

# Dhyana 2100 Camera User Manual



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## 1. Read Before Use

- This camera instruction document contains the basic information, product features, function introduction and maintenance of the camera. It is an internal document and published content of TUCSEN, which can make it easier for users to use TUCSEN cameras.
- This document is published only for the above purposes and does not constitute a license, transfer or any other right of the owner.
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## 2. Cautions

### Operation and Usage



Note

- Do not drop it. Disassemble, repair or replace the internal components by yourself. Otherwise, camera components may be damaged or electric shock may be caused.
- If liquids such as water, beverages or chemicals enter the equipment, please stop using and contact the nearest dealer or manufacturer for technical assistance.
- Do not touch the device with wet hands, otherwise electric shock may occur.
- Don't let children touch the device without supervision.
- Ensure that the camera temperature is within the specified temperature range. Otherwise, the equipment may be damaged due to extreme temperature.

### Installation and Maintenance



Note

- Please do not install it in a dusty place or near the air conditioner or heater to reduce the risk of camera damage.
- Avoid installation and operation in extreme environments with vibration, high temperature, humidity, dust, strong magnetic field, explosive/corrosive gas or gas.
- Do not apply excessive vibration and impact to the equipment. This may damage the equipment.
- Avoid direct exposure to high intensity light sources. This may damage the image sensor.
- Do not install equipment under unstable lighting conditions. Serious lighting changes will affect the quality of the image produced by the device.
- Do not use solvents or thinners to clean the equipment surface, as this will damage the housing surface.






Power Supply





Note

- Please use the original power adapter of the camera. Using an unmatched power adapter will damage the camera.
- If the voltage applied to the camera is greater than or less than the nominal voltage of the camera, the camera may be damaged or not working properly.
- Refer to the specification table for the nominal voltage of the camera.
- Before connecting the power cord to the camera, make sure the power is turned off. Otherwise, the camera may be damaged.

### 3. Packing List

Item Name	Specification / Model	Quantity	Pictures
sCMOS Camera	Dhyana 2100	1 ×	
Adapter Ring	F mount adapter ring	1 ×	
Power Adapter	24V/6.67A	1 ×	
USB Flash Drive	Software and driver included	1 ×	
CoaXPress Frame Grabber (Optional)	Euresys / KAYA	1 ×	

CoaXPress Cable	3m	4×	
External trigger Cable	HR10A-7P-4P	1×	

## 4. Product Specifications

### 4.1 Camera Introduction

The Dyhana 2100 is an ideal combination of high speed and high resolution. It not only has a speed of 450 frames/second at 21 million full resolution, but also has designed a high-speed binning mode especially for weak light applications, with higher sensitivity and dynamic range, and a speed of 1725 frames/second @ 5 MP. It is suitable for semiconductor/wafer detection, high-speed aerial photography, flat panel detection (FPD) and other imaging applications.

### 4.2 Main Features

- High speed and high resolution: 450 fps @ 21 MP has the ability to observe the details of samples under high-speed movement
- High speed binning mode: speed up to 1725 fps @ 5 MP
- High sensitivity: 63% @ 520nm
- Global shutter mode: no artifacts and distortion in high-speed images
- High dynamic range: 68.8 dB
- Deep TEC cooling suppresses dark noise: the cooling depth exceeds 30 °C
- Advanced air cooling water cooling mode: reduce dark current noise and vibration, which is conducive to stable operation of the instrument system
- CXP12 x4/x8 high-speed interface
- GenICAm™ compliant
- Conforming to the CoaXPress standard, it supports the mainstream frame



grabber on the market

- Support ROI
- Support Binning
- Flat field correction
- Dark field correction
- Support test image output
- Camera temperature monitoring

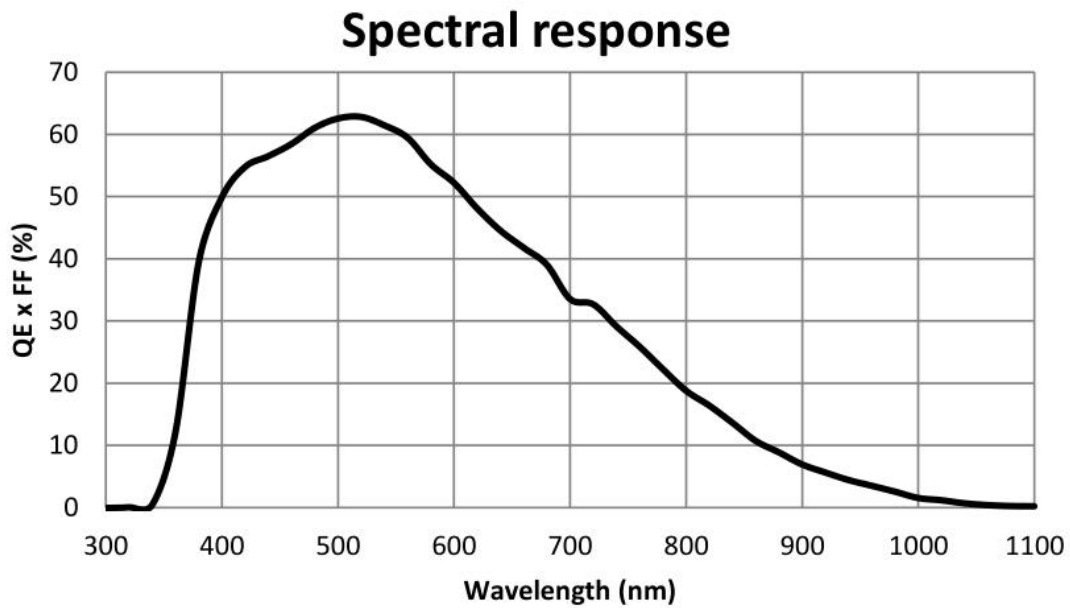
### 4.3 Parameter Specifications

Parameters	Properties
Camera Model	Dhyana 2100
Sensor Type	Front-illuminated CMOS
Shutter Type	Global shutter
Color/Mono	Mono
Effective Area	23.04 mm x 18.43 mm
Resolution	5120 (H) x 4096 (V)
Pixel Size	four point five $\mu$ m x 4.5 $\mu$ m
Quantum Efficiency	63% @ 520nm
Full-well Capacity	28 ke- (12 bit Gain 0) 16.5 ke- (12 bit Gain 2) 120 ke- (binned)
Dynamic Range	68.8 dB (12 bit Gain 2)
Frame Rate	450 fps @ 8 bit, 286 fps @ 10 bit, 250fps @ 12 bit(CXP12 x 8 ); 225fps @ 8 bit, 143fps @ 10 bit, 143 fps @ 12 bit (CXP12 x 4);
Readout Noise	3.5 e- @ 12 bit Gain3
Exposure Time	four $\mu$ s ~ 10 s
DSNU	two e-@12bit Gain3
PRNU	0.12%
Cooling Method	Air cooling&water cooling
Max. Cooling	30 °C lower than ambient temperature
Dark Current	0.5 e - @ chip temperature - 10 °C
Binning	2 x 2, 4 x 4, 8 x 8
ROI	Support
Trigger Mode	Hardware&Software
Output Trigger Signal	Exposure start signal, readout end signal
External Trigger Interface	Hirose
Data Interface	CXP12 (x4 / x8)



Bit Depth	8 bit, 10 bit, 12 bit
Optical Interface	M52/F-Mount/Customized
Power Supply	DC 24 V / 6 A
Power Consumption	≤ 120 W
Dimensions	95 mm x 95 mm x 140.5 mm
Weight	<2kg
Software	Samplepro
SDK	C/C++/C#
Compatible Systems	Windows/Linux
Operating Environment	Temperature 0~40°C, Humidity 10~85%

#### 4.4 Spectral Response

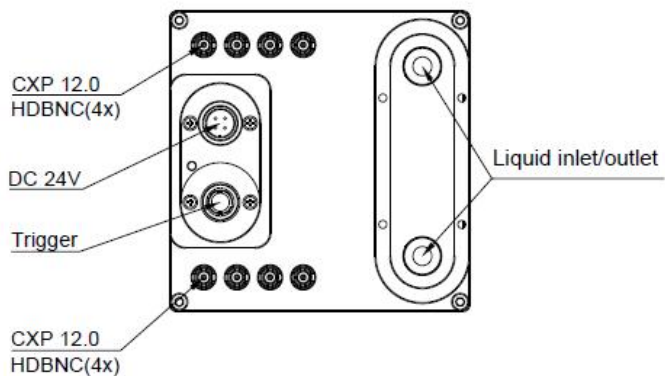
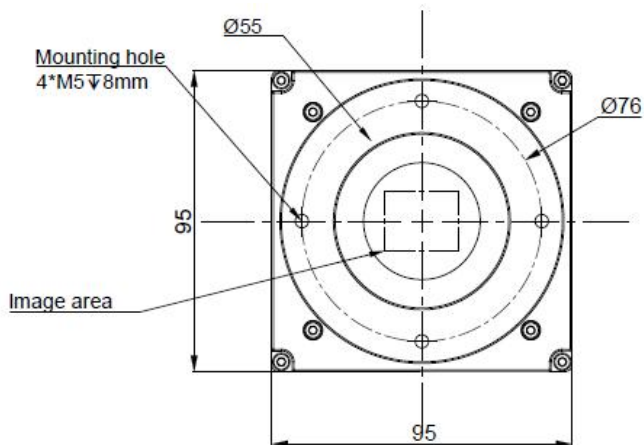
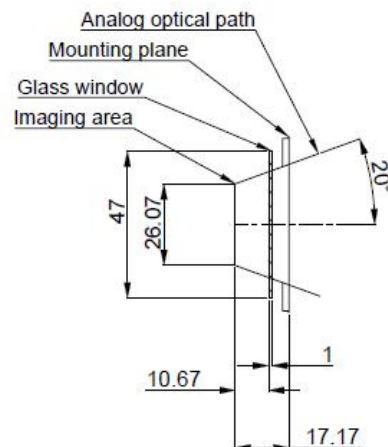
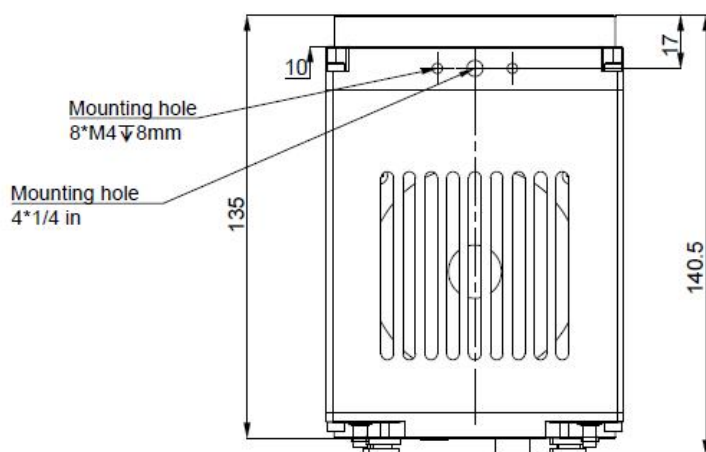


**Dhyana 2100 spectral response curve**



### 4.5 Mechanical Structure Specifications

Unit: mm, Diameter:  $\varnothing$ .



