Hikrobot Co., Ltd.

GigE Line Scan Camera

User Manual

HIKROBOT

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The symbols that may be found in this document are defined as follows.

Symbol	Description
Danger	Indicates a hazard with a high level of risk, which if not avoided, will result in death or serious injury.
Caution	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance degradation, or unexpected results.
Note	Provides additional information to emphasize or supplement important points of the main text.

Available Model

This manual is applicable to the following models of GigE Line Scan Camera:
MV-CL044-91NM, MV-CL044-91NC, MV-CL084-B1NM, and MV-CL084-B1NC.

Contact Information

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Contents

Chapter 1 Safety Instruction

The safety instructions are intended to ensure that the user can use the device correctly to avoid danger or property loss. Read and follow these safety instructions before installing, operating and maintaining the device.

1.1 Safety Claim

- To ensure personal and device safety, when installing, operating, and maintaining the device, follow the signs on the device and all safety instructions described in the manual.
- The note, caution and danger items in the manual do not represent all the safety instructions that should be observed, but only serve as a supplement to all the safety instructions.
- The device should be used in an environment that meets the design specifications, otherwise it may cause malfunctions, and malfunctions or component damage caused by non-compliance with relevant regulations are not within the scope of the device's quality assurance.
- Our company will not bear any legal responsibility for personal safety accidents and property losses caused by abnormal operation of the device.

1.2 Safety Instruction

Caution:

- Do not install the device if it is found that the device and accessories are damaged, rusted, water ingress, model mismatch, missing parts, etc., when unpacking.
- Avoid storage and transportation in places such as water splashing and rain, direct sunlight, strong electric fields, strong magnetic fields, and strong vibrations.
- Avoid dropping, smashing or vigorously vibrating the device and its components.
- It is forbidden to install the indoor device in an environment where it may be exposed to water or other liquids. If the device is damp, it may cause fire and electric shock hazard.
- Place the device in a place out of direct sunlight and ventilation, away from heat sources such as heaters and radiators.
- In the use of the device, you must be in strict compliance with the electrical safety regulations of the nation and region.
- Use the power adapter provided by the official manufacturer. The power adapter must meet the Limited Power Source (LPS) requirements. For specific requirements, please refer to the device’s technical specifications.
- Do not cover the device's plug or outlet for disconnecting power supply.
- It is strictly forbidden to wire, maintain, and disassemble the device is powered on.

Otherwise, there is a danger of electric shock.

- If the device emits smoke, odor or noise, please turn off the power and unplug the power cord immediately, and contact the dealer or service center in time.
- It is strictly forbidden to touch any terminal of the device when operating it. Otherwise there is a danger of electric shock.
- It is strictly forbidden for non-professional technicians to detect signals during device operation, otherwise it may cause personal injury or device damage.
- It is strictly forbidden to maintain the device is powered on, otherwise there is a danger of electric shock.
- Avoid aiming the lens at strong light (such as lighting, sunlight, or laser beams, etc.), otherwise the image sensor will be damaged.
- Keep clean of the device's image acquisition window. It is recommended to use cleaning water (not the alcohol-based corrosive solutions) to wipe off the dust. When the device is not in use, please add a dust cover to protect the image acquisition window.
- If the device does not work properly, please contact your dealer or the nearest service center. Never attempt to disassemble the device yourself (we shall not assume any responsibility for problems caused by unauthorized repair or maintenance).
- Please dispose of the device in strict accordance with the relevant national or regional regulations and standards to avoid environmental pollution and property damage.

Note:

- Check whether the device’s package is in good condition, whether there is damage, intrusion, moisture, deformation, etc. before unpacking.
- Check the surface of the device and accessories for damage, rust, bumps, etc. when unpacking.
- Check whether the quantity and information of the device and accessories are complete after unpacking.
- Store and transport the device according to the storage and transport conditions of the device, and the storage temperature and humidity should meet the requirements.
- It is strictly prohibited to transport the device in combination with items that may affect or damage the device.
- Quality requirements for installation and maintenance personnel:
  - Qualification certificate or working experience in weak current system installation and maintenance, and relevant working experience and qualifications. Besides, the personnel must possess the following knowledge and operation skills.
  - The basic knowledge and operation skills of low voltage wiring and low voltage electronic circuit connection.
  - The ability to comprehend the contents of this manual.
- Please read the manual and safety instructions carefully before installing the device.
- Please install the device strictly according to the installation method in this manual.
- The case of the device may be overheated, and it needs to be powered off for half an hour before it can be touched.
- The device should not be placed with exposed flame sources, such as lighted candles.

1.3 Electromagnetic Interference Prevention

- Make sure that the shielding layer of cables is intact and 360° connected to the metal connector when using shielded cables.
- Do not route the device together with other equipment (especially servo motors, high-power devices, etc.), and control the distance between cables to more than 10 cm. Make sure to shield the cables if unavoidable.
- The control cable of the device and the power cable of the industrial light source must be wired separately to avoid bundled wiring.
- The power cable, data cable, signal cable, etc. of the device must be wired separately. Make sure to ground them if the wiring groove is used to separate the wiring and the wiring groove is metal.
- During the wiring process, evaluate the wiring space reasonably, and do not pull the cables hard, so as not to damage the electrical performance of the cables.
- If the device is powered on and off frequently, it is necessary to strengthen the voltage isolation, and consider adding a DC/DC isolation power supply module between the device and the adapter.
- Use the power adapter to supply power to the device separately. If centralized power supply is necessary, make sure to use a DC filter to filter the power supply of the device separately before use.
- The unused cables of the device must be insulated.
- When installing the device, if you cannot ensure that the device itself and all equipment connected to the device are well grounded, you should isolate the device with an insulating bracket.
- To avoid the accumulation of static electricity, ensure that other equipment (such as machines, internal components, etc.) and metal brackets on site are properly grounded.
- During the installation and use of the device, high voltage leakage must be avoided.
- Use a figure-eight bundle method if the device cable is too long.
- When connecting the device and metal accessories, they must be connected firmly to maintain good conductivity.
- Use a shielded network cable to connect to the device. If you use a self-made network cable, make sure that the shielding shell at the aviation head is well connected to the aluminum foil or metal braid of the shielding cable.

Chapter 2 Cleaning Instruction

2.1 Device and Lens Cleaning

Four ways are available to clean the device and lens when they have dust or stains. Refer to the following table for different devices and their supported cleaning methods.

Table 2-1 Device and Cleaning Method

Device / Cleaning Method	Camera	Lens
Rubber Dust Air Blower	Support	Support
Mirror Brush Cleaning	Not Support	Support
Contact Cleaning	Support	Support
Lens Cleaning Paper	Not Support	Support

2.1.1 Rubber Dust Air Blower

You can use a rubber dusk air blower to clean the dust on the surface of the device filter and lens. The specific operation steps are as follows:

Steps

1. Blow the rubber dusk air blower downward several times to blow out the dust inside.
2. Hold the device or lens and tilt it down so that the air blower port and the device lens are at an angle of 45 degrees.
3. Blow to clean the dust on the surface of the device filter and lens.

Figure 2-1 Cleaning by Rubber Dust Air Blower

Note

- Do not go too far into the device's lens mount and avoid direct contact with the dust glass when cleaning.
- It is strictly forbidden to blow the lens directly from the mouth, and avoid spattering saliva particles onto the glass surface, causing serious secondary pollution.

2.1.2 Mirror Brush Cleaning

If the dust on the surface of the lens cannot be cleaned by rubber dusk air blower, use a mirror brush to gently remove the dust on the surface of the lens.

Note

Do not touch the bristles directly with your hands.

2.1.3 Contact Cleaning

For the stubborn stains on device filter or lens surface, such as finger marks, liquid stains, etc., it is recommended to use a fat-free cotton swab or dust-free cloth with high purity alcohol to wipe clean. Take the fat-free cotton swab as an example, and the specific operation steps are as follows:

Steps

1. Take a clean fat-free cotton swab, and dip it in proper amount of alcohol or cleaning liquid.

Note

Do not touch the head of the cotton swab by fingers.

2. Tilt the fat-free cotton swab about 60 degrees, resist the device filter or lens surface, clean from left to right, turn cotton swab over one side, and clean again from right to left.
3. Take another fat-free cotton swab that is not stained with alcohol or cleaning liquid and swipe the device filter or lens to absorb the remaining alcohol or cleaning liquid.
4. Check whether there is still a stain. If the stain changes position, repeat steps above, until the stain is cleaned.

Figure 2-2 Contact Cleaning

Note

If the stains on the lens cannot be wiped or clean, please clean by using lens cleaning paper. For specific operation steps, please refer to the next section.

2.1.4 Lens Cleaning Paper

For lens stains that cannot be cleaned by a fat-free cotton swab or dust-free cloth, use lens cleaning paper to clean them.

Before You Start

- Use lens paper purchased from a regular, professional photography store.
- Use freshly opened lens cleaning paper in a wet state.
- Make sure there is no hard dust on the lens.

Tear off the outer package of the lens cleaning paper, fold the pre-moistened paper to a suitable wiping state, and slowly spiral wipe it in the same direction from the center of the lens outward.

Figure 2-3 Cleaning by Lens Cleaning Paper

Note

- Do not use hard paper, paper towels, or napkins to clean the lens. These products contain scratching wood pulp, which will seriously damage delicate coating on the lens.
- Do not press the lens surface hard when cleaning it the lens cleaning paper. Otherwise, the fragile coating on the lens surface will be wiped off.

After completing the lens cleaning, no dust or water stains should be visible from all directions on the lens. If stains still exist, please contact us to return the device for cleaning.

2.2 Device Housing Cleaning

When cleaning the device, try to clean it in a closed room to avoid a large amount of dust in the environment. The specific operation steps are as follows:

Steps

1. Disconnect the device's power supply.
2. Take a soft lint-free cloth that will not cause static electricity during cleaning and soak it with a neutral detergent.
3. Wipe the device's housing with a soaked, lint-free cloth as appropriate.
4. Wait for the residual moisture to evaporate after wiping. When the moisture has completely evaporated, you can reconnect the device to the power supply.

Note

Do not use compressed air to accelerate evaporation.

After inspecting and confirming that the device lens and its housing are cleaned, install the device lens cap with the mount facing downwards, or store the lens properly.

Chapter 3 Overview

3.1 Introduction

The GigE line scan camera uses the Ethernet interface to transmit non-compressed images in real time, and it acquires images and sets parameters via the client software or SDK. The GigE line scan camera is applicable to the new energy, consumer electronics, medical material, textiles, railway, material sorting, etc.

3.2 Key Feature

- Adopts Ethernet interface and max. transmission distance of 100 meters theoretically.
- Supports auto and manual adjustment for gain and exposure time, and manual adjustment for Look-Up Table (LUT), Gamma correction, etc.
- Compact design and flexible installation.
- Supports ISP image functions and auto adjustment of white balance on the specific region or the whole image.
- Compatible with GigE Vision V2.0 and GenICam standard, and the third-party software based on the protocol and standard.

Note

- The specific functions may differ by device models.
- Refer to the device's specifications for specific parameters.

3.3 Operating Principle

The onboard block diagram of the device is shown below. After the image sensor receives the image data, it completes the image data processing through various built-in ISP image-processing algorithms, and finally completes the high-speed transmission of image data through the GigE Vision protocol.

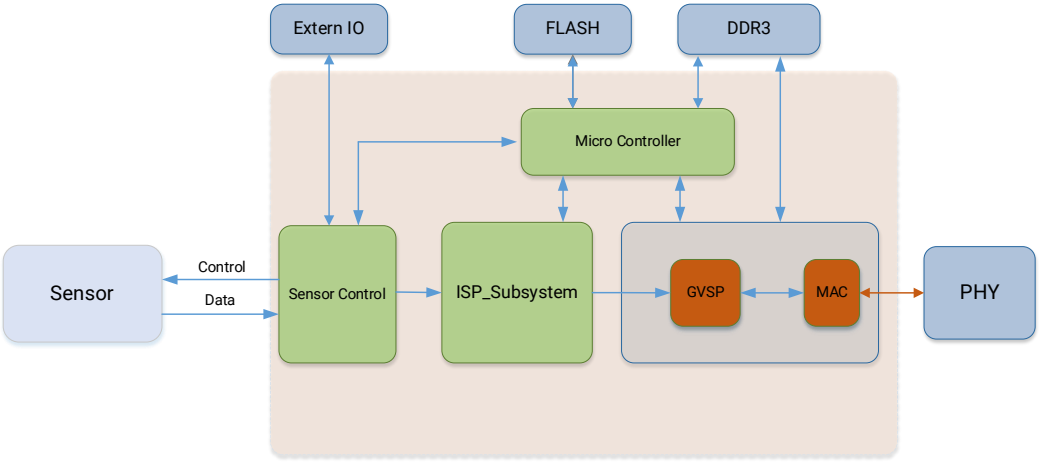


Figure 3-1 Operating Principle

Chapter 4 Device Hardware

4.1 Appearance

Note

- The device's appearance may differ by device models. The image below is for reference only. For specific appearance and dimension, please refer to the device's specification for details.
- The appearance is subject to change, and the actual device you purchased shall prevail.

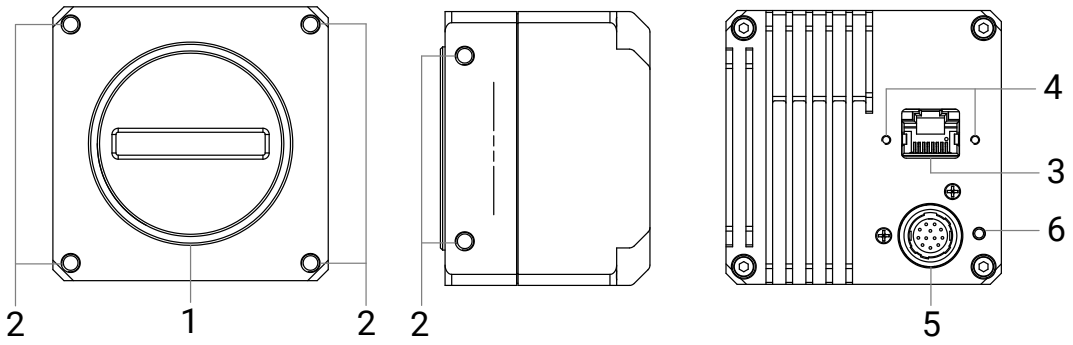


Figure 4-1 Appearance

Table 4-1 Component Description

No.	Component	Description
1	Lens Mount	It is used to install the lens. Refer to the device's specification for specific lens mount information.
2	Screw Hole	It refers to the M4 screw, and is used to fix the device to the installation position.
3	RJ45 Network Interface	It refers to the RJ45 network interface for transmitting data.
4	Screw Hole of Network Interface	It refers to the M2 screw hole for fixing the network cable.
5	Power and I/O Connector	It provides power supply, I/O, and serial port function. It includes 12-pin P10 connector. Refer to the device's specification and section ***Power and I/O Connector*** for details.
6	LED Indicator	It indicates the device's status. See section ***Indicator*** for details.

4.2 Power and I/O Connector

The device has a 12-pin P10 connector serving as the power and I/O connector that provides power supply, I/O, and serial port function.

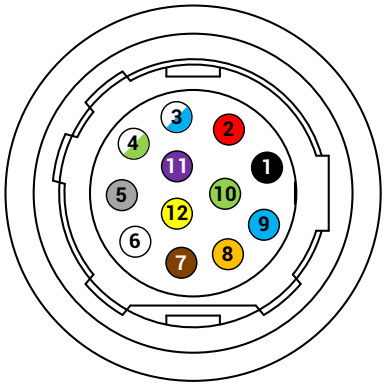


Figure 4-2 12-Pin P10 Connector

Note

- Refer to the table below and the label attached to the power and I/O cable to wire the device.
- The wire cores shown in figure and table are only the wire sequence and the corresponding wire core color of the cables sold by our company. If the cables are not purchased from our company, please refer to the actual wire sequence and the corresponding wire core color.

Table 4-2 Pin Definitions of 12-Pin P10 Connector

No.	Color	Signal	I/O Signal Source	Description
1	Black	GND	--	Device power supply ground
2	Red	DC_PWR	--	Direct current power supply positive
3	White/Blue	LINE0_P	Line 0+	Differential input/output IO 0 +
4	White/Green	LINE0_N	Line 0-	Differential input/output IO 0 -
5	Gray	GND	--	Device power supply ground
6	White	LINE3_P	Line 3+	Differential input/output IO 3 +
7	Brown	LINE3_N	Line 3-	Differential input/output IO 3 -
8	Orange	LINE4_P	Line 4+	Differential input/output IO 4 +
9	Blue	LINE1_P	Line 1+	Differential input/output IO 1 +
10	Green	LINE1_N	Line 1-	Differential input/output IO 1 -
11	Purple	DC_PWR	--	Direct current power supply positive

No.	Color	Signal	I/O Signal Source	Description
12	Yellow	LINE4_N	Line 4-	Differential input/output IO 4 -

4.3 Indicator

The device's indicator is used to indicate the operation status of the device.

Note

- The indicator status may differ by device models, and actual devices you purchased shall prevail.
- When the indicator is lit up, flashing rapidly, flashing slowly, and flashing very slowly, its unlit interval is 5 sec, 0.2 sec, 1 sec, and 2 sec respectively.
- The indicator sometimes may show a purple color when red and blue colors flashing at the same time.

Table 4-3 Indicator Description

No.	Indicator Color	Status	Device Status Description
1	Red	Flashing very slowly	The device's wiring exception occurs.
2	Red	Solid	The device exception occurs.
3	Blue	Flashing slowly	The device is acquiring images in trigger mode.
4	Blue	Flashing rapidly	The device is acquiring images normally.
5	Blue	Solid	The device is in an idle status.
6	Red and Blue	Slow flashing in alternative	The function of finding me is executed, or the firmware is updating.

Chapter 5 Power Supply and Heat Dissipation

5.1 Device Power Supply

The device provides two ways of power supply, including PoE and power supply via external DC power supply.
When the external DC power supply and PoE power supply exist at the same time, the external DC power supply preferentially supplies power to the device. If the external DC power supply is unplugged at this time, the device will switch to PoE power supply, and it is possible to restart the device.

5.1.1 PoE Power Supply

If the device supports Power over Ethernet (PoE) power supply, the network cable can be inserted into the RJ45 port. Use a PSE (Power Sourcing Equipment) that complies with the IEEE 802 3af standard and the IEEE 802 3at standard to power the device.

5.1.2 DC Power Supply

Connect the external DC power supply to the I/O connector through the I/O cable to power the device. Refer to the device's label for the specific voltage range of power supply.

Note

- Using a DC power supply that exceeds the specified voltage range may cause damage or abnormal operation of the device.
- Inserting a connector that does not match the I/O connector may cause damage or abnormal operation of the device. Refer to section ***Power and I/O Connector*** for details.
- Do not short-circuit the power supply and ground.

You can use an industrial power supply to provide DC power supply for the device. When using it, please observe the following precautions:

- Before carrying out any installation or maintenance work, make sure that the power supply is disconnected from the AC power and that there is no risk of accidental reconnection due to human negligence or wiring issues.
- Do not install the power supply in a humid environment, near liquid, in high-temperature conditions, in direct sunlight, or near flame sources.
- The industrial power supply has exposed high-voltage terminals. Please install it in an enclosed case or cabinet to prevent accidental contact by personnel.
- Maintain sufficient insulation distance between the internal components of the power supply and the screws.
- Ensure that the cooling fan and holes for heat dissipation are unobstructed. If adjacent

equipment generates heat, keep it at least 10 cm to 15 cm away from the power supply.
- Make sure the power supply is properly grounded before use.
- When using the power supply, do not exceed the upper limit of its output current and output power. Refer to the power supply's nameplate for specific parameters.
- Non-standard installations or using the power supply in high-temperature environments will increase the temperature of the internal components, potentially reducing output power.
- The power supply contains high-voltage circuits that pose a risk. If any abnormalities occur, disconnect the power first and have it inspected by a technician with professional electrical qualifications. Do not attempt to open the casing yourself.
- Avoid touching the power supply terminals within 5 minutes after the power has been cut off to prevent the risk of electric shock.

5.2 Heat Dissipation

The device contains photosensitive components. If the device's temperature rises, it will have a certain impact on the quality of the acquired image. Based on the above situation, this section will introduce the temperature parameters and installation suggestions to achieve better heat dissipation effect and improve the image quality and reliability of the device.

5.2.1 Temperature Parameter

Working Temperature

The temperature of the key components of industrial cameras is a key factor affecting image quality, operation stability and long-term reliability. The upper limit of the working environment temperature in the specification of the industrial camera refers to the maximum ambient temperature that the device can meet without any additional heat dissipation measures. Running within the working temperature can meet the temperature requirements on the electronic components and ensure the reliable operation of the device.
The monitoring point of the working environment temperature of the device is 80 mm away from the main housing of the device, as shown below. In the space where the device and the temperature measuring point are located, there is no object in the middle and the temperature is evenly distributed.

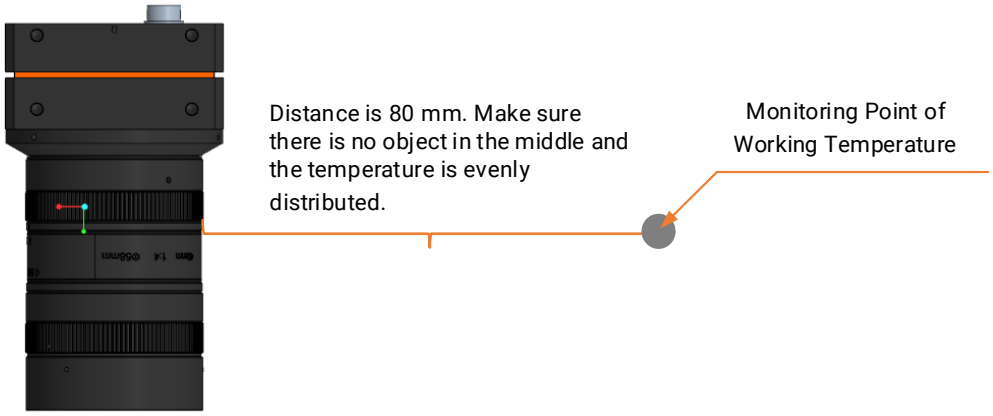


Figure 5-1 Monitoring Point of Working Temperature

Housing Temperature

After the heat generated by the electronic components is conducted to the device's housing, if the device does not have any additional heat dissipation measures, the heat is dissipated to the external environment in the form of convection and radiation through the device's housing.

The temperature of the device's housing will gradually rise during the heat dissipation process, and when the thermal equilibrium state is finally reached, the temperature tends to be stable. Therefore, we often feel that the device's housing has a certain temperature, or feel hot, which is a normal phenomenon of device heat dissipation.

The temperature of the internal electronic components is a key factor affecting image quality, device operating stability, and long-term reliability. Therefore, better image quality and reliability can be obtained by lowering the temperature of the housing and the internal electronic components.

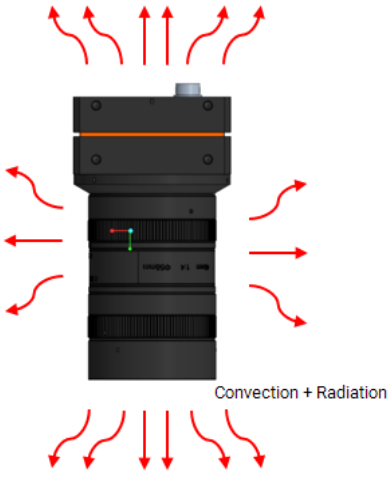


Figure 5-2 Housing Temperature

5.2.2 Heat Dissipation Measures

The temperature of the device housing is influenced by the power consumption, the device size, the environment, and additional heat dissipation measures. By designing the camera to be mounted in the field, additional camera cooling measures can quickly dissipate the heat from the housing to the outside environment.
In the industrial field, the heat of the camera housing can be dissipated through the mounting parts and fixed platforms, and the cooling effect of such cooling measures depends on the thermal conductivity of the material and the mounting parts. This section will be respectively on the material and mounting methods to do specific instructions.

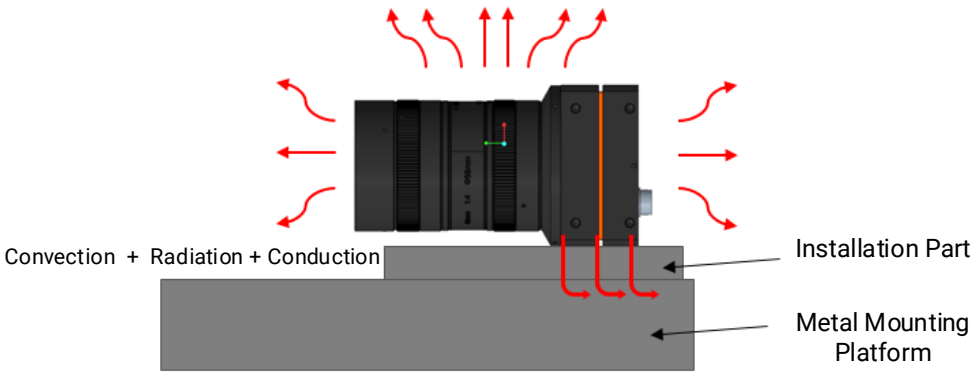


Figure 5-3 Heat Dissipation via Installation Part

- **Installation Part Material**
  - Use materials with high heat conduction, such as aluminum and copper, which can quickly transfer heat away.
  - Minimize the use of materials with low heat conduction, such as plastic and rubber.

Note

The heat dissipation mentioned in the following part (heat conduction path and contact area) is for materials with high heat conductivity.

- **Heat Conduction Path**
  - The heat conduction path of the installation part should be as short as possible to improve the heat conduction efficiency.
  - The thickness, length, and bending of the installation part will affect the heat conduction path distance of the device.

  As shown in the installation method 1 and 2 in the figure below, the thickness of the installation part should be reduced as much as possible to shorten the heat conduction path from the device to the metal mounting platform via the installation part.
  As shown in the installation method 3 and 4 in the figure below, the extension of the length of the installation part and the use of bent metal will lead to the lengthening of

the heat conduction path of the device.

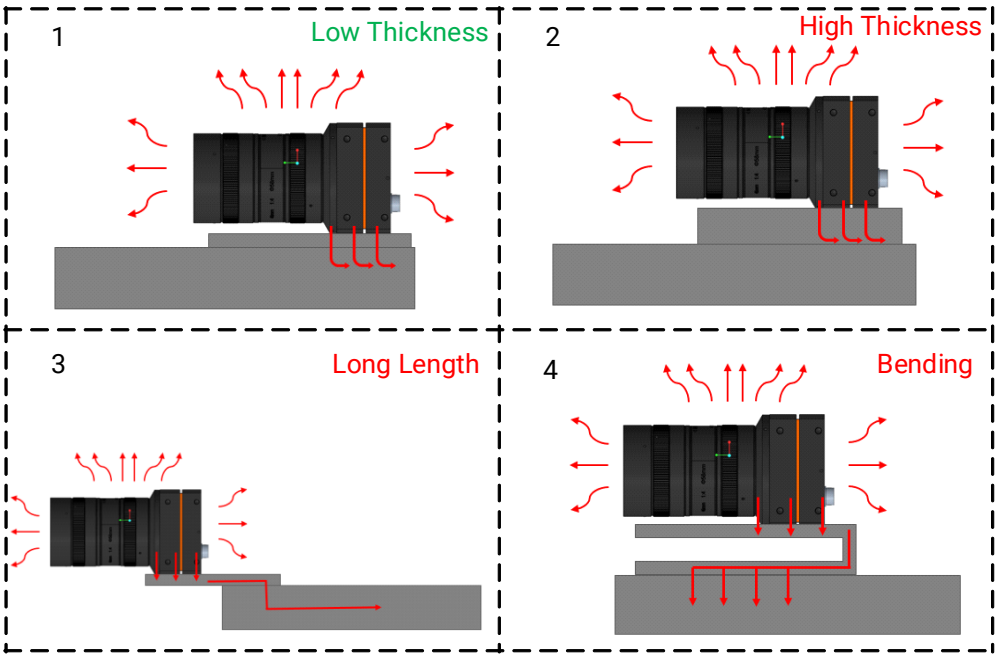


Figure 5-4 Heat Conduction Path of Different Installation Methods

- **Contact Area**
  Surface contact should be used among the device, installation parts and the mounting platform, and the contact area between installation surfaces should be increased as much as possible to improve the heat dissipation of the device. The flatness of the installation part should be within 0.1 mm, in case the actual contact surface is not completely close, affecting the heat dissipation effect.

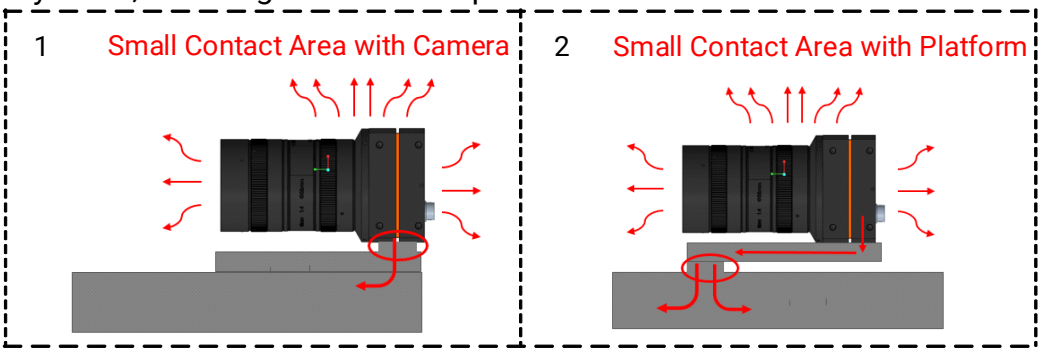


Figure 5-5 Contact Area

5.2.3 Low Heat Conduction Material

If the installation part is made of plastic, rubber, or other materials with poor heat conduction, the application of ventilation equipment such as fans or air conditioners can increase the airflow over the device's surface. This reduces the ambient air temperature around the device, enhancing heat dissipation through convection and thereby reducing the temperature of housing. As a result, the image quality and reliability of the device are

improved.

If the mounting platform is made of materials with very poor heat conduction such as plastic and wall, heat dissipation can be improved in the following ways:

- Increase the surface area of the installation part.
  If the installation part is in good contact with the device, it can be regarded as a part of the device's housing. The larger the heat dissipation area of the housing, the better the heat dissipation effect. Therefore, the larger the surface area of the installation part, the better the heat dissipation effect.
- The installation part can be made into a metal heat dissipation tooth shape, or a large area flat plate to improve the heat dissipation effect.

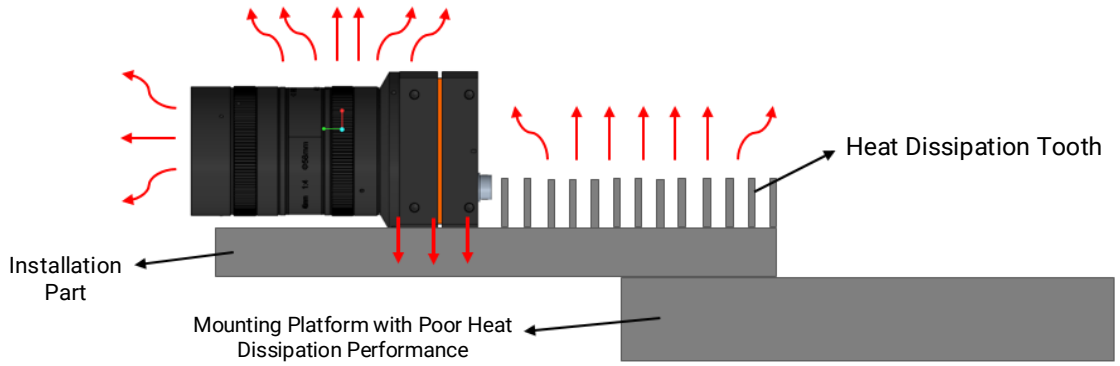


Figure 5-6 Add Heat Dissipation Tooth

- While increasing the heat dissipation area of the installation part, painting and oxidation can be used to increase the radiation heat exchange of the installation part to the external environment and strengthen the heat dissipation of the device.

