



# USB3.0 Area Scan Camera

User Manual

# Legal Information

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### Note

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Please take attention that changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### FCC Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

### FCC Conditions

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

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- This device must accept any interference received, including interference that may cause undesired operation.

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This product and - if applicable - the supplied accessories too are marked with "CE" and comply therefore with the applicable harmonized European standards listed under the Directive 2014/30/EU(EMCD), Directive 2001/95/EC(GPDS) and Directive 2011/65/EU(RoHS).



2012/19/EU (WEEE directive): Products marked with this symbol cannot be disposed of as unsorted municipal waste in the European Union. For proper recycling, return this product to your local supplier

upon the purchase of equivalent new equipment, or dispose of it at designated collection points. For more information see: <http://www.recyclethis.info>

2006/66/EC (battery directive): This product contains a battery that cannot be disposed of as unsorted municipal waste in the European Union. See the product documentation for specific battery information. The battery is marked with this symbol, which may include lettering to indicate cadmium (Cd), lead (Pb), or mercury (Hg). For proper recycling, return the battery to your supplier or to a designated collection point. For more information see: <http://www.recyclethis.info>



Warning: This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.




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## Symbol Conventions

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

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

## Available Model

This manual is applicable to the USB3.0 area scan camera.

## Safety Instruction

These 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.
- To ensure personal and device safety, when installing, operating, and maintaining the

device, follow the signs on the device and in the manual, 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.

### **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.
- The plug or socket of the device is a component for disconnecting the power supply, and do not block it.
- Make sure to disconnect the power supply when wiring, installing, disconnecting, etc. Do not operate with electricity, otherwise there will be a danger of electric shock.
- Please make sure to disconnect the power supply when wiring, disconnecting, etc. Do not operate with electricity, otherwise there will be 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.
- If it is necessary to clean the device, use a damp paper towel or a soft clean cloth to

moisten a little pure water, gently wipe off the dust, and do not use alcohol-based corrosive solutions. Make sure to power off the device and unplug the power socket when cleaning.

- Keep clean of the device's image acquisition window. It is recommended to use cleaning water to wipe off the dust.
- 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).
- Caution: If the device has battery, risk of explosion if battery is replaced by an incorrect type. Dispose of used batteries according to the instructions.
- 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.
- 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.

### **Personnel Requirement**

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.

### **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.
- Make sure that the connector metal barrier of the device is well connected to the PC and other chassis, and if necessary, copper foil should be used to enhance the grounding effect.
- 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.

## Contact Information

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# Contents

<b>Chapter 1 Overview</b> .....	<b>1</b>
1.1 Introduction .....	1
1.2 Key Feature.....	1
<b>Chapter 2 Appearance</b> .....	<b>2</b>
<b>Chapter 3 I/O Connector and Indicator</b> .....	<b>4</b>
3.1 Power and I/O Connector .....	4
3.2 Indicator .....	5
<b>Chapter 4 Installation</b> .....	<b>6</b>
4.1 Installation Preparation .....	6
4.2 Install Device .....	6
<b>Chapter 5 Device Connection</b> .....	<b>7</b>
5.1 Install MVS Client Software .....	7
5.2 Turn off Firewall .....	8
5.3 Check Driver .....	9
5.4 Connect Device to MVS Client Software .....	10
<b>Chapter 6 Client Software Layout</b> .....	<b>11</b>
<b>Chapter 7 Device Feature</b> .....	<b>13</b>
7.1 Global Shutter .....	13
7.2 Rolling Shutter .....	13
7.3 Sensor Shutter Mode .....	14
7.4 Non-Overlap Exposure and Overlap Exposure.....	16
7.4.1 Non-Overlap Exposure .....	16
7.4.2 Overlap Exposure .....	17
<b>Chapter 8 Image Acquisition</b> .....	<b>18</b>
8.1 Set Frame Rate.....	18
8.2 Set Overlap Mode .....	19
8.3 Set Acquisition Mode.....	19
8.4 Set Trigger Mode .....	20
8.4.1 Enable Internal Trigger Mode .....	20



8.4.2 Enable External Trigger Mode .....	20
8.5 Set Trigger Source .....	21
8.6 Set Trigger Related Parameters .....	24
Chapter 9 Trigger Output .....	<b>30</b>
9.1 Select Output Signal .....	30
9.2 Set Output Signal .....	30
9.2.1 Enable Line Inverter .....	30
9.2.2 Enable Strobe Signal .....	31
Chapter 10 I/O Electrical Features and Wiring .....	<b>36</b>
10.1 Input Signal .....	36
10.2 Output Signal .....	37
10.3 Bi-Directional Signal .....	39
10.4 Input Signal Wiring .....	41
10.5 Output Signal Wiring .....	42
10.6 Bi-Directional Signal Wiring .....	43
Chapter 11 Image Parameter .....	<b>47</b>
11.1 View Resolution .....	47
11.2 Set ROI .....	47
11.3 Set Image Reverse .....	48
11.4 Set Pixel Format .....	49
11.5 Set Super Bayer .....	51
11.6 Set Image Compression Mode .....	51
11.7 Set Test Pattern .....	52
11.8 Set Binning .....	55
11.9 Set Decimation .....	56
11.10 Set Exposure Time Mode .....	57
11.11 Set Exposure Auto .....	57
11.12 Set Sequencer Control and HDR .....	58
11.12.1 Set Sequencer .....	58
11.12.2 Set HDR .....	60
11.13 Set Gain .....	61

11.13.1 Set Analog Gain .....	61
11.13.2 Set Digital Gain .....	63
11.14 Set Brightness .....	63
11.15 Set Black Level .....	64
11.16 Set White Balance .....	64
11.17 Set Gamma Correction .....	65
11.18 Set Sharpness .....	67
11.19 Set Digital Noise Reduction .....	67
11.20 Set Contrast Ratio .....	68
11.21 Set AOI .....	69
11.22 Set Color Transformation Control .....	69
11.23 Set Hue .....	70
11.24 Set Saturation .....	71
11.25 Set Super Palette Control .....	72
11.26 Set LUT .....	73
11.27 Set Shading Correction .....	73
11.27.1 LSC Correction .....	74
11.27.2 Other Corrections .....	74
<b>Chapter 12 Other Functions .....</b>	<b>75</b>
12.1 Device Control .....	75
12.2 Embed Information into Image .....	77
12.3 Event Control .....	79
12.4 Transport Layer Control .....	81
12.5 U3V Protocol Control .....	82
12.6 Transfer Control .....	83
12.6.1 User Controlled Transfer Control .....	83
12.6.2 Basic Transfer Control .....	84
12.7 User Set Customization .....	85
12.7.1 Save User Set .....	85
12.7.2 Load User Set .....	86
12.7.3 Set User Default .....	87

12.8 Update Firmware .....	87
<b>Chapter 13 FAQ (Frequently Asked Question) .....</b>	<b>89</b>
13.1 Why the client software cannot list devices? .....	89
13.2 Why device connection fails after the device is listed in the client software? ....	89
13.3 Why the live view is back? .....	89
13.4 Why the device cannot be triggered although the live view is normal?.....	90
13.5 Why the device cannot get images required by the algorithm although live view and trigger signal are normal? .....	90
<b>Appendix A Device Parameter Index.....</b>	<b>91</b>
<b>Appendix B Revision History .....</b>	<b>99</b>

# Chapter 1 Overview

## 1.1 Introduction

The USB3.0 area scan camera uses the USB3.0 interface to transmit non-compressed images in real time, and it can acquire images and set parameters via the client software. The device is applicable to the automated optical inspection (AOI) for the surface mounted technology and the printed circuit board, food and pharmaceutical inspection, etc.

