normal by the test image.
- ② Check whether the power supply is normal by camera indicator status.
- ③ Check whether external trigger input is normal in External Trigger mode by camera indicator.

If users have any problems during the use of the camera, please contact our technical support in time, we will provide you with the service as soon as possible.