Chapter 6 Accessories

6.1 Lens

6.1.1 Lens Mount

The device supports standard M42-mount lenses which can be connected to F-mount, C-mount, and other lenses via the adapter ring. The thread depth of the M42-mount lens is not less than 5.5 mm.

6.1.2 Lens Selection

In order to meet the image acquisition needs of industrial cameras, our company provides a variety of lenses with high performance, high definition, low distortion rate, and other features. You should consider following factors when selecting a lens:

- Lens mount: The device supports standard M42-mount lenses. When selecting lens, select lens with the same mount. When the mounts of the device and the lens are different, part of the lens mounts may be connected by using the corresponding adapter ring.
- Flange back length: The flange back length of different lenses is varied. It is necessary to select the lens with the matched flange back length.
- Sensor size: Make sure that the target surface of the lens is larger than or equal to the size of the device's sensor size.
- Resolution: It represents the ability of the lens to record the details of an object. It is generally measured in the number of line pairs that can be distinguished per millimeter: line pairs/millimeter (lp/mm). The higher the resolution of the lens, the clearer the image. Make sure that the accuracy required by the system is less than the resolution of the lens when selecting the lens.
- Working distance: It refers to the distance from the first working surface of the lens to the measured object. Make sure that the working distance is greater than the minimum object distance of the lens when selecting a lens.
- Focal length: The distance from the center point of the lens to the clear image formed on the focal plane. The smaller the focal length value is, the larger the field of view of the image captured by the digital camera is. According to the focal length of the lens, the appropriate working distance can be set up, or the appropriate lens can be selected according to the requirements of the working distance.

Note

In order to better provide a suitable lens model, you can go to the official website of our company (***https://en.hikrobotics.com/***): **Products** → **Lens** → **Lens Selector** to enter

your application parameters, and you will find a suitable lens model. If you have any problems, please contact our technical support.

6.2 Cable

6.2.1 Cable Selection

According to the cable performance, it can be divided into standard, flexible, high flexible and super flexible cables. You need to select cables according to different scenarios.

- Standard cable: It is applicable to static scenario only.
- Flexible cable: It can withstand 100,000 times of drag chain or bending movement.
- High flexible cable: It can withstand 5 million times of drag chain movement.
- Super flexible cable: It can withstand 10 million times of drag chain movement, 3 million times of bending movement or 5 million times of twisting movement.

6.2.2 Wiring Principle

Regarding the power and I/O cable and network cable, attention should be paid to the application requirements of scenarios such as high-frequency communication and high-frequency motion. In such scenarios, if the cables are arranged in an inappropriate manner, various problems may be caused in use, such as cable skin wear, internal conductor breakage, and device packet loss. Based on the above situation, this section introduces the basic wiring principles and precautions of sports cables to help you install and use related products correctly and improve the overall healthy operating life of the system.

- The minimum bending radius of the chain rail during wiring should be controlled at more than 10 to 12 times the wire diameter (the larger the bending radius, the longer the cable movement life).
- Make sure that the cable does not spin in the chain rail, and the cable should be spread horizontally along the chain rail.
- If the cable is laid too tightly, the cable sheath and the chain rail will produce friction during the movement, which will cause the sheath to wear. Therefore, in the wiring process, the laying tension on the cable should be avoided.
- If the cable is fixed at the moving part of the chain rail, stress concentration will occur at the fixed position during the movement. Therefore, both ends of the cable can be fixed, but not at the middle moving section.
- Multiple cables may interfere with each other when moving in the chain rail. At this time, the chain rail with sufficient width should be selected to ensure that there is still a certain space after the cables are laid horizontally. The use of spacers is also an effective way to avoid interference. Note that there should also be at least 2 mm clearance between the spacer and the cable. Do not drain cables without spacers.
- Please keep the space factor occupied by the cable after laying within 30%, as shown

below.

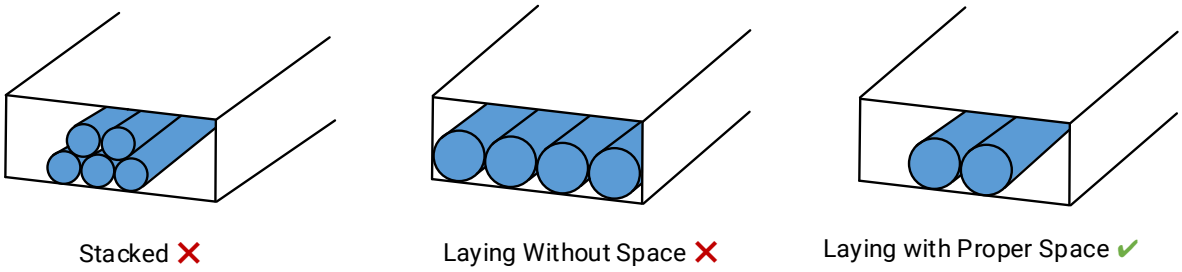


Figure 6-1 Cable Laying

- In the same chain rail, if there are cables with different thicknesses and diameters, the cables with small outer diameter are easily squeezed to the bottom by the cables with large outer diameter. In this case, use spacers for classification and isolation, as shown below.

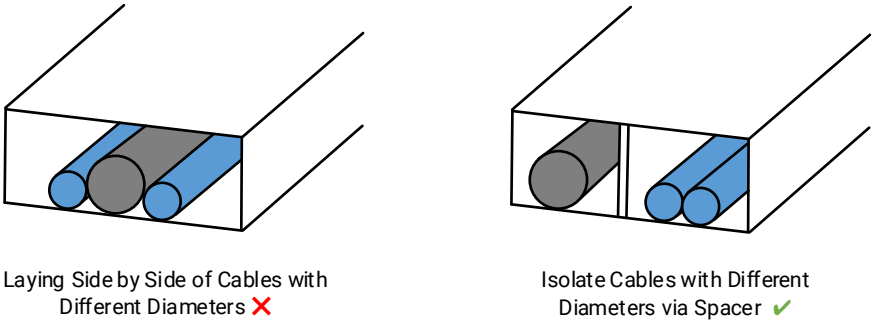


Figure 6-2 Isolated via Spacer

- If the wiring is in the same track as the hard object such as the air pipe, use a spacer to isolate it.
- If the chain rail is damaged, replace the chain rail and cable at the same time, because the damaged chain rail may aggravate the damage to the cable.
- Do not bend the cable vertically on the fixed point.

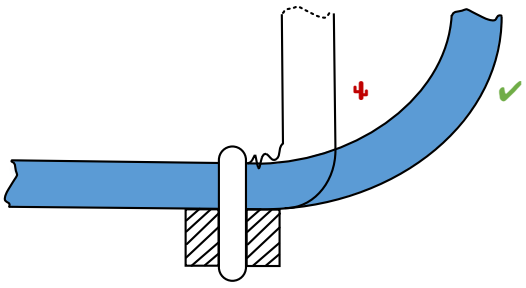


Figure 6-3 Vertically Bended Prohibited

- Make sure to reserve a suitable bending length for the cable.

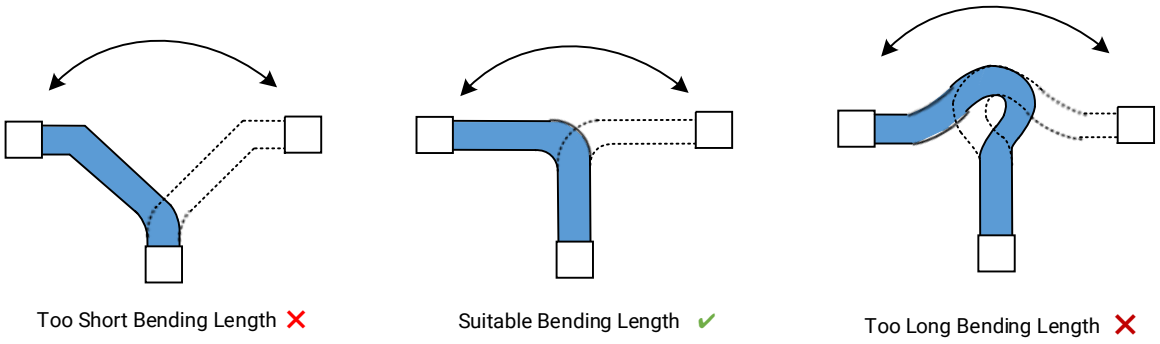


Figure 6-4 Suitable Bending Length

- Please keep a sufficient bending radius.

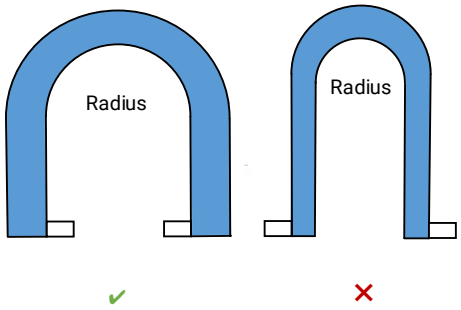


Figure 6-5 Sufficient Bending Radius

- When assembling the connector, please fix it on the connector net tail instead of the cable body.

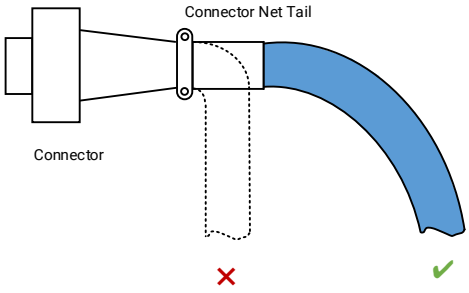


Figure 6-6 Assemble Connector

- Do not bind cables of different diameters together.

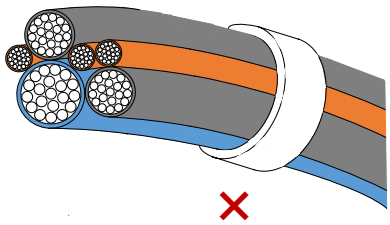


Figure 6-7 Improper Binding

Chapter 7 Quick Start Guide

7.1 Device Installation

7.1.1 Installation Preparation

You need to prepare following accessories before device installation.

Table 7-1 Accessories

No.	Name	Quantity	Description
1	Power and I/O Cable	1	It refers to the 12-pin power and I/O cable. You need to purchase separately.
2	DC Power Supply	1	You should select a suitable power adapter or switch power supply according to the device power supply and consumption. You need to purchase separately.
3	Network Cable	1	It refers to Cat5e or Cat6a network cable. You need to purchase separately.
4	Lens	1	You need to purchase separately in accordance with device's lens mount.
5	Lens Adapter	1	If other lenses are used, you need to purchase the lens adapter separately.

7.1.2 Install Device

The topology diagram of the device is shown below.

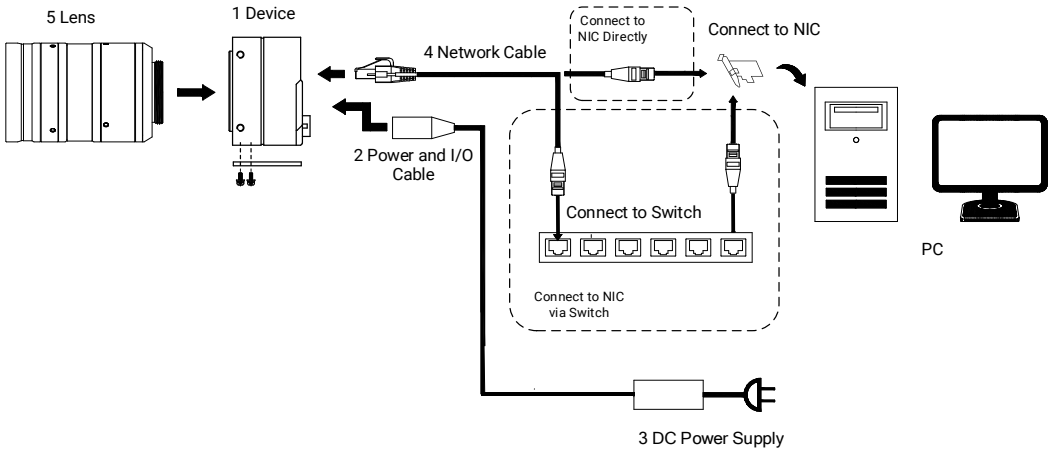


Figure 7-1 Topology Diagram

Note

The topology diagram is for reference only.

Before You Start

- Make sure that the device in package is in good condition and all assembly parts are included.
- Make sure that all related devices are powered off during the installation.

Steps

1. Fix the device to the installation position, select an appropriate lens, and install on the device.

Note

During device installation, heat dissipation measures of installation parts can be taken to improve the efficiency of heat dissipation. Refer to section ***Heat Dissipation Measures*** for details.

2. Use the Cat5e or Cat6a network cable to connect device to a switch or a network interface card.
3. Use one of the following methods for power supply.

- Direct plug-in power supply: Use the 12-pin power and I/O cable to connect device to a proper power adapter. Refer to section ***Power and I/O Connector*** for details.
- PoE power supply: It is valid for the devices that support the PoE function only. You can use a network cable to connect the device to a switch or network card with the PoE function. Refer to the device's specification for PoE information.

7.2 Install Client Software

MVS client software is used to connect and set device's parameters, and acquire images.

Note

- The MVS client software is compatible with 32/64-bit Windows 7/10/11, 32/64-bit Linux, and Android 4.4 to 9.0 operating systems. Here we take Windows as an example.
- The graphic user interface may differ by different versions of the client software you use.
- The client software has integrated driver required by hardware, and no need to download and install other drivers.
- You can download the client software from ***en.hikrobotics.com***.

Steps

1. Double click the MVS installation package.
2. Select the language.
3. Read and check **Terms of the License Agreement**.

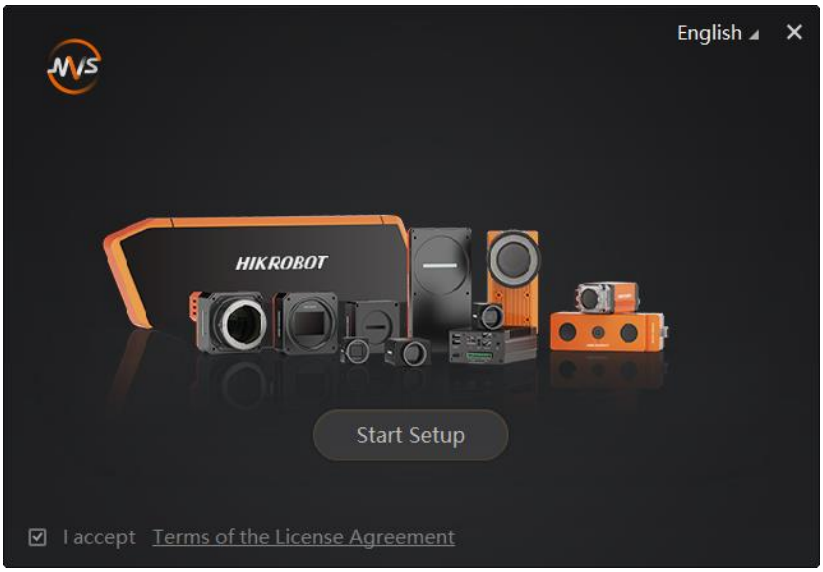


Figure 7-2 Installation Interface

4. Click **Start Setup**.
5. Select installation directory, driver and others.

- **Select Driver**: You can check **GIGE**, **USB 3.0** and **PCIE** according to actual demands.
- **Others**: Check **Enable built-in debug features** to make it easier to use breakpoints while the device is connected and streaming images. Check **Enable Jumbo Frame for All NICs** to enhance network transmission performance. Check **PCIe-CML**, **PCIe-CXP**, **PCIE-GEV**, **PCIE-XoF** to enumerate the corresponding frame grabbers.

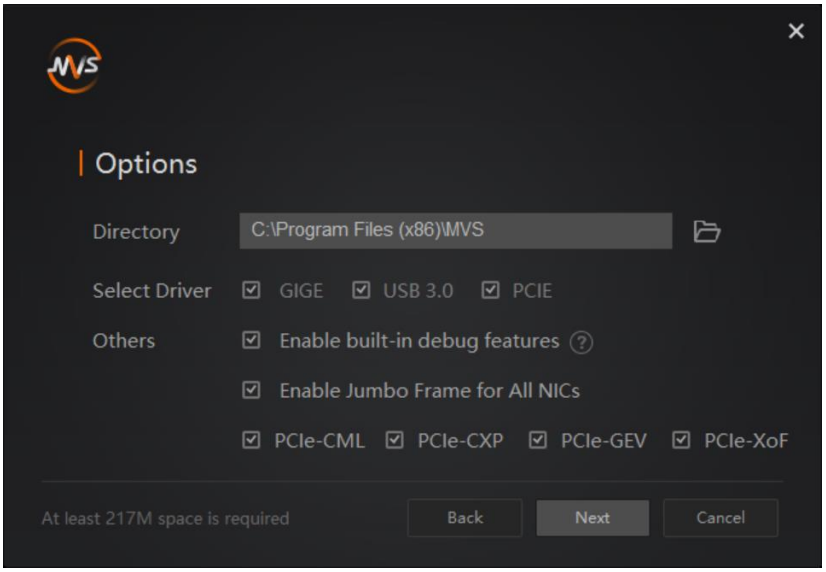


Figure 7-3 Installation Options

Note

- Regarding options, it is recommended to keep default settings.
- **PCIe-CML**, **PCIe-CXP**, **PCIE-GEV**, **PCIE-XoF** can be checked only when **PCIE** is checked.

- **PCIe-CML**, **PCIe-CXP**, **PCIE-GEV**, **PCIE-XoF** supports frame grabbers developed by our company only.

6. Click **Next** to install.
7. Finish the installation process according to the prompts.

7.3 Set PC Environment

To ensure stable client running and data transmission, you are recommended to set PC environment.

7.3.1 Turn off Firewall

Steps

Note

For different Windows versions, the path name or interface may differ. Please refer to the actual condition.

1. Go to Windows Firewall.
- Windows 7 system: Click **Start** → **Control Panel** → **Windows Firewall**.
- Windows 10 system: Click **Start** → **Control Panel** → **System and Security** → **Windows Defender Firewall**.
- Windows 11 system: Click **Start** → **Settings** → **Privacy & security** → **Windows Security** → **Firewall & network protection**.
2. For Windows 7 and 10 system, click **Turn Windows Defender Firewall on or off** on the left. For Windows 11, select the network and turn off in **Microsoft Defender Firewall**.
3. Select **Turn off Windows Defender Firewall (not recommended)**.

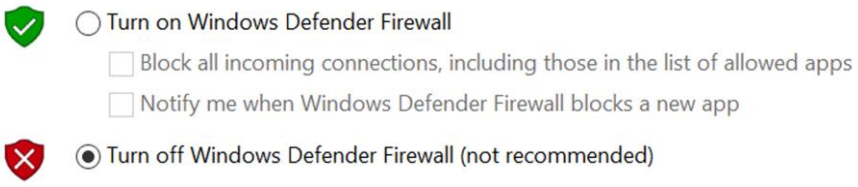


Figure 7-4 Windows Defender Firewall

4. Click **OK**.

7.3.2 Set Network

Device Network

Go to **Tool** → **IP Configurator** in the menu bar to open the tool. You can use the tool to check the device status, modify the IP address of the device, and save the IP address to the static memory.

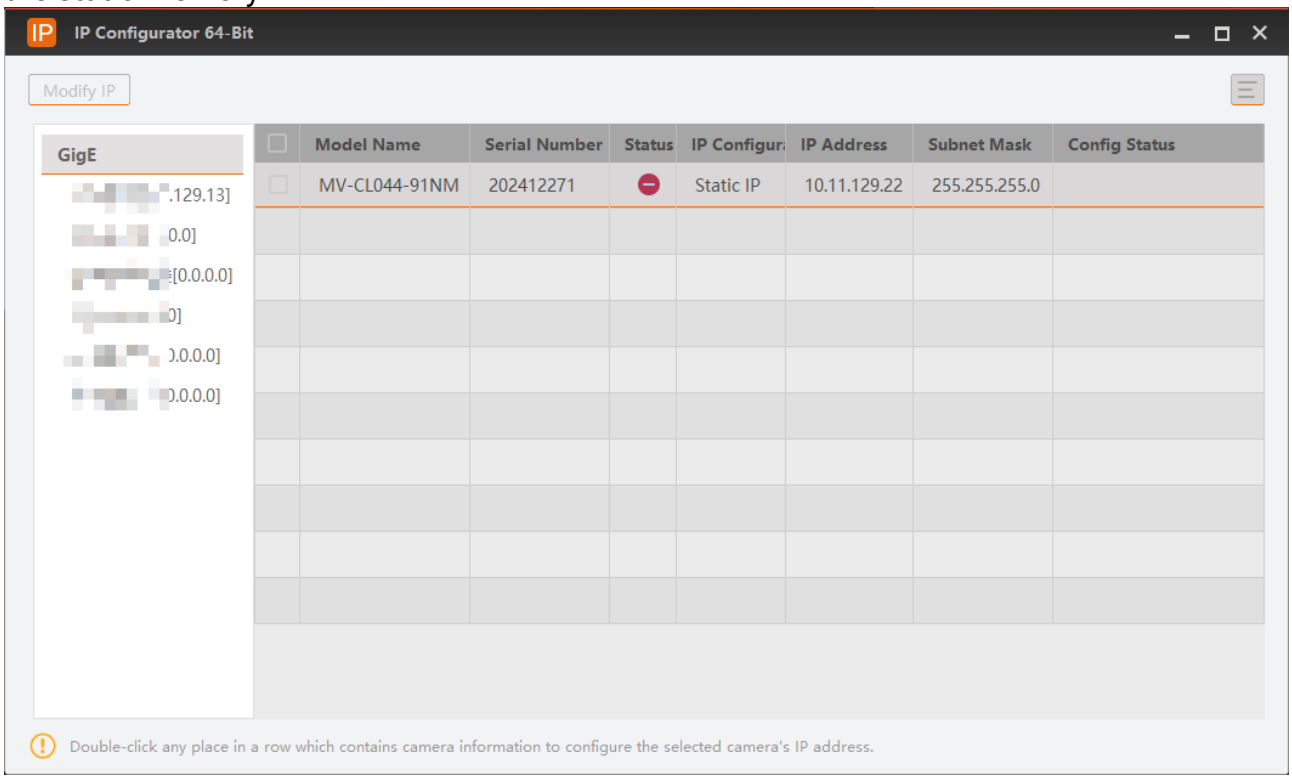


Figure 7-5 Set Device Network

PC Network

Steps

Note

For different Windows versions, the specific setting path and interface may differ. Please refer to the actual condition.

1. Go to PC network settings page: **Start** → **Control Panel** → **Network and Internet** → **Network and Sharing Center** → **Change adapter settings**.
2. Select NIC and set the IP obtainment mode.
- Select **Obtain an IP address automatically** to get an IP address of the PC automatically.
- Or select **Use the following IP address** to set an IP address for the PC manually.

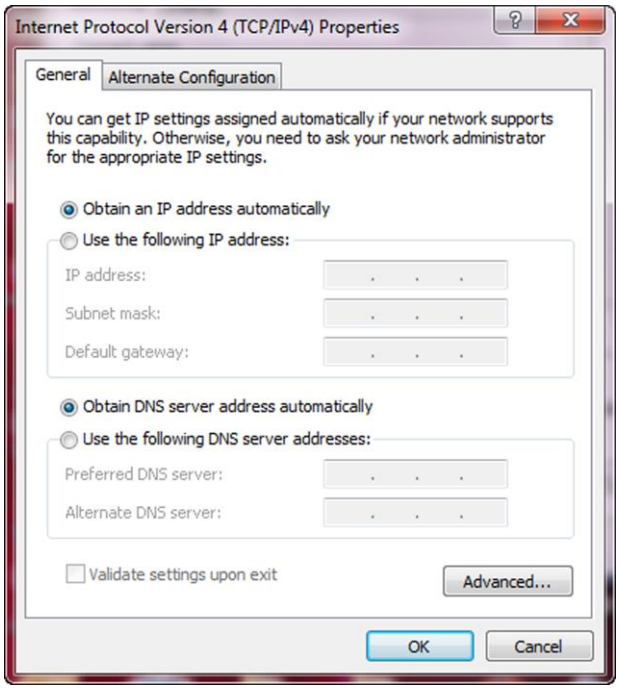


Figure 7-6 Set PC Network

3. Set NIC property via the PC.
   1) Go to NIC settings page: **Control Panel** → **Hardware and Sound** → **Device Manager** → **Network Adapter**.
   2) Select corresponding network interface card, and click **Advanced**.
   3) Set **Jumbo Packet** value to 9014 Bytes.

7.4 Basic Operation

Steps

Note

Refer to the user manual of the device and client software for detailed operations.

1. Run the MVS client software.
2. Double click the device model for connection.

The client software displays the device's information, as shown below.

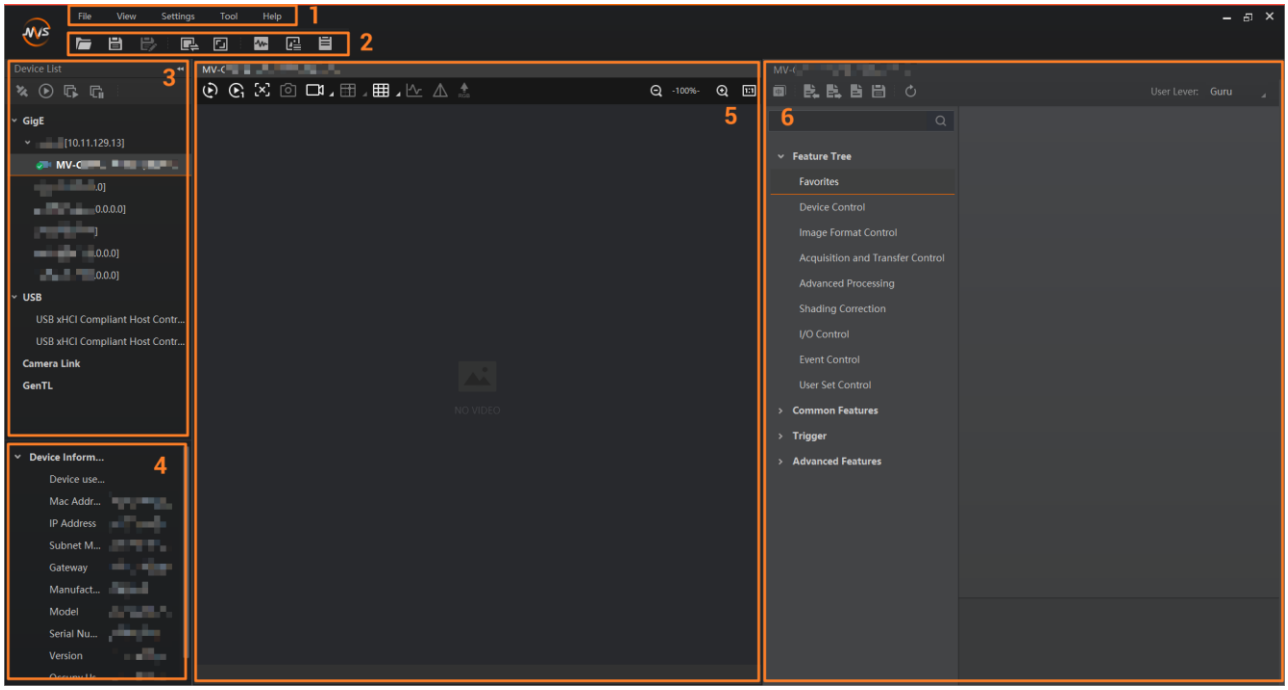


Figure 7-7 Main Window

Note

For specific main window of the client software, please refer to the actual one you got.

Table 7-2 Main Window Description

No.	Name	Description
1	Menu Bar	The menu bar displays function modules, including **File**, **View**, **Settings**, **Tool**, and **Help**.
2	Control Toolbar	The control toolbar provides quick operations for the device, such as file function, window division, and viewing of device status, embedded information, and log.
3	Device List Panel	This panel displays the list of devices, and you can connect or disconnect device.
4	Device Information Panel	This panel displays the detailed information of connected device.
5	Display Window	This area displays the acquired images in real time.
6	Feature Panel	This panel displays the device's parameters, and you can configure them according to actual demands.

3. Set the device's pixel format, exposure time, etc., in the feature panel.
4. Click in the display window to acquire images continuously.

5. Set flat field correction in the feature panel according to the needs.

Note

The white balance settings are required for the color camera in order to output a true color image.

6. In MVS software, capture an image and check if the image brightness is normal. If the image is too bright or too dark, you may add an additional light source, or adjust the lens aperture to improve the brightness.
7. Check whether the captured image is in focus. If not, you may perform the following steps:

1) Place a legend with clear edges that can distinguish between dark and bright, and make sure the legend is in the range of the camera's field of view.
2) Adjust the focus knob on the lens to ensure the dark and bright edges can be clearly distinguished.
3) If the edges occupies within 3 pixels in width, it means that the image is in focus.

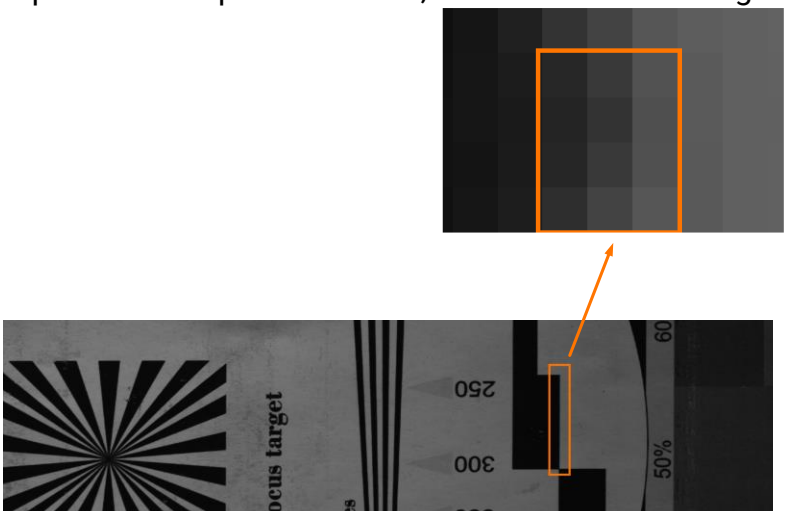


Figure 7-8 Legend

8. (Optional) Set the device's other parameters in the feature panel.

Note

The device's feature panel and parameters may differ by device models.

Chapter 8 I/O Electrical Features and Wiring

The device has 4 configurable input or output lines (Line 0/1/3/4), and these lines can be configured as differential input/output according to actual demands.

8.1 I/O Electrical Features

8.1.1 Differential Input Circuit

The differential input signal in I/O signals supports the single-ended input, and its internal circuit is shown below.