## 5. Installation

### 5.1 Camera Components and Functions

The interfaces and functions of the Dyhana 2100 camera are shown in Figure 5-1 and Table 5-1 below.

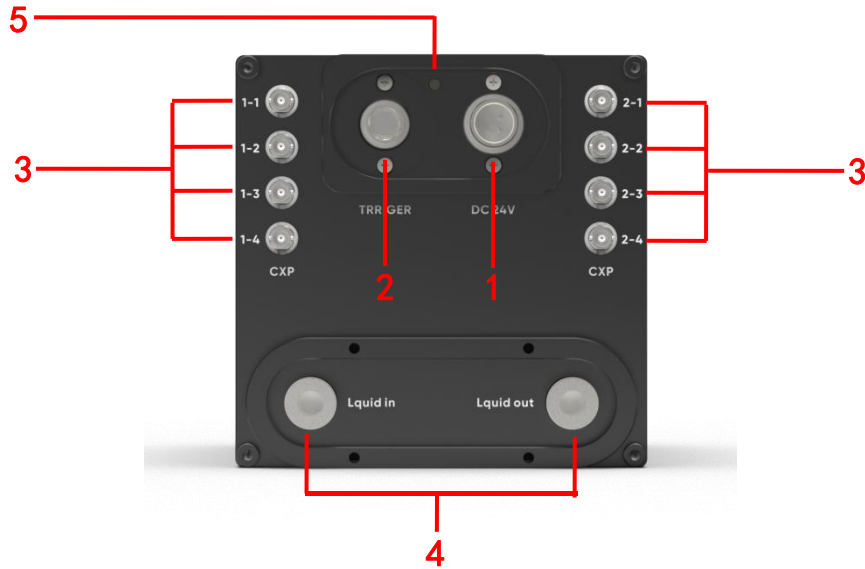


Figure 5-1 Location of the Dyhana 2100 Camera Interface

Table 5-1 Functions of each interface of the Dyhana 2100 camera

No.	Part Name	Function
1	DC 24V	Power
2	TRIGGER	Trigger
3	CXP12 x4/x8	Camera data transmission
4	Liquid In/Out	Water cooling input/output
5	Indicator Light	Indicates whether the camera is working

**Note:** When the camera is connected to the power supply, the indicator light is on and the red light is flashing; When the software is turned on and the camera works normally, the color of the indicator light changes from red flashing to green orange flashing.

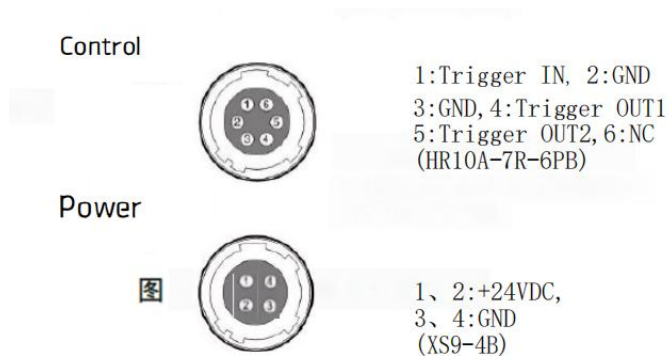


Figure 5-1 Power and trigger pin definitions

- (1) The trigger level is 3.3V and must not exceed 5V;
- (2) The trigger level is judged to be high when it is higher than 2.6V, low when the trigger level is lower than 0.6V, and indeterminate from 0.6 to 2.5V, with possible erroneous trigger states.

## 5.2 Camera Installation

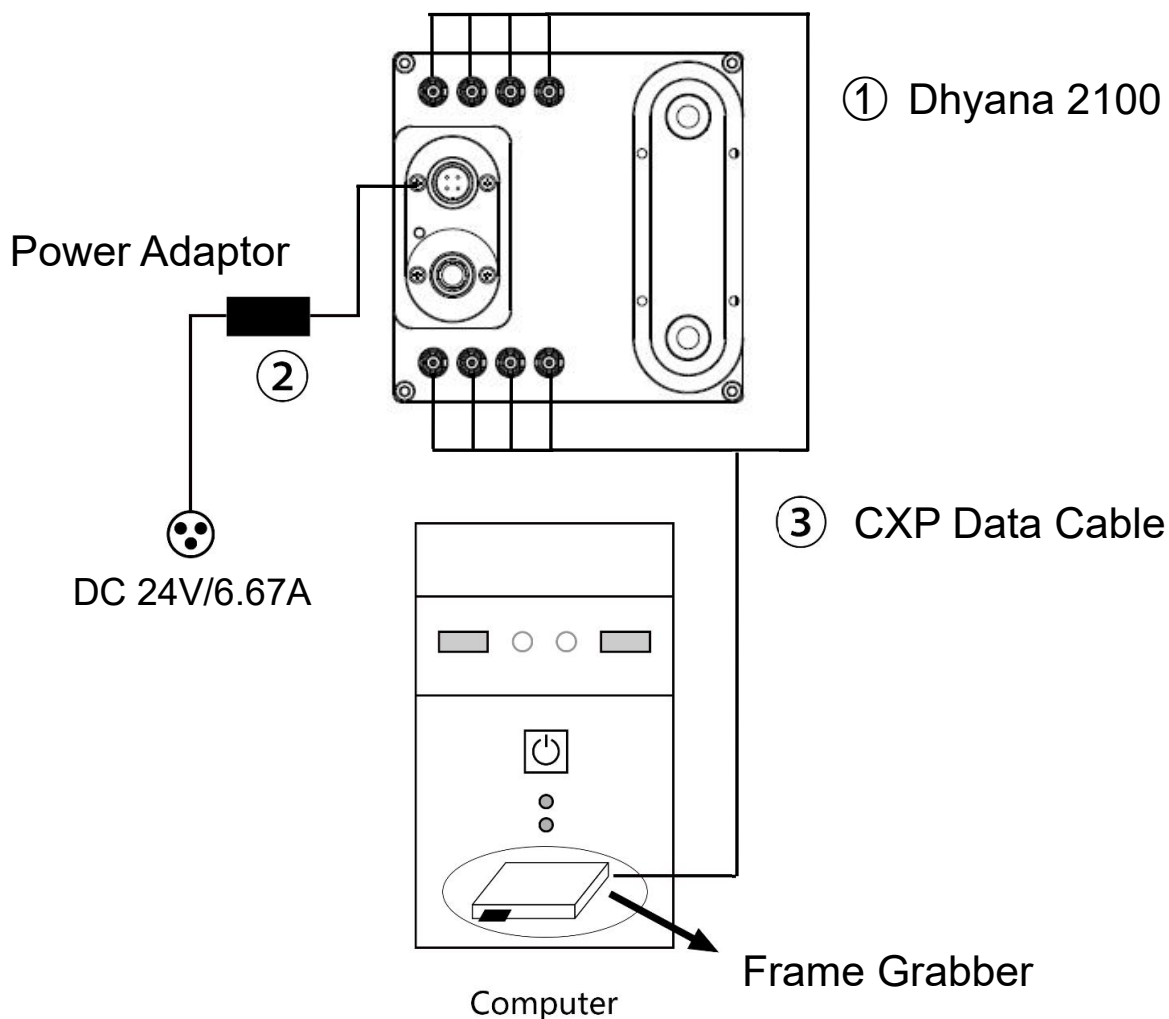


Fig. 5-2 Connection Diagram of Dyhana 2100

1. **Power Connection:** Use the factory matched 24V/6.67A power supply;
2. **Water Cooling System Connection** (if the camera is in air cooling mode, please omit this step): Use the recommended matching water circulation system to connect the two water circuit ports of the camera, turn on the water circulation for heat dissipation and ensure that the water circuit is smooth without water leakage, and the recommended water temperature is 25°C and 20°C;
3. **Installation of Frame Grabber Driver:** It supports KAYA and Euresys frame grabbers. The computer installs the frame grabber (it is recommended to install it in PCIE 3.0 x16 slot) and the driver matching the frame grabber. See Section 5.3 for details:

KAYA\_Vision\_Point\_Setup\_2020.3\_Windows\_64 (only Win10 is supported)

KAYA\_Vision\_Point\_Setup\_2020.3\_Ubuntu\_18.04\_x64.tar (Linux)

egrabber-win10-x86\_64-12.8.1.54 (Euresys burning firmware is 1-Camera)

egrabber-win7-x86\_64-14.0.1.170 (Euresys burning firmware is 1-Camera)

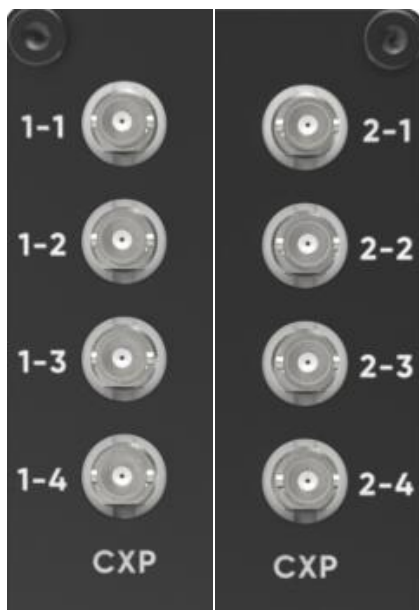
4. **CXP-12 Connection:** Use the factory matched CXP-12 cables to connect the camera and the frame grabber, connect 4 cables with a single frame grabber, and connect 8 cables with a dual frame grabber, as shown in the figure below. After each frame grabber is connected, lock the connection port of each cable.