## 1.2 Key Feature

- Supports auto and manual adjustment for gain, exposure time and white balance, manual adjustment for Look-Up Table (LUT), Gamma correction, etc.
- Adopts the image interpolation algorithm for the color reproduction.
- Supports the hardware trigger, software trigger, free run, etc.
- Adopts screw holes for fixing USB3.0 cable.
- Compatible with the USB3 Vision Protocol, the GenICam Standard, and the third-party software based on the protocol and standard.

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### Note

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

## Chapter 2 Appearance

**Note**

- 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.

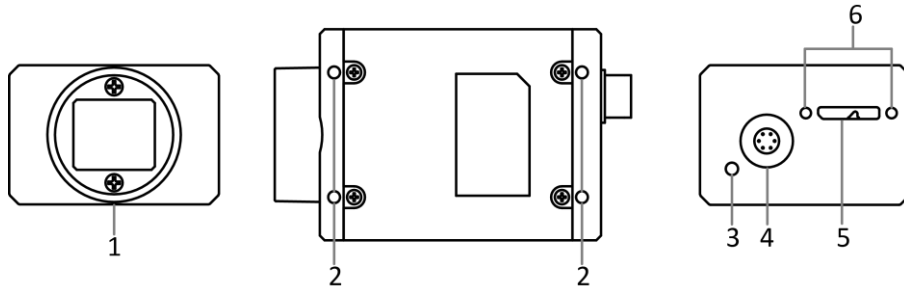


Figure 2-1 Appearance (Type I)

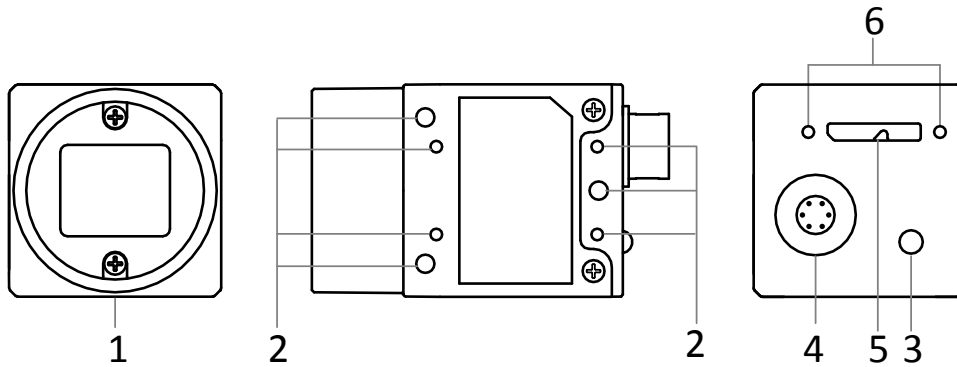


Figure 2-2 Appearance (Type II)

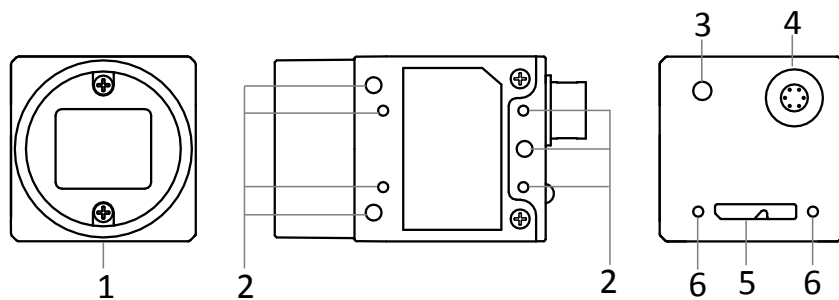


Figure 2-3 Appearance (Type III)

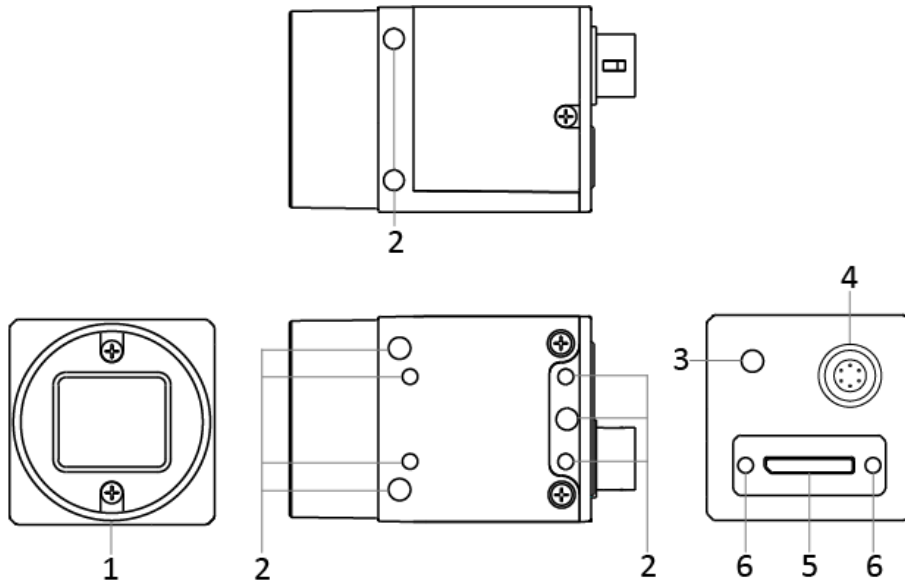


Figure 2-4 Appearance (Type IV)

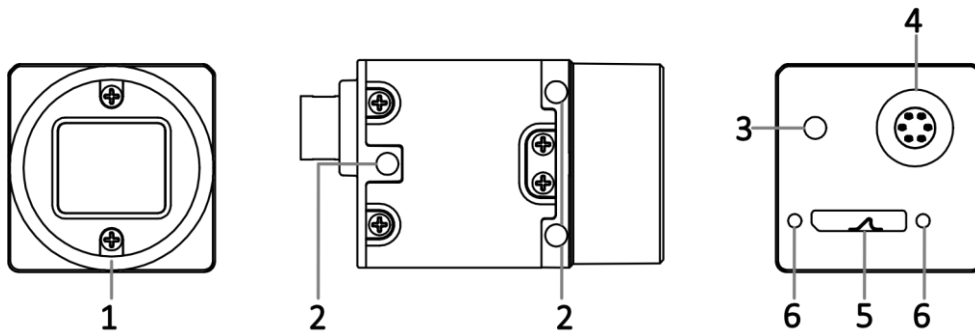


Figure 2-5 Appearance (Type V)

Table 2-1 Component Description

No.	Component	Description
1	Lens Mount	It is used to install the lens.
2	Screw Hole	It is used to fix the device to the installation position.
3	LED Indicator	It indicates the device's status.
4	Power and I/O Interface	It refers to the power and I/O interface that provides power, and input/output signal.
5	USB3.0 Interface	It is used to provide power and transmit data.
6	Screw Hole	It refers to the M2 screw hole for fixing the USB3.0 cable.

## Chapter 3 I/O Connector and Indicator

### 3.1 Power and I/O Connector

All devices have a 6-pin P7 connector as the power and I/O connector that provides power and I/O signals, as shown below.

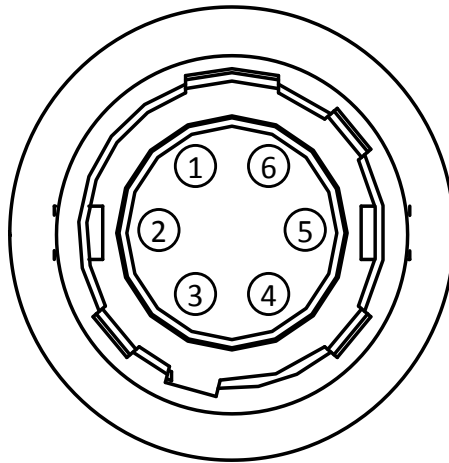


Figure 3-1 6-Pin P7 Connector

#### Note

Refer to the table below and the label attached to the power and I/O cable to wire the device.