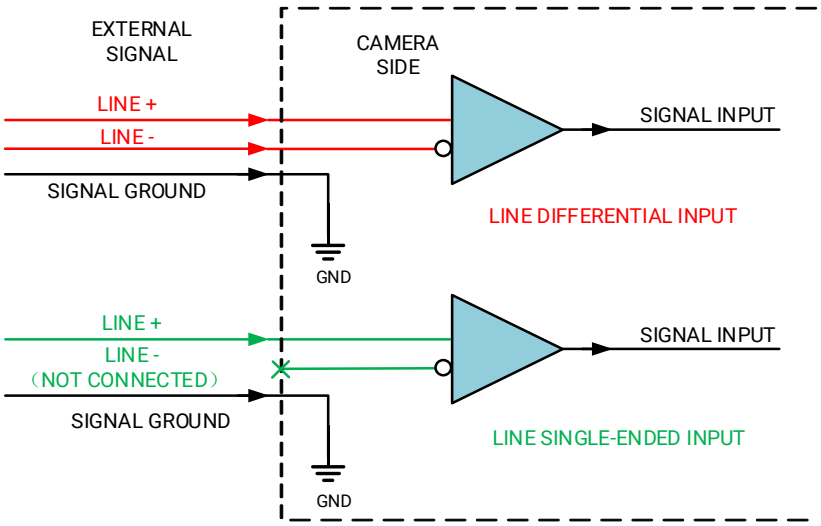


Figure 8-1 Internal Circuit of Differential Input

The RS-422 standard, RS-644 standard, and TTL & LVTTL standard input signal are applied to the differential input.

RS-422 Standard Input

In order to make sure the normal operation of input circuit, it is required to connect device's ground signal with external ground signal if the differential input adopts RS-422 standard signal.
RS-422 standard defines the connection of the bus structure, and the inputs of several devices can be connected to the RS-422. Up to 10 devices can be connected at the same time, of which only one device is the main dispenser (D) and other devices are receivers (R). The circuit length between the receiver and the bus should be as short as possible.
The bus must have a 120 Ω terminal resistance (RT).
When the device is the last receiver on the bus structure, the device's terminal resistance

needs to be enabled, and the rest device's terminal resistances need to be disabled. Multiple terminal resistance should not be enabled on the bus structure, which will reduce signal reliability and may cause damage to the RS-422 device.

RS-644 Standard Input

If the differential input adopts RS-644 standard signal, the input terminal's 120 Ω terminal resistance should be enabled.

TTL & LVTTL Standard Input

If the differential input adopts TTL & LVTTL standard signal, the input terminal's 120 Ω terminal resistance should be disabled, and its input electrical feature requirement is shown below.

Table 8-1 Electrical Feature Requirement of TTL & LVTTL

Voltage Range	Description
0 V to 1 V	Level low
1 V to 3 V	Unstable voltage, and it is not recommended to use it.
3.3 V to 24 V	Level high

8.1.2 Differential Output Circuit

The internal circuit of differential output signal in I/O signals is shown below.

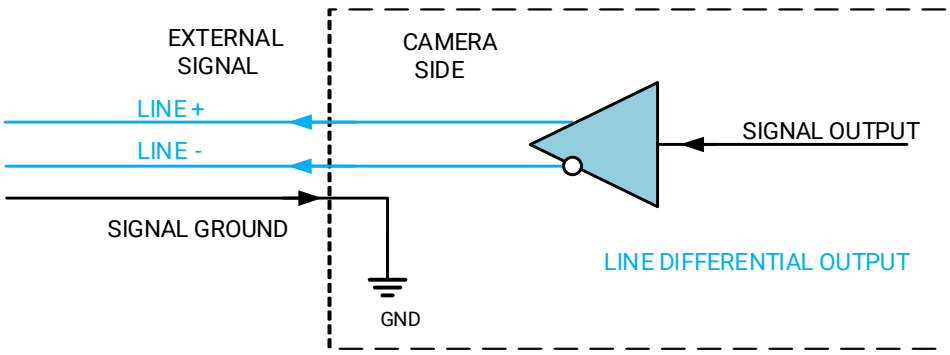


Figure 8-2 Internal Circuit of Differential Output

The RS-422 standard and RS-644 standard are applied to the differential output.

RS-422 Standard Output

In order to make sure the normal operation of output circuit, it is required to connect device's ground signal with external ground signal. The output interface can be connected to the RS-422 bus structure as a main dispenser.

RS-644 Standard Output

The device adopting RS-422 standard output signal cannot directly connect to RS-644 standard. When connecting RS-644 standard output, it is required to add a resistance network in device's output location. In order to make sure the normal operation of output circuit, it is required to connect device's ground signal with external ground signal.

8.2 Signal Wiring

This section introduces how to wire the device according to its pin definitions.

8.2.1 Input Signal Wiring

The device can receive input signals via the hardware trigger to acquire images. The input signals include differential signal and single-ended signal.

Note

- Make sure that the hardware trigger signals have been configured as input signal.
- It is recommended to connect Line 0 or Line 4 if the input signal is 24 V, avoiding damage to the I/O interface caused by excessive voltage.

The wiring is shown below if the differential signal source provides trigger signal.

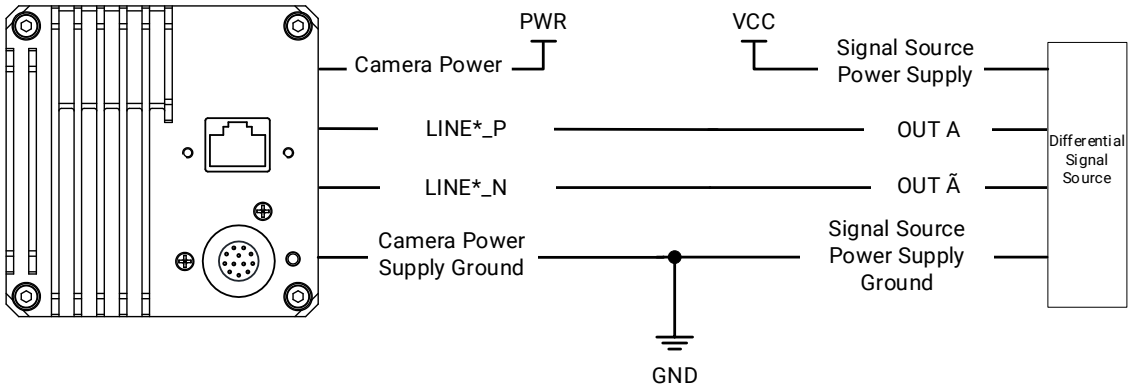


Figure 8-3 Differential Input Wiring

If the PNP single-ended signal source provides signal, there are two different wirings as shown below.

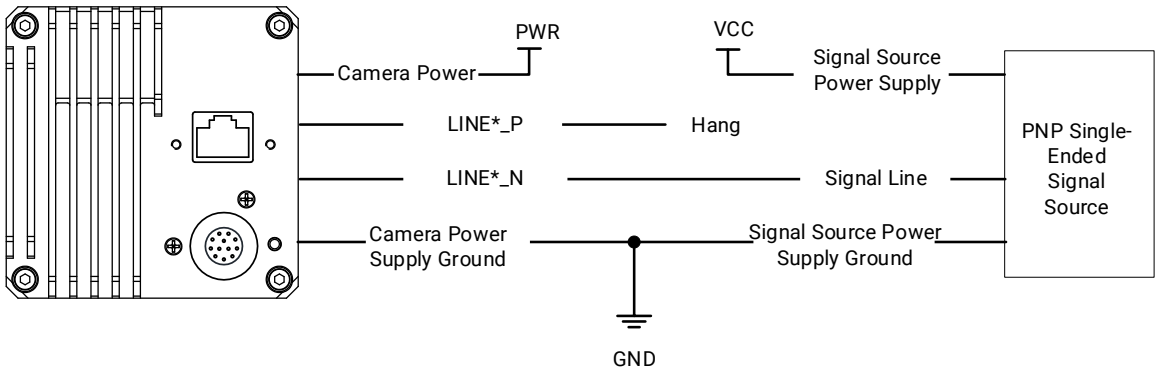


Figure 8-4 PNP Single-Ended Input Wiring Without Pull-Down Resistor

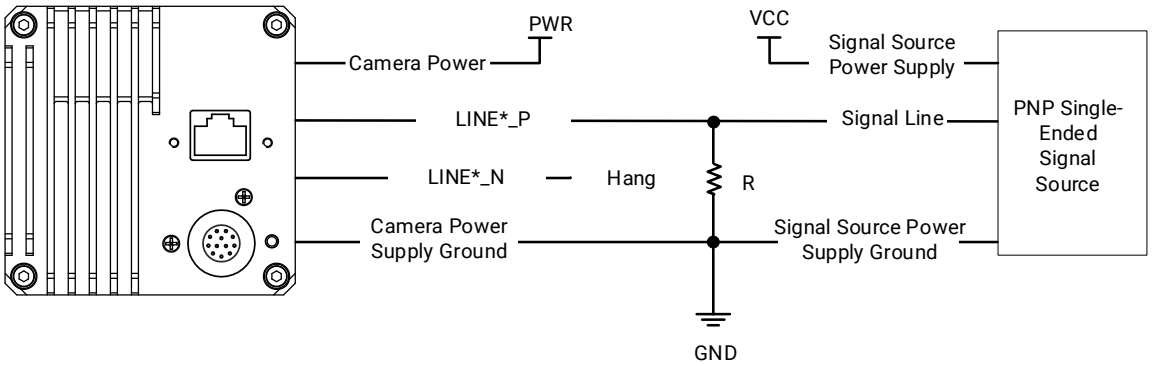


Figure 8-5 PNP Single-Ended Input Wiring with Pull-Down Resistor (1 KΩ to 4.7 KΩ)

If the NPN single-ended signal source provides signal, there are two different wirings as shown below.

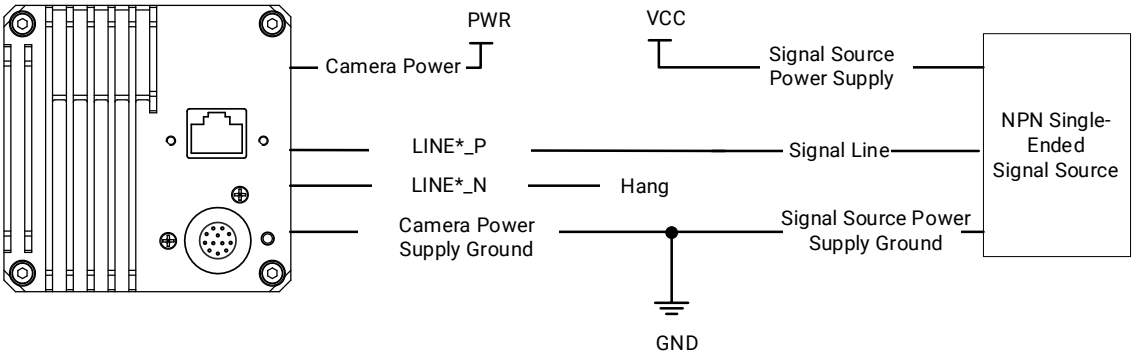


Figure 8-6 NPN Single-Ended Input Wiring Without Pull-Up Resistor

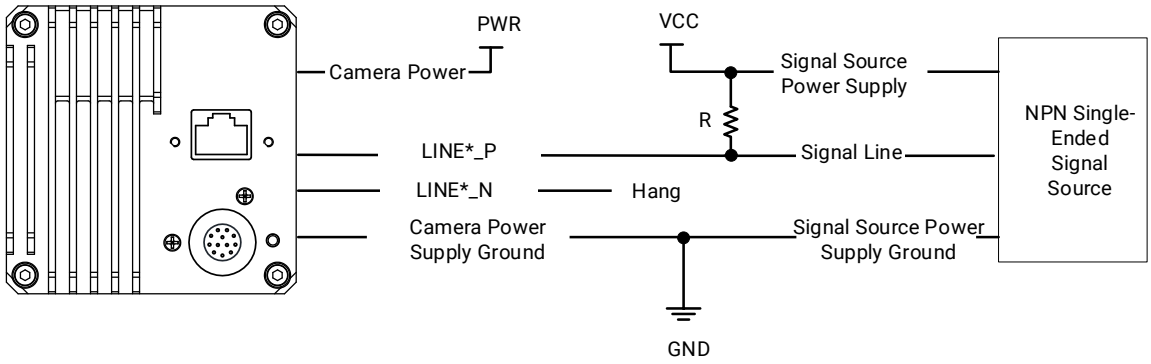


Figure 8-7 NPN Single-Ended Input Wiring with Pull-Up Resistor (1 KΩ to 10 KΩ)

8.2.2 Output Signal Wiring

The device's 2 bi-directional I/O lines can be configured to output signal to trigger other devices.

Note

Wiring varies depending on I/O signal which is configured as differential output or single-ended output.

If I/O signals are used as differential output, the wiring is shown below.

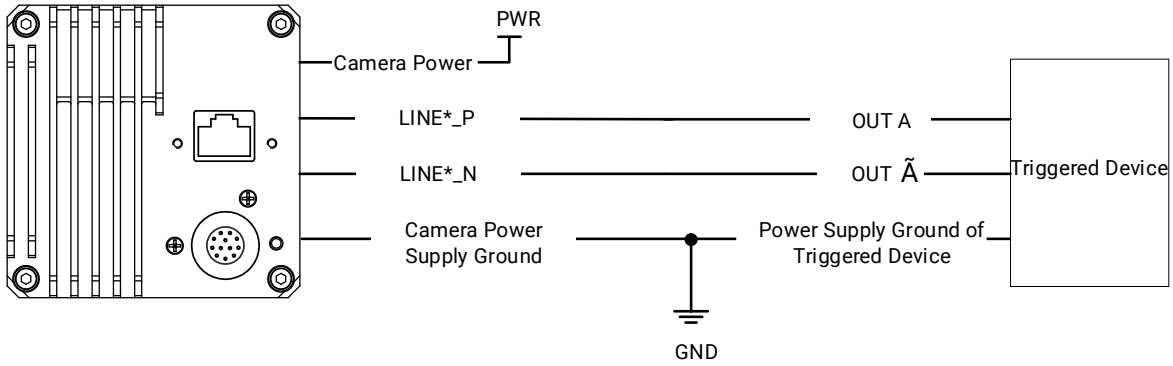


Figure 8-8 Differential Output Wiring

If I/O signals are used as single-ended output, a pull-up resistor of 1 kΩ to 10 kΩ needs to be added. The value of the VCC voltage should match with that of the required trigger voltage.

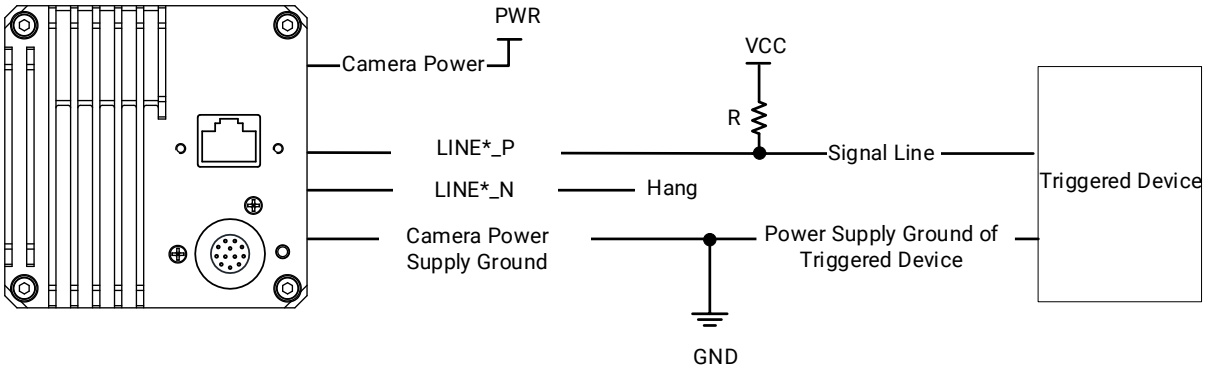


Figure 8-9 Single-Ended Output Wiring with Pull-Up Resistor

Chapter 9 Trigger Input and Output

9.1 Trigger Input

9.1.1 Set Trigger Mode

The device has 4 types of trigger modes, including internal trigger mode, line trigger mode, frame trigger mode, and line + frame trigger mode. The trigger mode is controlled by **FrameTrigger Mode** in **Frame Trigger Control**, and **LineTrigger Mode** in **Line Trigger Control**.

Note

The **Frame Trigger Control** can be set only if the **Frame Scan** is selected as **Scan Mode**.

Table 9-1 Trigger Mode Description

Trigger Mode	FrameTrigger Mode Parameter	LineTrigger Mode Parameter	Description
Internal Trigger	Off	Off	The device acquires images per lines via its internal signal and outputs images per frames according to configured parameters.
Line Trigger	Off	On	The device acquires images per lines via the external signal and outputs images per frames according to configured parameters.
Frame Trigger	On	Off	The device acquires images after receiving the external signal, and acquires images per lines via its internal signal.
Line + Frame Trigger	On	On	The device acquires images after receiving the external signal, and acquires images per lines via another external signal.

9.1.2 Set Trigger Source

The device's trigger source includes software trigger, hardware trigger, shaft encoder control, frequency converter control, action command trigger, and anyway mode. Refer to

the tables below to see the trigger source under frame trigger mode or in line trigger mode.

Note

- The trigger sources in the tables below are valid for frame trigger mode, line trigger mode, or line + frame trigger mode.
- In line + frame trigger mode, when the trigger source selected by the frame trigger and the line trigger and the trigger-related parameters are the same, the first signal of trigger source will be used as the frame trigger signal to make the device start to acquire images, and the subsequent signals as line trigger signal to acquire images per lines until the processing of one frame of image is completed, and then the processing of the next frame of image is performed.

Table 9-2 Trigger Source Description in Frame Trigger Mode

External Trigger Source	Path	Parameter	Description
Software Trigger	**Acquisition and Transfer Control → Frame Trigger Control → FrameTrigger Source**	Software	The software sends trigger signal to the device via network interface to acquire images.
Hardware Trigger		Line *	External device connects to the device via device's I/O interface. External device sends trigger signal to the device to acquire images.
Frequency Converter Control		Frequency Converter	This trigger source sends trigger signal to the device through frequency conversion to acquire images.
Action Command Trigger		Action 1	The action command sends trigger signal to the device to acquire images.
Anyway		Anyway	The device can receive software trigger, hardware trigger, frequency converter control, or action command trigger to acquire images.

Table 9-3 Trigger Source Description in Line Trigger Mode

External Trigger Source	Path	Parameter	Description
Hardware Trigger	**Acquisition and Transfer Control → Line Trigger Control → LineTrigger**	Line *	External device connects to the device via device's I/O interface. External device sends trigger signal to the device to acquire images.
Shaft Encoder Control		Encoder Module Out	This trigger source sends trigger signal to the device through shaft encoder module to acquire images.

External Trigger Source	Path	Parameter	Description
Frequency Converter Control	**Source**	Frequency Converter	This trigger source sends trigger signal to the device through frequency conversion to acquire images.
Anyway		Anyway	The device can receive hardware trigger, shaft encoder control, or frequency converter control to acquire images.

Set and Execute Software Trigger

The software trigger is valid when the frame trigger is enabled.

Steps

1. Go to **Acquisition and Transfer Control** → **Scan Mode**, and select **Frame Scan**.
2. Enable **FrameTrigger Mode** in **Acquisition and Transfer Control** → **Frame Trigger Control**.
3. Select **Software** as **FrameTrigger Source**.
4. Click **Execute** in **FrameTrigger Software**.

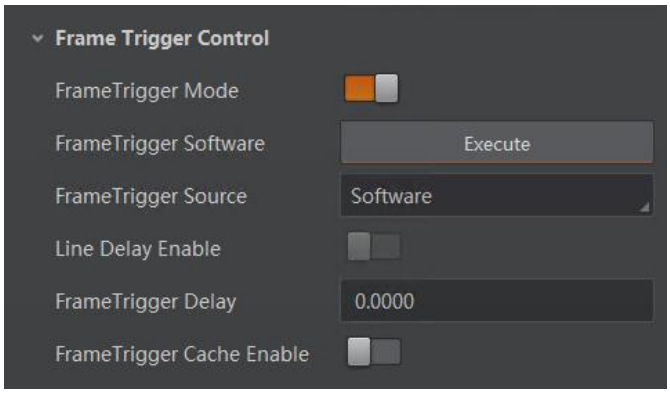


Figure 9-1 Set and Execute Software Trigger

Note

Refer to section ***Set Trigger Related Parameters*** for parameters that can be configured in the trigger source, including acquisition burst frame count, trigger delay, and trigger cache.

Set and Execute Hardware Trigger

The hardware trigger is valid when the frame trigger or line trigger is enabled. In hardware trigger, external device sends trigger signal to the device to acquire images via I/O connector.

Steps

1. Go to **Acquisition and Transfer Control** → **Scan Mode**, and select **Frame Scan** or **Line Scan**.
2. Enable **FrameTrigger Mode** in **Frame Trigger Control** or **LineTrigger Mode** in **Line Trigger Control**.

Note

The **Frame Trigger Control** can be set only if the **Frame Scan** is selected as **Scan Mode**.

3. Select **Line** ⋆ as **FrameTrigger Source** or **LineTrigger Source** according to actual demands.

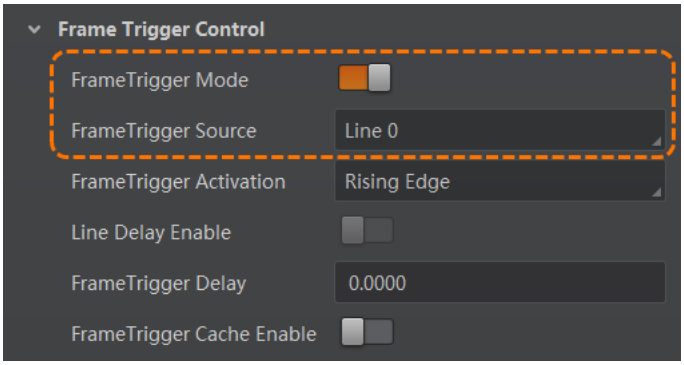


Figure 9-2 Set and Execute Hardware Trigger

Note

Refer to section ***Set Trigger Related Parameters*** for parameters that can be configured in the trigger source, including acquisition burst frame count, trigger activation, trigger delay, trigger debouncer, and trigger cache.

When selecting bi-directional configurable line as the hardware trigger source, you need to make sure that its line mode is input. Go to **I/O Control**, select specific line as **Line Selector**, and **Input** as **Line Mode**.

Note

Here we take Line 1 as an example to introduce how to set bi-directional configurable line as the hardware trigger source. Refer to the device you got for the actual condition.

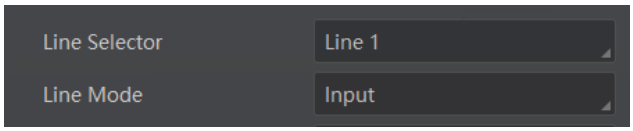


Figure 9-3 Line Selector

You can also set the signal type for the selected bi-directional configurable line. Go to **I/O Control**, and set **Line Format** according to actual demands.

- **SingleEnded**: It can receive single-ended input signal.
- **Differential**: It can receive TTL & LVTTL standard input signal.

Caution

You need to select line format according to the external device connected. Otherwise, I/O may be damaged.

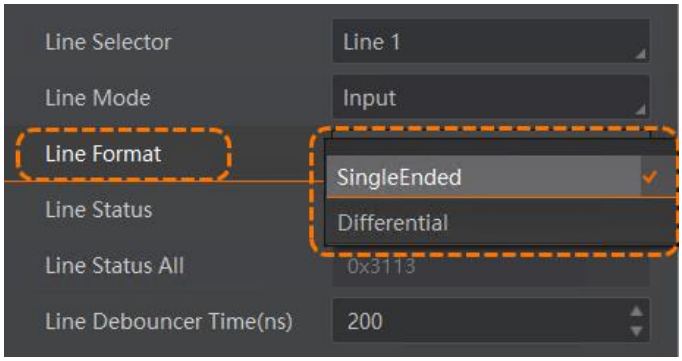


Figure 9-4 Set Line Format

Set and Execute Shaft Encoder Control

If the device enables the line trigger, you can select shaft encoder control as trigger source. At this time, the device will receive signal A and signal B with phase difference. The function demonstration of shaft encoder module is shown below.

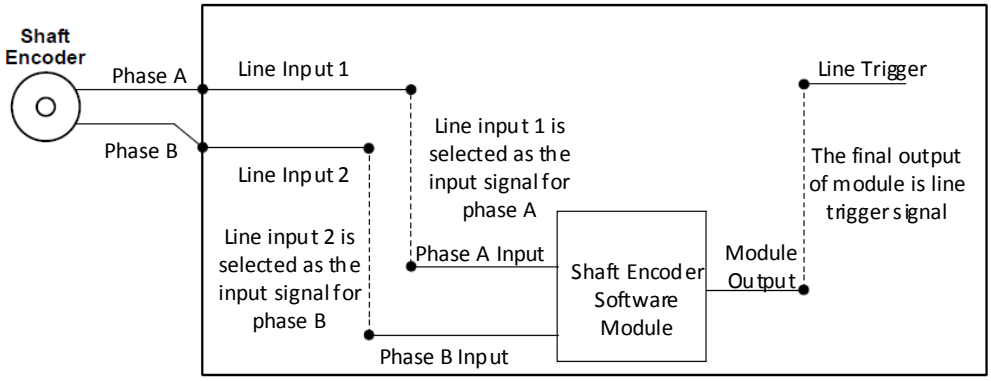


Figure 9-5 Function Demonstration

The advantages of shaft encoder are as follows:
- Encoder output pulse frequency is proportional to rotating speed.
- The output pulse acts as a trigger signal for line scan device.
- Synchronize acquisition speed and sample movement of device.
- Non-uniform motion can also be a perfect match.
- A trigger signal can be set as acquiring multiple lines or multiple frames with adjustable ratio.

Follow steps below to set shaft encoder control.

Steps

1. Click **Encoder Control**, and set **Encoder Source A** and **Encoder Source B** according to actual demands.

Note

It is recommended to select different signal sources for source A and source B. If the same signal source is selected for A and B, the shaft encoder will not output the signal.

2. Set **Encoder Trigger Mode**.
- **Any Direction** means that both forward and backward direction will trigger.
- **Forward Only** mean that only forward direction will trigger.
- **Backward Only** mean that only backward direction will trigger.

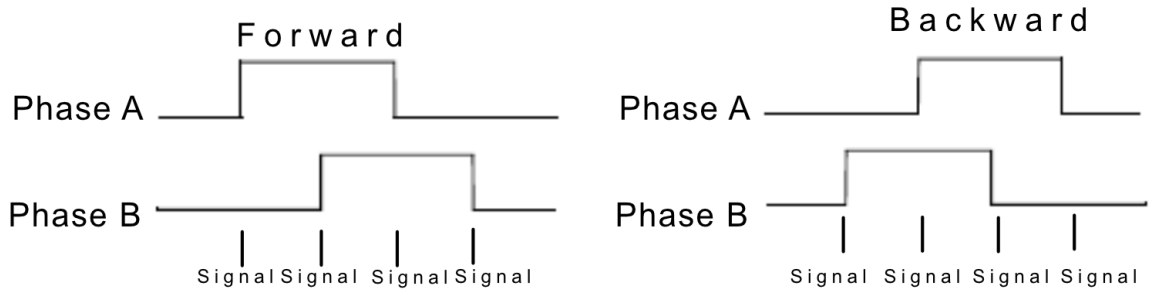


Figure 9-6 Process Logic

Note

Phase A and phase B of the encoder corresponds 4 signals each, as shown below.

3. Set **Encoder Counter Mode**.
- **Ignore Direction** means that both forward and backward direction will count.
- **Follow Direction** means that the forward direction is valid, and **Encode Counter** will increase.
- **Backward Direction** means that the backward direction is valid, and **Encode Counter** will increase.

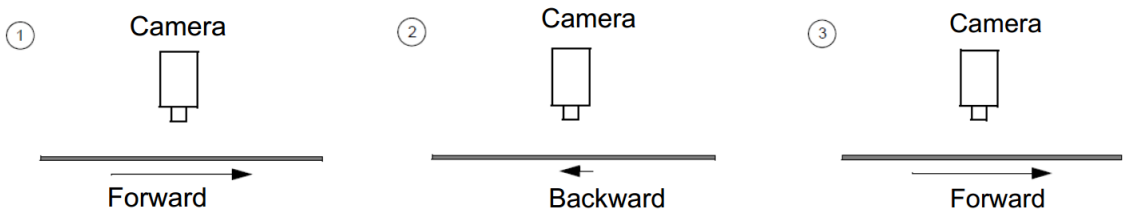


Figure 9-7 Counter Description

4. (Optional) Set max. counter value in **Encoder Counter Max**.

Note

- The range of **Encoder Counter Max.** may differ by device models.
- After reaching the max. value, it will be cleared automatically or you can clear manually by clicking **Encoder Counter Reset**.

5. (Optional) Set **Encoder Max Reverse Counter** to avoid outputting images if the object moves backward accidently during measurement, and click **Execute** in **Encoder Reverse Counter Reset** to let the device to output images again.

Set and Execute Frequency Converter Control

If the device enables the frame trigger or the line trigger, you can select Frequency Converter as trigger source. The hardware signal trigger or shaft encoder control signal can be converted into the signal frequency of frame trigger or line trigger by device's frequency converter module.
The frequency converter module includes PreDivider, Multiplier, and PostDivider.

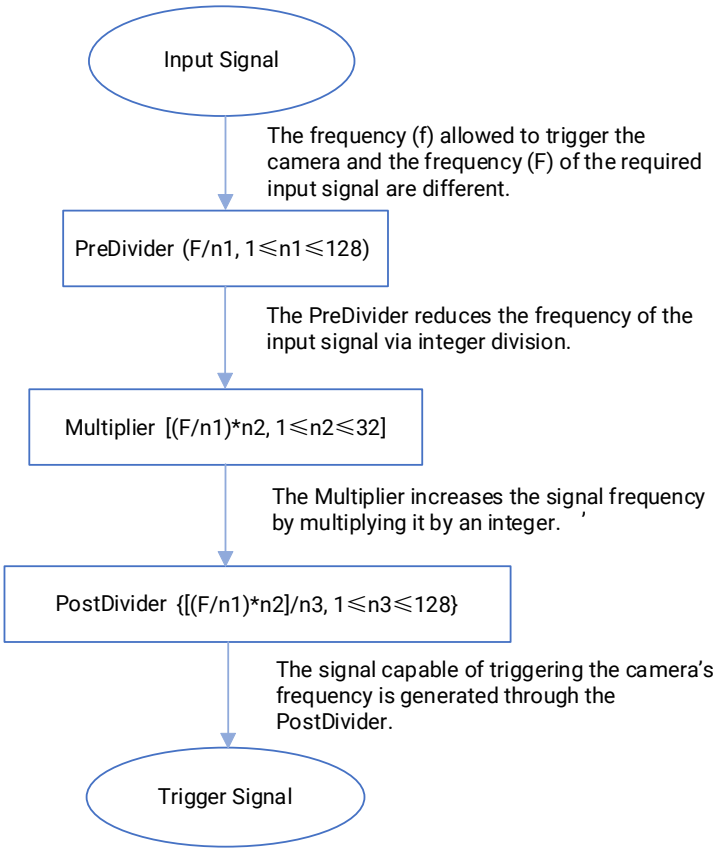


Figure 9-8 Encoder Frequency Converter Control

PreDivider

The input signal first enters the PreDivider module, which reduces source signal frequency via integer division, and then the signal is sent to the Multiplier module.
The PreDivider module reduces periodic jitter on the input signal, and signals above 100 kHz must go through the PreDivider module to reduce the frequency for the Multiplier can only receive signals in the range of 10 Hz to 100 kHz frequency range. The periodic jitter of shaft encoder signal is accepted.

Multiplier

After the signal is processed by the PreDivider, it is sent to the Multiplier. The Multiplier multiplies the signal by an integer to increase its signal frequency, and then the signal is sent to the PostDivider.
Parameter can be set as rising or falling edge. If a rising edge is set, each rising edge of the signal coming from the PreDivider will be locked to match the signal of the rising edge, and vice versa.

During this process, make sure do not increase signal frequency via too larger multipliers to avoid trigger signal frequency beyond the max. line rate of the device. Even if a smaller multiplier is selected, an excessively high frequency may be generated in the frequency adjustment, exceeding the max. line rate of the device.