CXP 1-1 / 2-1 $\longleftrightarrow$  CH1 / A

CXP 1-2 / 2-2 $\longleftrightarrow$  CH2 / B

CXP 1-3 / 2-3 $\longleftrightarrow$  CH3 / C

CXP 1-4 / 2-4 $\longleftrightarrow$  CH4 / D



Camera



KAYA Frame Grabber



Euresys Frame Grabber

- Power on the camera, and open the SamplePro software after the camera is started; If water cooling is used alone, the water circulation system must be started and operated normally before the camera is started to avoid overheating;

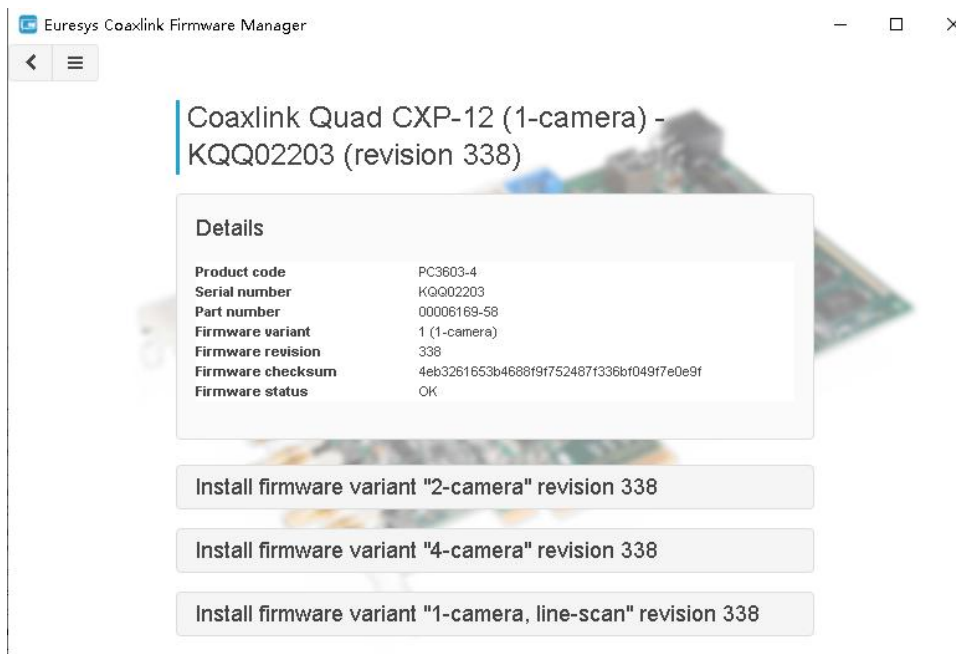
➤ **Note:**

(1) When connecting 4 CXP cables to each frame grabber, the line sequence shall be continuous and one-to-one corresponding;

(2) Steps for switching firmware mode of Euresys frame grabber: Open the Coaxlink Firmware Manager in the drive installation directory ->select firmware ->write

successfully ->turn off the computer ->turn on the computer ->firmware of the frame grabber takes effect;

Firmware takes effect when the computer is powered off and then turned on instead of restarting the computer.



### 5.3 Frame Grabber Installation

Turn off the computer and open the cover of the computer, as shown in the following figure. Select a PCIe slot with a transmission bandwidth greater than 850MB/s to insert the frame grabber. Secure with screws before restarting the computer.

**Note:** If there is a compatibility problem with the frame grabber, please confirm whether the firmware of the frame grabber is the latest version, and timely upgrade the firmware of the frame grabber.

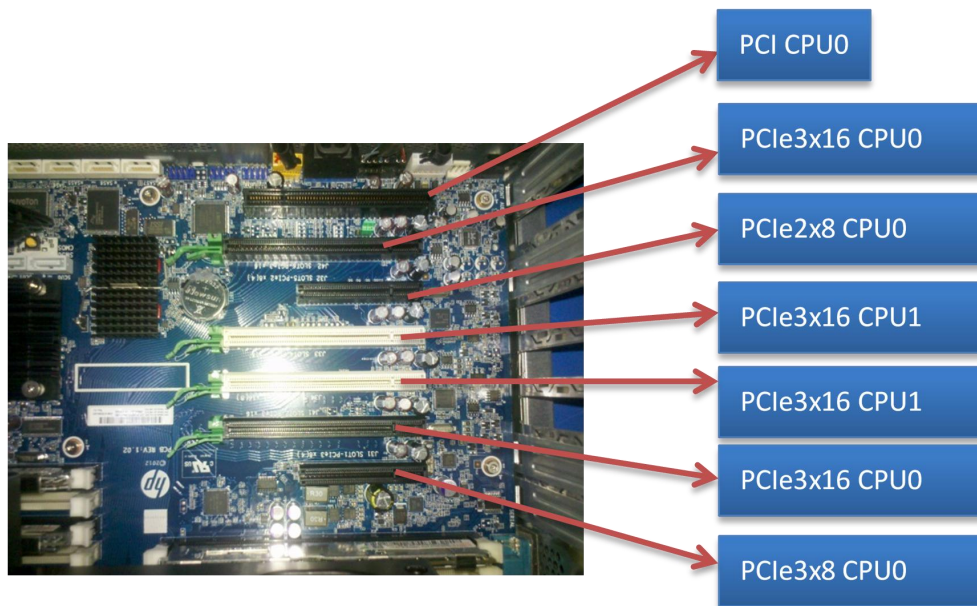


Figure 5-3 Computer motherboard diagram

Table 5-2 Maximum Transmission Rate Corresponding to Different PCIe Slots

PCIe	x1	x4	x8	x16
1.0	250MB/s	1GB/s	2GB/s	4GB/s
2.0	500MB/s	2GB/s	4GB/s	8GB/s
3.0	985MB/s	3.9GB/s	7.8GB/s	15.7GB/s