Table 3-1 Pin Definitions

No.	Signal	I/O Signal Source	Description
1	DC_PWR	--	Device's power supply
2	OPTO_IN	Line 0+	Opto-isolated input
3	GPIO	Line 2+	Can be configured as input or output
4	OPTO_OUT	Line 1+	Opto-isolated output
5	OPTO_GND	Line 0-/1-	Opto-isolated signal ground
6	GND	Line 2-	Device's power supply ground

## 3.2 Indicator

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

### Note

- When the indicator is flashing rapidly, flashing slowly, or flashing very slowly, its unlit interval is 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 3-2 Indicator Description**

No.	Indicator Color	Status	Device Status Description
1	Red	Flashing very slowly	The data cable is disconnected.
2	Red	Solid	Updating firmware failed, reading configuration file failed, or other exception occurs.
3	Red	Light up	When executing Find Me function via the client software, the indicator displays this status.
4	Blue	Solid	The device is in idle status. The data cable has connected, and the device is ready.
5	Blue	Flashing rapidly	The data cable has connected, and the device is acquiring images in the internal trigger mode. Data transmission speed reaches the rated speed of USB3.0.
6	Blue	Flashing slowly	The data cable has connected, and the device is acquiring images in the internal trigger mode. Data transmission speed reaches the rated speed of USB2.0.
7	Blue	Flashing very slowly	The data cable has connected, and the device is acquiring images in the external trigger mode.
8	Red and blue	Flash alternatively	The device firmware is updating.



## Chapter 4 Installation

### 4.1 Installation Preparation

You need to prepare following accessories before device installation.

**Table 4-1 Accessories**

No.	Name	Quantity	Description
1	Power and I/O Cable	1	It refers to the 6-pin power and I/O cable. You need to purchase separately.
2	USB3.0 Cable	1	It refers to the micro USB3.0 (type B) cable. You need to purchase separately.
3	DC Power Supply	1	You should select suitable power adapter or switch power supply according to the device power supply and consumption. You need to purchase separately.
4	Lens	1	It refers to the C-mount lens. You need to purchase separately.

### 4.2 Install Device

#### **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.
2. Install the lens to the device.
3. Use the micro USB3.0 (type B) cable to connect the device with the PC or other devices.
4. Select a power supply method:
  - Direct power supply: Use the 6-pin power and I/O cable to connect device to a proper power adapter.
  - USB power supply: Use the USB3.0 cable to connect the device to the PC or other devices via USB3.0 interface.

## Chapter 5 Device Connection

Device connection to the client software is required for device's configurations and remote operations. This section introduces how to install the client software, connect the device to the client software, etc.

### 5.1 Install MVS 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 XP/7/10, 32/64-bit Linux, and 64-bit MacOS operating systems. Here we take Windows as an example.
  - The graphic user interface may differ by different versions of client software you use.
  - You can download the client software from [en.hikrobotics.com](http://en.hikrobotics.com).
- 

#### Steps

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

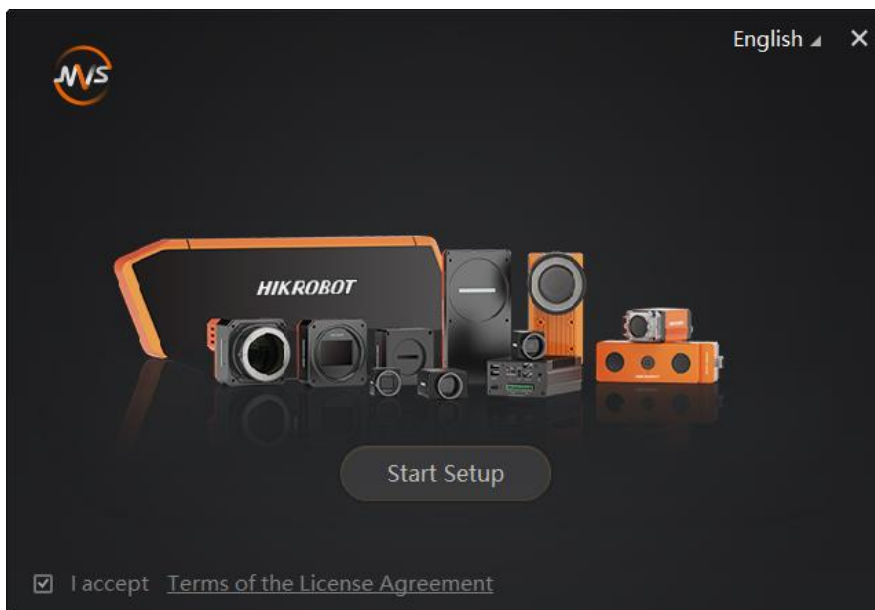
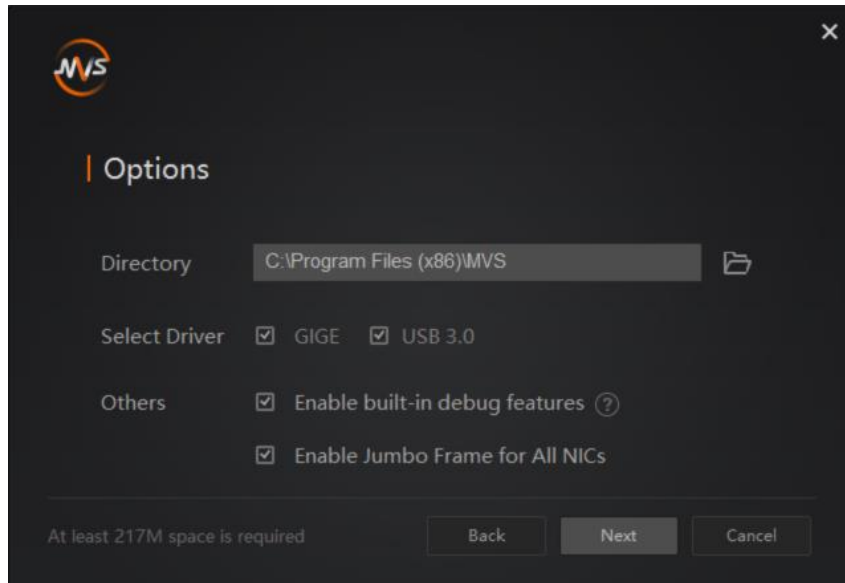


Figure 5-1 Installation Interface

4. Click **Start Setup**.



**Figure 5-2 Default Settings**

5. Keep default settings, and click **Next**.
6. Finish the installation according to the interface prompts.

## 5.2 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 XP system: Click **Start** → **Control Panel** → **Security Center** → **Windows Firewall**.
  - Windows 7 system: Click **Start** → **Control Panel** → **Windows Firewall**.
  - Windows 10 system: Click **Start** → **Control Panel** → **System and Security** → **Windows Defender Firewall**.
2. Click **Turn Windows Defender Firewall on or off** on the left.
3. Select **Turn off Windows Defender Firewall (not recommended)**.

-   Turn on Windows Defender Firewall
  - Block all incoming connections, including those in the list of allowed apps
  - Notify me when Windows Defender Firewall blocks a new app
-   Turn off Windows Defender Firewall (not recommended)

**Figure 5-3 Windows Defender Firewall**

4. Click **OK**.

## 5.3 Check Driver

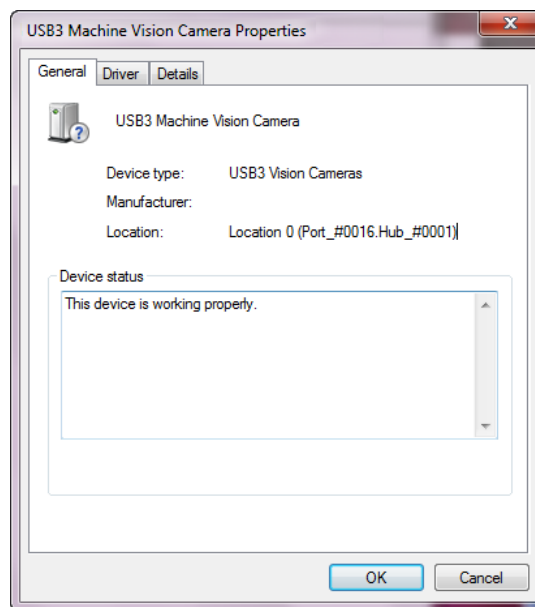
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### **Note**

Before using the device, you need to make sure that the PC has installed the USB driver correctly. Otherwise, the client software cannot find the device.