PostDivider

PostDivider reduces signal frequency via an integer factor, and uses the newly generated frequency signal as the device's trigger signal.
Follow steps below to set frequency converter control.

Steps

1. Click **Frequency Converter Control**, and select specific line, **Encoder Module Out** or **N/A** as **Input Source** according to actual demands.

Note

N/A means that the signal source is not selected.

2. Set **Rising Edge** or **Falling Edge** as **Signal Alignment** according to actual demands.
3. Set **PreDivider**, **Multiplier** and **PostDivider**.

The device supports displaying trigger line rate.

Note

- Parameters of trigger line rate and resulting trigger line rate may differ by device models.
- Make sure that line trigger is enabled and input source value of frequency converter control and trigger source value of acquisition control is the same before viewing trigger line rate.
- The trigger line rate is valid when the external trigger source is selected as the **Input Source**. If N/A is selected, the trigger line rate is 0.
- It is recommended to make sure the frequency of the final trigger signal does not exceed the maximum line frequency of the camera during frequency conversion.

- **Trigger Line Rate**: It refers to the external trigger raw line rate after filtering, and it only involves external trigger signals.
- **Resulting Trigger Line Rate**: It refers to the external trigger frequency devices received after the external trigger raw line rate is calculated via frequency converter control. It only involves external trigger signals.

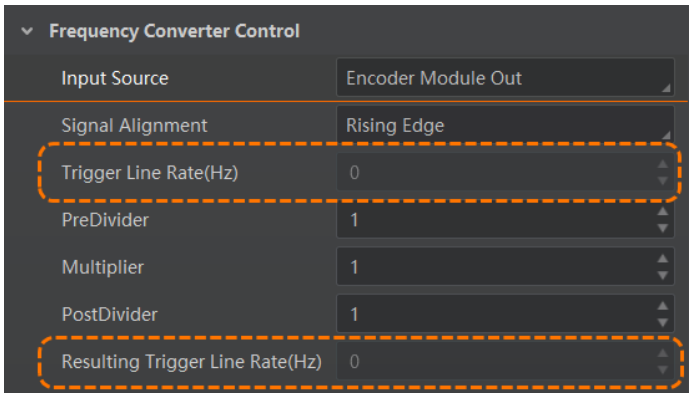


Figure 9-9 View Trigger Line Rate

Set and Execute Anyway Mode

When the device enables the frame trigger or the line trigger, you can select anyway mode as trigger source. In this mode, the device can receive all trigger source signals to acquire images.

Steps

1. Go to **Acquisition and Transfer Control** → **Scan Mode**, and select **Frame Scan** or **Line Scan**.
2. Enable **FrameTrigger Mode** in **Frame Trigger Control** or **LineTrigger Mode** in **Line Trigger Control**.
3. Select **Anyway** as **FrameTrigger Source** or **LineTrigger Source**.

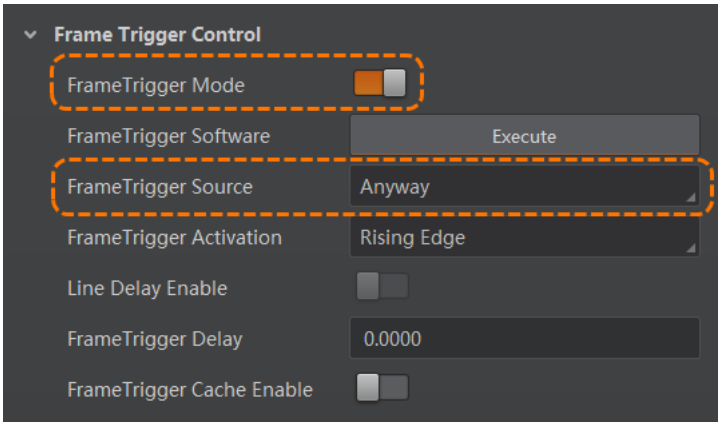


Figure 9-10 Set and Execute Free Trigger

Note

Refer to section ***Set Trigger Related Parameters*** for parameters that can be configured in the trigger source, including acquisition burst frame count, trigger activation, trigger delay, trigger debouncer, and trigger cache.

9.1.3 Set Trigger Related Parameters

When the line trigger mode or frame trigger mode is enabled, you can set some related parameters, including acquisition burst frame count, trigger delay, trigger cache, trigger activation, and trigger debouncer.

Note

- Different trigger sources and trigger modes can set various parameters.
- Frame trigger cache and line trigger cache may differ by device models.
- √ is supported, and × is not supported.

If the frame trigger is enabled, the relation between trigger source and trigger related parameters is shown below.

Table 9-4 Trigger Source and Trigger Related Parameters in Frame Trigger Mode

Trigger Source / Trigger Parameters	Software Trigger	Hardware Trigger	Frequency Converter Control	Anyway Mode
Acquisition Burst Frame Count	√	√	√	√
Frame Trigger Activation	×	√	√	√
Trigger Delay	√	√	√	√
Frame Trigger Cache	√	√	√	√
Trigger Debouncer	×	√	×	×

If the line trigger is enabled, the relation between trigger source and trigger related parameters is shown below.

Table 9-5 Trigger Source and Trigger Related Parameters in Line Trigger Mode

Trigger Source / Trigger Parameters	Hardware Trigger	Shaft Encoder Control	Frequency Converter Control	Anyway Mode
Line Trigger Activation	√	√	√	√
Trigger Delay	√	√	√	√

Trigger Source / Trigger Parameters	Hardware Trigger	Shaft Encoder Control	Frequency Converter Control	Anyway Mode
Line Trigger Cache	√	√	√	√
Trigger Debouncer	√	×	×	√

Set Acquisition Burst Frame Count

In frame trigger mode, you can set acquisition burst frame count. Go to **Acquisition and Transfer Control → Acquisition Burst Frame Count**, and enter **Acquisition Burst Frame Count** according to actual demands.

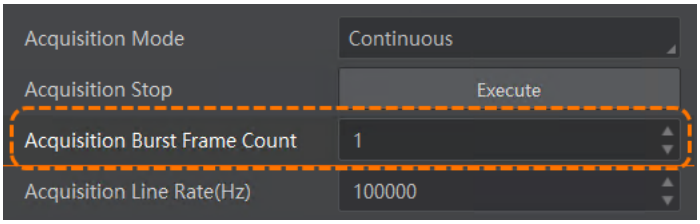


Figure 9-11 Set Acquisition Burst Frame Count

Note

- The range of **Acquisition Burst Frame Count** is from 1 to 1023.
- If **Acquisition Burst Frame Count** is 1, the device is in single frame trigger mode. If **Acquisition Burst Frame Count** is larger than 1, the device is in multi-frame trigger mode.
- If **Acquisition Burst Frame Count** is n, when input 1 trigger signal to the device, the device stops acquiring images after exposing n times and outputting n frame images.
- The sequence diagram below uses rising edge as trigger activation, and the device's height parameter is 4.

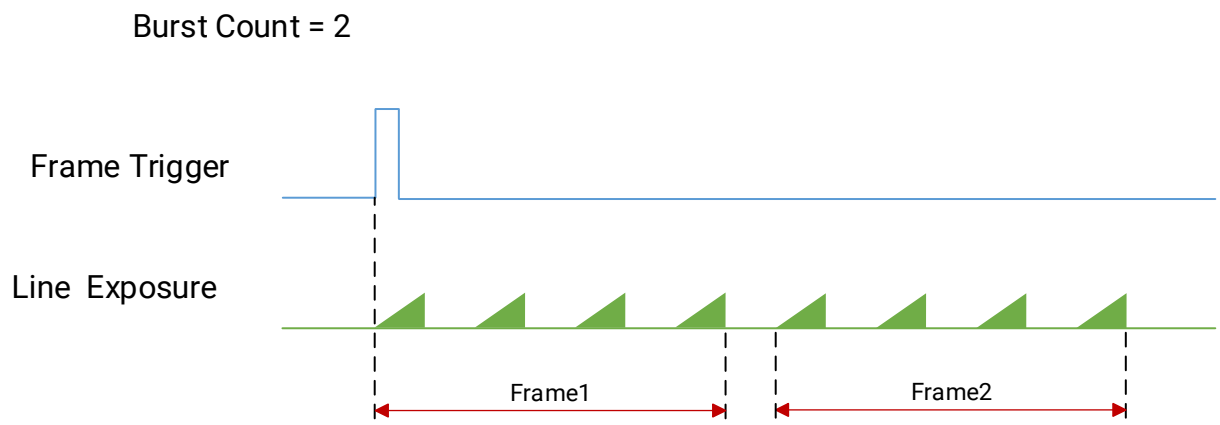


Figure 9-12 Sequence Diagram of Acquisition Burst Frame Count

Set Trigger Activation

The device supports triggering image acquisition in the rising edge, falling edge, level high, level low, or any edge of the external signal.

- **Rising Edge**: It means that when the level signal sent by external device is in rising edge, the device receives trigger signal and starts to acquire images.
- **Falling Edge**: It means that when the level signal sent by external device is in falling edge, the device receives trigger signal and starts to acquire images.
- **Any Edge:** It means that when the level signal sent by external device is in rising or falling edge, the device receives trigger signal and starts to acquire images.
- **Level High**: The level high of the trigger signal is valid. As long as the trigger signal is in level high, the device is in image acquisition status.
- **Level Low**: The level low of the trigger signal is valid. As long as the trigger signal is in level low, the device is in image acquisition status.

Note

The setting method for trigger activation is different in frame trigger and line trigger.

Set Trigger Activation in Frame Trigger

Go to **Acquisition and Transfer Control** → **Frame Trigger Control**, and set **FrameTrigger Activation** according to actual demands.

- When rising edge, falling edge, or any edge is selected as **FrameTrigger Activation**, you can set trigger delay. When **Line Delay Enable** is enabled, set the number of trigger lines for delay in the **FrameTrigger Delay**, or when the **Line Delay Enable** is disabled, set the trigger time for delay in the **FrameTrigger Delay**.

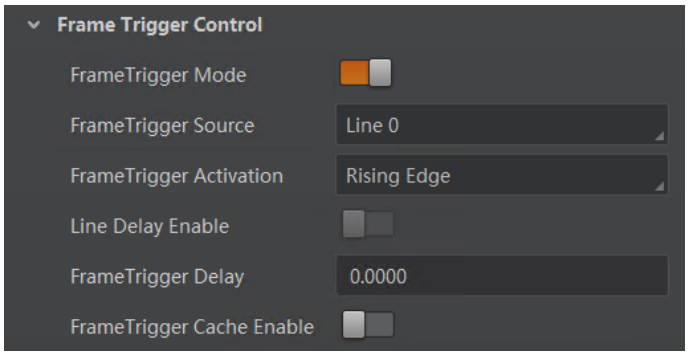


Figure 9-13 Set Trigger Activation in Frame Trigger

Note

The **Line Delay Enable** is valid only when the line trigger mode is enabled.

- When level high or level low is selected as **FrameTrigger Activation**, the device will be triggered according to selected method.

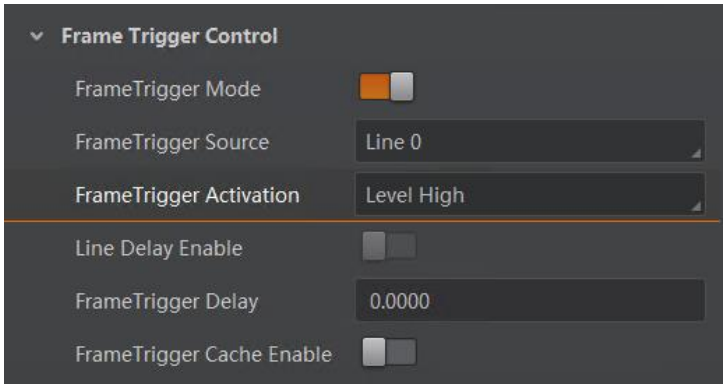


Figure 9-14 Level Trigger in Frame Trigger

Note

When Line 0/1/3 is selected as the trigger source in the frame trigger mode, the images are output during the level high by default.

Set Trigger Activation in Line Trigger

Go to **Acquisition and Transfer Control** → **Line Trigger Control**, and set **LineTrigger Activation** according to actual demands.

In the line trigger mode, the trigger activation is related with **Exposure Mode**.

- When you select **Rising Edge**, **Falling Edge**, or **Any Edge** as **LineTrigger Activation**, you can select **Timed** as **Exposure Mode** only, and **Exposure Auto** and **Exposure Time** determine the exposure time.
- When you select **Level Low** or **Level High** as **LineTrigger Activation**, you can select **Timed** or **Trigger Width** as **Exposure Mode**. Exposure time is determined by the duration of the level signal only if **Trigger Width** is selected.

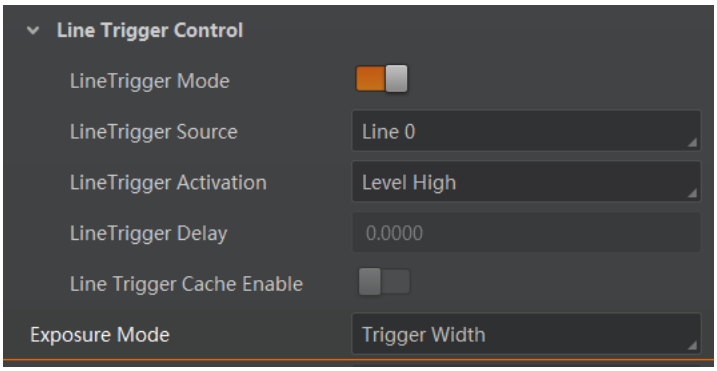


Figure 9-15 Set Trigger Activation in Line Trigger

Set Trigger Cache

Note

- The trigger cache in frame trigger or line trigger modes may differ by device models.
- The setting method for trigger cache is different in frame trigger and line trigger.

If the device enables the frame trigger or line trigger, it has the frame/line trigger cache function. During the triggering process, if the device receives new trigger signal, it will save and process the signal if you enable this function. Trigger cache enable can save up to 3 trigger signals.

Set Trigger Cache in Frame Trigger

Go to **Acquisition and Transfer Control** → **Frame Trigger Control**, and enable **FrameTrigger Cache Enable**.

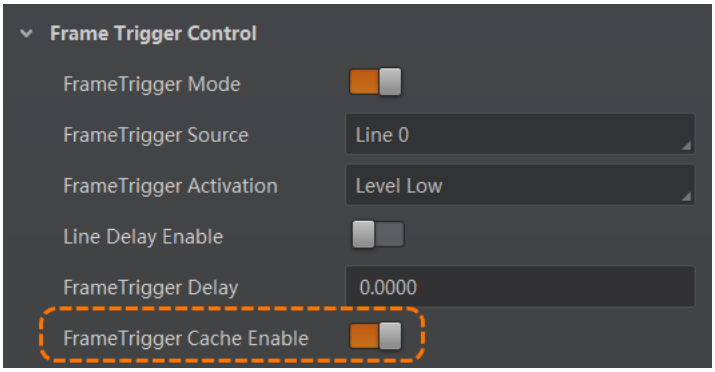


Figure 9-16 Set Trigger Cache in Frame Trigger

If the device receives the 1st trigger signal first, and the device receives the 2nd trigger signal during processing the 1st trigger signal.

- Disable Trigger Cache Enable: the 2nd trigger signal will be filtered without processing.

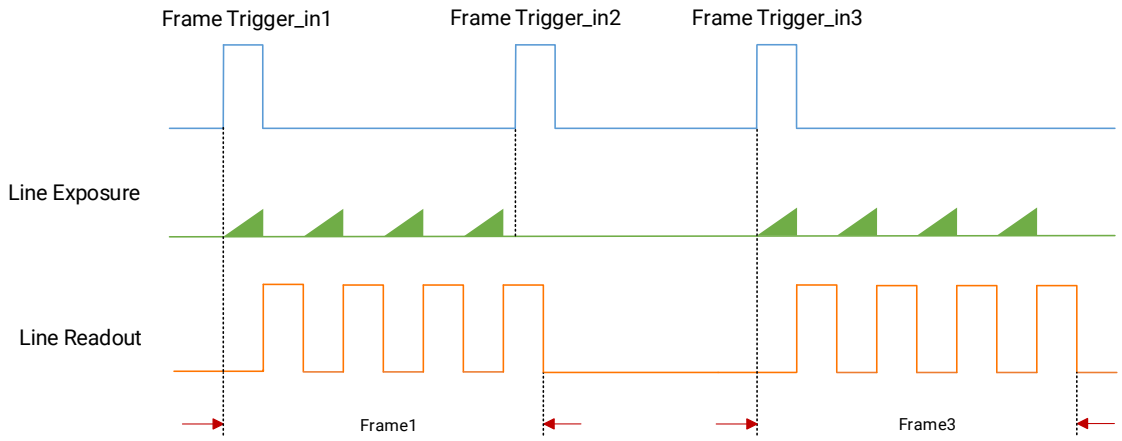


Figure 9-17 Second Frame Filtered

- Enable Trigger Cache Enable: the 2nd trigger signal will be saved.

If the 1st frame image's exposure time of the 2nd trigger signal is not earlier than the device's last frame creation time of the 1st trigger signal, and then the 2nd trigger signal's 1st frame image is created normally.

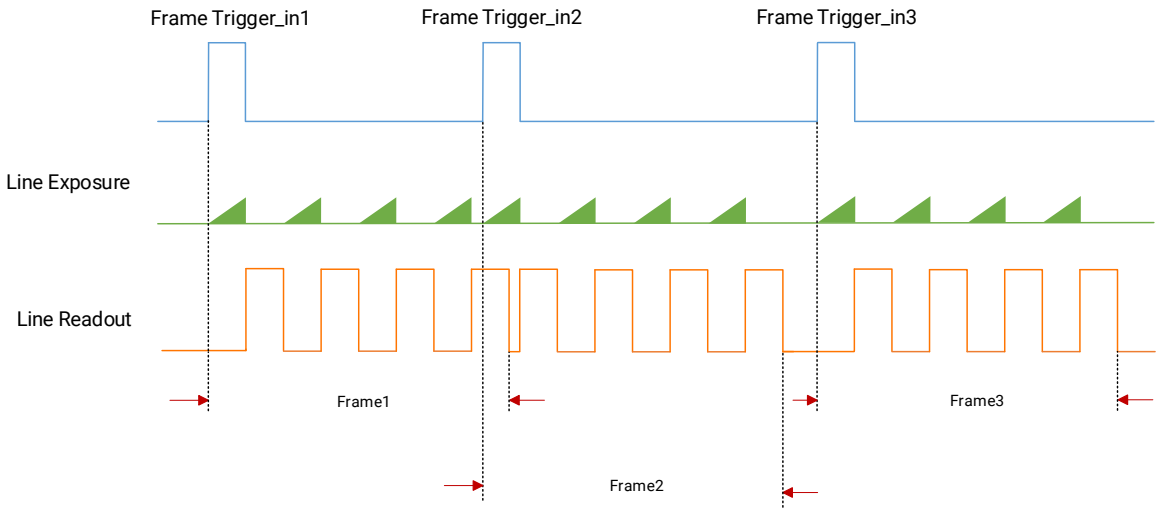


Figure 9-18 Second Frame Created Normally

If the 1st frame image's exposure time of the 2nd trigger signal is earlier than the device's last frame creation time of the 1st trigger signal, and then the device will delay this exposure time. Make sure this exposure time is not earlier than the device's last frame creation time of the 1st trigger signal.

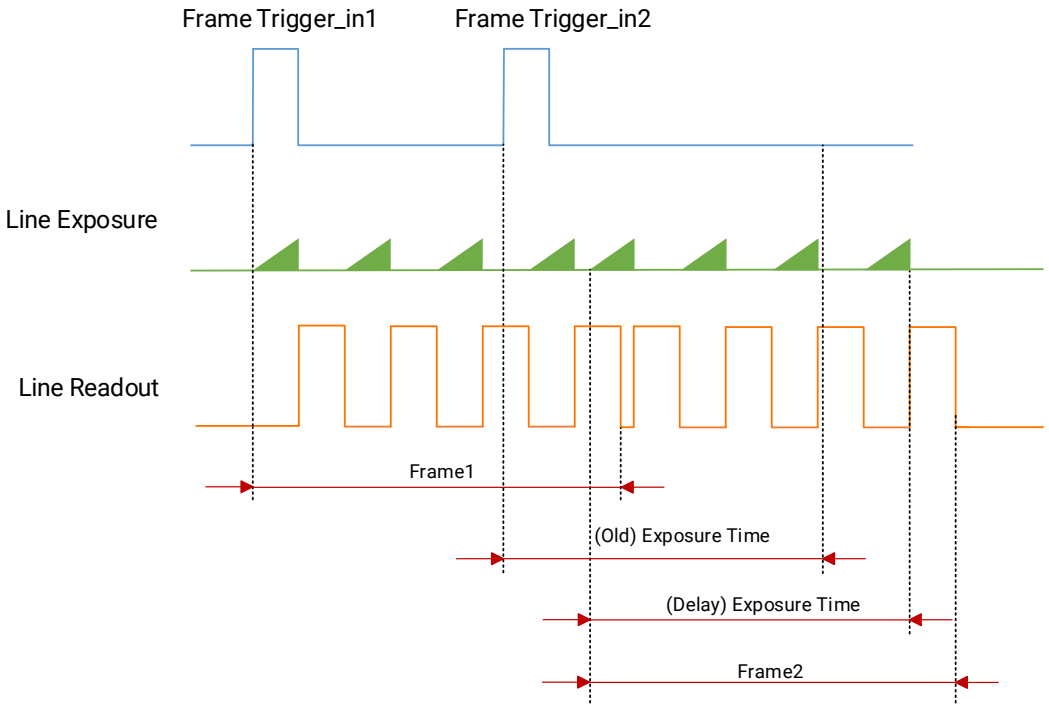


Figure 9-19 Sequence Diagram

Note

The three sequence diagrams above use rising edge as trigger activation, and the device's height parameter is 4.

Set Trigger Cache in Line Trigger

Go to **Acquisition and Transfer Control** → **Line Trigger Control**, and enable **Line Trigger Cache Enable**.

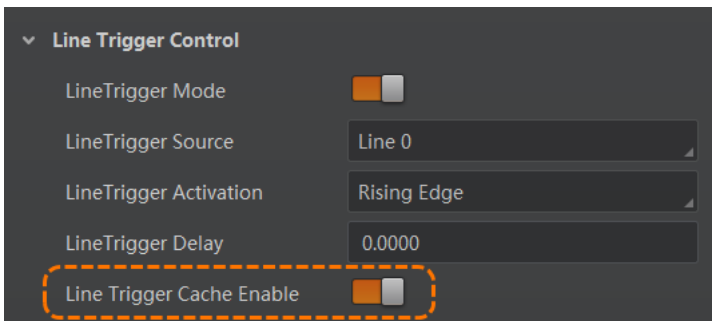


Figure 9-20 Set Trigger Cache in Line Trigger

Set Trigger Debouncer

The trigger debouncer function allows the device to filter out unwanted short external trigger signal that is input to the device.

Go to **I/O Control** → **Line Debouncer Time**, and enter **Line Debouncer Time** according to actual demands. The range of **Line Debouncer Time** is from 0 μs to 1000000 μs, and the step is 100 ns.

Note

If the **Line Debouncer Time** you set is greater than the time of trigger signal, this trigger signal will be ignored.

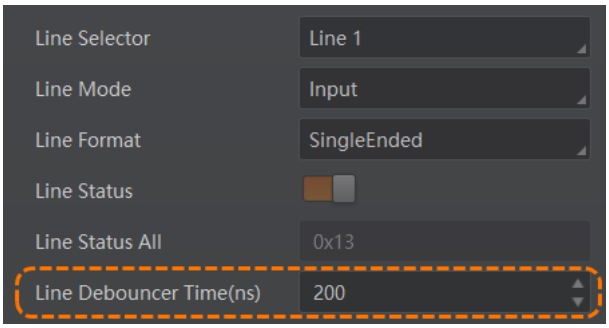


Figure 9-21 Set Trigger Debouncer

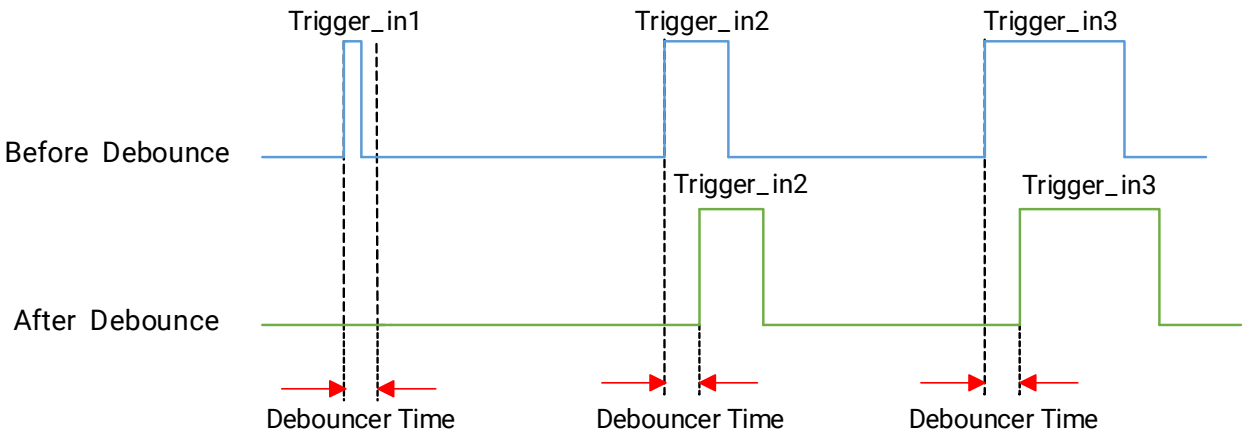


Figure 9-22 Sequence Diagram of Trigger Debouncer

Note

The sequence diagram above uses rising edge as trigger activation.

Set Trigger Delay

The trigger delay function allows the device to add a delay between the receipt of trigger signal and the moment the trigger becomes active.
Go to **Acquisition and Transfer Control** → **Frame Trigger Control**, and enable **Line Delay Enable** and set **FrameTrigger Delay**.

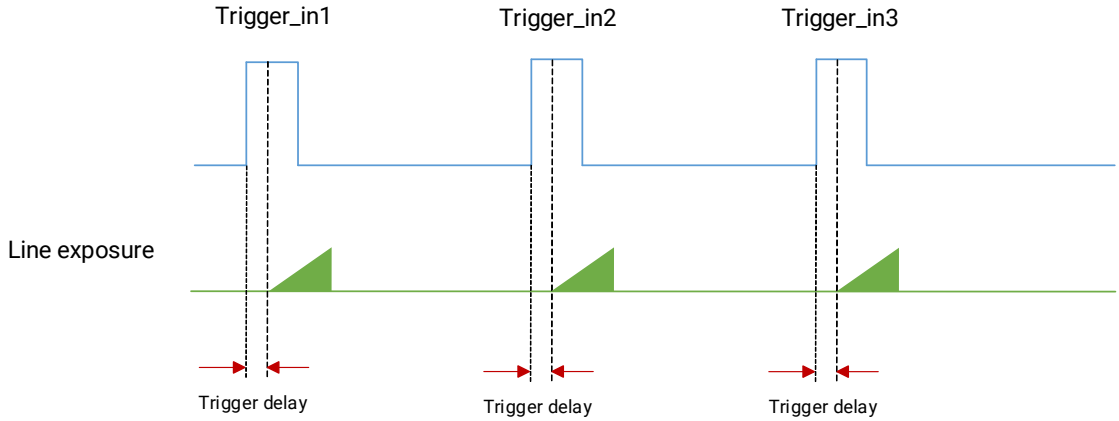


Figure 9-23 Sequence Diagram of Trigger Delay

Note

- The sequence diagram above uses rising edge as trigger activation.
- When **Line Delay Enable** is enabled, set the number of trigger lines for delay in the **FrameTrigger Delay**, or when the **Line Delay Enable** is disabled, set the trigger time for delay in the **Trigger Delay**.
- The **Line Delay Enable** is valid only when the line trigger mode is enabled.

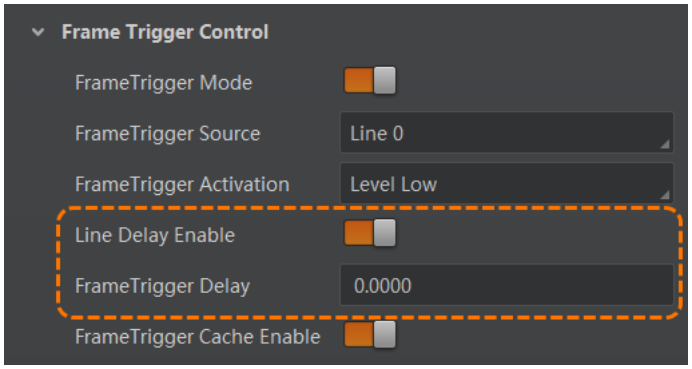


Figure 9-24 Set Trigger Delay

9.2 Trigger Output

The device has multiple bi-directional configurable lines. The method of setting bi-directional configurable line as output line as follows:

Steps

1. Go to **I/O Control**, and select specific line as **Line Selector**.
2. Set **Strobe** as **Line Mode**.
3. Set **Line Format** according to actual demands.

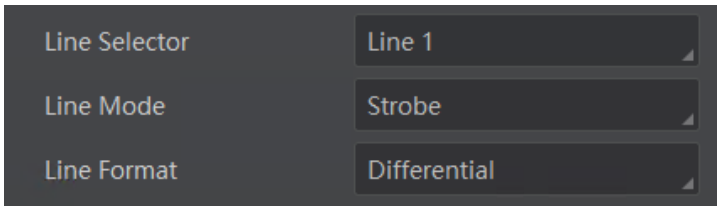


Figure 9-25 Select Output Signal

Note

- Differential stands for the differential signal.
- If a bi-directional configurable line signal is selected as **Line Selector** and **Line Mode** is **Input** currently, but you cannot set **Strobe** as **Line Mode**. The reason is that the bi-directional configurable line signal is selected as trigger source in one of line trigger/frame trigger/shaft encoder control/ frequency converter control settings. You should set other line signals as trigger source in line trigger/frame trigger/shaft encoder control/ frequency converter control settings all.

The output signal of the device is switch signal that can be used to control external devices such as light source, PLC, etc. There are two ways to set output signal, including line inverter and strobe signal.

9.2.1 Enable Line Inverter

The line inverter function allows the device to invert the electrical signal level of an I/O line. Go to **I/O Control** → **Line Inverter**, and enable it.

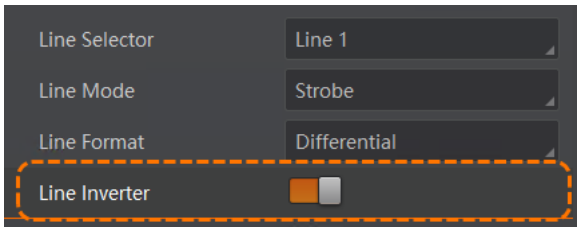


Figure 9-26 Enable Line Inverter

Note

The line inverter function is disabled by default.

9.2.2 Enable Strobe Signal

The strobe signal is used to directly output I/O signal to external devices when the device's event source occurs.
If you need to let the device output signals when it outputs one frame image, follow steps below to set it.

Steps

1. Click **I/O Control**, and set **Exposure Start Active** as **Line Source**.
2. Select **Frame Mode** as **Strobe Source Selector**.
3. Enable **Strobe Enable**.