## 5.4 Driver Installation

### 1. Kaya Frame Grabber Driver Installation

**Note:** Kaya frame grabber only supports Win10 (x64) in Windows

1.1 Double click the KAYA frame grabber driver to start the installation

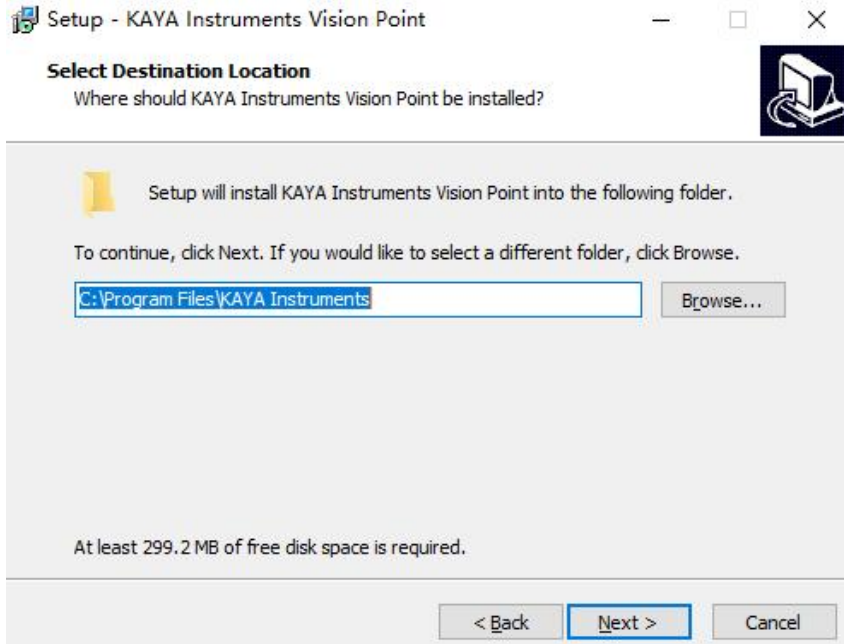


1.2 Click "Next" to install the next step



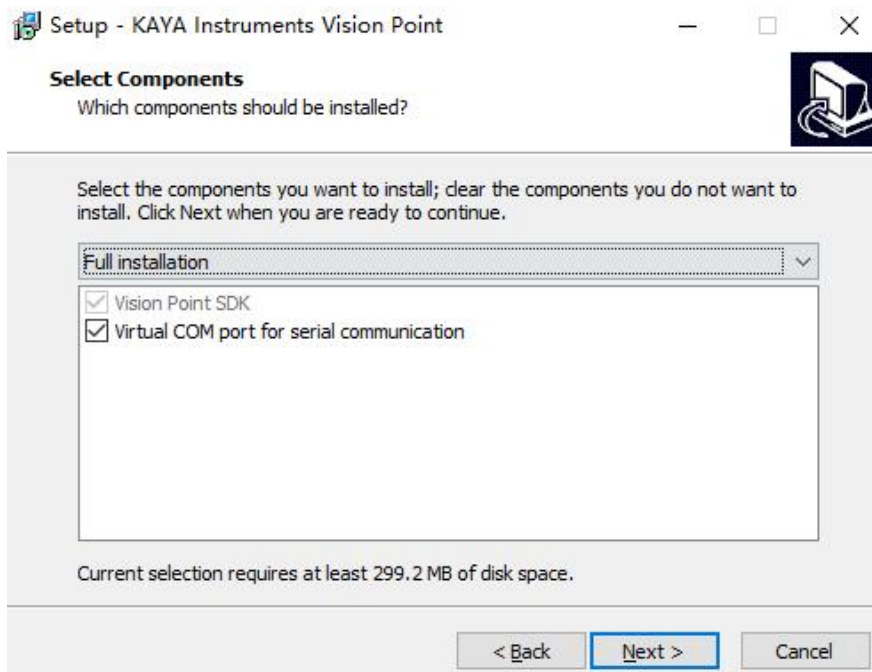


1.3 Select the installation location of the drive, press the default configuration, and click "Next"

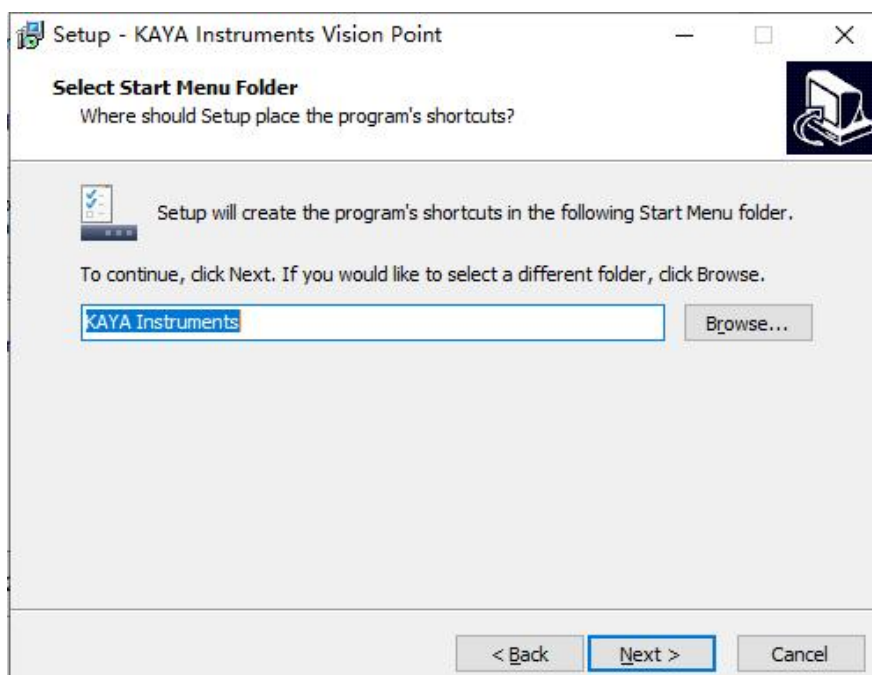


1.4 Continue to click "Next" according to the operation prompt

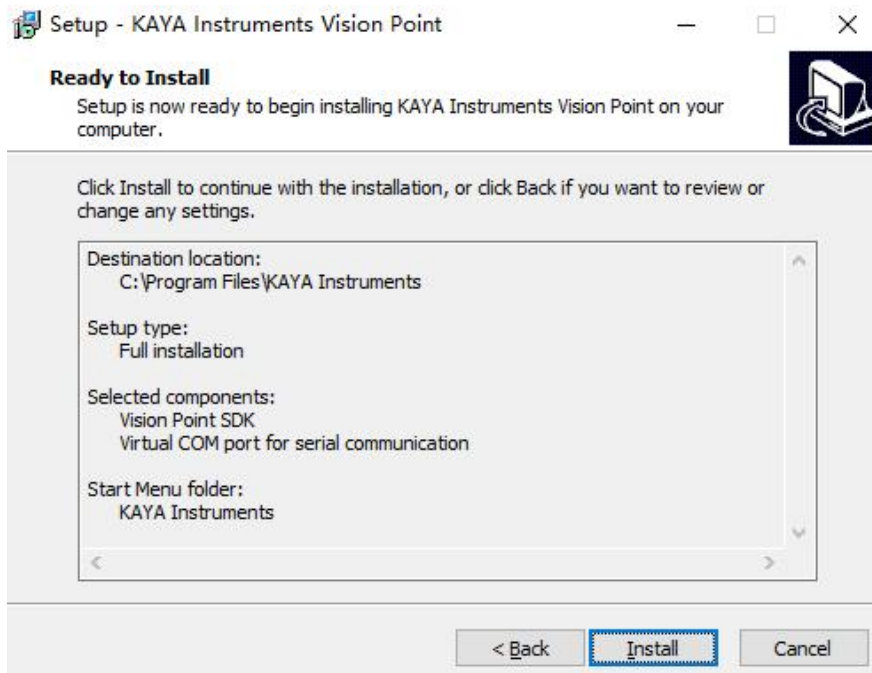




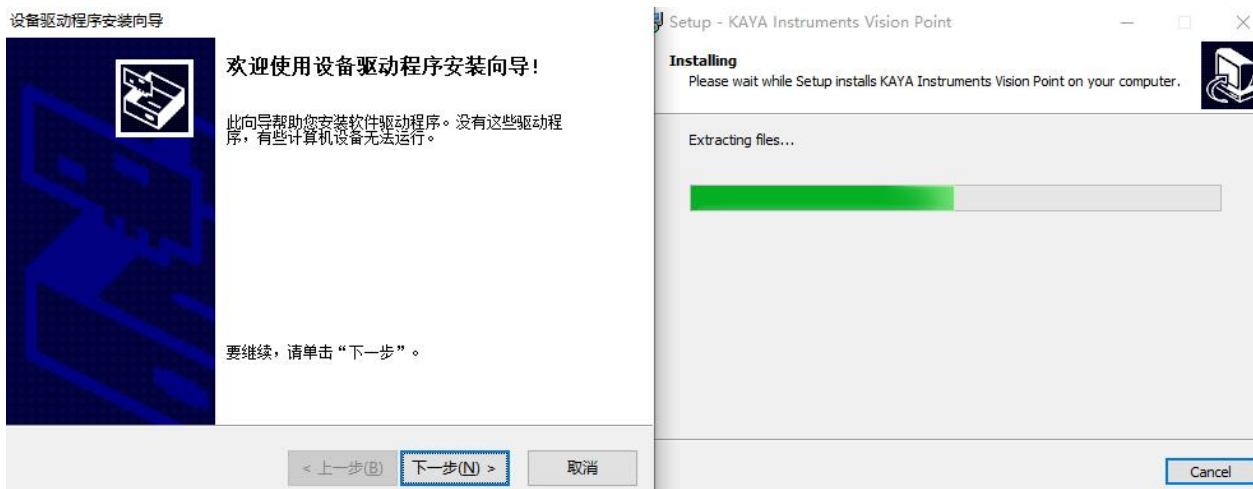
### 1.5 Continue "Next"



### 1.6 Click "Install" to upgrade



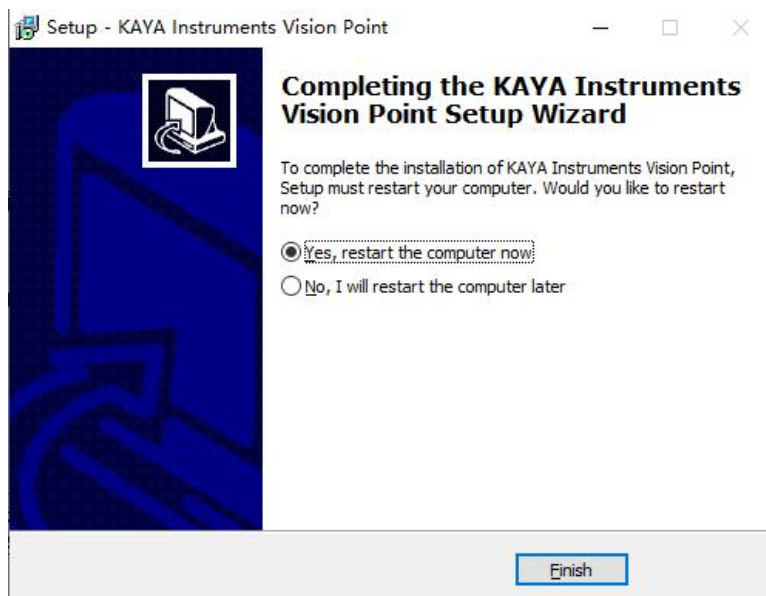
### 1.7 Click "Install" to continue the installation after upgrading



1.8 Click "Finish" to proceed to the next step



1.9 Choose to restart the computer immediately, and click "Finish" to restart the computer to complete the installation.



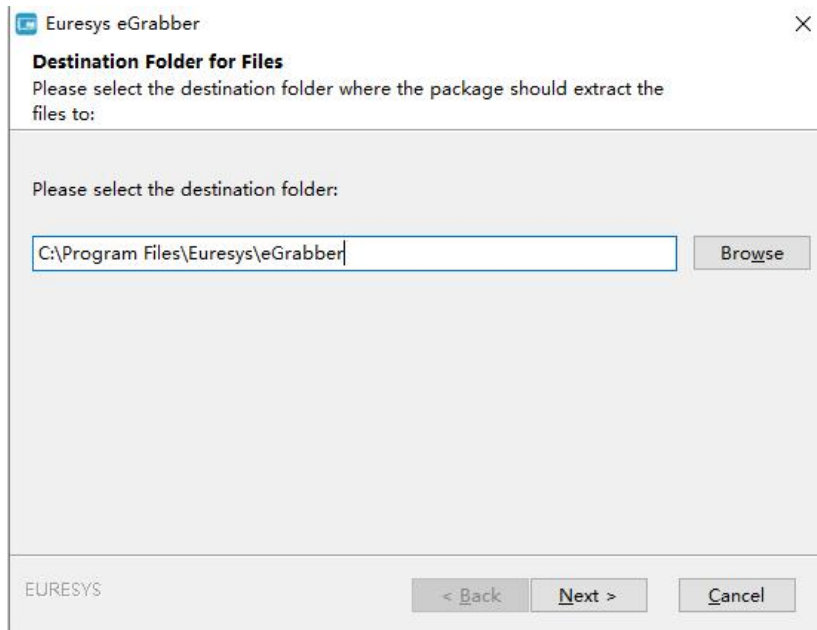
## 2. Euresys Frame Grabber Driver Installation