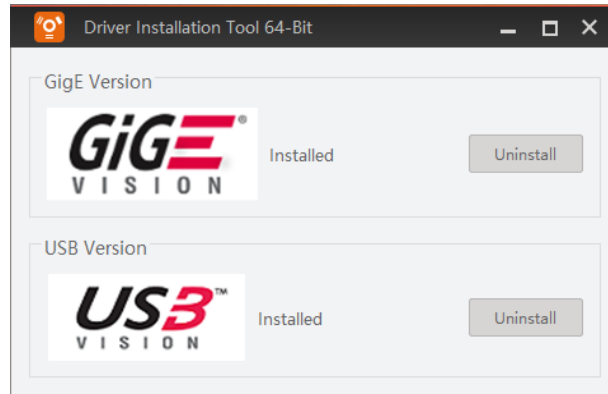
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After connecting the device, the PC will automatically check and install the USB driver. After installation, you can view the added driver in the device manager of the PC, and right click **Properties** to view its properties.



**Figure 5-4 Driver Properties**

If the installation of the driver is failed, you can use the driver installation tool to install the driver again manually. Go to **Start** → **MVS Folder** → **Driver Installation Tool**, click **Driver Installation Tool** to run it, and click **Uninstall** or **Install** of the corresponding driver to uninstall or install the driver again.



**Figure 5-5 Driver Installation Tool**


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### **Note**

The specific path of finding the driver installation tool may differ by Windows version and the client software version you installed.

---

## 5.4 Connect Device to MVS Client Software

After running the client software, double click the device name in the device list, or click  to connect the device to the client software.

## Chapter 6 Client Software Layout

After connecting to the device, the client software can read the its attributes and display them.

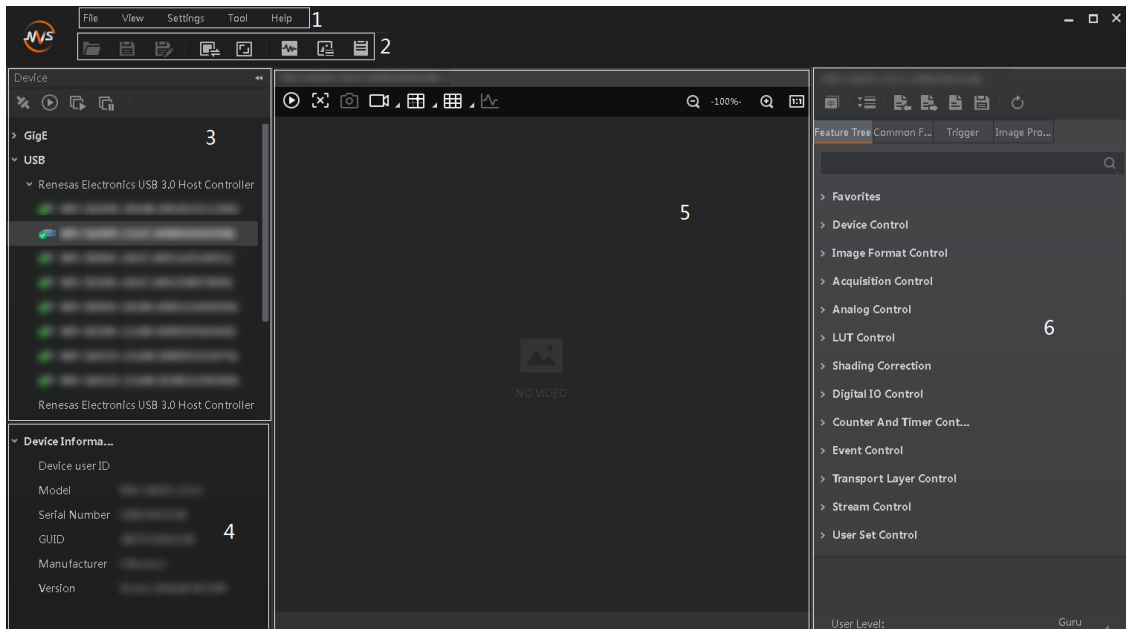


Figure 6-1 Main Window


### Note

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

Table 6-1 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.
3	Device List Panel	This panel displays device list, and you can connect or disconnect device, modify device IP address, etc.
4	Device Information Panel	This panel displays the detailed device information.
5	Display Window	This area displays the acquisition images in real-time. You can click different icons to capture and save image, record, etc.

No.	Name	Description
6	Feature Panel	You can view and set features of the selected device, and perform operations such as importing, exporting, and saving features.

Click  in the device's feature panel to unfold the specific parameters, and set them according to actual demands.

---

 **Note**

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

---

**Table 6-2 Feature Tree Description**

Feature Name	Description
Device Control	You can view the device information, edit its name, reset the device, etc.
Image Format Control	You can view and set the device's resolution, image reverse function, pixel format, region of interest, test pattern, etc.
Acquisition Control	You can view and set the device's acquisition mode, frame rate, trigger mode, exposure time, etc.
Analog Control	You can view and set the device's gain, black level, Gamma correction, sharpness, etc.
LUT Control	You can view the Look-Up Table (LUT), and set its index and value.
Shading Correction	You can set shading correction to correct shade.
Digital IO Control	You can set the different input and output signals.
Counter and Timer Control	You can view and set the counter-related parameters.
Transport Layer Control	You can view and set the parameters of the device's transport layer.
Stream Control	You can view the size of payload, data head, and data end.
User Set Control	You can save or load the device's parameters.

## Chapter 7 Device Feature

### 7.1 Global Shutter

For device that supports global shutter, its exposure starts and ends in each line simultaneously. After the exposure, data readout starts line by line. All pixels expose at the same time, then readout at different time.

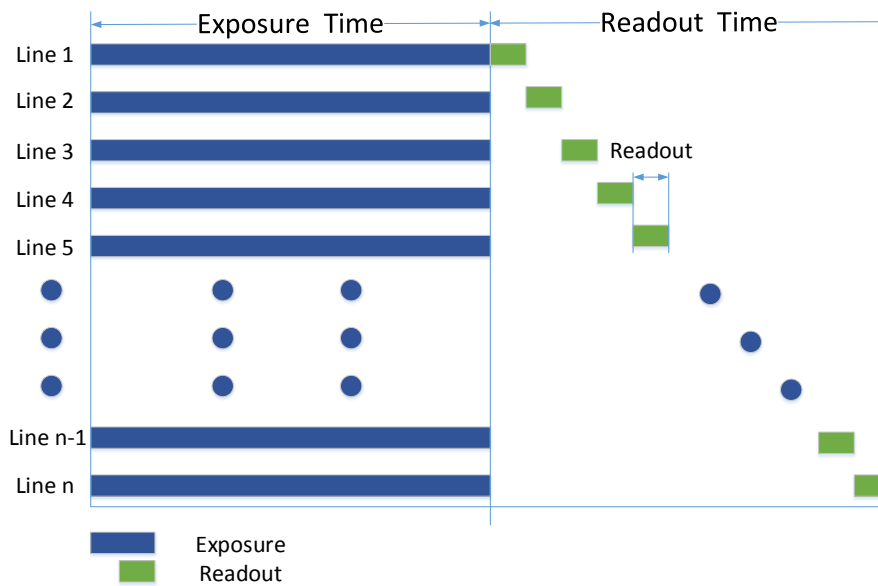


Figure 7-1 Global Shutter

### 7.2 Rolling Shutter

For device that supports rolling shutter, as soon as the exposure ends, the data readout starts simultaneously. After the whole action, the rest of rows start to expose and read out one by one. All pixels expose at the same time, then readout at different time.