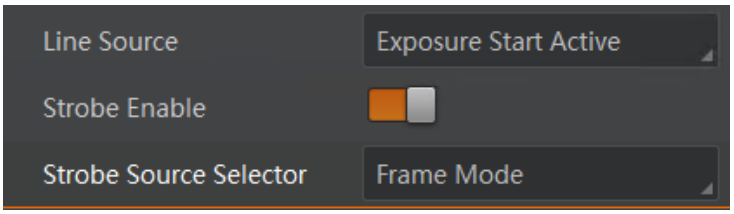


Figure 9-27 Select Frame Mode as Strobe Source Selector

Note

When the **Scan Mode** is **Frame Scan**, the **Frame Mode** can be selected as **Strobe Source Selector**.

If you need to let the device output signals when event sources occur that are corresponding to each line image, follow steps below to set it.

Steps

1. Click **I/O Control**, and select **Line Mode** as **Strobe Source Selector**.
2. Set **Line Source** according to actual demands.
3. Enable **Strobe Enable**.

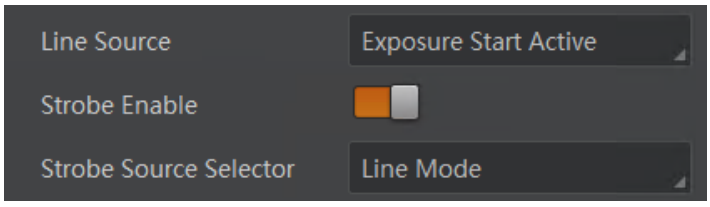


Figure 9-28 Select Line Mode as Strobe Source Selector

After selecting a specific line source, an event information will be generated, and the device will output a Strobe signal at the same time. The supported line sources are as follows:

Table 9-6 Line Source Description

Line Source	Description
Exposure Start Active	The device outputs signals to external devices when it starts exposure.
Frame Burst Start Active	The device outputs signals to external devices when the device's frame burst starts.
Frame Burst End Active	The device outputs signals to external devices when the device's frame burst stops.
Soft Trigger Active	The device outputs signals to external devices when it has a software trigger.
Hard Trigger Active	The device outputs signals to external devices when it has a hardware trigger.
Counter Active	The device outputs signals to external devices when it has a counter trigger.
Timer Active	The device outputs signals to external devices when it has a timer trigger.
Frame Start Active	The device outputs signals to external devices when it starts doing the capture of a frame.
Frame End Active	The device outputs signals to external devices when it stops doing the capture of a frame.

When **Counter Active** is selected as **Line Source**, you can go to **Counter and Timer Control** and set specific parameters according to actual demands.

Table 9-7 Description of Counter and Timer Control

Parameter	Read/Write	Description
Counter Selector	Read and write	It selects counter source. **Counter 0** is available only at present.
Counter Event Source	Read and write	It selects the signal source of counter trigger, and **Off**, **Line** * or **Link Trigger** * is available. It is disabled by default. It is available only when **Line*** is set as **Input**.
Counter Event Activation	Read and write	It selects the activation mode of the selected counter event source, including rising edge, falling edge, and any edge.

Parameter	Read/Write	Description
Counter Reset Source	Read and write	It selects the signal source of resetting counter. **Software** is available only. It is disabled by default.
Counter Reset	Write is available under certain condition	It resets counter and it can be executed when selecting **Software** as **Counter Reset Source**.
Counter Value	Read and write	It is the counter value with the range of 1 to 4294967295. **Note** The specific range of counter value may differ by device models.
Counter Current Value	Read only	It displays the number of executed external trigger.

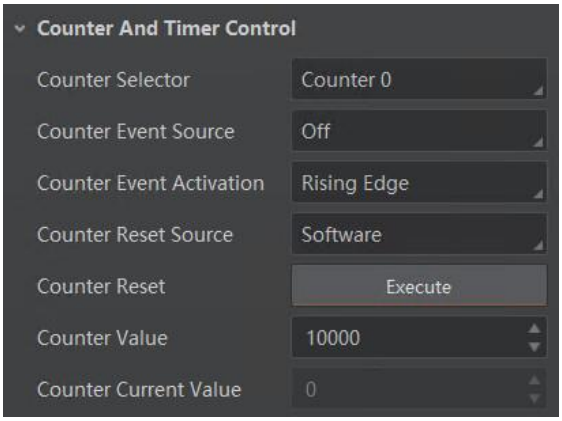


Figure 9-29 Counter and Timer Control

If **Timer Active** is selected as **Line Source**, you can set **Strobe Line Duration** and **Strobe Line Delay**, and the device will output signal correspondingly after click **Execute** in **Line Trigger Software**.

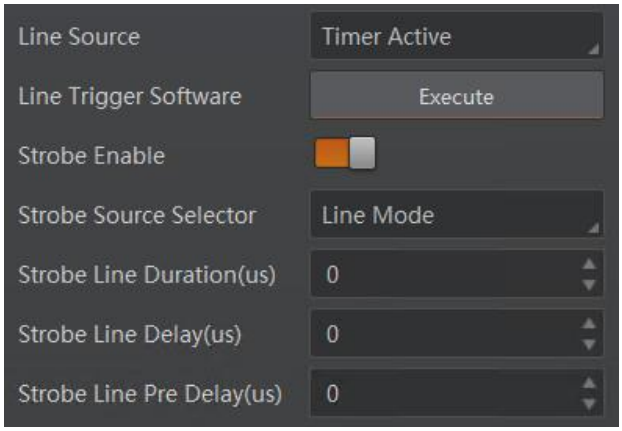


Figure 9-30 Timer Active Parameter

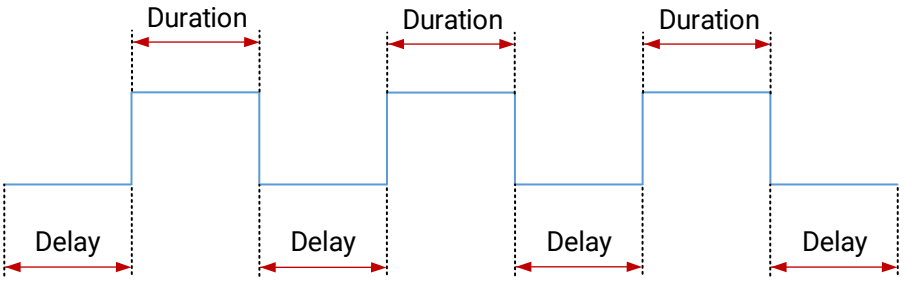


Figure 9-31 Sequence Diagram of Timer Active

Set Strobe Line Duration

After enabling strobe signal, you can set its duration. The unit is μs.
Go to **I/O Control** → **Strobe Line Duration**, and enter it according to actual demands.

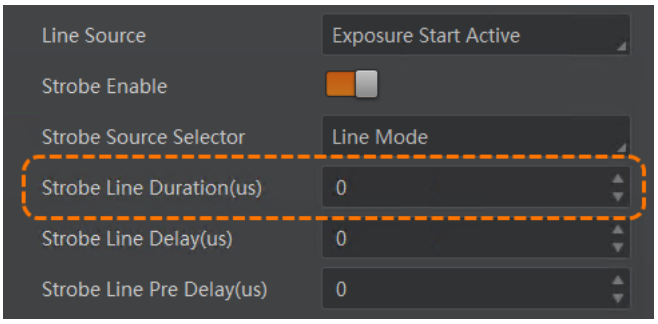


Figure 9-32 Set Strobe Line Duration

Note

- When the **Strobe Line Duration** value is 0, the strobe duration is equal to the exposure time.
- When the **Strobe Line Duration** value is not 0, the strobe duration is equal to **Strobe Line Duration** value.

Set Strobe Line Delay

The device supports setting strobe line delay to meet actual demands. When exposure starts, the strobe output does not take effect immediately. Instead, the strobe output will delay according to the strobe line delay setting.

Go to **I/O Control** → **Strobe Line Delay**, and enter **Strobe Line Delay** according to actual demands. The sequence diagram of strobe line delay is shown below.

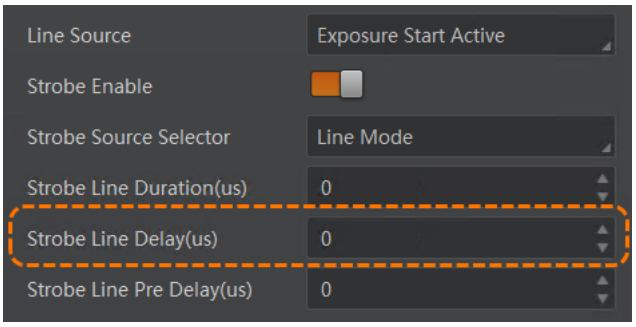


Figure 9-33 Set Strobe Line Delay

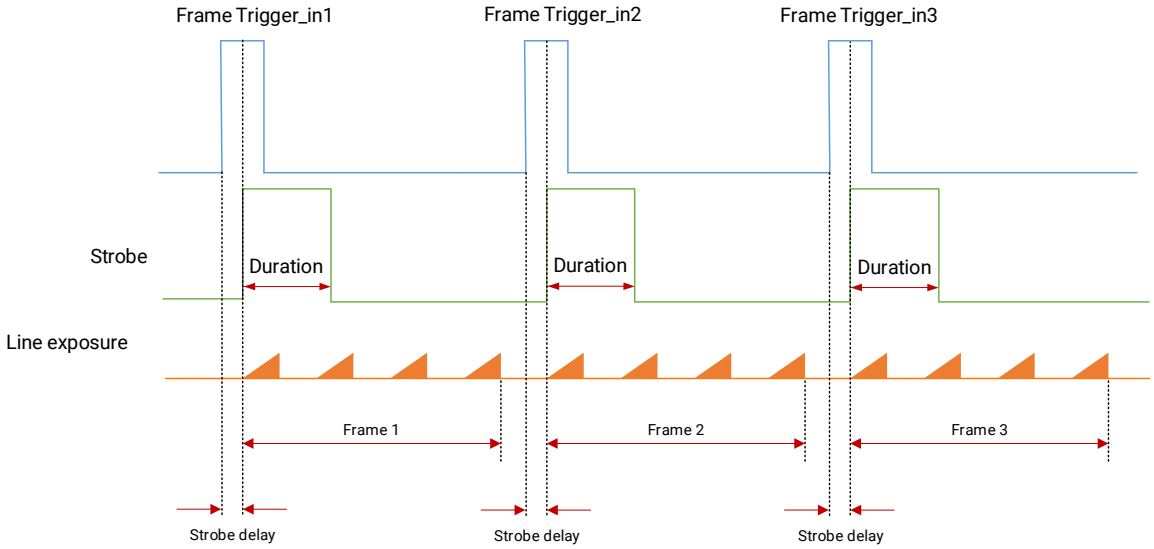


Figure 9-34 Sequence Diagram of Strobe Line Delay

Note

- The device's height parameter is 4 in the sequence diagram above.
- The range of the strobe line delay is from 0 to 10000, and the unit is μs.

Set Strobe Line Pre Delay

The device also supports the function of strobe line pre delay, which means that the strobe signal takes effect early than exposure. This function is applied to the external devices that have slow response speed.

Go to **I/O Control** → **Strobe Line Pre Delay**, and enter **Strobe Line Pre Delay** according to actual demands. The sequence diagram of strobe line pre delay is shown below.

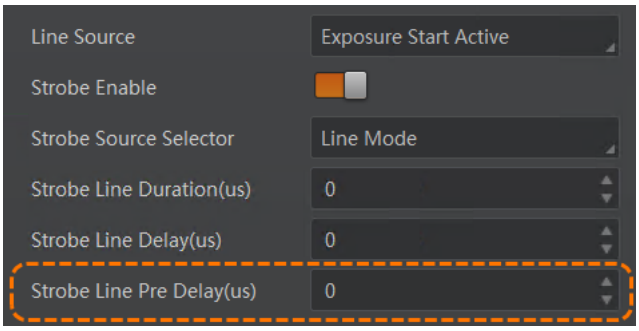


Figure 9-35 Set Strobe Line Pre Delay

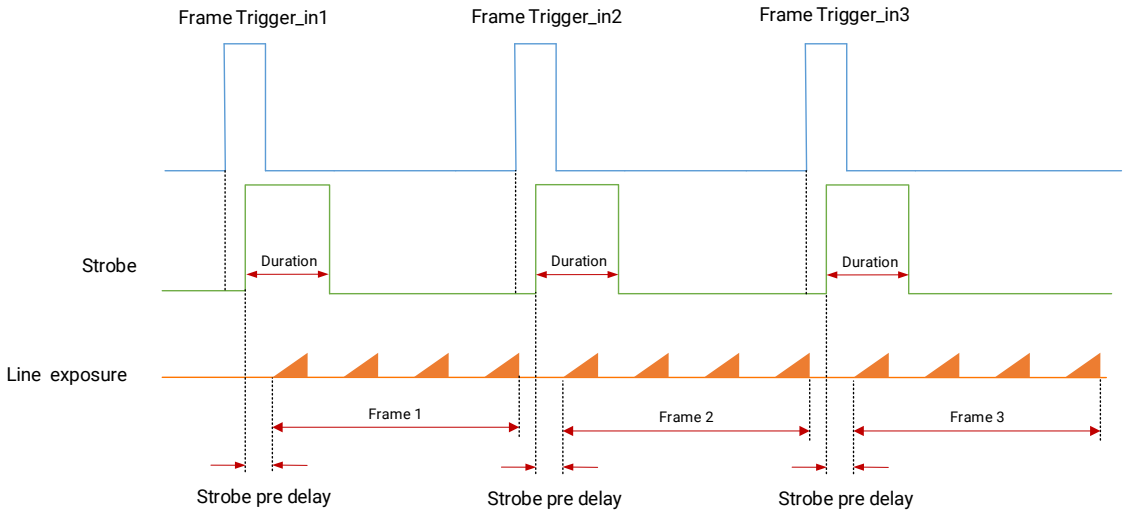


Figure 9-36 Sequence Diagram of Strobe Line Pre Delay

Note

- The device's height parameter is 4 in the sequence diagram above.
- The range of the strobe line delay is from 0 to 10, and the unit is μs.

Chapter 10 Image Acquisition

10.1 Set Line Rate

10.1.1 Line Rate Overview

Line rate refers to the number of image lines that is output by the device per second. The frame rate of the device is proportional to its line rate, and is inversely proportional to the image height, that is, Fps = Lps (line rate)/Height (image height).
The following factors determine the device's line rate in real time.

- Readout time: The less the readout time and the higher the line rate will be.
- Exposure time: The less the exposure time, the higher the line rate will be.
- Pixel format: The more bytes pixel format occupy, the lower the line rate will be.
- Link quantity: The more CoaXPress cables are used, the larger transmitted data and the higher the line rate will be.

Steps

1. Go to **Acquisition and Transfer Control** → **Acquisition Line Rate(Hz)**, and enter the value.
2. Enable **Acquisition Line Rate Control Enable**.

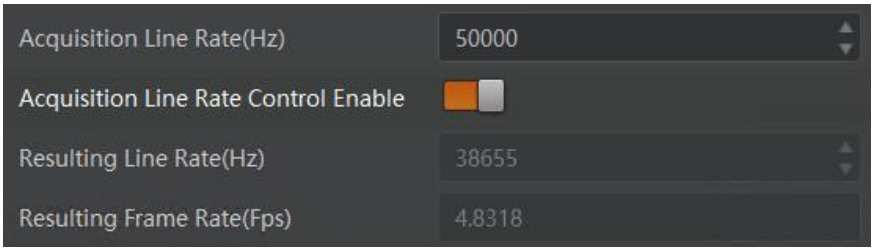


Figure 10-1 Set Line Rate

Note

- If the real-time line rate is smaller than the value you set, the device acquires images by the real-time line rate.
- If the real-time line rate is larger than the value you set, the device acquires images by the value you set.

3. View the device's final line rate and frame rate in **Resulting Line Rate(Hz)** and **Resulting Frame Rate(Fps)**.

10.1.2 Adjust Line Rate

Image compression and image stretching may occur when the captured line rate does not match with the moving speed of the target object.

- **Normal**: Captured line rate = moving speed of the target object
- **Image stretching**: Captured line rate > moving speed of the target object
- **Image compression**: Captured line rate < moving speed of the target object

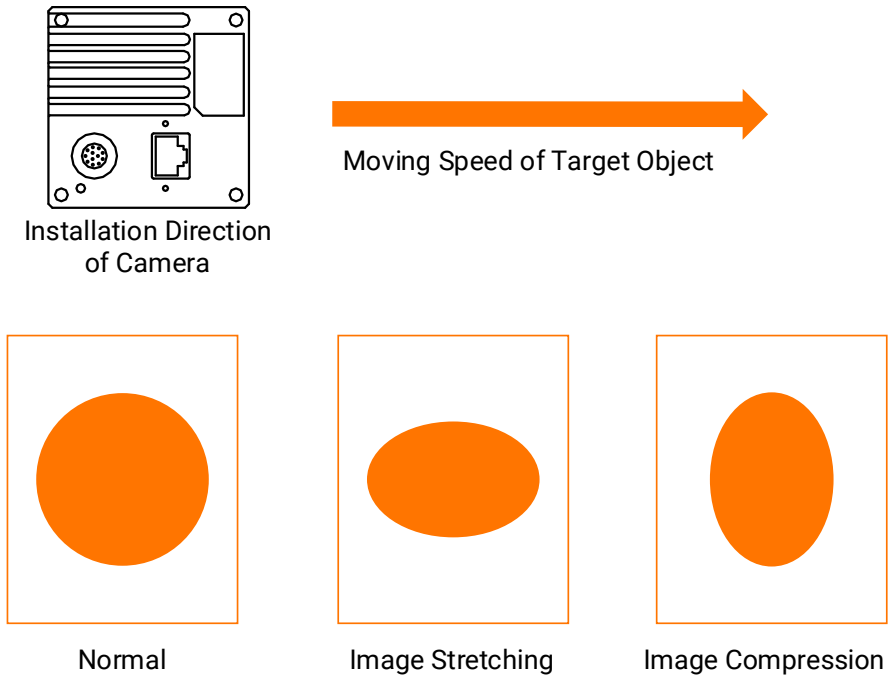


Figure 10-2 Adjust Line Rate

You can adjust the pixel ratio in both the length and width directions of a circular or square object to 1:1. Image compression or image stretching can be adjusted by increasing and decreasing the line rate, respectively.

The method of adjusting the line rate varies depending on the moving speed of the target object.

- When the target object is moving at a uniform speed, set the **Acquisition Line Rate(Hz)** to the line rate calculated from the object's moving speed.

The calculation formula of line rate is shown below. The Pixel is the lateral resolution of the camera, V is the moving speed of the target object, and L is the lateral length of the object.

$$\text{Hz (Line Rate)} = \frac{\text{Pixel} \times \text{V}}{\text{L}}$$

- When the target object is moving at a non-uniform speed, you can change to line trigger mode, and adjust the line rate by setting the pre-divider, multiplier and post-divider. Refer to section ***Set Trigger Mode*** and section ***Set and Execute Frequency Converter Control***.

10.2 Set Scan Direction

Note

- Make sure that the scan direction and the moving direction of objects are matched. Otherwise, acquired images may be abnormal.
- The scan direction can be set only when **2/4-TDI** is selected as **TDI Mode**. Refer to ***Set TDI Function*** for details.

The scan direction function is used to change the scan direction of the sensor used on measured objects. The figures below are the actual effects.

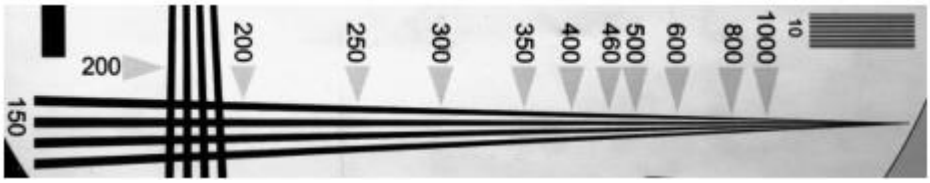


Figure 10-3 Image when Direction Matched of Mono Device

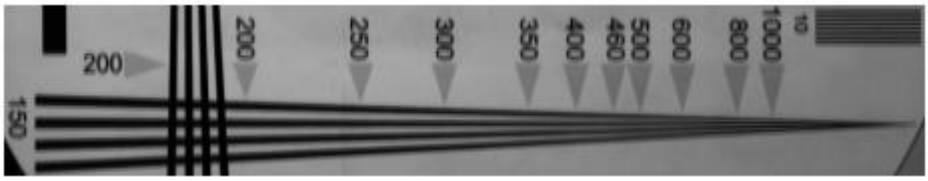


Figure 10-4 Image when Direction Mismatched of Mono Device

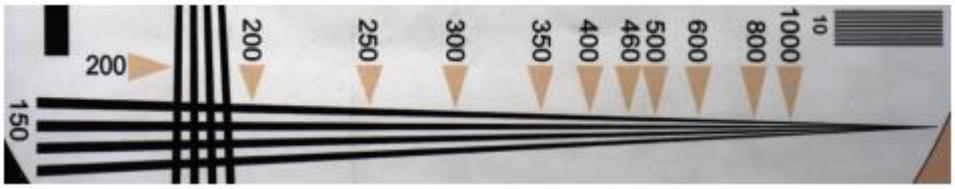


Figure 10-5 Image when Direction Matched of Color Device

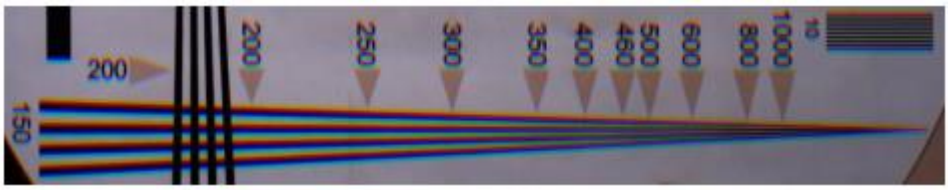


Figure 10-6 Image when Direction Mismatched of Color Device

Steps

1. Go to **Image Format Control** → **Direction Source**.
2. Set **Direction Source** according to actual demand.

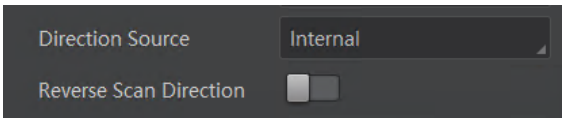


Figure 10-7 Internal Direction Source

3. (Optional) Select **Internal** as **Direction Source** and enable **Reverse Scan Direction** if you want to use the internal signal to achieve reverse scan function.
4. (Optional) Select **Line3 Level** as **Direction Source** and the device will switch to forward scan direction if Line 3 is in high level. Otherwise, the device will switch to backward scan direction.
5. (Optional) Select **Line3 Edge** as **Direction Source** and the device will switch scan direction if Line 3 is in rising edge.

10.3 Set Frame Timeout

The device supports frame timeout function that affects the device's acquisition and image output mechanism.

Go to **Acquisition and Transfer Control**, enable **Frame Timeout Enable**, and select **Partial Image Output Mode** according to actual demands.

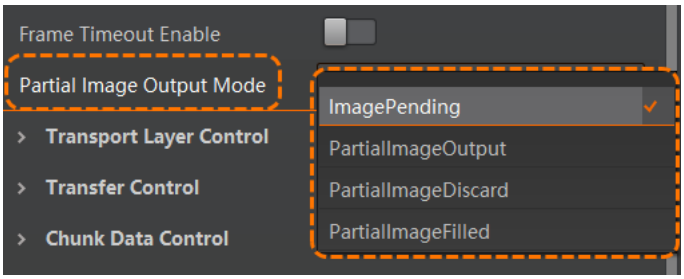


Figure 10-8 Set Frame Timeout

Table 10-1 Partial Image Output Mode Description

Parameter	Description
Image Pending	After the number of lines output by the device reaches the configured image height (height parameter), one frame of the image will be outputted. If the number of output lines does not reach the image height (height parameter), the SDK will not output the image, and the SDK will wait for the line data until it reaches the image height before outputting the image.
PartialImageOutput	When the number of lines output by the device reaches the configured image height (height parameter) within the frame timeout period, and one frame of image will be output. If the number of lines output by the device does not reach the configured image height (height parameter) within the frame timeout period, the SDK will output the image according to the actual height.

Parameter	Description
PartialImageDiscard	When the number of lines output by the device reaches the configured image height (height parameter) within the frame timeout period, and one frame of image will be output. If the number of lines output by the device does not reach the configured image height (height parameter) within the frame timeout period, the SDK discards the image.
PartialImageFilled	When the number of lines output by the device reaches the configured image height (height parameter) within the frame timeout period, and one frame of image will be output. If the number of lines output by the device does not reach the configured image height (height parameter) within the frame timeout period, SDK will output the image after filling the black according to the height parameter for the remaining part.

Note

- If **Frame Timeout Enable** is enabled, you can select **PartialImageOutput**, **PartialImageDiscard**, and **PartialImageFilled**.
- If **Frame Timeout Enable** is not enabled, the image output is related with configured trigger mode.
  - When the **FrameTrigger Mode** and **LineTrigger Mode** are **Off**, or when **LineTrigger Mode** is **On**, only **Image Pending** is supported.
  - When the **FrameTrigger Mode** and **LineTrigger Mode** are **On**, and **FrameTrigger Activation** and **LineTrigger Activation** are **Level High** or **Level Low**, or when **FrameTrigger Mode** is **On**, and **FrameTrigger Activation** is **Level High** or **Level Low,** all image output modes are supported, and the device outputs last frame of image in accordance with configured image output mode.
- The **Frame Trigger Control** can be set only if the **Frame Scan** is selected as **Scan Mode**.

10.4 Set Line Discard Function

Note

The line discard function can be set only when **2/4-TDI** is selected as **TDI Mode**. Refer to ***Set TDI Function*** for details.

Due to the inherent functional features of the sensor or the device itself, the first few lines of image acquisition may have abnormal images and need to be discarded. The device provides line discard function, which can adjust and control the number of external line trigger signals to ensure that the image acquisition meets the usage requirements.
You can go to **Image Format Control**, and enable **Abnormal Line Enable** according to actual demands.

- When this function is enabled, the external device needs to send N more trigger signals

to meet the line height of image acquisition, and the first N lines of abnormal images are discarded.

- When this function is not enabled, the quantity of external trigger signal is equal to that of the device's line height, and any abnormal lines that may exist are not discarded.

Note

The lines of abnormal images that are discarded is determined by internal logic of the camera.

10.5 Set Acquisition Mode

The device supports two types of acquisition modes, including **SingleFrame** mode and **Continuous** mode. Go to **Acquisition and Transfer Control** → **Acquisition Mode**, and select **Continuous** or **SingleFrame** as **Acquisition Mode** according to actual demands.

- **SingleFrame**: When device starts image acquisition, it acquires one image only, and then stops.
- **Continuous**: When device starts image acquisition, it acquires images continuously. Real-time frame rate decides the acquisition frame number per second. You can stop image acquisition manually.

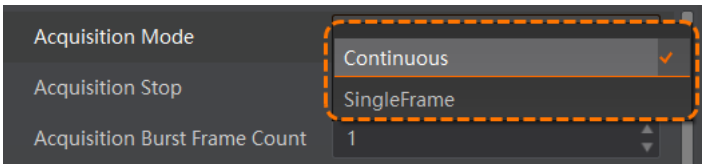


Figure 10-9 Set Acquisition Mode

Chapter 11 Image Parameter

11.1 View Resolution

Note

The device displays the image with max. resolution by default.

Go to **Image Format Control**, and you can view resolution by reading **Width Max** and **Height Max**.
Width Max stands for the max. pixels per inch in width direction, and **Height Max** stands for the max. pixels per inch in height direction.

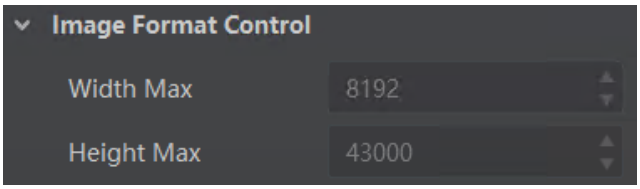


Figure 11-1 View Resolution

11.2 Set ROI

If you are only interested in a certain region of the image, you can set a Region of Interest (ROI) for the device.

Note

- The device supports one ROI only, and you can select **Region 0** as **Region Selector**.
- Region of interest can be set only when you stop real-time acquisition.

Go to **Image Format Control** → **Region Selector**, and enter **Width**, **Height**, and **Offset X**.

Note

- The **Width** plus **Offset X** should not be larger than **Width Max**, and **Height** should not be larger than **Height Max**.
- The step size of the **Width**, **Height**, and **Offset X** may vary. Please refer to the actual one.

- **Width**: It stands for horizontal resolution in ROI area.
- **Height**: It stands for vertical resolution in ROI area.
- **Offset X**: It refers to the horizontal coordinate of the upper left corner of the ROI.
- **Offset Y**: It refers to the vertical coordinate of the upper left corner of the ROI.

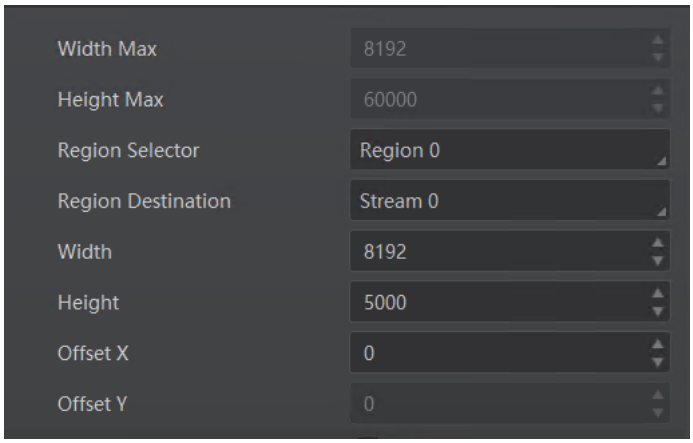


Figure 11-2 Set ROI

11.3 Set Image Reverse

The device supports reversing images in a horizontal way. Go to **Image Format Control**, and enable **Reverse X** according to actual demands.

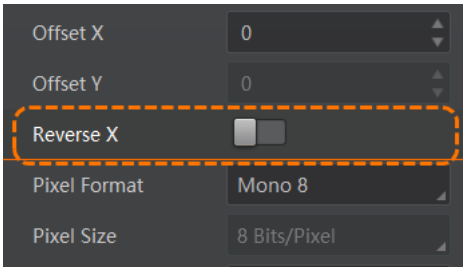


Figure 11-3 Set Image Reverse

11.4 Set Pixel Format

This function allows you to set the pixel format of the image data transmitted by the device. Go to **Image Format Control** → **Pixel Format**, and set **Pixel Format** according to actual demands.

Note

The specific pixel formats may differ by device models.
If there is no need to identify the color of the object, it is recommended to use a mono camera.

Table 11-1 Pixel Format and Pixel Size

Pixel Format	Pixel Size (Bits/Pixel)
Mono 8, Bayer 8	8

Pixel Format	Pixel Size (Bits/Pixel)
Mono 10/12, Bayer 10	16
RGB 8, BGR 8	24

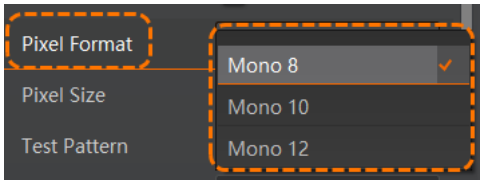


Figure 11-4 Set Pixel Format

The default output data format of mono device is Mono 8. The default output data format of color device is Bayer 8, and it can be converted into RGB format via pixel interpolation algorithm. RGB format can be converted into BGR format via the order adjustment.
Bayer GR, Bayer GB, Bayer BG, Bayer RG and Bayer RBGG patterns are shown below.