**Note:** Euresys frame grabber supports Win7/Win10 systems in Windows

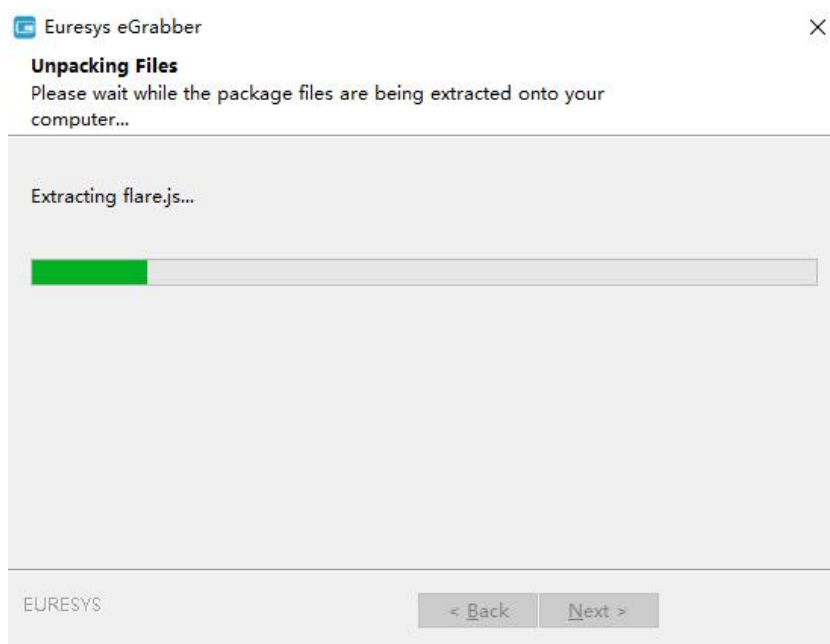
egrabber-win10-x86\_64-14.0.1.170.exe

egrabber-win-x86\_64-14.0.1.170.exe

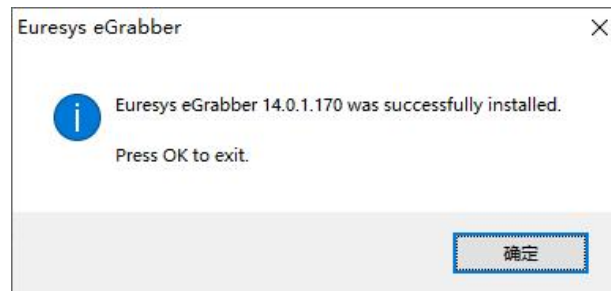
2.1 Taking the installation under Win10 as an example, double-click the corresponding driver to start the installation, and click "Next" to proceed to the next step



2.2 Wait for the installation to complete



### 2.3 Click OK after installation



## 5.5 Software Installation

The Samplepro software comes with the USB flash drive, which can be directly decompressed for use.

### Note:

1. When the Samplepro software is started for the first time, run it as the administrator, and then double-click the software directly;
2. Opening the frame grabber software and Samplepro software at the same time will cause the software to fail to recognize the camera;
3. The orange light is always on when the camera works normally. If the startup software NO Camera appears, please check whether the connection sequence between the camera and the frame grabber matches, or restart the computer and reinstall the frame grabber driver. (KAYA frame grabber is not compatible with Win7 system of some computers).

## 5.6 Connecting the Water Cooler

Please carefully read the official operating instructions of the water cooler before connecting it.

### Note:

#### 1、 Selection of Cooling Water

It is recommended to use pure water. If the working environment of the water cooler is below zero temperature, please use antifreeze.

#### 2、 Cooling Water Temperature

It is recommended to set the water temperature in the cooling water circulator at 20°C, and the temperature difference between the ambient temperature and the water



temperature should not exceed 5°C.

### 3、 Environment

Under improper environmental conditions, condensation water may appear in the water valve and water pipe, which may damage the equipment. To ensure the normal operation of the equipment, the temperature difference between ambient temperature and water temperature can refer to the appendix of this section.

4、 Use the Cooling Water Circulator correctly (refer to the instruction manual of the cooling water circulator)

### 5、 Installing Water Cooling pipes

### 6、 Camera Cooling Process

① Before the camera runs, ensure that the cooling water circulator and the camera water valve are installed correctly, and turn on the cooling water circulator,

Observe that there is no overflow and the water flow is smooth before running the camera.

② Guaranteed water flow: 1L/min.

③ When the camera is running, the cooling water circulator must not be turned off to stop cooling.

**Note:** If the water flow cannot be guaranteed to be 1L/min due to water pipe aging, please replace the water pipe in time.

### 7. Camera Off

① Cut off the camera power, turn off the cooling water circulator and other related equipment.

② Discharge the water in the cooling water circulator.

**Attachment:** The water temperature of the chiller shall be selected according to the temperature and humidity of the actual environment. Please refer to the table of condensation points corresponding to temperature and humidity, as shown below. The recommended water temperature should be higher than the dewing temperature in the table. If the ambient temperature is 25 °C and the relative humidity is 70%, the water temperature should not be lower than 19 °C.

## Appendix:

-		湿度 Humidity / %							
		20%	30%	40%	50%	60%	70%	80%	90%
温 度 Temperature / °C	5							1.8	3.5
	6							2.8	4.5
	7						1.9	3.8	5.5
	8						2.9	4.8	6.5
	9					1.6	3.8	5.7	7.4
	10					2.6	4.8	6.7	8.4
	11					3.5	5.7	7.7	9.4
	12				1.9	4.5	6.7	8.7	10.4
	13				2.8	5.4	7.7	9.6	11.4
	14				3.7	6.4	8.6	10.6	12.4
	15			1.5	4.7	7.3	9.6	11.6	13.4
	16			2.4	5.6	8.2	10.5	12.6	14.4
	17			3.3	6.5	9.2	11.5	13.5	15.3
	18			4.2	7.4	10.1	12.4	14.5	16.3
	19		1.0	5.1	8.4	11.1	13.4	16.4	18.3
	20		1.9	6.0	9.3	12.0	14.4	16.4	18.3
	21		2.8	6.9	10.2	12.9	15.3	17.4	19.3
	22		3.6	7.8	11.0	13.9	16.3	18.4	20.3
	23		4.5	8.7	12.0	14.8	17.2	19.4	21.3
24		5.4	9.6	12.9	15.8	18.2	20.3	22.3	
25	0.5	6.2	10.5	13.9	16.7	19.1	21.3	23.2	
26	1.3	7.1	11.4	14.8	17.6	20.1	22.3	24.2	
27	2.1	8.0	12.3	15.7	18.6	21.1	23.3	25.2	
28	3.0	8.8	13.2	16.6	19.5	22.0	24.2	26.2	
29	3.8	9.7	14.0	17.5	20.4	23.0	25.2	27.2	

Fig. 5-6 Dew Point Corresponding to Temperature and Humidity

## 6. Software Instructions

### 6.1 Software Start Interface

Double click SamplePro to open the camera software. The software start interface is shown in Figure 6-1. Wait until the loading is completed. The boot time varies with different frame grabbers. (The startup time of Euresys frame grabber is about 10s, and that of KAYA frame grabber is about 20s)

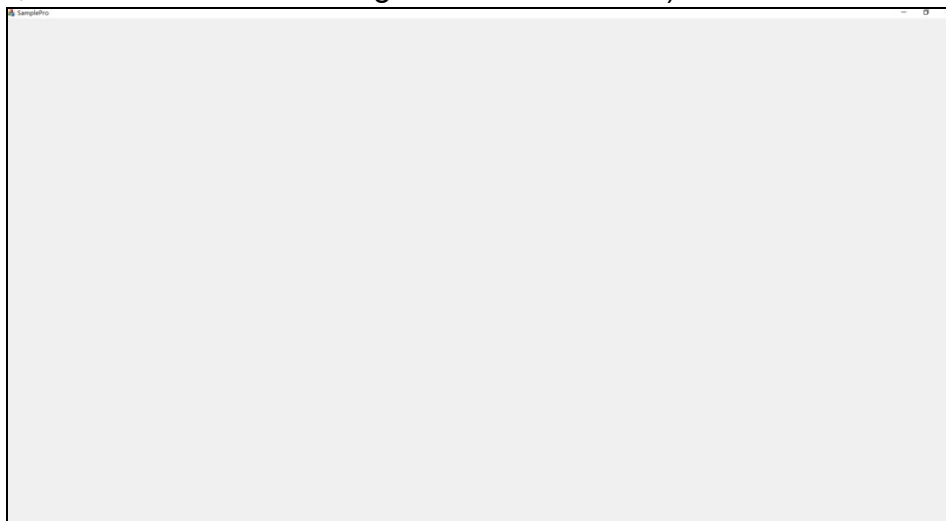


Figure 6-1 Software Start Interface

### 6.2 Window Composition

The main interface of SamplePro software consists of five parts: "Preview Window", "Software Window", "Image Capture", "Camera Control" and "Image Adjustment", as shown in Figure 6-2.