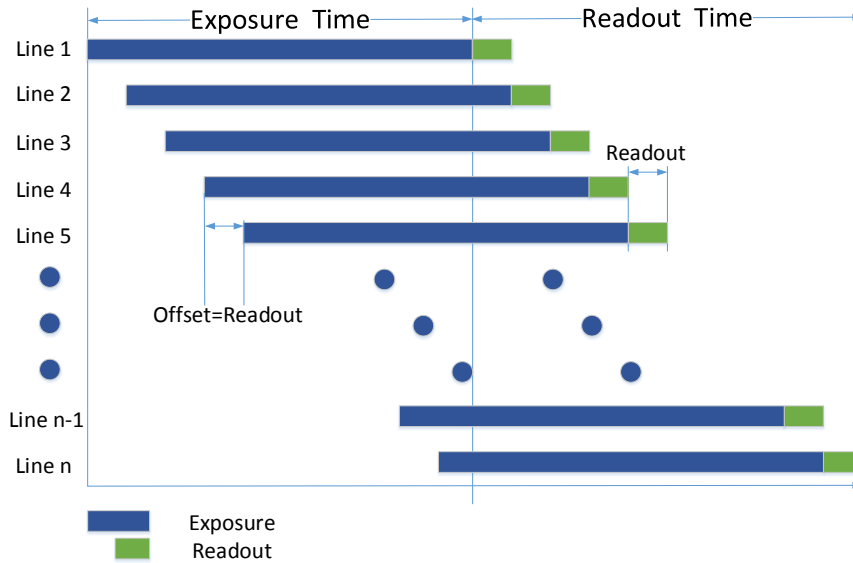


Figure 7-2 Rolling Shutter

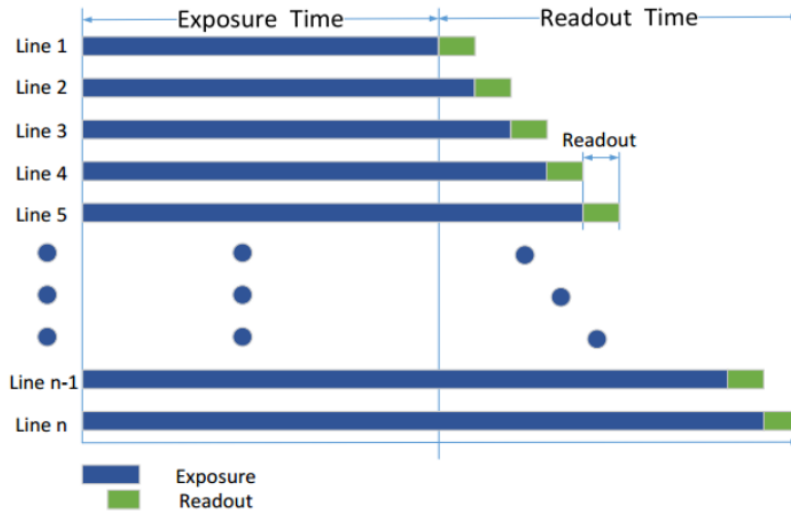
## 7.3 Sensor Shutter Mode

### Note

- Only some models of devices with rolling shutter and corresponding firmware support the sensor shutter mode. The actual product you purchased should prevail.
- Stopping the real-time acquisition is required before setting the sensor shutter mode.
- For some device models, only when **Trigger Mode** is **On**, you can set **Sensor Shutter Mode**.

The sensor shutter mode allows you to set the operating mode of the device's electronic shutter. The shutter mode refers to the way in which the image data is captured and processed.

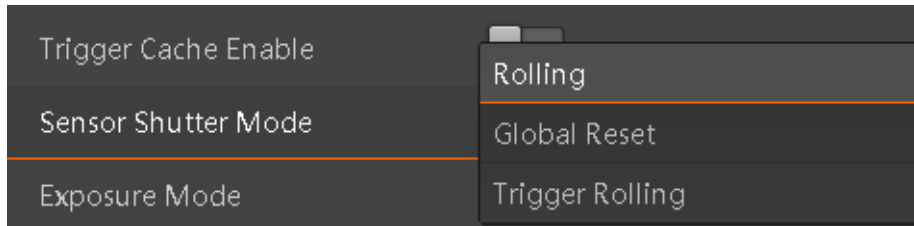
In general, there are 3 sensor shutter modes, including **Global Reset**, **Rolling** and **Trigger Rolling**. Global reset means that all of the sensor's pixels start exposing at the same time, but stop exposing at different time.



**Figure 7-3 Global Reset**

Rolling means that the device exposes the pixel rows one after the other, and it supports sensor's pixels exposure and pixel data readout proceeding at the same time. While trigger rolling does not support that sensor's pixels exposure and pixel data readout proceed at the same time.

You can go to **Acquisition Control** → **Sensor Shutter Mode**, and select **Sensor Shutter Mode** according to actual demands.



**Figure 7-4 Sensor Shutter Mode**

## 7.4 Non-Overlap Exposure and Overlap Exposure

The process that the device captures one frame of image includes two stages, exposure and readout. According to the overlap relation between the exposure time and the readout time, devices with different sensors can be divided into overlap exposure and non-overlap exposure.

### 7.4.1 Non-Overlap Exposure

After completing the current frame's exposure and readout, the next frame starts to expose and read out. This process is called non-overlap exposure. The non-overlap exposure's frame period is larger than the sum of the exposure time and the readout time, as shown below.