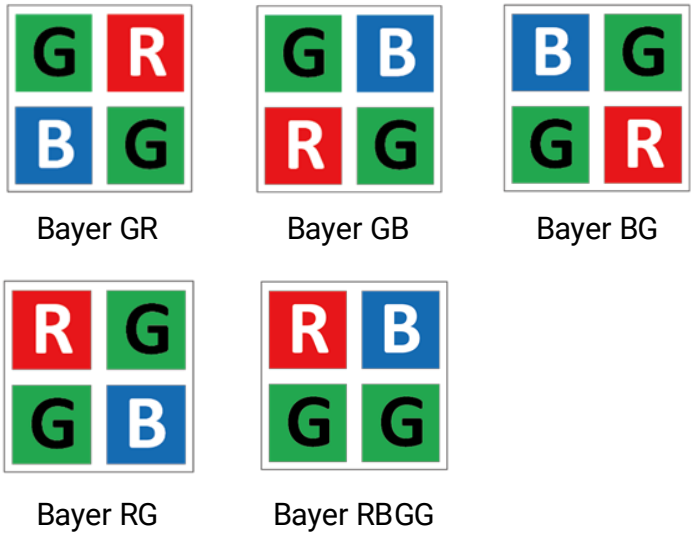


Figure 11-5 Pixel Pattern

11.5 Set Test Pattern

Note

The test pattern may differ by device models.

The device supports test pattern function. When there is exception in real-time image, you can check whether image of test mode have similar problem to determine the reason. This function is disabled by default, and at this point, the output image by the device is real-time image. If this function is enabled, the output image by the device is test image.
Go to **Image Format Control** → **Test Pattern**, and set **Test Pattern** according to actual demands.

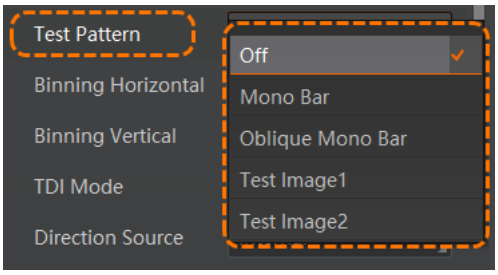
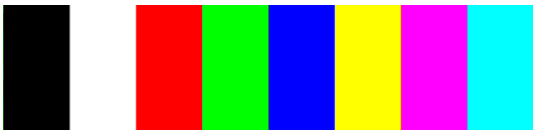


Figure 11-6 Set Test Pattern

The device offers 5 test patterns, including **Mono Bar**, **Oblique Mono Bar**, **Vertical Color Bar**, **Test Image 1**, and **Test Image 2**.

Table 11-2 Image of Test Pattern

Test Pattern	Image
Vertical Color Bar	
Mono Bar	
Oblique Mono Bar	
Test Image1	
Test Image2	

Note

- The pattern of **Vertical Color Bar** is not supported by the mono device.
- The patterns of the test image 1 and test image 2 may differ by device models.

11.6 Set Binning

The purpose of setting binning is to enhance sensibility. With binning, multiple sensor

pixels are combined as a single pixel to reduce resolution and improve image brightness. For a color device, it merges the pixel values of adjacent pixels of the same color horizontally, as shown below.

Figure 11-7 Binning Horizontal 2

Figure 11-8 Binning Vertical 2

If the horizontal binning coefficient and the vertical binning coefficient of the color device are both configured to 2, the device merges the 4 adjacent sub-pixels of the same color according to the corresponding position, and outputs the merged pixel value as a sub-pixel, as shown below.

Figure 11-9 Binning Horizontal 2 and Binning Vertical 2

Click **Binning Selector**, and set **Binning Horizontal** and **Binning Vertical** according to actual demands.

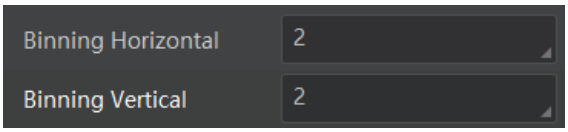


Figure 11-10 Set Binning

Note

- **Binning Horizontal** is the image's width and offset X, and **Binning Vertical** is the image's height.
- If the device's vertical resolution is 1, and then there is no **Binning Vertical**.
- The binning function may differ by device models.

11.7 Set TDI Function

Note

The TDI function may differ by device models.

TDI refers to Time Delay Integration, and it is a method of line scanning which provides dramatically increased responsivity compared to other video scanning methods. It permits much greater scanning speeds in low light, or allows reduced lighting levels (and costs) at conventional speeds. In general, there are 3 TDI modes, including 1 line, 2-TDI, and 4-TDI.

- 1 line refers to single line mode, and the device selects 1 line data as output result.
- 2-TDI means that the device overlaps 2 adjacent line data, and outputs 1 line data as final result.
- 4-TDI means that the device overlaps 4 adjacent line data, and outputs 1 line data as final result.

Go to **Image Format Control** → **TDI Mode**, and set **TDI Mode** according to actual demands.

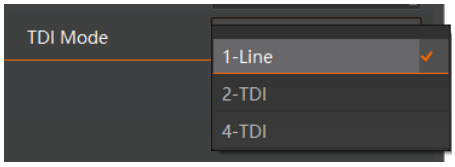


Figure 11-11 Set TDI Mode

11.8 Set Sequence

If the device supports sequencer, you can configure multiple groups of parameters including exposure time and digital gain. The principle of the sequencer is shown below.

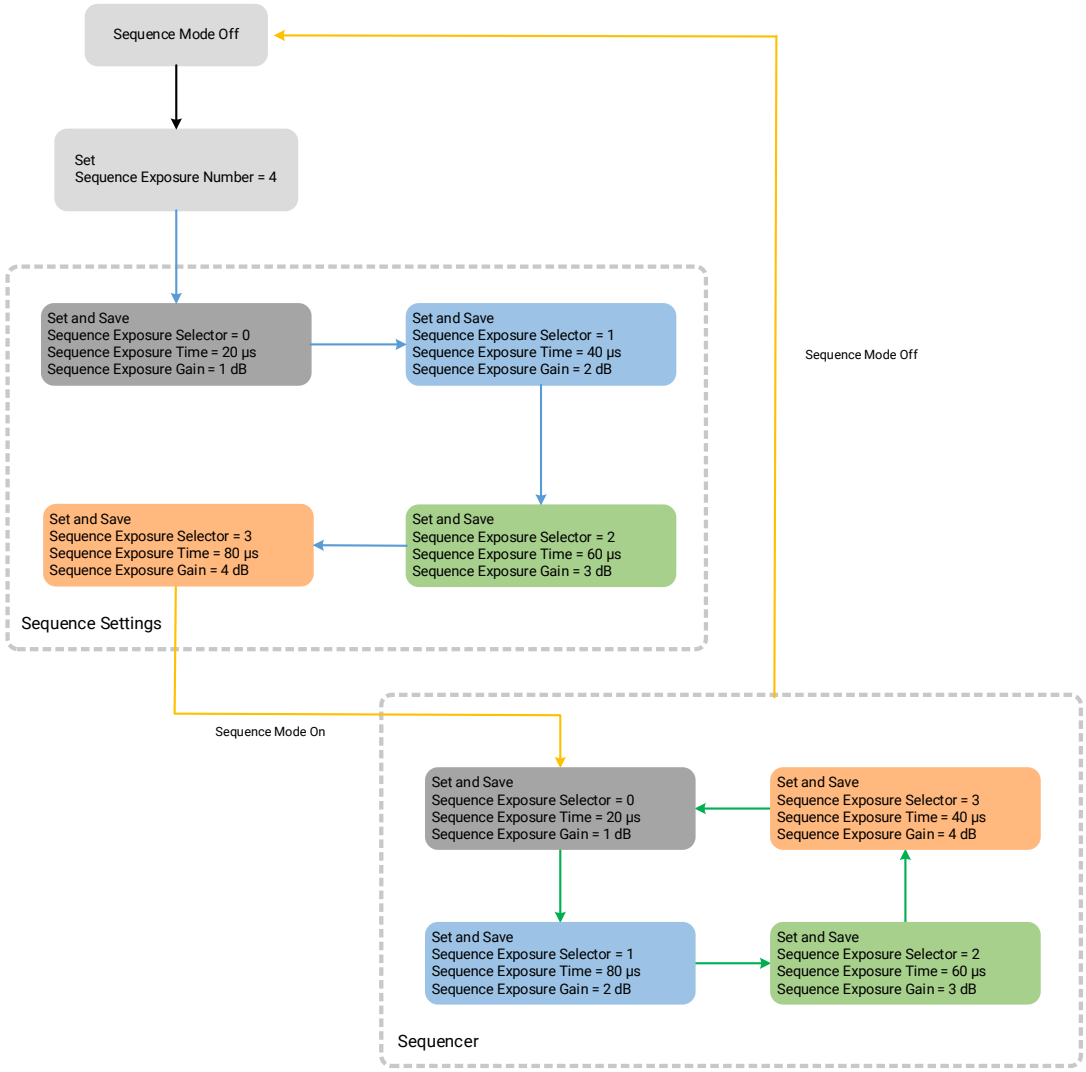


Figure 11-12 Principle of Sequencer

Note

- The sequence mode function may differ by device models.
- Some device models support TDI function. The sequence mode cannot be set when **4-TDI** is selected as **TDI Mode**. Refer to ***Set TDI Function*** for details.

Steps

1. Go to **Image Format Control**, and set **Sequence Exposure Number** to configure how many groups to join sequencer according to actual demands.

Note

Up to 4 groups of parameters can be configured.

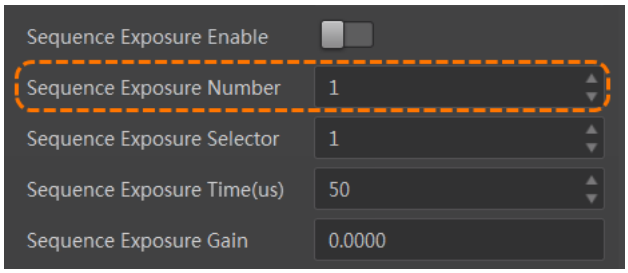


Figure 11-13 Set Sequence Exposure Number

2. Set **Sequence Exposure Selector** to select one group of parameters.
3. Set the exposure time and digital gain of the selected parameter in **Sequence Exposure Time** and **Sequence Exposure Gain**.

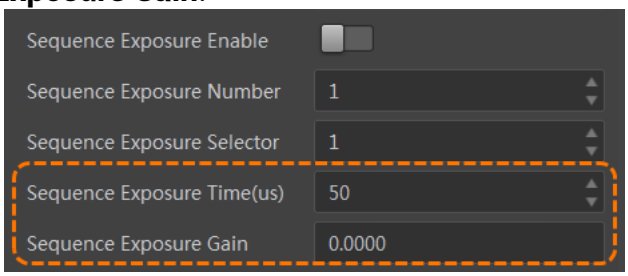


Figure 11-14 Set Sequence Exposure Time and Gain

4. Repeat step 2 to step 3 to configure other group of parameters.
5. Enable **Sequence Exposure Enable** to start sequencer after configuration.

Note

When the sequence mode function is enabled, the device will automatically adjust the related parameters. Please refer to the actual one you got.

11.9 Set Sensor Mode

Note

- The sensor mode function may differ by device models.
- The sensor mode can be set only when **2/4-TDI** is selected as **TDI Mode**. Refer to ***Set TDI Function*** for details.

The device provides two types of sensor mode, including high full well mode and high sensitivity. Go to **Image Format Control** → **Sensor Mode**, and set this parameter according to actual demands.

- **High Full Well Mode**: It provides a higher dynamic range, enhancing image clarity and reducing noise. It is applicable for the environment with low illumination

- **High Sensitivity**: It is selected by default. In this mode, the device provides better photosensitivity performance and the brighter image.

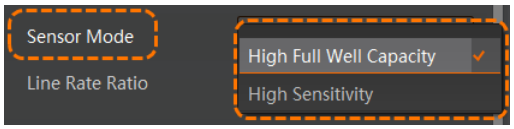


Figure 11-15 Set Sensor Mode

11.10 Set Exposure Mode

The exposure mode supports **Timed** and **Trigger Width**. When selecting **Timed**, you can set **Exposure Auto** and **Exposure Time**. When you select **Trigger Width**, the exposure time and level signal time are the same, and **Exposure Auto** and **Exposure Time** are invalid.

Note

The **Trigger Width** can be selected as the **Exposure Mode** when the requirements below are met:

- **LineTrigger Mode** in **Line Trigger Control** is enabled.
- **Line** ⋆ is selected as the **LineTrigger Source**.
- **Level High** or **Level Low** is selected as **LineTrigger Activation.**

The **Exposure Auto** supports 3 types, including **Off**, **Once** and **Continuous**. Go to **Acquisition and Transfer Control** → **Exposure Auto**, and select **Exposure Auto** according to actual demands.

- **Off**: The device exposures according to the value set in **Exposure Time (μs)**.
- **Once**: The device adjusts the exposure time automatically according to the image brightness. After adjusting, it will switch to **Off** mode.
- **Continuous**: The device adjusts the exposure time continuously according to the image brightness.

When the exposure mode is set as **Once** or **Continuous**, the exposure time should be within the range of **Auto Exposure Time Lower Limit (μs)** and **Auto Exposure Time Upper Limit (μs)**.

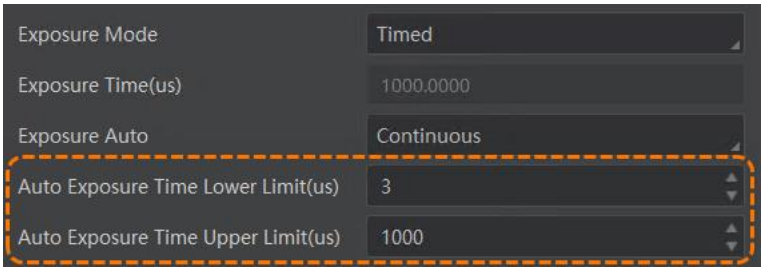


Figure 11-16 Set Exposure Time under Once or Continuous Mode

11.11 Set Gain

Note

The gain function may differ by device models.

The device has 2 types of gain, including the analog gain and digital gain. The analog gain is applied before the signal from the device sensor is converted into digital values, while digital gain is applied after the conversion.

11.11.1 Set Analog Gain

Go to **Advanced Processing** → **Preamp Gain**, and set **Preamp Gain** according to actual demands.

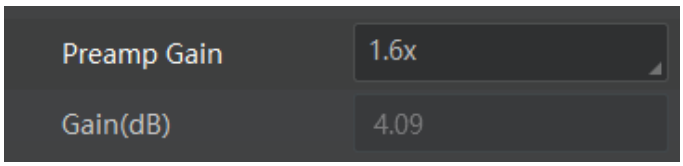


Figure 11-17 Set Analog Gain

Note

When increasing gain, the image noise will increase too, which will influence image quality. If you want to increase image brightness, it is recommended to increase the device's exposure time first. If the exposure time reaches its upper limit, and at this point, you can increase the gain.

11.11.2 Set Digital Gain

Apart from analog gain, the device supports digital gain function. When analog gain reaching its upper limit and the image is still too dark, it is recommended to improve image brightness via digital gain.
Click **Advanced Processing**, enable **Digital Shift Enable**, and enter **Digital Shift** according to actual demands.

Figure 11-18 Set Digital Gain

Note

- The digital gain function is disabled by default, and its value range is from –24.082399

to 23.999836.

- When increasing the digital gain, the image noise will greatly increase too, which will severely influence image quality. It is recommended to use analog gain first, and then to adjust digital gain if the analog gain cannot meet demands.

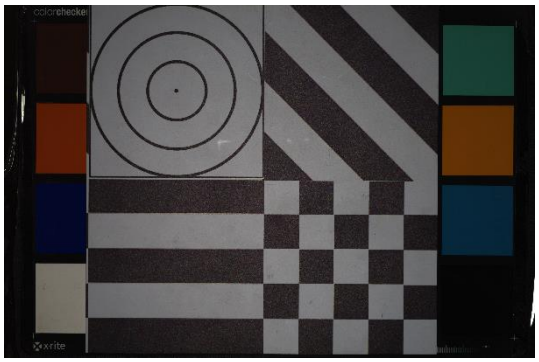
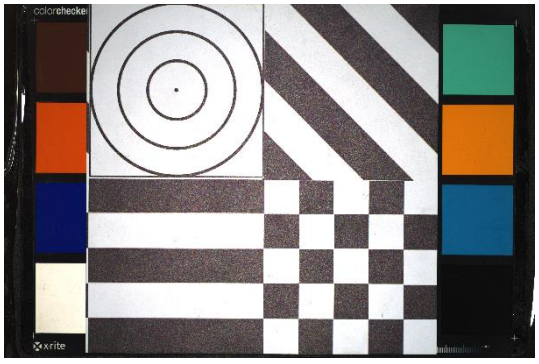
11.12 Set Brightness

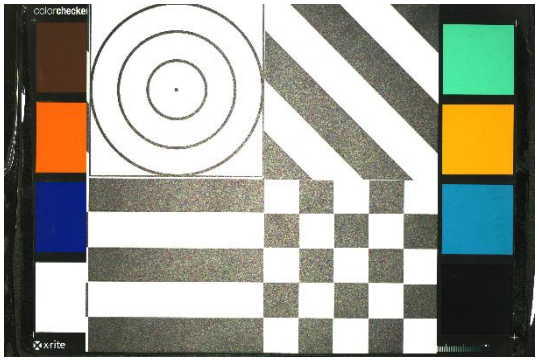
The device brightness refers to the brightness when the device adjusts image under **Once** or **Continuous** exposure mode.

Note

- You should enable **Once** or **Continuous** exposure mode first before setting brightness.
- After setting brightness, the device will automatically adjust exposure time to let image brightness reach target one. Under **Once** or **Continuous** exposure mode, the higher the brightness value, the brighter the image will be.
- The range of brightness is between 0 and 255.

Table 11-3 Brightness Example

Brightness Value	Image
Brightness=25	
Brightness=75	

Brightness Value	Image
Brightness=120	

Go to **Advanced Processing** → **Brightness**, and enter **Brightness** according to actual demand.

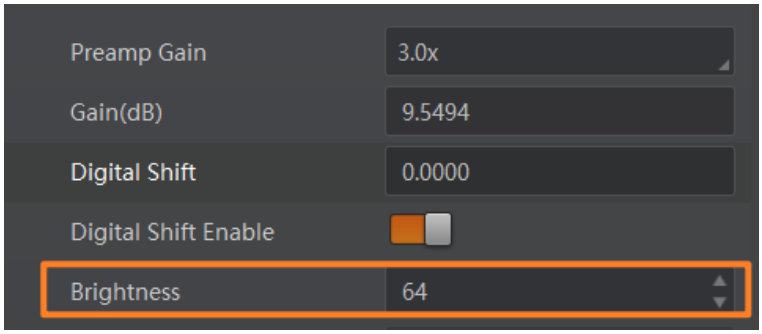


Figure 11-19 Set Brightness

11.13 Set Black Level

The device supports black level function that allows you to change the overall brightness of an image by changing the gray values of the pixels by a specified amount.
Go to **Advanced Processing** → **Black Level Enable**, enable **Black Level Enable**, and enter **Black Level** according to actual demands.

Figure 11-20 Set Black Level

11.14 Set White Balance

Note

White balance is only available for color devices.

The white balance refers to the device color adjustment depending on different light sources. Adjust the R/G/B ratio to ensure that the white regions are white under different color temperatures. Ideally, the proportion of R/G/B in the white region is 1:1:1.
The device supports 3 types of white balance mode, including **Off**, **Once** and **Continuous**. Click **Advanced Processing** → **Balance White Auto**, and select **Balance White Auto** according to actual demands.

- **Off**: You need to set the R, G, B ratio manually via **Balance Ratio Selector** and **Balance Ratio**. The range is from 1 to 4095, and 1024 means ratio is 1.0.
- **Once**: Adjust the white balance for a certain amount of time then stop.
- **Continuous**: Adjust the white balance continuously.

It is recommended to correct white balance when there is great difference between the device's color effect and actual effect. You can correct white balance as shown below.

Steps

1. Put a white paper in the range of the device's field of view, and make sure the paper covers the entire field of view.
2. Set exposure and gain.

Note

It is recommended to set image brightness value between 120 and 160.

3. Select **Wide** as **AWB Color Temperature Mode** to let the device adjust white balance again if the image's color effect is not good under the default condition of **Balance White Auto** is **Continuous** and **AWB Color Temperature Mode** is **Narrow**.

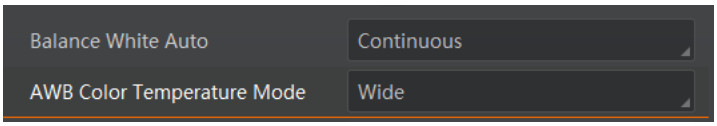


Figure 11-21 Set Parameters

If there is still great difference between correction effect and actual color, it is recommended to correct white balance according to following steps.

Steps

Note

- Here we take **Green** as an example. For specific **Balance Ratio Selector** value, please refer to the actual condition.
- In order to avoid repeated correction after rebooting the device, it is recommended to save white balance parameter to **User Set** after white balance correction. You can refer

to the section ***Save User Set*** and ***Load User Set*** for details.

- If the light source and color temperature in environment change, you need to correct white balance again.
- When the pixel format of the device is Bayer, you can also adjust the white balance via the white balance setting tool in the software client of version 3.2.0 and above. For detailed information, please refer to the user manual of the software client.

1. Select **Off** as **Balance White Auto**. At this time, **Balance Ratio** is 1024.
2. Find corresponding R/G/B channel in **Balance Ratio Selector**. Here we take **Green** as an example.
3. Find device's R/G/B value.
4. Take **Green** as correction standard, and manually adjust other two channels (R channel and B channel) to let these three channels have same value.

11.15 Set Gamma Correction

The device supports Gamma correction function. Generally, the output of the device's sensor is linear with the photons that are illuminated on the photosensitive surface of the sensor. Gamma correction provides a non-linear mapping mechanism as shown below.

- Gamma value between 0.5 and 1: image brightness increases, dark area becomes brighter.
- Gamma value between 1 and 4: image brightness decreases, dark area becomes darker.

Note

This function is disabled by default.

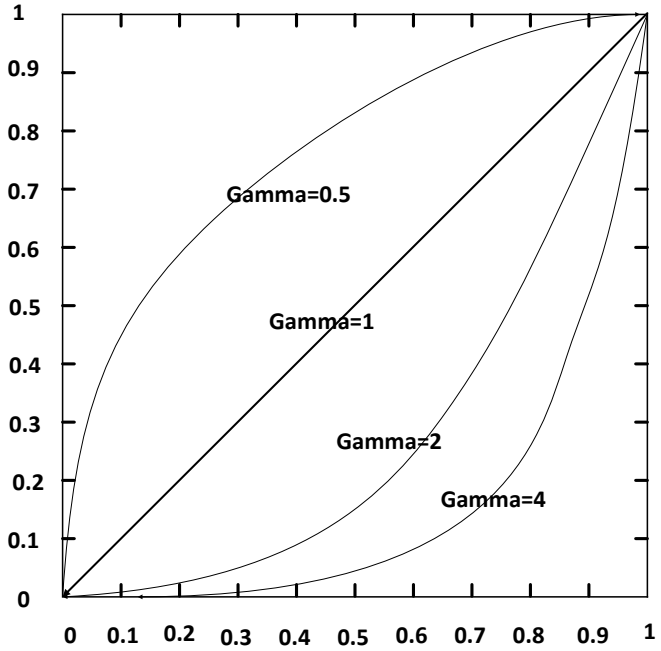


Figure 11-22 Set Gamma Correction

Table 11-4 Gamma Correction Example

Gamma Value	Image
Gamma=0.5	
Gamma=1.5	
Gamma=2	

There are 2 types of Gamma correction, including **User** mode and **sRGB** mode. Settings method is different as shown below.

User Mode

Steps

1. Go to **Advanced Processing** → **Gamma Selector**.
2. Select **User** as **Gamma Selector**.
3. Enable **Gamma Enable** to enable it.
4. Enter **Gamma** according to actual demands, and its range is from 0 to 4.

Figure 11-23 Set User Mode

sRGB Mode

Steps

1. Go to **Advanced Processing** → **Gamma Selector**.
2. Select **sRGB** as **Gamma Selector**.
3. Enable **Gamma Enable** to enable it.

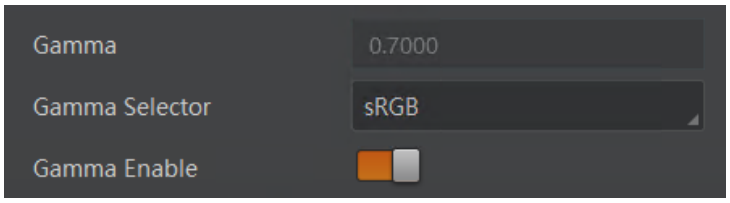


Figure 11-24 Set sRGB Mode

11.16 Set Digital Noise Reduction

Note

Excessive noise reduction will affect the image details.

The function of digital noise reduction can increase the image's SNR and improve its quality.

Steps

1. Go to **Advanced Processing** → **Digital Noise Reduction Mode**.
2. Select **Expert** as **Digital Noise Reduction Mode**.
3. Enter **Denoise Strength** and **Noise Correct** according to actual demands.

- **Denoise Strength** refers to the intensity of the digital noise reduction. You can increase it to have a better effect.
- **Noise Correct** refers to the noise horizontal correction value, and it is used to adjust the noise curve.

Figure 11-25 Set Digital Noise Reduction

11.17 Set AOI

Note

- The AOI function may differ by device models.
- AOI 1 is used to adjust the brightness when the device is in once or continuous exposure mode, and AOI 2 is used to adjust the white balance when the color device is in once or continuous white balance mode.

The device supports AOI function that can adjust the brightness and white balance of the entire image based on the area you selected.

Steps

1. Click **Advanced Processing** → **AutoFunctionAOI Control** → **Auto Function AOI Selector**, and select **AOI 1** or **AOI 2**.
2. Enter **Auto Function AOI Width**, **Auto Function AOI Height**, and **Auto Function AOI Offset X** according to actual demands.
3. Enable **Auto Function AOI Usage Intensity** if **AOI 1** is selected as **Auto Function AOI Selector**. Or enable **Auto Function AOI Usage White Balance** if **AOI 2** is selected as **Auto Function AOI Selector**.

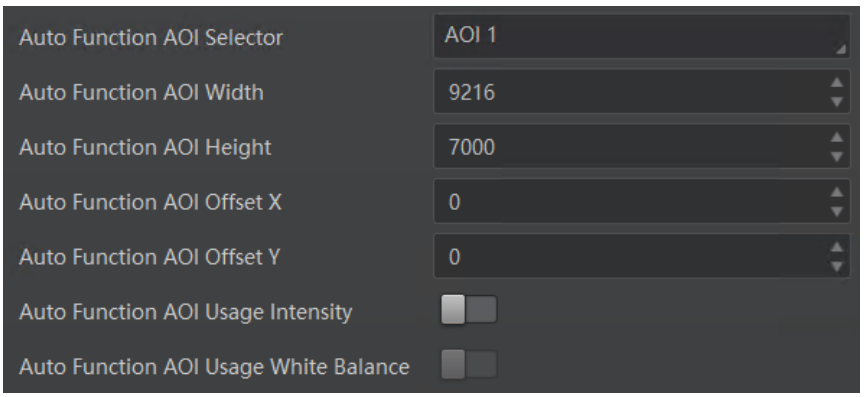


Figure 11-26 Set AOI

11.18 Set Color Transformation Control

Note

- The function of color transformation control is only available for color devices.
- Currently, **RGBtoRGB** is available for **Color Transformation Selector** only.
- If the pixel format is Bayer, this function is not supported.

After the image is processed by the white balance, the overall image will be dark, and at the same time, various colors may deviate from their standard values to varying degrees. At this time, it is necessary to multiply the color of the image by the correction matrix to correct each color to its standard value, so that the overall color of the image is more vivid. The color correction function is implemented by multiplying each RGB component by a correction matrix. The currently supported color conversion module is RGB to RGB.
Two methods are available to set color transformation control.

Steps

1. Go to **Color Transformation Control**, and enable **CCM Enable**.
2. You can enable/disable **Color Transformation Enable** to set this function.

When **Color Transformation Enable** is disabled, you can set **Color Transformation Value** according to actual demand.

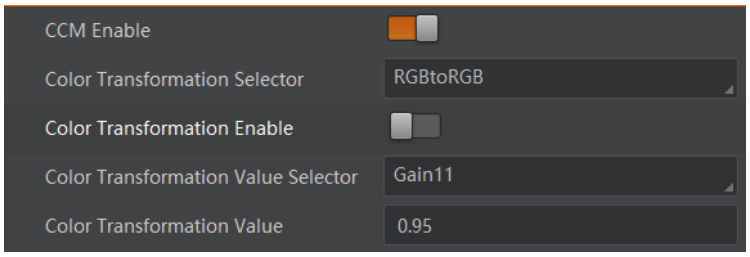


Figure 11-27 Set Color Transformation

When **Color Transformation Enable** is enabled, you can set hue and saturation to control color transformation value.

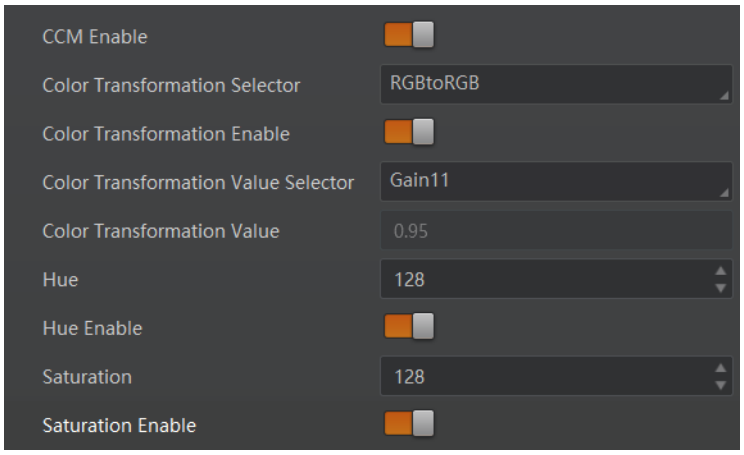


Figure 11-28 Set Color Transformation

11.19 Set Hue

Note

- The hue function is only available for color devices.
- In Mono pixel format, hue function is not supported.
- The range of hue is between 0 and 255.

Adjusting the hue shifts the colors of the image. After hue is set, the device will perform color correction based on the hue value to bring the image tone to the target value. For example, when hue is set to 128, the red in the image appears as real red. When hue is 0, the hue is reversed 128 degrees counterclockwise, and red becomes blue. When hue is 255, the hue rotates 128 degrees clockwise, and red becomes green. Image examples of different hue values are shown below.

Table 11-5 Hue Example

Hue Value	Image
Hue=0	
Hue=128	
Hue=255	

Before You Start

Make sure the **Pixel Format** of the color device is **RGB**, or **BGR**, and enable **Color Transformation Enable**.

Steps

1. Go to **Color Transformation Control**, and enable **Hue Enable**.
2. Enter **Hue** according to actual demands.

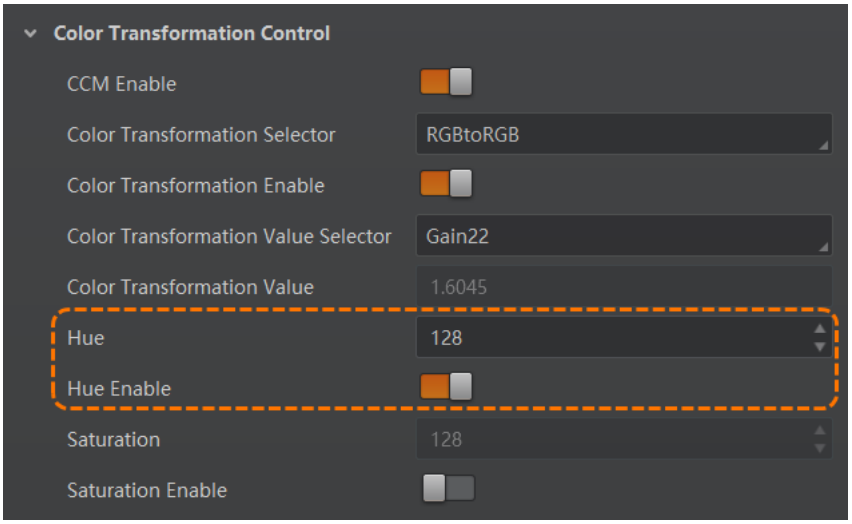


Figure 11-29 Set Hue

11.20 Set Saturation

Note

- The saturation function is only available for color devices.
- In Mono pixel format, saturation function is not supported.
- The range of saturation is between 0 and 255.