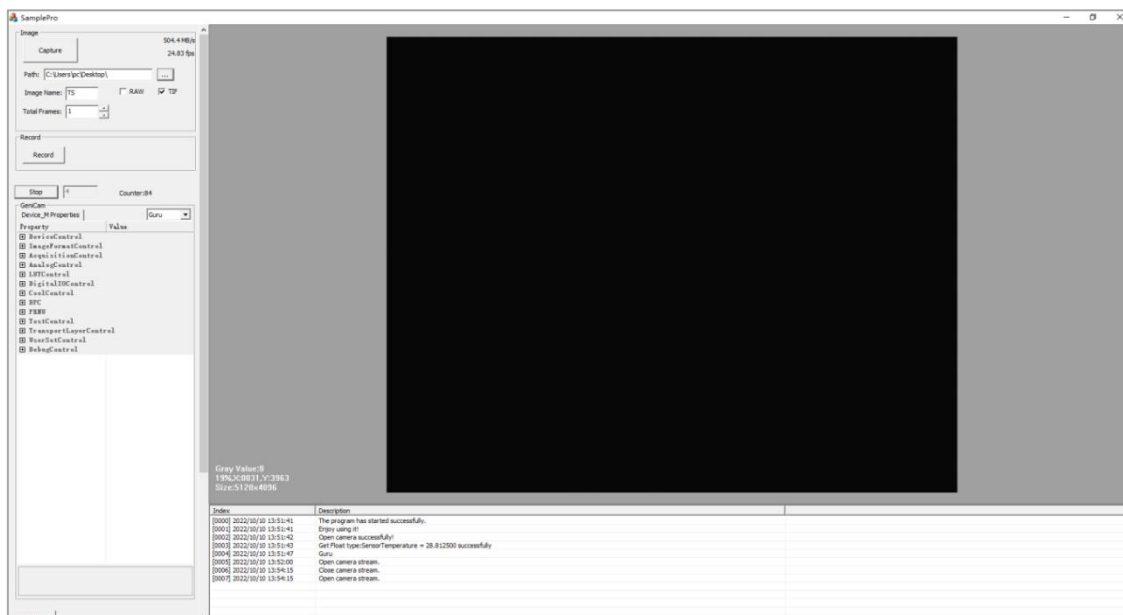


Figure 6-2 Window Composition



### Preview Window

The preview window displays the camera's real-time picture under the stream module. The preview window supports real-time zooming. Users can zoom in or out of the preview window by using the mouse wheel according to actual needs.

The lower left corner of the preview window will display the pixel gray value, coordinates and image resolution of the mouse position in the real-time screen according to the mouse, as shown in Figure 6-2-1.



Fig. 6-2-1 Information Display

### Software Window

Software windows are common " — window minimization", " □ window maximization, downward restore", and " × window close".

### Image Capture

The image photography module is the basic shooting and recording function of the camera. Users can select different image formats to capture pictures and customize the duration of video recording according to their needs. By default, they will be saved in the img folder under the software root directory.

### Camera Control

The main functions of the camera are all expanded under this module, and users can expand under the corresponding function modules according to the use needs.

### Image Adjustment

In the image adjustment interface, the user can adjust the image gamma value and contrast value according to the difference between the real-time preview effect and the actual sample, and set the left and right color scales to achieve the desired image effect, as shown in Figure 6-2-2.

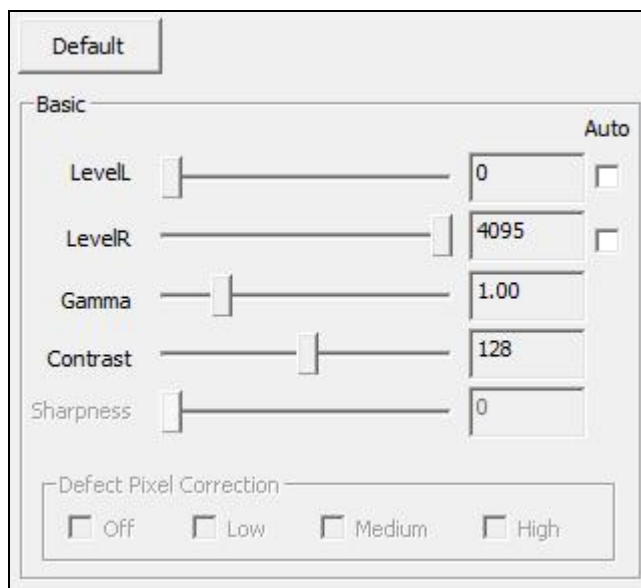


Figure 6-2-2 Image Adjustment Module

### 6.3 Image Capture

As shown in Figure 6-3, the image capture module supports the basic shooting and recording functions of the camera.

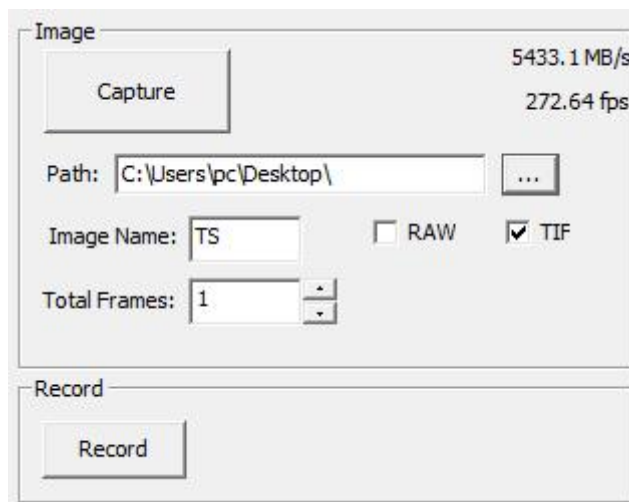



Figure 6-3 Image capture module

- ◆ Capture: Click the button to take a picture;
- ◆ Path: Grab the image and video saving path, click to customize the path; 
- ◆ Image Name: The name of the picture, which supports customization and the default TS prefix;
- ◆ Raw TIF: Select the image format, support RAW and TIF formats of the original image, default TIF format, and support checking at the same time;

- ◆ Total Frames: User-defined selection of the number of pictures taken, and 1 picture is saved by default;
- ◆ Record: Start recording manually;
- ◆ Stop Record: Stop recording manually;
- ◆ 5433.1MB/s 272.64fps: Display camera real-time speed and frame rate.

## 6.4 Camera Control

The main functions of the camera are developed under this module, and the camera plotting mode is controlled here, as shown in Figure 6-4.

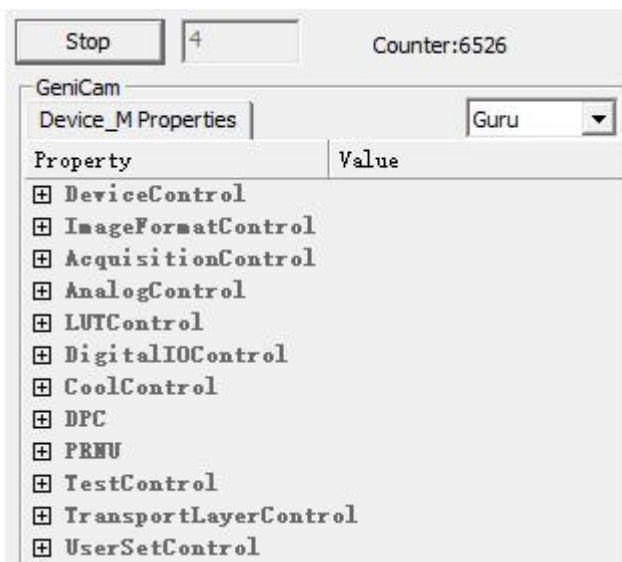
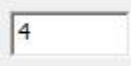
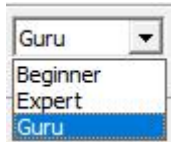


Figure 6-4 Camera Control Module

- ◆ Stop: When the camera is in stream mode, the preview window will plot in real time; when the camera is in external trigger mode, it will plot according to the trigger signal;
- ◆ Live: The camera works normally and does not plot;
- ◆ : In the live state, you can set the memory allocation space to be applied. The larger the value is, the less frame loss will occur during image storage, and the software will run slower; The smaller the value is, the frame loss may occur in high-speed image storage, and the software runs smoothly. It is recommended to set the value to be large when saving images, and set the value to 4 when not saving images.



- ◆ : Operator mode selection, including Beginner, Expert and Guru. Please select Guru mode to use all camera functions.

### 6.4.1 DeviceControl

Display camera basic information (read-only), UserID editing, camera reset, Device temperature, Sensor Board temperature, and Sensor temperature in real time. As shown in Fig. 6-4-1

DeviceControl	
DeviceMode	BaseMode
DeviceVendorName	Tucsen
DeviceModelName	Dhyana 2100
DeviceManufacturer...	Tucsen CXP Camera
DeviceVersion	2D01221009
DeviceSerialNumber	RBSTI09022003
DeviceUserID	20
DeviceSFNCVersionM...	2
DeviceSFNCVersionM...	0
DeviceSFNCVersionS...	0
DeviceManifestEntr...	0
DeviceManifestXMLM...	1
DeviceManifestXMLM...	0
DeviceManifestXMLS...	4
DeviceManifestSche...	1
DeviceManifestSche...	0
DeviceManifestPrim...	Local:Dhyana_2100...
DeviceILType	Coa X Press
DeviceILVersionMajor	1
DeviceILVersionMinor	1
DeviceILVersionSub...	0
DeviceLinkSelector	0
DeviceLinkSpeed	0.000000
DeviceLinkThroughp...	0.000000
DeviceLinkCommandT...	0.000000
DeviceReset	<b>DeviceReset</b>
DeviceIndicatorMode	Active
DeviceTemperature	44.562500
SensorBoardTempera...	25.562500
SensorTemperature	31.187500

Fig. 6-4-1

- ◆ **DeviceMode**: Single and double frame grabber channel switching of the camera. When the camera uses a single frame grabber, select BaseMode mode; Select FULL Mode when using dual frame grabber;
- ◆ **DeviceUserID**: DeviceUserID supports user-defined input and editing, and supports input of common numeric characters such as Chinese and English;

- ◆ **DeviceReset**: The device reset button eliminates the need to power off the camera, and the camera automatically loads the default parameter configuration;

DeviceTemperature	59.937500
SensorTemperature	10.816750
SensorFrameCounter	220
CxpFrameCounter	220

Fig. 6-4-2

- ◆ **DeviceTemperature**: Display Device temperature in real time (read-only);
- ◆ **SensorTemperature**: Display Sensor temperature in real time (read-only);
- ◆ **SensorFrameCounter**: Current sensor count, total data sent;
- ◆ **CxpFrameCounter**: Current CXP terminal count. When the camera is in dual camera mode, the CXP terminal count is only half of the sensor;

**Note:** When the frame rate is too high, several frames of data will be transmitted from the Sensor, but CXP has stopped counting, and several frames will be lost.

### 6.4.2 ImageFormatControl

Set camera resolution, ROI, Binning, horizontal and vertical mirroring, pixel width, and test image. As shown in Fig. 6-4-3.