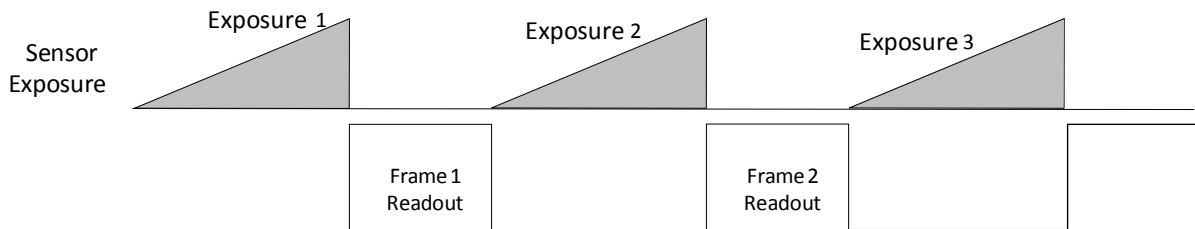


Figure 7-5 Internal Trigger Non-Overlap Exposure

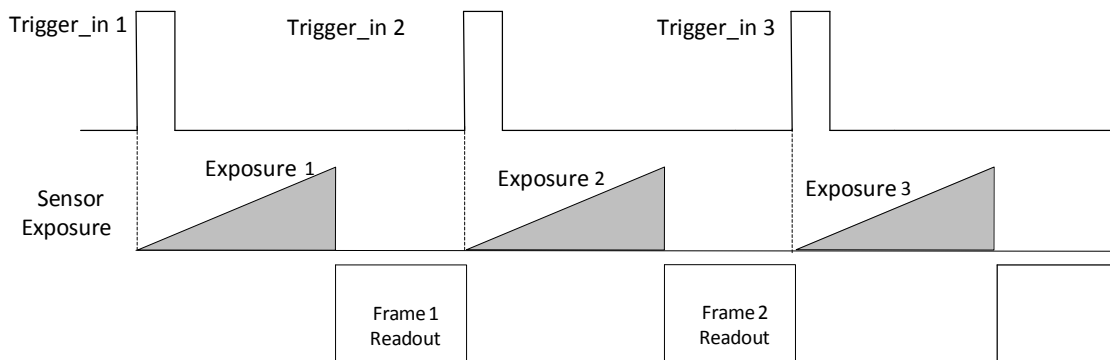


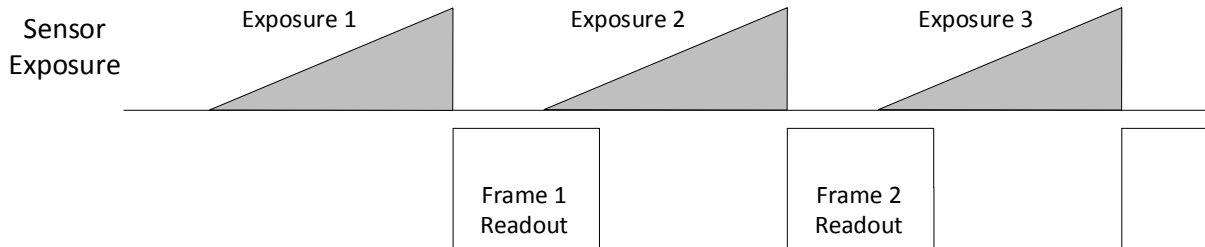
Figure 7-6 External Trigger Non-Overlap Exposure

**Note**

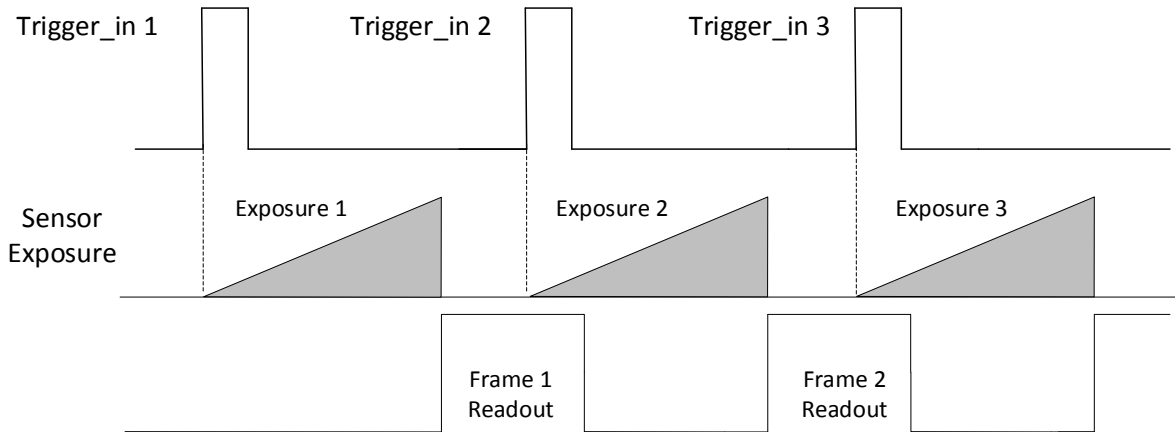
The device will ignore the external signal in the readout section under this mode.

### 7.4.2 Overlap Exposure

Overlap exposure refers to the overlap between the current frame exposure and the previous frame readout. In other words, when the previous frame starts to read out, the current frame starts to expose simultaneously, as shown below.



**Figure 7-7 Internal Trigger Overlap Exposure**



**Figure 7-8 External Trigger Overlap Exposure**

## Chapter 8 Image Acquisition

### 8.1 Set Frame Rate

Frame rate refers to the image number that is acquired by the device per second. The higher frame rate, and shorter time used for image acquisition will be. The following four factors determine the device's frame rate in real-time.

- Frame readout time: The frame readout time is related with device's sensor performance and image height. The lower the image height and less the frame readout time, and the higher the frame rate will be.
- Exposure time: If the reciprocal of max. frame rate that the device supports is  $t$ , and when the configured exposure time is larger than  $t$ , the less the exposure time, the higher the frame rate will be. When the configured exposure time is less than or equal to  $t$ , exposure time will not influence the frame rate.
- Bandwidth: The larger the bandwidth, the higher the frame rate will be.
- Pixel format: The more bytes pixel format occupy, the lower the frame rate will be.

#### Steps

1. Go to **Acquisition Control** → **Acquisition Frame Rate**, and enter **Acquisition Frame Rate**.
2. Enable **Acquisition Frame Rate Control Enable**.

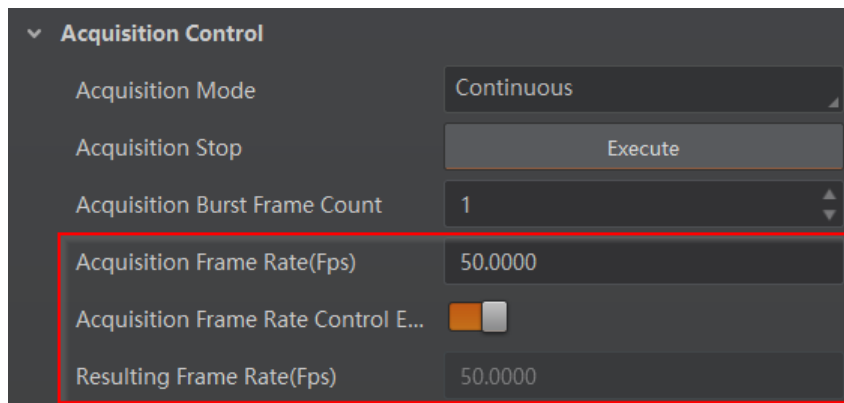


Figure 8-1 Set Frame Rate

#### Note

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

3. View the device's final frame rate in **Resulting Frame Rate**.

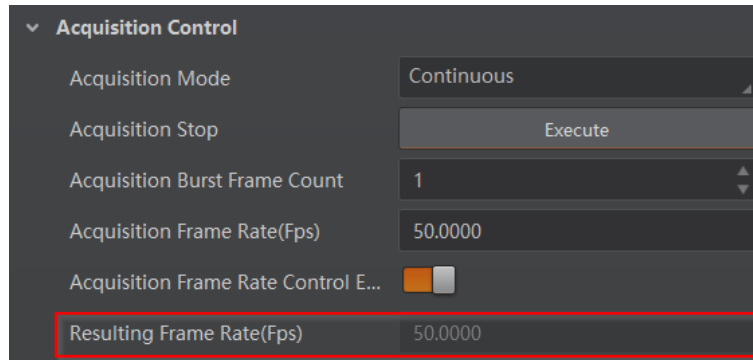


Figure 8-2 View Resulting Frame Rate

## 8.2 Set Overlap Mode

### Note

The overlap mode may differ by device models. Refer to section **Non-Overlap Exposure and Overlap Exposure** for detailed introduction.

The device's overlap function is controlled by the overlap mode. Go to **Acquisition Control** → **Overlap Mode**, select **On** as **Overlap Mode** to have overlap exposure, and select **Off** as **Overlap Mode** to have non-overlap exposure.

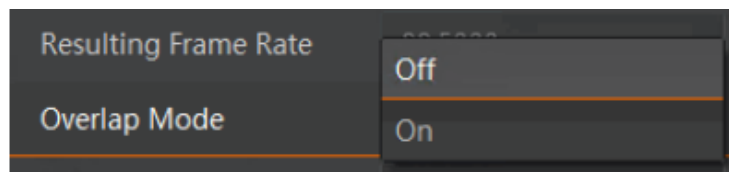


Figure 8-3 Set Overlap Mode

## 8.3 Set Acquisition Mode

The device supports two types of acquisition modes, including **SingleFrame** mode and **Continuous** mode. Go to **Acquisition 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.