Adjusting the saturation changes the colorfulness of the colors. A higher saturation, for example, makes colors easier to distinguish. Image examples of different saturation values are shown below.

Table 11-6 Saturation Example

Saturation Value	Image
Saturation=0	
Saturation =128	
Saturation =255	

Before You Start

Make sure the **Pixel Format** of the color device is **RGB**, or **BGR**, and enable **Color Transformation Enable**.

Steps

1. Go to **Color Transformation Control**, and enable **Saturation Enable**.
2. Enter **Saturation** according to actual demands.

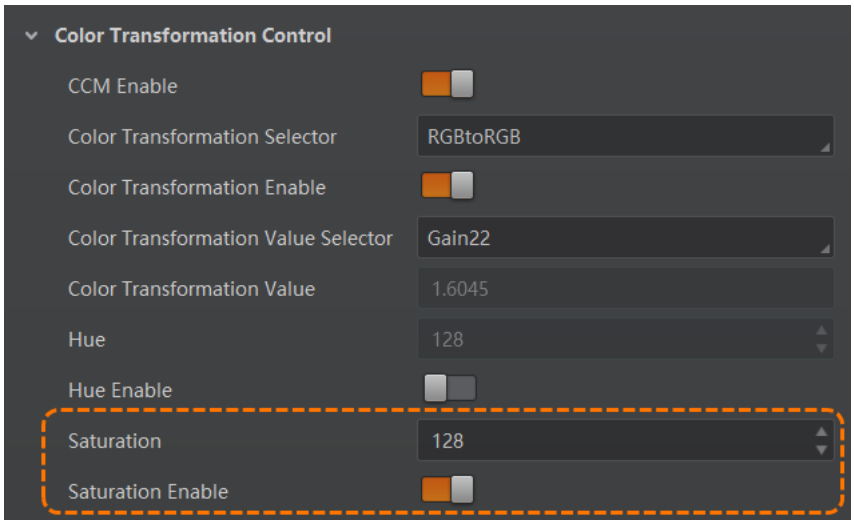


Figure 11-30 Set Saturation

11.21 Set LUT

A Look-Up Table (LUT) is a customizable grayscale-mapping table. You can stretch and amplify the grayscale range. The mapping can be linear or customized curve.

Note

- You cannot use Gamma correction function and LUT function at the same time.
- For the device that supports TDI function, the LUT should be executed again after you switch to TDI mode.
- The range of the LUT index is from 0 to 1023.
- The range of the LUT value is from 0 to 4095. The value of LUT value is four times the value of LUT index by default.

Steps:

1. Click **LUT Control**, and enable **LUT Enable**.
2. Enter **LUT Index** and **LUT Value** according to actual demands.
3. Click **Execute** in **LUT Save** to save it.

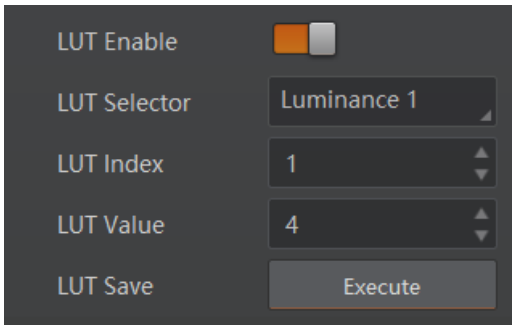


Figure 11-31 Set LUT

11.22 Set Shading Correction

The flat field correction (FFC) includes PRNUC correction and FPNC correction, and they are used to improve the image uniformity that may be impacted by the sensor, light sources, external conditions, etc.

11.22.1 Set FPNC Correction

Steps

1. Click **Shading Correction**, and **User Flat Field Correction** is disabled by default.

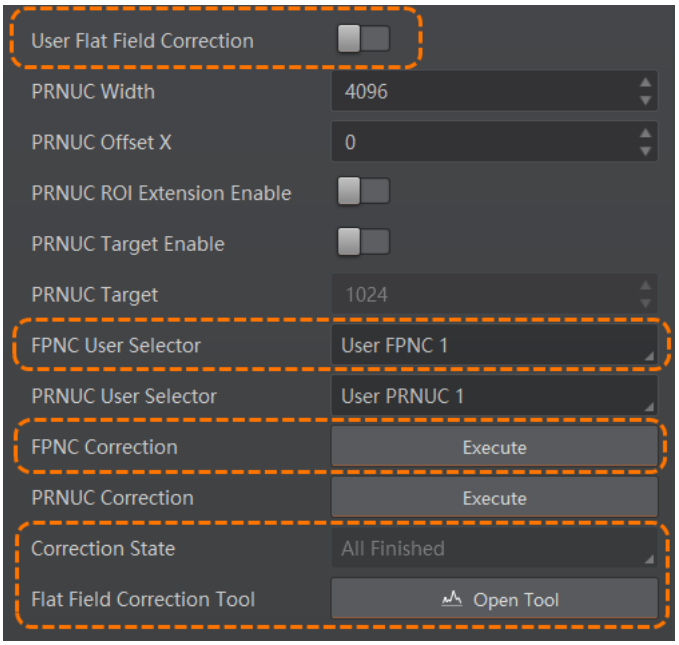


Figure 11-32 Set FPNC Correction

2. Select one **User FPNC** from **FPNC User Selector**.
3. Click **Execute** in **FPNC Correction**, or click **Open Tool** in **Flat Field Correction Tool** and click **Perform FPN Calibration**.

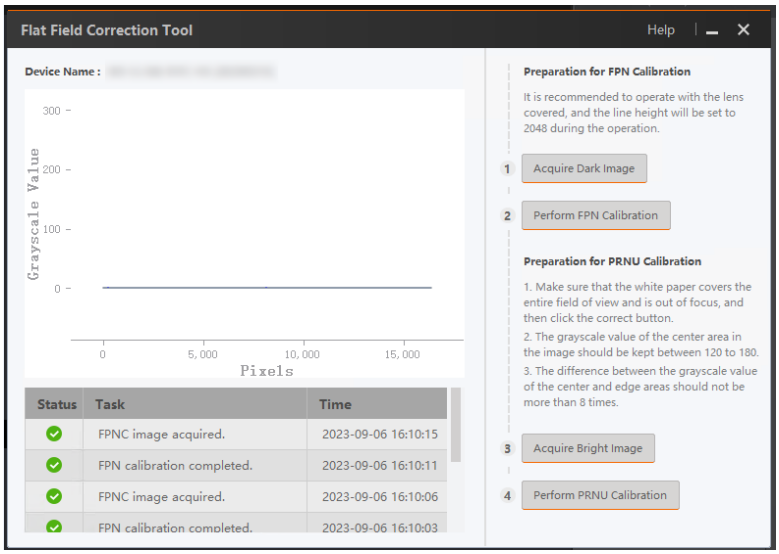


Figure 11-33 Flat Field Correction Tool

Note

Refer to ***Flat Field Correction Tool User Manual*** for details.

4. Enable **User Flat Field Correction**.

Note

After **User Flat Field Correction** is enabled, you can enable FPNC correction and PRNUC correction at the same time.

The status of FPNC correction process can be viewed via **Correction State**. There are five statuses in total:

- **All Finished**: It means that the correction is done.
- **Doing Correction**: It means that the correction is executing.
- **Saving Data**: It means that the correction data is saving.
- **Transferring Data**: It means that the correction data is sending.
- **Error**: It means that the correction fails.

Note

The status of PRNUC correction process can also be viewed via **Correction State**.

11.22.2 Set PRNUC Correction

The device supports PRNUC (Photo-Response Non-Uniformity Correction) function that eliminates vertical line on the images. Two correction methods are available, including global correction and ROI correction. The effect of PRNUC correction is shown blow.

Figure 11-34 Before PRNUC Correction

Figure 11-35 After PRNUC Correction

Global PRNUC Correction

Steps

1. Click **Shading Correction**, and **User Flat Field Correction** is disabled by default.

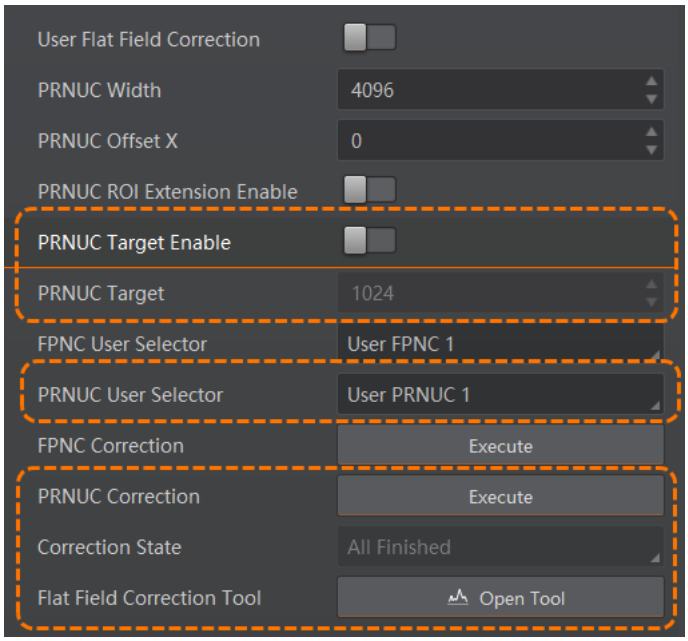


Figure 11-36 Set Shading Correction

2. Select one **User PRNUC** from **PRNUC User Selector**.
3. Set PRNUC target related parameters according to actual demands.

- Disable **PRNUC Target Enable** if you want to use the device's auto correction standard. At this time, the device compares and corrects the average gray value of each column with the average gray value of the entire image.
- Enable **PRNUC Target Enable** if you want to manually correct. For mono devices, set **PRNUC Target**. At this time, the device compares and corrects the average gray value of each column with the configured gray value.

4. Click **Execute** in **PRNUC Correction**, or click **Open Tool** in **Flat Field Correction Tool** and click **Perform PRNUC Calibration**.

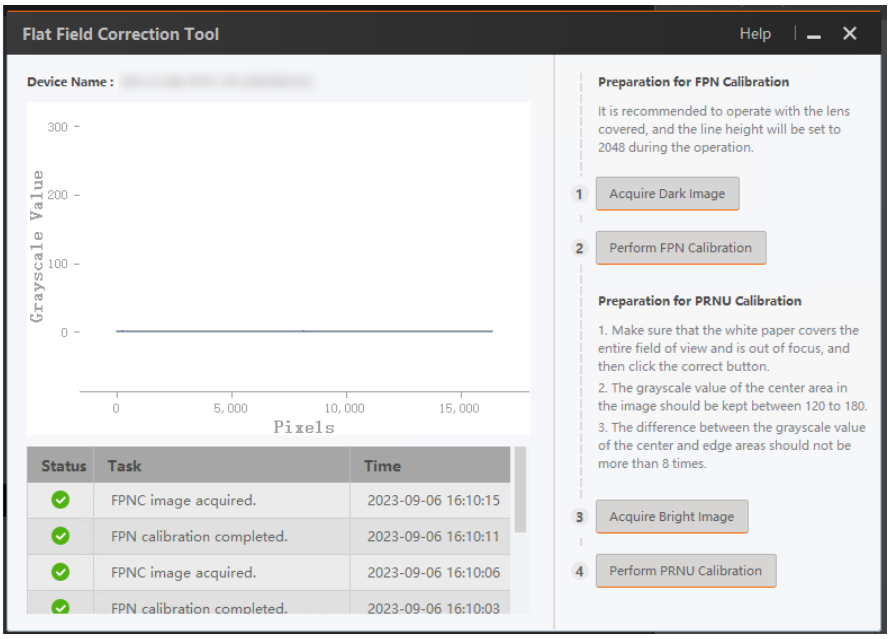


Figure 11-37 Flat Field Correction Tool

Note

Refer to ***Flat Field Correction Tool User Manual*** for details.

5. Enable **User Flat Field Correction**.

Note

After **User Flat Field Correction** is enabled, you can enable FPNC correction and PRNUC correction at the same time.

ROI PRNUC Correction

If you want to execute PRNUC correction for specific areas, set **PRNUC Width** and **PRNUC Offset X** to set ROI, and enable **PRNUC ROI Extension Enable** to execute PRNUC Correction out of the ROI.

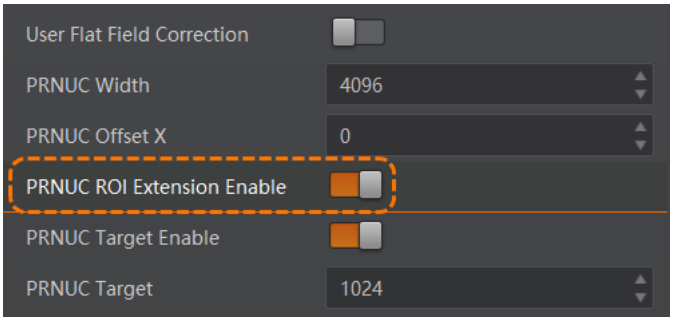


Figure 11-38 ROI PRNUC Correction

Note

Refer to section *Global PRNUC Correction* and ***Flat Field Correction Tool User Manual*** for details of flat field correction tool.

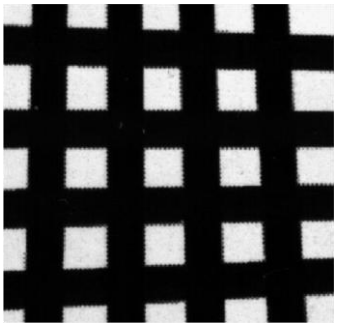
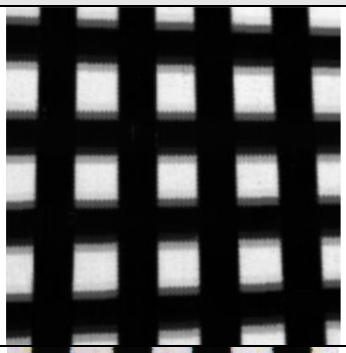
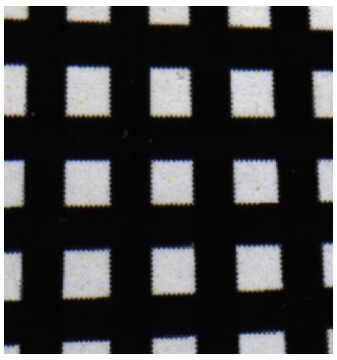
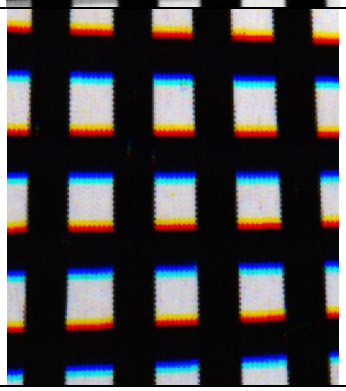
11.23 Set Line Rate Ratio

Note

The line rate ratio function can be set only when **2/4-TDI** is selected as **TDI Mode**. Refer to *Set TDI Function* for details.

You can go to **Image Format Control**, and set **Line Rate Ratio** according to actual demands. Line rate ratio is used to adjust the ratio between the device's line rate and that of the actual object to adjust the pixel deviation between upper line and lower line in images. Refer to the table below for effect contrast.

Table 11-7 Effect Contrast of Line Rate Ratio

Device Type	Normal Image	Abnormal Image
Mono Device		
Color Device		

- It is recommended to set line rate ratio larger than 1 when the device's line rate is larger than that of the object.
- It is recommended to set line rate ratio smaller than 1 when the device's line rate is smaller than that of the object.
- It is recommended to set line rate ratio as 1 when the device's line rate is equal to that of the object.

Chapter 12 Other Functions

12.1 User Set Customization

This function allows you to save or load device settings. The device supports four sets of parameters, including one default set and three user sets, and the relation among four sets of parameters is shown below.

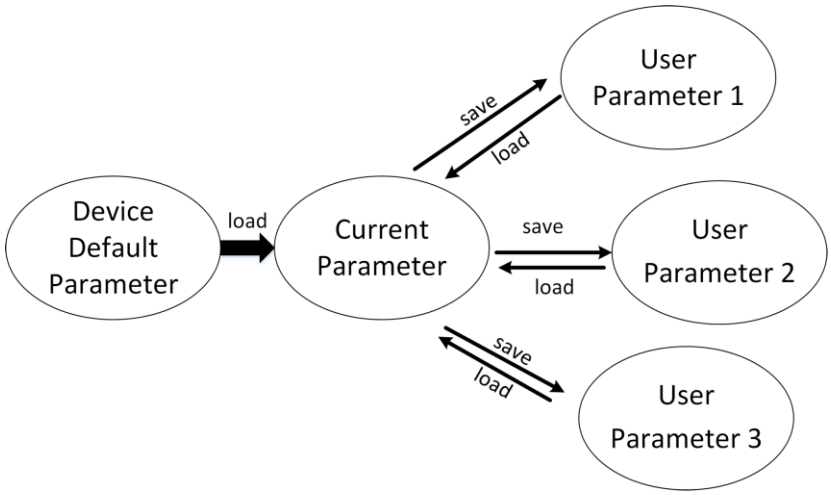


Figure 12-1 Parameter Relation

Note

After setting user parameters, it is recommended to save user parameters and select them as the default parameters.

12.1.1 Save User Set

Steps

1. Go to **User Set Control**, and select a user set in **User Set Selector**.

Note

Here we take selecting **User Set 1** as an example.

2. Click **Execute** in **User Set Save** to save parameter.

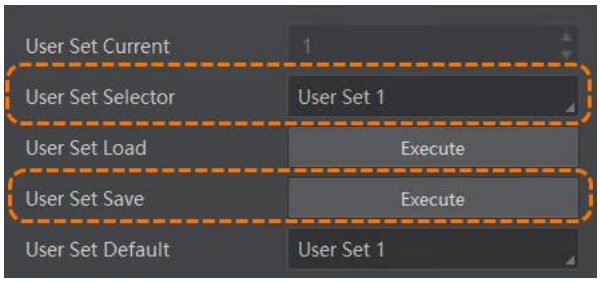


Figure 12-2 Save User Set

12.1.2 Load User Set

Note

Loading user set is available only when the device is connected but without live view.

Steps

1. Go to **User Set Control**, and select a user set in **User Set Selector**.

Note

Here we take selecting **User Set 1** as an example.

2. Click **Execute** in **User Set Load** to load parameter.

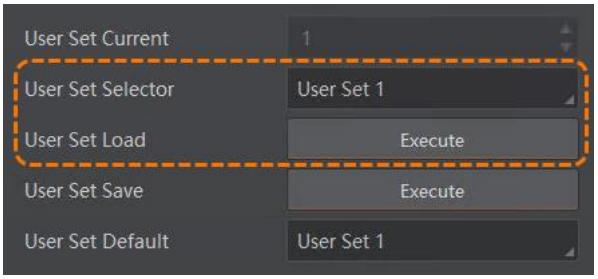


Figure 12-3 Load User Set

12.1.3 Set User Default

You can also set default parameter by going to **User Set Control** and selecting a user set in **User Set Default**.

Note

- The User Set Default is the user set that will be loaded upon power cycling the camera
- Here we take selecting **User Set 1** as an example.

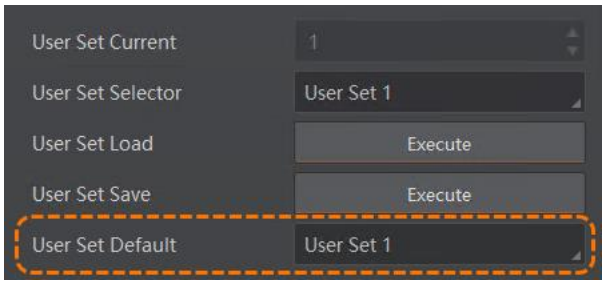


Figure 12-4 Set User Default

12.2 Device Control

Note

The specific device control parameters may differ by device models.

In **Device Control**, you can view device information, edit device name, reset device, etc. The specific parameters in **Device Control** are shown below.

Table 12-1 Parameter Description

Parameter	Read/Write	Description
Device Type	Read Only	It is the device type.
Device Scan Type	Read Only	It is the scan type of the device's sensor.
Device Vendor Name	Read Only	It is the name of the manufacturer of the device.
Device Model Name	Read Only	It is the model of the device.
Device Manufacturer Info	Read Only	It is the manufacturer information about the device.
Device Firmware Version	Read Only	It is the firmware version of the device.
Device Serial Number	Read Only	It is device's serial number.
Device User ID	Read & Write	Device name and it is empty by default. You can set according to your preference. ● If User ID is empty, the client software displays the device model. ● If you set it, the client software displays the User ID you set.
Device Uptime (s)	Read Only	It is the period of time when device is powered up.
Board Device Type	Read Only	It is the device type.
Device Connection Selector	Read & Write	It selects which connection of the device to

Parameter	Read/Write	Description
		control.
Device Connection Speed (Mbps)	Read Only	It indicates the speed of transmission of the specified connection.
Device Link Selector	Read & Write	It selects which link of the device to control
Device Link Speed (Mbps)	Read Only	It indicates the speed of transmission negotiated on the specified link.
Device Link Connection Count	Read Only	It returns the number of physical connection of the device used by a particular link.
Device Link Heartbeat Mode	Read & Write	It activates or deactivates the link's heartbeat.
Device Stream Channel Count	Read only	It indicates the number of streaming channels supported by the device.
Device Stream Channel Selector	Read & Write	It selects the stream channel to control.
Device Stream Channel Type	Read Only	It reports the type of the stream channel.
Device Stream Channel Link	Read Only	It is the index of device's link to use for streaming the specified stream channel.
Device Stream Channel Endianness	Read Only	It is the endianness of multi-byte pixel data for this stream.
Device Stream Channel Packet Size (B)	Read & Write	It specifies the stream packet size, in bytes, to send on the selected channel for a transmitter or specifies the maximum packet size supported by a receiver.
Device Event Channel Count	Read Only	It indicates the number of event channels supported by the device.
Device Character Set	Read Only	It is character set used by the strings of the device's bootstrap registers.
Device Reset	Write Only	Click **Execute** to reset the device.
Device Temperature Selector	Read & Write	It selects device component to view its temperature. Currently, only sensor can be selected only.
Device Temperature	Read Only	It displays the temperature of selected components in **Device Temperature Selector**.
Find Me	Read & Write	The function of finding me is executed. Click

Parameter	Read/Write	Description
		Execute to find the currently operating device.
Device Max Throughput (Kbps)	Read Only	It is max. bandwidth of the data that can be streamed out of the device.
Device PJ Number	Read Only	It is the device's project number.

12.3 Embed Information into Image

The device supports embedding information into image data. The information will be embedded into the image according to the enabling condition of each type of information in the order of the image embedding information listed in the table below.

Note

White Balance is only available for the color devices.

Table 12-2 Image Embedding Information

Image Embedding Info.	Byte	Data Format
Timestamp	4	Refer to figure below.
Gain	4	4 bytes are used to transfer the gain information. Each low 8 bits of the 4 valid data are combined to transfer the gain information. Value Range: 0 to 1023. Note: High bits will be complemented with 0 automatically.
Exposure	4	4 bytes are combined to show the exposure time, and the unit is μs.
Brightness Info	4	Ranges from 0 to 4095
Frame Counter	4	Ranges from 0 to 2^{32}-1
Ext Trigger Count	4	Ranges from 0 to 2^{32}-1
Line Input Output	4	The 1st byte is input, and each bit corresponds to 1 input. The 2nd byte is output, 3rd and 4th bytes are reserved.
Width	4	Ranges from 0 to 2^{32}-1
Height	4	Ranges from 0 to 2^{32}-1
Offset X	4	Ranges from 0 to 2^{32}-1
Offset Y	4	Ranges from 0 to 2^{32}-1
Pixel Format	4	Ranges from 0 to 2^{32}-1
White Balance	8	R/G/B occupies 2 bytes each. Value Range: 0 to 4095.

Image Embedding Info.	Byte	Data Format
ROI Position	8	The starting coordinates occupy two bytes each with the column coordinates at the front and the row coordinates at the back. The length and width coordinates each occupy two bytes.

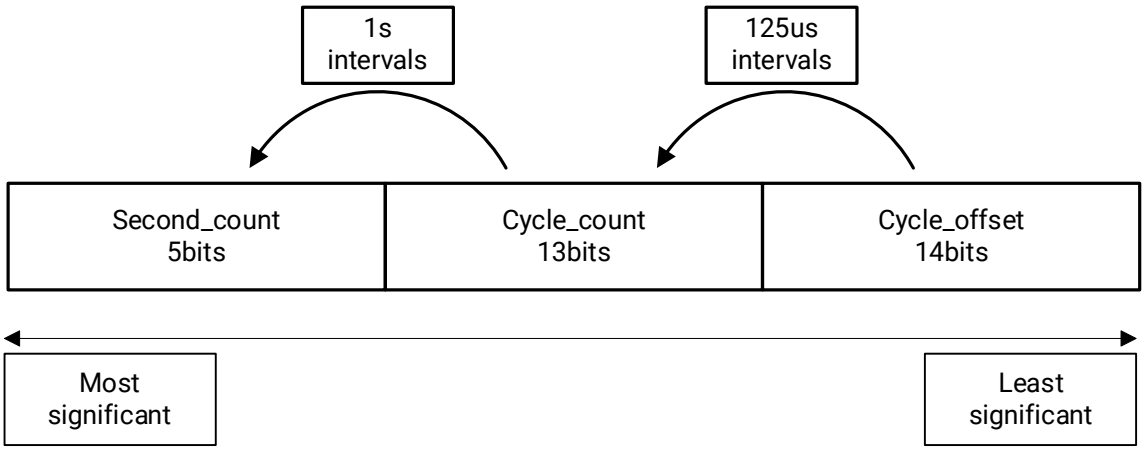


Figure 12-5 Data Format of Timestamp

You can embed information into the image via Chunk function.

Steps

1. Go to **Chunk Data Control** → **Chunk Mode Active**, and **Chunk Mode Active**.

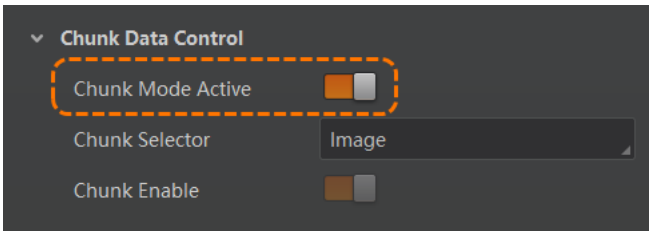


Figure 12-6 Enable Chunk Mode Active

2. Select **Chunk Selector** according to actual demands.
3. Enable **Chunk Enable** to embed information into the image.

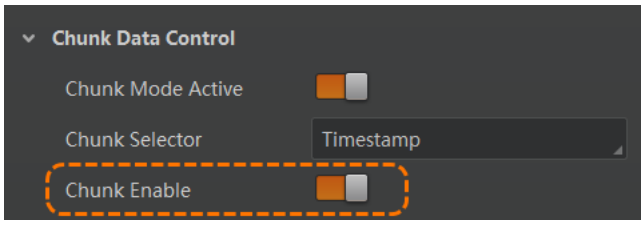


Figure 12-7 Chunk Enable

4. (Optional) Repeat steps above to add multiple Chunk information types.
5. Click on the control toolbar of the client software to view specific information.

12.4 Set Action Command

Note

- Only V3.1.0 and above version of MVS client software support GigE Vision action command.

The action command allows you to execute actions on multiple devices at roughly the same time by using a single broadcast protocol message.

Steps

1. Go to **Transport Layer Control** → **GEV IEEE 1588**, and enable **GEV IEEE 1588**.
2. Go to **Acquisition and Transfer Control** → **Frame Trigger Control**, and enable **FrameTrigger Mode**.
3. Select **Action 1** as **FrameTrigger Source**.
4. Go to **Tool** → **GigE Vision Action Command** in the menu bar.

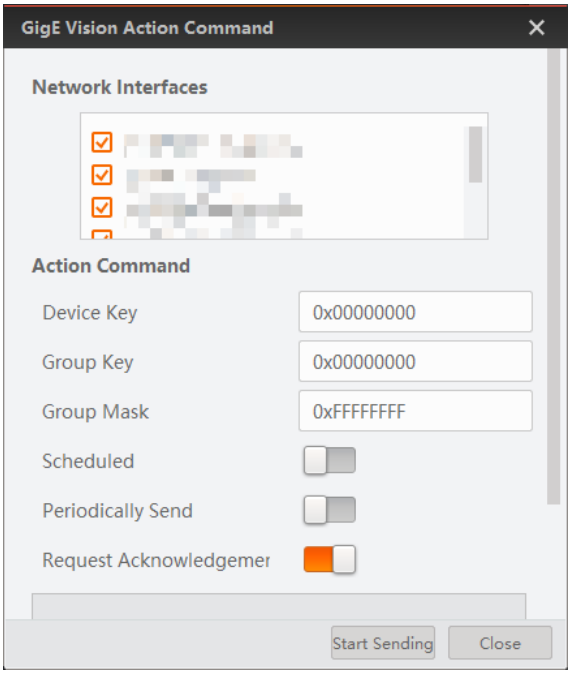


Figure 12-8 GigE Vision Action Command

5. Select **Network Interfaces** to set the subnet that the command to be sent to.

Note

- All options will be selected by default.
- This function is only applicable to the cameras within the same LAN and cannot be used in different LANs. It is recommended to select one of the network cards.

6. Enter **Action Device Key**, **Action Group Key**, and **Action Group Mask**.

Table 12-3 Parameter Description

MVS Parameter Name	Device Parameter Name	Description
Device Key	Action Control → Action Device Key	The parameter value should be the same.
Group Key	Action Control → Action Group Key	The parameter value should be the same.
Group Mask	Action Control → Action Group Mask	The bitwise AND operation of the **Group Mask** against the **Action Group Mask** feature should results in non-zero.

7. (Optional) Enable **Scheduled**. Click in **Benchmark Camera** to select one device as benchmark device. Once benchmark device is selected, other devices keep time synchronization with it.
8. (Optional) Enter **Delay Time** according to actual demands.

Note

- The delay time is 20 ns by default.
- When the benchmark device receives the command, all devices will trigger certain actions simultaneously after the specified delay time.

9. (Optional) Enable **Periodically Send** to enable the client to send commands periodically, and enter **Sending Interval** according to actual demands.

Note

The default value of sending interval is 1000 ms, and its range is from 1 ms to 3600000 ms.

10. (Optional) Enable **Request Acknowledgement** to display the acknowledgement messages.
11. Click **Start Sending**.

12.5 File Access Control

Note

The file access control function may differ by device model.

The file access function can import or export the device's feature files and save them in mfa format. The supported feature files include User Set 1/2/3, LUT Luminance 1/2/3, USER PRNUC 1/2/3, USER FPNC 1/2/3, and License Notice.