ImageFormatControl	
SensorMode	Normal
WidthMax	5120
HeightMax	4096
Width	5120
Height	4096
OffsetX	0
OffsetY	0
BinningAver	<input checked="" type="checkbox"/>
BinningHorizontal	X1
BinningVertical	X1
ReverseX	<input type="checkbox"/>
ReverseY	<input type="checkbox"/>
PixelFormat	Mono 8
TestPattern	Off

Fig. 6-4-3

- ◆ **SensorMode**: The sensor supports Normal and FastBinning modes. FastBinning can improve the camera frame rate and signal-to-noise ratio;
- ◆ **WidthMax**: Display the maximum horizontal resolution of the current image in real time (gray read-only);

- ◆ HeightMax: Display the maximum vertical resolution of the current image in real time (gray read-only);

**Note:** Normal resolution is  $5120 \times 4096$ , FastBinning resolution  $2560 \times 2016$ ;

- ◆ Width: Horizontal width setting of the current image, the minimum input is 128, and the step is 32;
- ◆ Height: Current image height setting, minimum input 1, step is 1;
- ◆ OffsetX: The starting point position of the current image horizontal width, the minimum input is 0, and the step is 1;
- ◆ OffsetY: The starting point position of the current image height. It is gray read-only. FPGA automatically centers ROI according to the height setting to improve the frame rate. For example, under Normal, if Height = 2048, OffsetY = 1024.
- ◆ BinningAver: The camera Binning mode is switched. When the status is checked, Binning is the mean Bin; When unchecked, Binning is SumBin.
- ◆ BinningHorizontal: Horizontal binning mode selection, supported  $\times 1$ 、 $\times 2$ 、 $\times 4$ 、 $\times 8$ ;
- ◆ BinningVertical: Vertical binning mode selection, supporting  $\times 1$ 、 $\times 2$ 、 $\times 4$ 、 $\times 8$ ;
- ◆ ReverseX: Horizontal mirror switch. If it is checked, the image will be flipped horizontally;
- ◆ ReverseY: Vertical mirror switch. If it is checked, the image will be flipped vertically;
- ◆ PixelFormat: Pixel width switching, supporting 8bit, 10bit and 12bit;
- ◆ TestPattern: Sensor raw data output, supporting horizontal grayscale gradient, bevel grayscale gradient, bevel grayscale gradient movement, and sensor test image; as shown in Fig. 6-4-4.

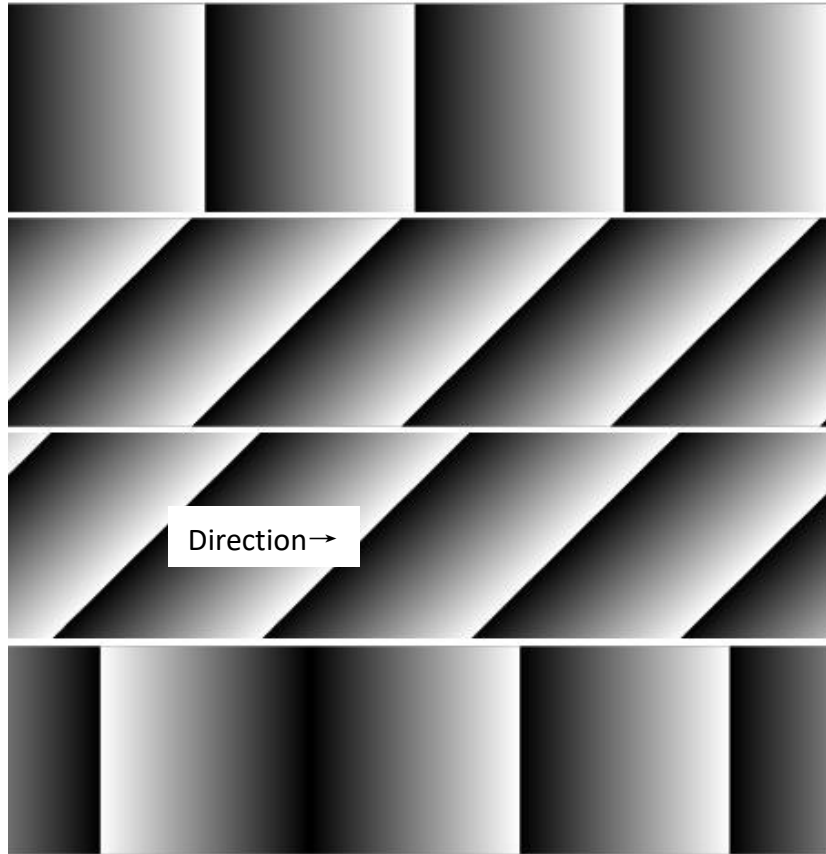


Fig. 6-4-4

### 6.4.3 AcquisitionControl

Set the camera frame rate, trigger mode, exposure mode, trigger filter, etc., as shown in Figure 6-4-5.

AcquisitionControl	
AcquisitionMode	Continuous
AcquisitionStart	AcquisitionStart
AcquisitionStop	AcquisitionStop
AcquisitionFrameRa...	362.394867
AcquisitionFrameRate	25.000000
FrameRateMode	On
ExposureMode	Timed
ExposureTimeMax	37.994999
ExposureTime	35.000000
TriggerMode	Off
TriggerFrameNum	1
TriggerSoftware	TriggerSoftware
TriggerSource	ExternalTrigger
TriggerActivation	Rising Edge

Fig. 6-4-5

- ◆ Acquisition Start: In stream mode, counting restarts after plotting is paused;
- ◆ Acquisition Stop: In stream mode, the current software plotting is suspended and counting stops;

- ◆ AcquireFrameRateMax: Displays the maximum frame rate that the camera can set under the current parameters (gray read-only);
- ◆ AcquireFrameRate: Set the current frame rate of the camera, the minimum setting is 0.095Hz;
- ◆ FrameRateMode: When in On state, the frame rate setting takes precedence. At this time, the maximum exposure time  $s=0.95/\text{frame rate}$  can be set; When it is in the Off state, the exposure time setting takes priority. At this time, the maximum frame rate  $\text{Hz}=0.95/\text{exposure time } s$  can be set;
- ◆ ExposureMode: Exposure mode selection, supporting three modes: Timed (manual exposure time is determined by interface parameter setting), Auto (automatic exposure mode, maximum automatic exposure time is 50ms) and PulseWidth (exposure time is determined by externally triggered high-level duration)

**Note:** When TriggerMode is in On state, PulseWidth can be selected.

- ◆ ExposeTimeMax: Displays the maximum exposure time that the camera can set under the current parameters (gray read-only);
- ◆ ExposeTime: Set the current exposure time of the camera, in ms; The manual exposure time range is 4 $\mu$ s~10s, and the automatic exposure time range is 4 $\mu$ s~50ms;
- ◆ TriggerMode: In On status, external trigger is enabled. In exposure mode, PulseWidth can be selected;

**Note:** When using Full Mode dual frame grabber mode, the number of external triggers must be a multiple of 2.

- ◆ TriggerFrameNum: set the number of frames triggered by an external trigger and a soft trigger pulse, for example: the maximum frame rate of the external trigger camera is 100Hz, the pulse frequency is set to 50Hz, the number of pulses is 100, and the TriggerFrameNum is set to 2. When the trigger signal is triggered, the camera frame rate doubles 100Hz, triggering 200 frames of the plot;



**Note:** The default parameter 1 is recommended for TriggerFrameNum.

TriggerFrameNum > 1 may trigger frame loss.

- ◆ TriggerSoftware: Software trigger, click the button to trigger;
- ◆ TriggerSource: Supports ExternalTrigger and SoftTrigger. When TriggerMode is in On status, users can select ExternalTrigger and SoftTrigger according to trigger requirements;
- ◆ TriggerActivation: Trigger polarity selection, support Rising Edge, Falling Edge and Any Edge;

**Note:** When ExposureMode is in PulseWidth, the trigger polarity does not support Any Edge. When dual camera mode is selected, the number of triggers must be a multiple of 2. If the number is odd, frames will be lost.

### 6.4.4 AnalogControl

Analog, digital gain and black level regulation are shown in Figure 6-4-6.

AnalogControl	
AnalogGain	Gain0
DigitalGain	X1.0000
BlackLevel	0

Fig. 6-4-6

- ◆ AnalogGain: Analog gain, which supports Gain0, Gain1, Gain2, and Gain3;
- ◆ DigitalGain: Digital gain, support × 1~ × 15.5 Switching;
- ◆ BlackLevel: Black level, increase or decrease the background gray value of the image, 8-bit adjustable - 255~255, 10bit and 12bit scaled conversion.

### 6.4.5 LUTControl

LUT module is shown in Figure 6-4-7

LUTControl	
LUTSelector	Luminance
LUTEnable	<input type="checkbox"/>
LUTIndex	1
LUTValue	0
LUTSave	LUTSave
LUTLoad	LUTLoad

Fig. 6-4-7

- ◆ LUTEnable: LUT control switch, which is not enabled by default;

- ◆ LUTIndex: INPUT value. After input, the output value corresponding to the applied curve will be automatically loaded. The range is 0~4095;
- ◆ LUTValue: OUTPUT value, loaded according to the entered LUTIndex value, which can be manually modified and saved, ranging from 0 to 4095;
- ◆ LUTSave: Save the modified curve;
- ◆ LUTLoad: Load the LUT curve written by the application;

Before using the LUT function, the user needs to open the UpdateTool software to write the LUT configuration according to the actual use, as shown in Figure 6-4-8.