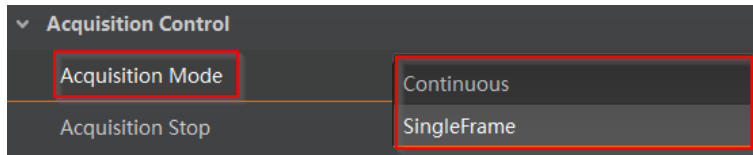


Figure 8-4 Set Acquisition Mode

## 8.4 Set Trigger Mode

The device supports two types of trigger modes, including internal trigger mode and external trigger mode. Go to **Scan Control** → **Trigger Control** → **Trigger Mode** and set it.

- **Internal Trigger Mode:** In this mode, the device acquires images via its internal signals.
- **External Trigger Mode:** In this mode, the device acquires images via external signals like software signal and hardware signal. The trigger source of external trigger mode includes software trigger, hardware trigger, counter trigger, and free trigger.

### 8.4.1 Enable Internal Trigger Mode

Go to **Acquisition Control** → **Trigger Mode**, and select **Off** as **Trigger Mode**.

---

#### Note

**Off** refers to the internal trigger mode.

---

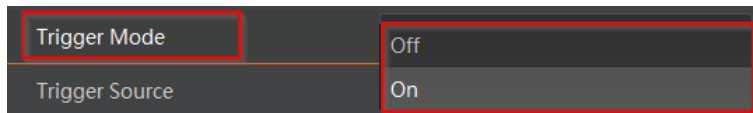


Figure 8-5 Enable Internal Trigger Mode

### 8.4.2 Enable External Trigger Mode

Go to **Acquisition Control** → **Trigger Mode**, and select **On** as **Trigger Mode**.

---

#### Note

**On** refers to the external trigger mode.

---

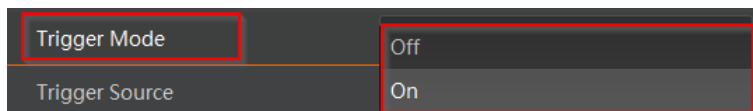


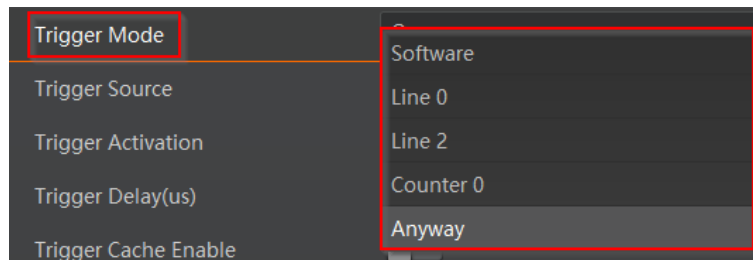
Figure 8-6 Enable External Trigger Mode

## 8.5 Set Trigger Source

The device's trigger source includes software trigger, hardware trigger, counter trigger, and free trigger. Go to **Acquisition Control** → **Trigger Source**, and select **Trigger Source** according to actual demands.

**Table 8-1 Trigger Source Description**

Trigger Source	Parameter	Description
Software Trigger	Software	The software sends trigger signal to the device via USB interface to acquire images.
Hardware Trigger	Line 0, Line 2	External device connects device via device I/O interface. External device sends trigger signal to device to acquire images.
Counter Trigger	Counter 0	The counter sends trigger signal to the device to acquire images.
Free Trigger	Anyway	The device can receive software trigger and hardware trigger to acquire images.



**Figure 8-7 Set Trigger Source**

### Note

These four external trigger sources are valid only when the **Trigger Mode** is **On**.

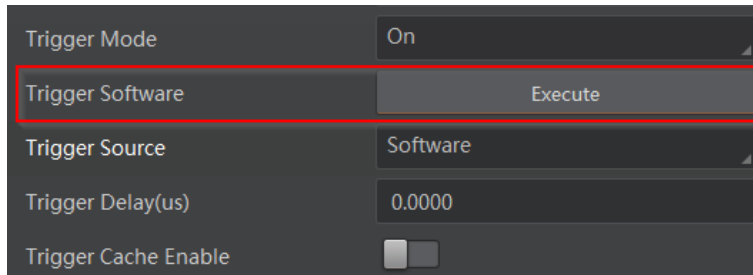
### Set and Execute Software Trigger

In software trigger, the software sends trigger signal to the device via USB interface to acquire images.

#### Steps

1. Go to **Acquisition Control** → **Trigger Mode**, and select **On** as **Trigger Mode**.
2. Select **Software** as **Trigger Source**.
3. Click **Execute** in **Trigger Software**.





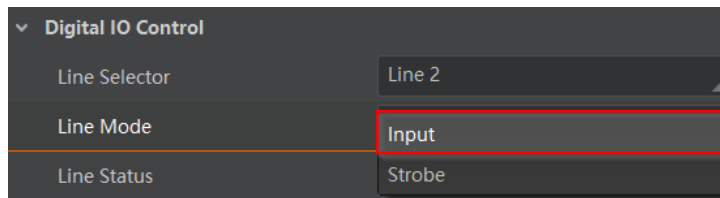
**Figure 8-8 Set and Execute Software Trigger**

## Set and Execute Hardware Trigger

The device has one opto-isolated input (Line 0), and one bi-directional I/O (Line 2) that can be configured as input signal. The steps for configuring Line 2 as input signal as follows.

### Steps

1. Go to **Digital IO Control** and select **Line 2** as **Line Selector**.
2. Select **Input** as **Line Mode**.

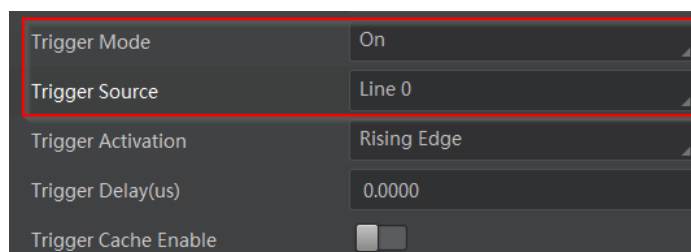


**Figure 8-9 Set Line 2 as Input Signal**

In hardware trigger, external device sends trigger signal to the device to acquire images via I/O connector.

### Steps

1. Go to **Acquisition Control** → **Trigger Mode**, and select **On** as **Trigger Mode**.
2. Select **Line 0** or **Line 2** as **Trigger Source** according to actual demands.



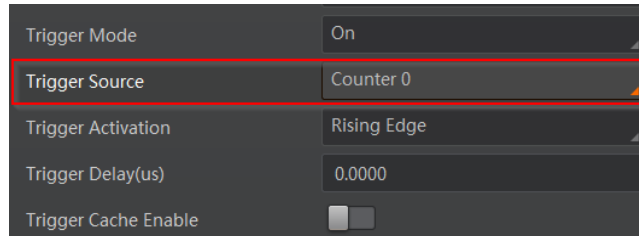
**Figure 8-10 Set and Execute Hardware Trigger**

## Set and Execute Counter Trigger

In counter trigger, the counter sends trigger signal to the device to acquire images.

### Steps

1. Go to **Acquisition Control** → **Trigger Mode**, and select **On** as **Trigger Mode**.
2. Select **Counter 0** as **Trigger Source**.

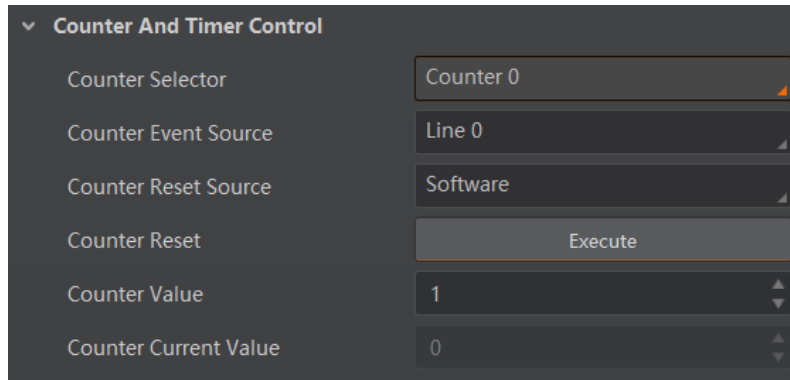


**Figure 8-11 Set and Execute Counter Trigger**

When using counter trigger, you need to set parameters of **Counter and Timer Control** as shown below.