Steps

1. Select a device in the device list, and click  to open the file access dialogue box.

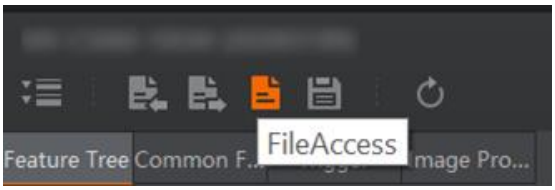


Figure 12-9 File Access

2. Select **Device Feature** and click **Import** or **Export**.

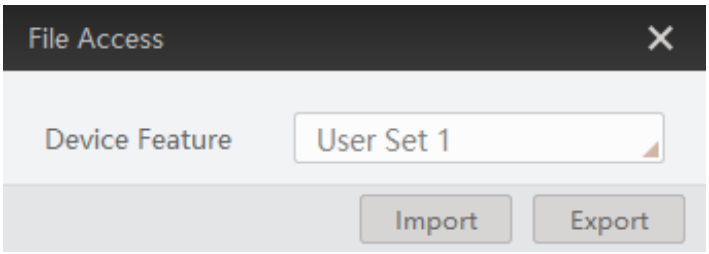


Figure 12-10 Import or Export

3. Select a file in MFA format from local PC to import, or select a saving path and enter file name to save and export.

Note

- If **User Set 1/2/3** is selected as device feature, you need to load the corresponding user set you selected to take effect.
- If **LUT Luminance 1/2/3** is selected as device feature, and they will take effect only when you select the same parameters in LUT Selector.
- **USER PRNUC 1/2/3** has the same mechanism with **LUT Luminance 1/2/3** mentioned above.
- If **USER FPNC 1/2/3** is selected as device feature, and they will take effect immediately when **FPNC User Enable** is enabled.
- Importing and exporting the device feature among the same model of devices are supported.
- **License Notice** supports exporting only.

12.6 Event Control

The event control can record events happen to the device and allow you to view them.

Steps

1. Go to **Event Control** → **Event Selector**, and select **Event Selector** according to actual demands.

Note

The specific events may differ by device models.

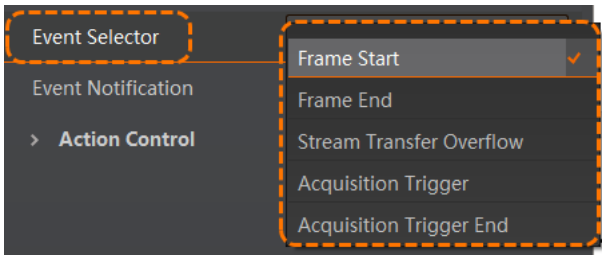


Figure 12-11 Event Selector

2. Select **Notification On** as **Event Notification** to output event.

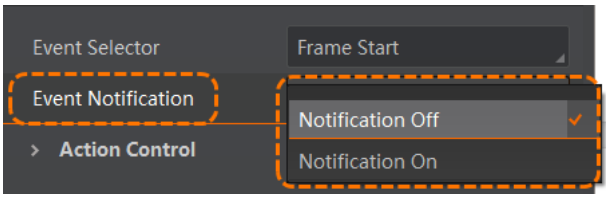


Figure 12-12 Set Event Control

3. Right click the connected device and click **Event Monitor**.

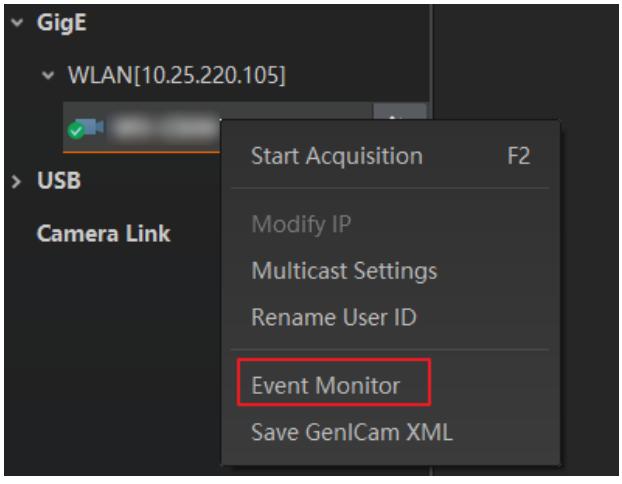


Figure 12-13 Event Monitor

4. Check **Messaging Channel Event**, and view specific event after device starts live view.

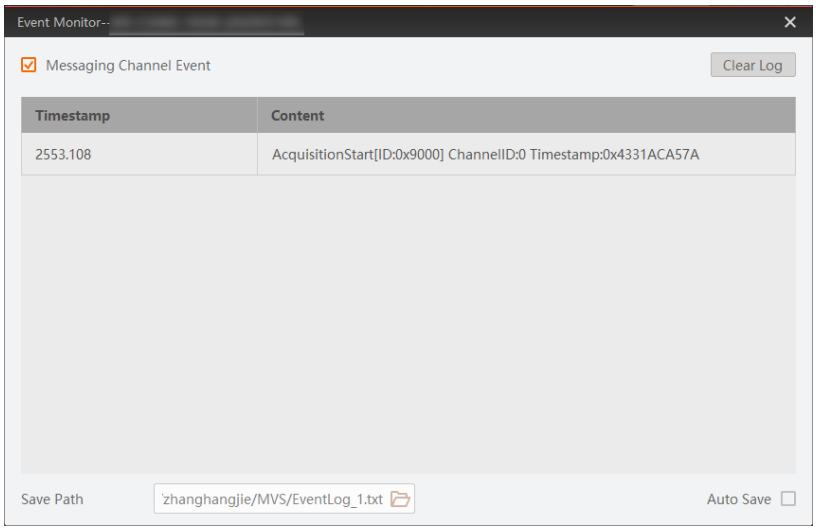


Figure 12-14 Event Monitor Window

12.7 Transport Layer Control

You can go to **Transport Layer Control** to view the device's payload size, GEV version, etc.

Note

The specific parameters of transport layer control may differ by device models.

Table 12-4 Parameters of Transport Layer Control

Parameter	Read/Write	Description
Payload Size(B)	Read Only	It is the device's load size.
Streaming Mode	Read & Write	It is the network transmission mode. ● Quick Frame Mode: After the device acquires a data package, the package will be transferred to the PC via network immediately, and acquisition speed improves. ● Standard Mode: After the device acquires a complete frame, the image will be transferred to the PC via network.
Fast Collect Slow Trans Mode	Read & Write	It refers to the mode with quick collection and slow transmission. In this mode, the speed of image acquisition is increased, but the transmission speed is unchanged. This function is only applicable to the scenarios

Parameter	Read/Write	Description
		where the transmission bandwidth is momently exceeded in the continuous acquisition mode or the frame trigger mode, and is not suitable for the scenarios where the transmission bandwidth is exceeded constantly.
GEV Version Major	Read Only	It is the major version in GEV version.
GEV Version Minor	Read Only	It is the minor version in GEV version.
GEV Device Mode Is Big Endian	Read Only	It is the endianness in device's register.
GEV Device Mode Character Set	Read Only	It is the character set in device's register.
GEV Interface Selector	Read Only	It sets which physical network interface to be controlled.
GEV MAC Address	Read Only	It is the MAC address of the network interface.
GEV Supported Option Selector	Read & Write	It selects the GEV option to interrogate for existing support.
GEV Supported Option	Read Only	It indicates whether the selected GEV option is supported or not.
GEV Current IP Configuration LLA	Read Only	It indicates whether the Link Local Address IP configuration scheme is activated on the given network interface.
GEV Current IP Configuration DHCP	Read & Write	It indicates whether the DHCP IP configuration scheme is activated on the given network interface.
GEV Current IP Configuration Persistent IP	Read & Write	It indicates whether persistent IP configuration scheme is activated on the given network interface.
DEV PAUSE Frame Reception	Read & Write	It controls whether incoming pause frames are handled on the given logical link.
GEV Current IP Address	Read Only	It is the current IP address for the given network interface.
GEV Current Subnet Mask	Read Only	It is the current subnet mask of the given interface.
GEV Current Default Gateway	Read Only	It is the default gateway IP address to be used on the given network interface.

Parameter	Read/Write	Description
GEV First URL	Read Only	It is the first choice of URL for the XML device description file.
GEV Second URL	Read Only	It is the second choice of URL to the XML device description file.
GEV Number of Interfaces	Read Only	It indicates the number of physical network interfaces supported by this device.
GEV Persistent IP Address	Read & Write	It indicates the persistent IP address for this network interface. It is only used when the device boots with the persistent IP configuration scheme.
GEV Persistent Subnet Mask	Read & Write	It indicates the persistent subnet mask associated with the persistent IP address on this network interface. It is only used when the device boots with the persistent IP configuration scheme.
GEV Persistent Default Gateway	Read & Write	It indicates the persistent default gateway for this network interface. It is only used when the device boots with the persistent IP configuration scheme.
GEV Link Speed	Read Only	It indicates the speed of transmission negotiated by the given network interface in Mbps.
GEV Message Channel Count	Read Only	It indicates the number of message channels supported by this device.
GEV Stream Channel Count	Read Only	It indicates the number of stream channels supported by this device.
GEV Heartbeat Timeout (ms)	Read & Write	It indicates the current heartbeat timeout in milliseconds.
GEV Heartbeat Disable	Read & Write	It disables the GEV Heartbeat.
GEV Timestamp Tick Frequency (Hz)	Read Only	It indicates the number of timestamp ticks in 1 second (frequency in Hz).
Timestamp Control Latch	Read & Write	It latches the current timestamp value of the device.
Timestamp Control Reset	Read & Write	It resets the timestamp value for the device.

Parameter	Read/Write	Description
Timestamp Control Latch Reset	Read & Write	It resets the timestamp control latch.
Timestamp Value	Read Only	It is a read only element. It indicates the latched value of the timestamp.
GEV CCP	Read & Write	It controls the device access privilege of an application.
GEV MCP Host Port	Read & Write	It controls the port to which the device must send messages. Setting this value to 0 closes the message channel.
GEV MCTT (ms)	Read & Write	It provides the transmission timeout value in milliseconds.
GEV MCRC	Read & Write	It controls the number of retransmissions allowed when a message channel message times out.
GEV MCSP	Read Only	It indicates the source port for the message channel.
GEV Stream Channel Selector	Read Only	It selects the stream channel to control.
GEV SCP Interface Index	Read Only	It is the Index of network interface to be used.
GEV SCP Host Port	Read & Write	It is the host port of the channel
GEV SCP Direction	Read Only	It transmits or receives the channel.
GEV SCPS Fire Test Packet	Read Only	It sends a test packet.
GEV SCPS Do Not Fragment	Read & Write	The state of this feature is copied into the “do not fragment” bit of the IP header of each stream packet.
GEV SCPS Big Endian	Read Only	It is the Endianness of multi-byte pixel data for this stream.
GEV SCPS Packet Size(B)	Read & Write	It specifies the stream packet size (in bytes) to send on this channel.
Auto SCPD	Read & Write	After it is enabled, the SCPD value will be adjusted automatically.
GEV SCPD	Read & Write	It indicates the delay (in timestamp counter units) to insert between each packet for this stream channel.
GEV SCDA	Read & Write	It indicates the destination IP address for

Parameter	Read/Write	Description
		this stream channel.
GEV SCSP	Read Only	It indicates the source UDP port address for this stream channel.
Gev IEEE 1588	Read & Write	It enables the IEEE 1588 Precision Time Protocol to control the timestamp register.
Gev IEEE 1588 Slave Only	Read & Write	After enabling, the device serves as a sub device in IEEE 1588 mode.
Gev IEEE 1588 Status	Read Only	The status of the IEEE 1588 Precision Time Protocol.

12.8 Transfer Control

You can go to **Transfer Control** to view the device's transfer sources, transfer mode, queue information, etc.

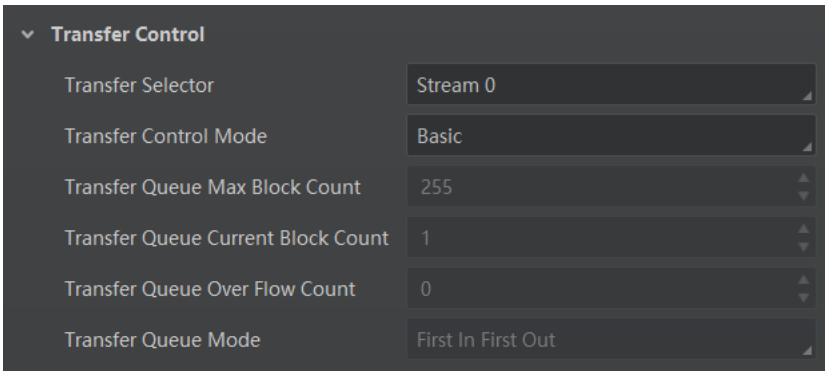


Figure 12-15Transfer Control

Table 12-5 Parameters of Transfer Control

Parameter	Read/Write	Description
Transfer Selector	Read & Write	It selects the transfer source. Only **Stream 0** is supported.
Transfer Control Mode	Read & Write	It selects the transfer mode. Only **Basic** is supported.
Transfer Queue Max Block Count	Read Only	It displays the max. image quantity that the device's memory can save before the compression.
Transfer Queue Current Block Count	Read Only	It displays current image quantity saved by the memory.
Transfer Queue Over Flow	Read & Write	It is the image quantity discarded by FPGA.

Parameter	Read/Write	Description
Count		
Transfer Queue Mode	Read & Write	It is the operating mode of memory queue.

12.9 Multicast Function

The multicast function enables multiple PCs to access the same device at the same time. At the same time, the same device can only be connected by one client in controller and data receiver mode or controller mode, but can be connected by multiple clients in data receiver mode. The multicast mode of each device within the client is controlled individually. The description of three multicast modes is shown below.

Table 12-6 Multicast Mode Description

Multicast Mode	Description
Controller and Data Receiver	This mode allows you to read and edit the device's parameters, and get its image data.
Controller	This mode allows you to read and edit the device's parameters, but you cannot get its image data.
Data Receiver	This mode allows you read the device's parameters and get its image data, but you cannot edit its parameters.

When the multicast function is enabled, the device icon on the client software of other PCs will change to  , and you can connect the device via the data receiver mode.
You can set multicast function for both the available device and connected device in the device list, but the specific settings are different.

12.9.1 Set Multicast (Available Status)

Follow steps below to set multicast function if the device is in available status.

Steps

1. Right click the available device, and click **Multicast Settings**.

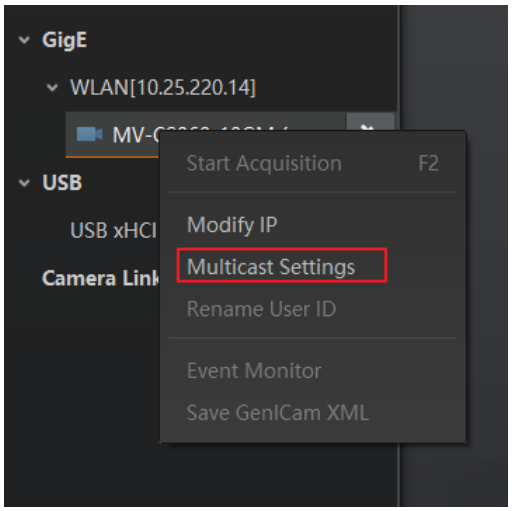


Figure 12-16 Multicast Settings

2. Select **Role**, and enter the **IP Address** and **Port**.

Note

- The available status device can use multicast function in **Controller and Data Receiver** mode or **Controller** mode.
- The IP address should be class D IP address, and the port ranges from 0 to 65535.

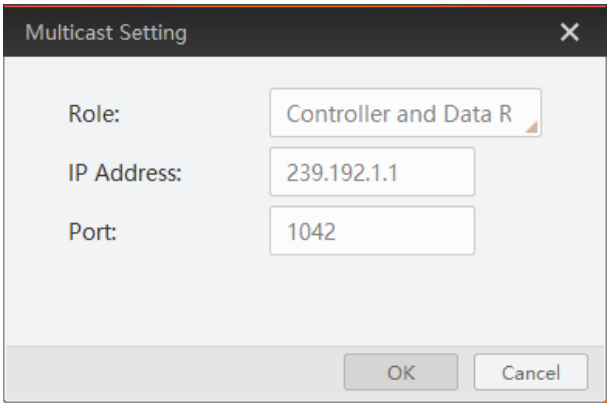


Figure 12-17 Set Parameters

3. Click **OK**.

12.9.2 Set Multicast (Connected Status)

Follow steps below to set multicast function if the device is in connected status.

Steps

1. Right click the available device, and click **Multicast Settings**.

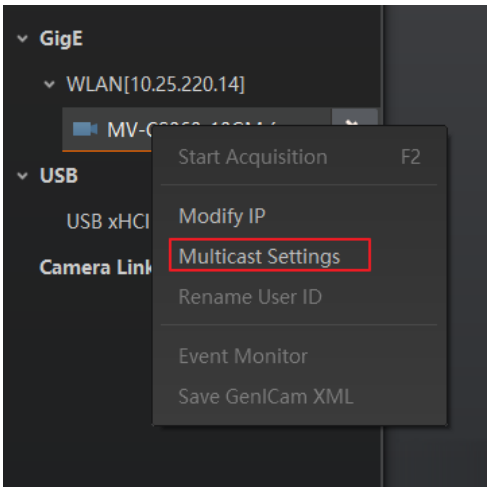


Figure 12-18 Multicast Settings

2. Enable the multicast function, and edit the **IP Address** and **Port**.

Note

- The connected status device can use multicast function in Controller and Data Receiver mode only.
- The IP address should be class D IP address, and the port ranges from 0 to 65535.

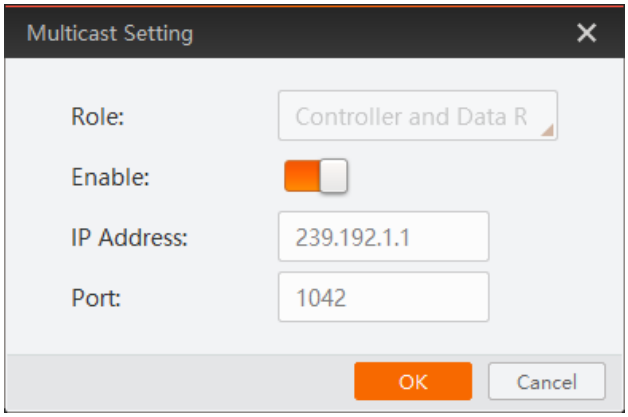


Figure 12-19 Set Parameters

3. Click **OK**.

12.10 Update Firmware

You can use the MVS Tool Kit to update the device's firmware.

Note

The MVS Tool Kit is installed by default when you install the MVS client software.

Steps

1. Go to **All** → **Configuration Tool** → **Firmware Upgrade Tool** after running MVS Tool Kit.
2. Click in **GigE** to enumerate devices.
3. Click to select firmware upgrade package (dav file).
4. Click **Update** to start updating.

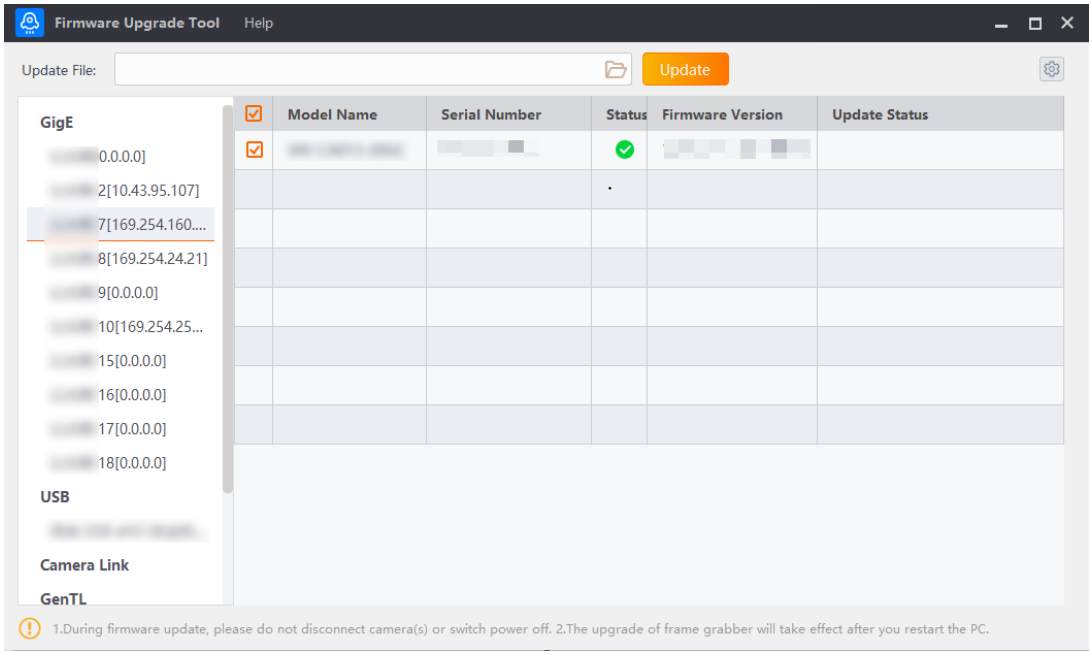


Figure 12-20 Update Firmware

Note

- The device will restart automatically after updating the firmware.
- The firmware updating process may take a few minutes. Please wait patiently.
- During firmware updating, do not disconnect the device or switch power off.

Chapter 13 FAQ (Frequently Asked Question)

13.1 Why the client software cannot list devices?

Table 13-1 Question 1

Possible Cause	Solution
The device is not powered on.	Check the device's power supply and network connection by observing the device's indicator and network link indicator.
Incorrect network cable connection.	

13.2 Why device connection fails after the device is listed in the client software?

Table 13-2 Question 2

Possible Cause	Solution
The device and the client software are not in the same network segment.	Use IP configurator tool to edit the device's IP address to make sure that the device and the client software are in the same network segment.
The device has been connected by other programs.	Disconnect the device with other programs, and reconnect it to the client software.

13.3 Why the live view is back?

Table 13-3 Question 3

Possible Cause	Solution
The device's lens aperture is not removed.	Remove the device's lens aperture.
The device exception occurs.	Power off and restart the device.

13.4 Why the device cannot be triggered although the live view is normal?

Table 13-4 Question 4

Possible Cause	Solution
The trigger mode is not enabled or the device is not triggered.	Enable the trigger mode and make sure that the selected trigger source matches with the corresponding I/O signal.
Incorrect trigger wiring.	Check if the input of trigger signal and wiring are correct or not.

13.5 Why Strobe cannot be set as Line Mode?

Table 13-5 Question 5

Possible Cause	Solution
The **Line** ***** is selected as the trigger source among **FrameTrigger**/**LineTrigger**/**Shaft Encoder Control**/**Frequency Converter Control**.	Select **Line** ***** in all modes (**FrameTrigger**/**LineTrigger**/**Shaft Encoder Control**/**Frequency Converter Control)**, and then you can set **Strobe** as **Line Mode**.

Chapter 14 Revision History

Table 14-1 Revision History

Version	Document No.	Revision Date	Revision Details
V4.0.1	UD42118B	Mar. 17, 2025	● Edit device models. This manual is applicable to the following models of GigE Line Scan Camera: MV-CL044-91NM, MV-CL044-91NC, MV-CL084-B1NM, and MV-CL084-B1NC. ● Add section Set Sequence
V4.0.0	UD41663B	Jan. 21, 2025	● Original version. This user manual is applicable to the MV-CL044-91NM and MV-CL044-91NC GigE Line scan camera.

Appendix A Device Parameter Index

Here list all parameters of the device mentioned in different sections of this user manual. You can quickly locate parameters in different sections by viewing tables below.

A.1 Device Control

Table A-1 Device Control

Parameters	Section
Device Type	Section Device Control
Device Scan Type	
Device Vendor Name	
Device Model Name	
Device Manufacturer Info	
Device Firmware Version	
Device Serial Number	
Device User ID	
Device Uptime (s)	
Board Device Type	
Device Connection Selector	
Device Connection Speed (Mbps)	
Device Link Selector	
Device Link Speed (Mbps)	
Device Link Connection Count	
Device Link Heartbeat Mode	
Device Stream Channel Count	
Device Stream Channel Selector	
Device Stream Channel Type	
Device Stream Channel Link	
Device Stream Channel Endianness	

Parameters	Section
Device Stream Channel Packet Size (B)	
Device Event Channel Count	
Device Character Set	
Device Reset	
Device Temperature Selector	
Device Temperature	
Find Me	
Device Max Throughput (Kbps)	
Device PJ Number	

A.2 Image Format Control

Table A-2 Image Format Control

Parameters	Section
Width Max	Section Set Resolution and ROI
Height Max	
Region Selector	
Region Destination	
Width	
Height	
Offset X	
Offset Y	
Reverse X	Section Set Image Reverse
Pixel Format	Section Set Pixel Format
Pixel Size	
Sequence Exposure Enable	Section Set Sequence
Sequence Exposure Number	
Sequence Exposure Selector	
Sequence Exposure Time	
Sequence Exposure Gain	

Parameters	Section
Test Pattern	Section Set Test Pattern
Binning Horizontal	Section Set Binning
Binning Vertical	
TDI Mode	Section Set TOI Function
Direction Source	Section Set Scan Direction
Reverse Scan Direction	
Abnormal Line Enable	Section Set Line Discard Function
Sensor Mode	Section Set Sensor Mode
Line Rate Ratio	Section Set Line Rate Ratio

A.3 Acquisition and Transfer Control

Table A-3 Acquisition and Transfer Control

Parameters	Section
Acquisition Mode	Section Set Acquisition Mode
Acquisition Stop	
Acquisition Burst Frame Count	Section Set Line Rate
Acquisition Line Rate (Fps)	
Acquisition Line Rate Control Enable	
Resulting Line Rate (Fps)	
Resulting Frame Rate	
FrameTrigger Mode	Section Trigger Input
FrameTrigger Source	
FrameTrigger Activation	
Line Delay Enable	
FrameTrigger Delay	
FrameTrigger Cache Enable	
LineTrigger Mode	
LineTrigger Source	

Parameters	Section
LineTrigger Activation	
LineTrigger Delay	
LineTrigger Cache Enable	
Exposure Mode	Section Set Exposure Mode
Exposure Time (μs)	
Exposure Auto	
Auto Exposure Time Lower Limit (μs)	
Auto Exposure Time Upper Limit (μs)	
Frame Timeout Enable	Section Set Frame Timeout
Frame Timeout Time(ms)	
Partial Image Output Mode	

A.4 Transport Layer Control

Table A-4 Transport Layer Control

Parameters	Section
Payload Size(B)	Section Transport Later Control
Streaming Mode	
Fast Collect Slow Trans Mode	
GEV Version Major	
GEV Version Minor	
GEV Device Mode Is Big Endian	
GEV Device Mode Character Set	
GEV Interface Selector	
GEV MAC Address	
GEV Supported Option Selector	
GEV Supported Option	
GEV Current IP Configuration LLA	
GEV Current IP Configuration DHCP	

Parameters	Section
GEV Current IP Configuration Persistent IP	
GEV PAUSE Frame Reception	
GEV Current IP Address	
GEV Current Subnet Mask	
GEV Current Default Gateway	
GEV First URL	
GEV Second URL	
GEV Number Of Interfaces	
GEV Persistent IP Address	
GEV Persistent Subnet Mask	
GEV Persistent Default Gateway	
GEV Link Speed	
GEV Message Channel Count	
GEV Stream Channel Count	
GEV Heartbeat Timeout(ms)	
GEV Heartbeat Disable	
GEV Timestamp Tick Frequency(Hz)	
Timestamp Control Latch	
Timestamp Control Reset	
Timestamp Control Latch Reset	
Timestamp Value	
GEV CCP	
GEV MCP Host Port	
GEV MCTT(ms)	
GEV MCRC	
GEV MCSP	
GEV Stream Channel Selector	
GEV SCP Interface Index	
GEV SCP Host Port	
GEV SCP Direction	

Parameters	Section
GEV SCPS Fire Test Packet	
GEV SCPS Do Not Fragment	
GEV SCPS Big Endian	
GEV SCPS Packet Size(B)	
Auto SCPD	
GEV SCPD	
GEV SCDA	
GEV SCSP	
GEV IEEE 1588	
Gev IEEE 1588 Slave Only	
Gev IEEE 1588 Status	

A.5 Transfer Control

Table A-5 Transfer Control

Parameters	Section
Transfer Selector	Section Transfer Control
Transfer Control Mode	
Transfer Queue Max Block Count	
Transfer Queue Current Block Count	
Transfer Queue OverFlow Count	
Transfer Queue Mode	

A.6 Chunk Data Control

Table A-6 Chunk Data Control

Parameters	Section
Chunk Mode Active	Section Embed Information into Image
Chunk Selector	

Parameters	Section
Chunk Enable	

A.7 Advanced Processing

Table A-7 Advanced Processing

Parameters	Section
Preamp Gain	Section Set Gain
Gain (dB)	
Digital Shift	
Digital Shift Enable	
Brightness	Section Set Brightness
Black Level	Section Set Black Level
Black Level Enable	
Balance White Auto	Section Set White Balance
AWB Color Temperature Mode	
Balance Ratio Selector	
Balance Ratio	
Gamma	Section Set Gamma Correction
Gamma Selector	
Gamma Enable	
Digital Noise Reduction Mode	Section Set Digital Noise Reduction
Denoise Strength	
Noise Correct	
Auto Function AOI Selector	Section Set AOI
Auto Function AOI Width	
Auto Function AOI Height	
Auto Function AOI Offset X	
Auto Function AOI Offset Y	
Auto Function AOI Usage Intensity	
AutoF Function AOI Usage White Balance	
CCM Enable	Section Set Color

Parameters	Section
Color Transformation Selector	Transformation Control
Color Transformation Enable	
Color Transformation Value Selector	
Color Transformation Value	
Hue	Section Set Hue
Hue Enable	
Saturation	Section Set Saturation
Saturation Enable	

A.8 LUT Control

Table A-8 LUT Control

Parameters	Section
LUT Selector	Section Set LUT
LUT Enable	
LUT Index	
LUT Value	
LUT Save	

A.9 Shading Correction

Table A-9 Shading Correction

Parameters	Section
User Flat Field Correction	Section Set Shading Correction
PRNUC Width	
PRNUC Offset X	
PRNUC ROI Extension Enable	
PRNUC Target Enable	
PRNUC Target	

Parameters	Section
PRNUC User Selector	
PRNUC Correction	
Correction State	
Flat Field Correction Tool	
Line Rate Ratio	

A.10 I/O Control

Table A-10 I/O Control

Parameters	Section
Line Selector	Section Trigger Output
Line Mode	
Line Format	
Line Inverter	
Line Status	
Line Status All	
Line Debouncer Time	
Line Source	
Strobe Enable	
Strobe Source Selector	
Strobe Line Duration (μs)	
Strobe Line Delay (μs)	
Strobe Line Pre Delay (μs)	
Encoder Selector	Section Set and Execute Shaft Encoder Control
Encoder Source A	
Encoder Source B	
Encoder Trigger Mode	
Encoder Counter Mode	
Encoder Counter	

Parameters	Section
Encoder Counter Max	
Encoder Counter Reset	
Encoder Max Reverse Counter	
Encoder Reverse Counter Reset	
Input Source	Section Set and Execute Frequency Converter Control
Signal Alignment	
Trigger Line Rate(Hz)	
PreDivider	
Multiplier	
PostDivider	
Resulting Trigger Line Rate(Hz)	
Counter Selector	Section Enable Strobe Signal
Counter Event Source	
Counter Reset Source	
Counter Reset	
Counter Value	
Counter Current Value	

A.11 Event Control

Table A-11 Event Control

Parameters	Section
Event Selector	Section Event Control
Event Notification	
Action Device Key	Section Multicast Function
Action Queue Size	
Action Selector	
Action Group Mask	

Parameters	Section
Action Group Key	

A.12 User Set Control

Table A-12 User Set Control

Parameters	Section
User Set Current	Section User Set Customization
User Set Selector	
User Set Load	
User Set Save	
User Set Default	

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