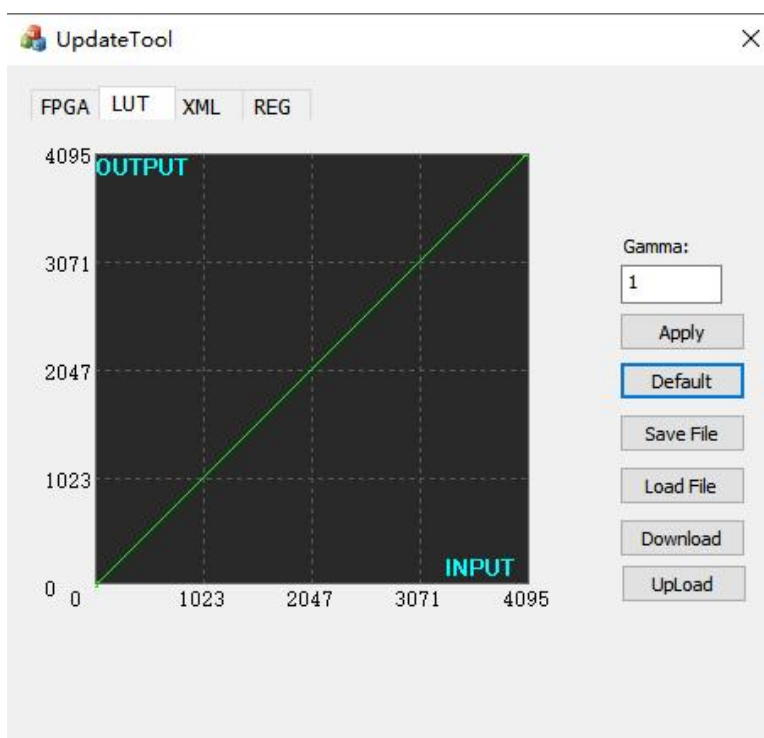


Fig. 6-4-8

- ◆ Gamma: Enter a value to call up the corresponding INPUT-OUTPUT curve;
- ◆ Apply: Apply the current calling LUT curve;
- ◆ Default: Restore the LUT curve state when the default value is Gamma=1;
- ◆ Save File: Save the current LUT curve to the specified file path;
- ◆ Load File: Load the saved LUT curve file;
- ◆ DownLoad: Configure the currently applied LUT curve to the camera;
- ◆ UpLoad: Load and read the applied LUT curve from the camera (you need to save the LUT curve in SamplePro before loading and reading);

The application steps are as follows: ① Input the required gamma value first; ② Click Apply to apply the currently selected curve; ③ Click DownLoad to configure the curve to the camera.

### 6.4.6 DigitalIOControl

The camera trigger output module is shown in Figure 6-4-9

[-] DigitalIOControl	
TriggerOutSel	Ch0
[-] TriggerOutConfig	
TriggerOutMode	ExposureStart
TriggerOutInverter	<input type="checkbox"/>
TriggerOutDelay	0
TriggerOutDuration	10

Fig. 6-4-9

- ◆ TriggerOutSel: Two output channels Ch0 and Ch1 are selected;
- ◆ TriggerOutMode: Select the output type for the currently selected Ch0 or Ch1. Both output channels support ExposureStart and ReadEnd;
- ◆ TriggerOutInverter: Enabling high and low level inversion to control the output signal inversion;
- ◆ TriggerOutDelay: Delay exposure time of output signal, adjustable range 0~10000, unit: us;
- ◆ TriggerOutDuration: Duration of high level of output signal, adjustable range: 0~10000, unit: us.

### 6.4.7 CoolControl

The camera cooling control module is shown in Fig. 6-4-10.

[-] CoolControl	
FanOperationMode	Temperature
FanDutyFactor	50
TECOperationMode	Temperature
TECDutyFactor	0
CoolOperationTempe...	10

Fig. 6-4-10

- ◆ FanOperationMode: Fan mode gear: Off, On, Temperature;
- ◆ FanDutyFactor: Fan speed gear, adjustable by 20~100%;
- ◆ TECOperationMode: TEC mode: Off, On, Temperature;

- ◆ TECCutyFactory: TEC power gear, adjustable by 0~100%;
- ◆ CoolOperationTemperature: Refrigeration target temperature, adjustable range - 30~50 °C, default 10 °C.

### 6.4.8 DPC

DPC	
DPCMode	Off
DPCLevel	Low
DPCGenerate	DPCGenerate
DPCSave	DPCSave
DPCLoad	DPCLoad

Fig. 6-411-

- ◆ DPCMode: Static bad pixel correction enable switches Off and On;
- ◆ DPCLevel: Static bad pixel correction gear selection, supporting Low, Middle and High;
- ◆ DPCGenerate: Click DPCGenerate to correct in dark field environment with long exposure time;
- ◆ DPCSave: Save DPCGenerate correction results;
- ◆ DPCLoad: Load bad point correction results.

### 6.4.9 PRNU

PRNU	
PRNUMode	Off
PRNUSelector	PRNU 0
TargetLevelAUTO	<input checked="" type="checkbox"/>
PRNUTargetLevel	200
PRNUGenerate	PRNUGenerate
PRNUSave	PRNUSave
PRNULoad	PRNULoad
PRNUFactorySave	PRNUFactorySave
PRNUFactoryReset	PRNUFactoryReset

Fig. 6-412-

- ◆ PRNUMode: PRNU correction enable switch, PRNU is turned off in Off gear, and PRNU is turned on in ON gear;
- ◆ PRNUSelector: PRNU gear selection, supporting 6 groups of data from PRNU0 to PRNU5;
- ◆ TargeLevelAUTO: Automatic PRNU mode (the system automatically calculates

the average brightness value of the current image). After enabling, click PRNUGenerate under uniform light in the bright field to automatically generate PRNU correction data;

- ◆ PRNUTargetLevel: Manual PRNU mode. After unchecking the automatic PRNU mode, adjust the brightness of the bright field uniform light to the set gray value by setting the PRNU gray value. Click PRNUGenerate to automatically generate PRNU correction data; (For example, if PRNUTargetLevel is set to 128, then it is necessary to adjust the uniform light of the bright field to the roughly half saturated state of the image, and then click online PRNU correction);
- ◆ PRNUGenerate: Click to do online PRNU correction;
- ◆ PRNUSave: Save the current PRNU results to the selected PRNU0~PRNU5;
- ◆ PRNULoad: Load the saved PRNU data from the selected PRNU0~PRNU5;
- ◆ PRNUFactorySave: Perform factory backup of selected PRNU0~PRNU4;
- ◆ PRNUFactoryReset: Restore the selected PRNU0~PRNU4 to factory backup parameters.

### 6.4.10 CoaXPress

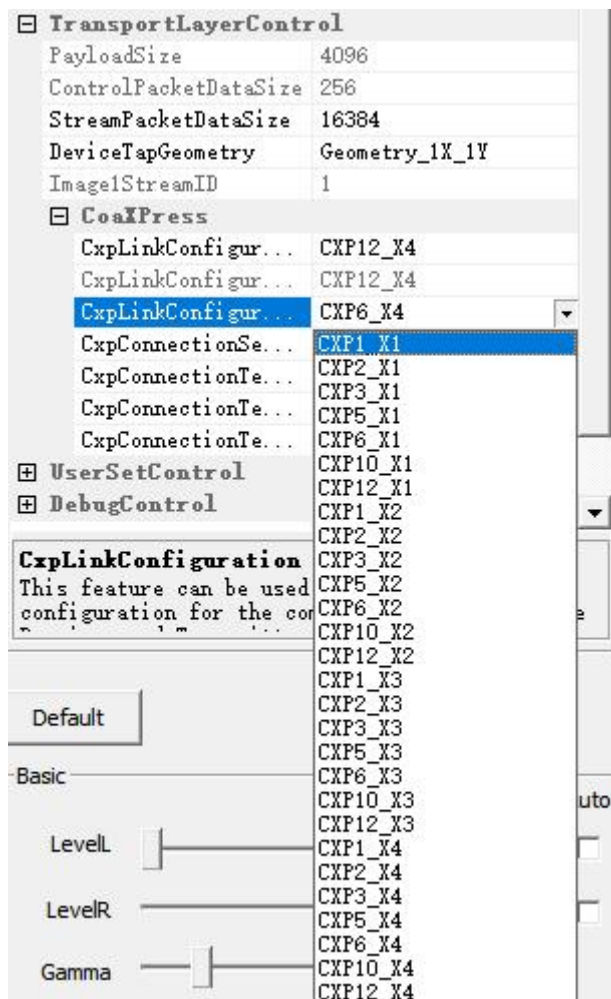


Fig. 6-413-

- ◆ **CxpLinkConfigur... CXP12\_X4**: CXP starts the connection selection by default;
- ◆ **CxpLinkConfigur... CXP12\_X4**: CXP mode switching, default CXP12\_ X4, it needs to be switched in the live state, and the grey cannot be switched in the stop state of the stream mode.

### 6.4.11 UserSetControl

The user configuration module is shown in Figure 6-4-14.

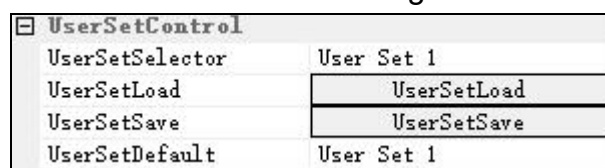


Fig. 6-4-14



- ◆ UserSetSelector: User settings storage, providing three configurations: Default, User Set1 and User Set2;
- ◆ UserSetLoad: Default, user set1 and user set2 parameters selected for camera loading;
- ◆ UserSetSave: Save the modified parameter configuration in the selected User Set1 and User Set2 groups;
- ◆ UserSetDefault: A group of user configurations that are loaded by default after the camera is reset or powered off and restarted. As shown in Figure 6-4-11, the user configuration module is set to User Set1 by default, and the parameters of User Set1 are loaded after the camera is reset or powered off and restarted.



## 7. After Sales

1. Log in to the official website and click the [Technical Support] module to get FAQs.

2. Warranty:

(1) The product warranty period is 24 months from the date of shipment. If the damage during this period meets the warranty requirements, we will repair it free of charge;

(2) The scope of warranty is limited to defects in product materials and manufacturing. Damage caused by self disassembly, water ingress, throwing, etc. and natural disasters are not covered by the warranty.

3. Contact professionals for technical support:

TEL: 400-075-8880 0591-88194580-811

Email: [service@tucsen.com](mailto:service@tucsen.com)

Or log in to TUCSEN official website and leave a message: <http://www.tucsen.com>.

Please prepare the following information in advance:

- 1) Camera model and S/N (product serial number);
- 2) Software version number and computer system information;
- 3) Description of the problem and any images related to the problem.