**Table 8-2 Parameters of Counter and Timer Control**

Parameter	Read/Write	Description
Counter Selector	Read and write	It selects counter source. <b>Counter 0</b> is available only at present.
Counter Event Source	Read and write	It selects the signal source of counter trigger. <b>Line 0</b> or <b>Line 2</b> is available. This parameter is disabled by default.
Counter Reset Source	Read and write	It selects the signal source of resetting counter. <b>Software</b> is available only. This parameter is disabled by default.
Counter Reset	Write is available under certain condition	It resets counter and it can be executed only when selecting <b>Software</b> as <b>Counter Reset Source</b> .
Counter Value	Read and write	It is the counter value with the range of 1 to 1023.
Counter Current Value	Read only	It displays the number of executed external trigger.



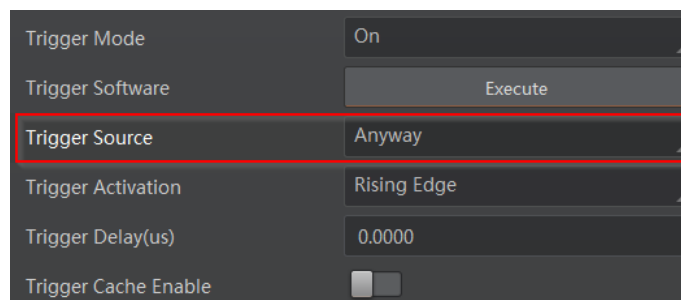
**Figure 8-12 Counter and Timer Control**

## Set and Execute Free Trigger

In free trigger, the device can receive software trigger and hardware trigger to acquire images.

### Steps

1. Go to **Acquisition Control** → **Trigger Mode**, and select **On** as **Trigger Mode**.
2. Select **Anyway** as **Trigger Source**.



**Figure 8-13 Set and Execute Free Trigger**

## 8.6 Set Trigger Related Parameters

In external trigger mode, you can set five related parameters, including acquisition burst frame count, trigger activation, trigger delay, trigger cache, and trigger debouncer.

### Note

- Different trigger sources can set various parameters in external trigger mode.
  - When hardware is trigger source, you can set all five parameters mentioned above.
  - When software is trigger source, you can set acquisition burst frame count, trigger delay, and trigger cache only.
  - When the device is in counter trigger or free trigger, you can set acquisition burst frame count, trigger activation, trigger delay, and trigger cache.
-

## Set Acquisition Burst Frame Count

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

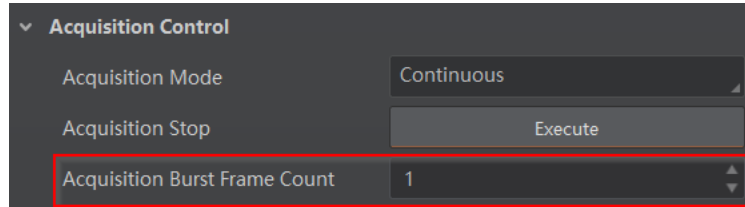


Figure 8-14 Set Acquisition Burst Frame Count

### 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.

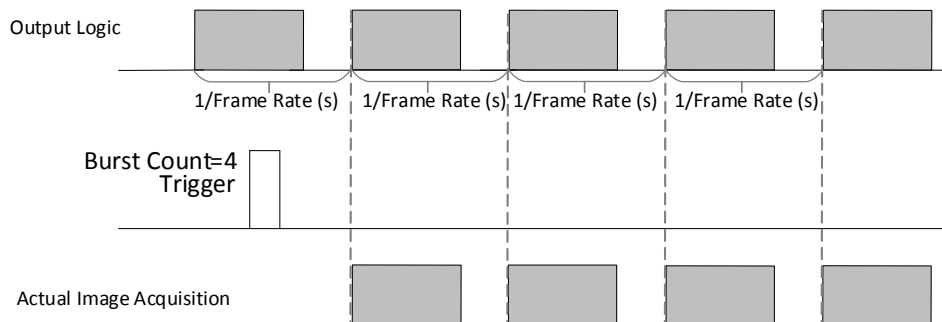


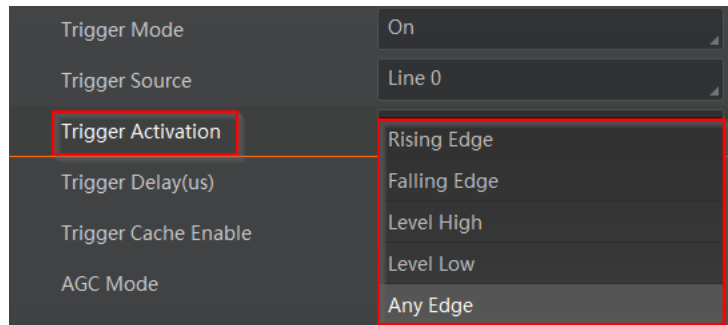
Figure 8-15 Sequence Diagram of Acquisition Burst Frame Count

## 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. Go to **Acquisition Control** → **Trigger Activation**, and select **Rising Edge**, **Falling Edge**, **Level High**, **Level Low** or **Any Edge** as **Trigger Activation**.

- **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.
- **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.

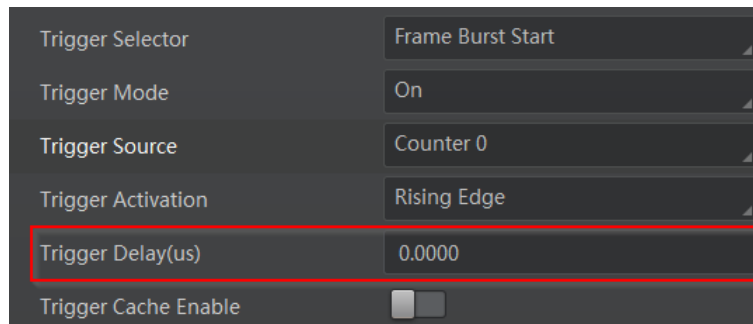
- **Level Low:** The level low of the trigger signal is valid. As long as the trigger signal is in level low, the device is in image acquisition status.
- **Any Edge:** It means that when the level signal sent by external device is in rising edge, falling edge, level high or level low, the device receives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



**Figure 8-16 Set Trigger Activation**

## Set Trigger Delay

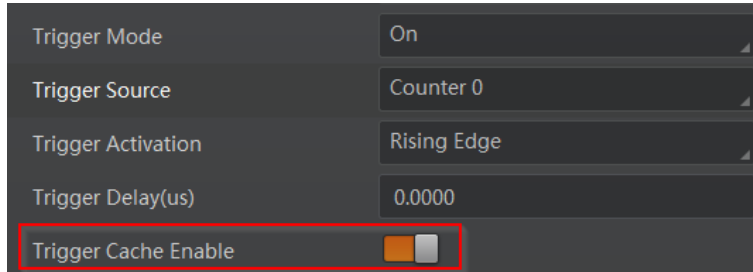
The trigger delay function allows the device to add a delay between the receipt of trigger signal and the moment the trigger becomes active. Go to **Acquisition Control** → **Trigger Delay**, and enter **Trigger Delay**, and the unit is  $\mu\text{s}$ .



**Figure 8-17 Set Trigger Delay**

## Set Trigger Cache

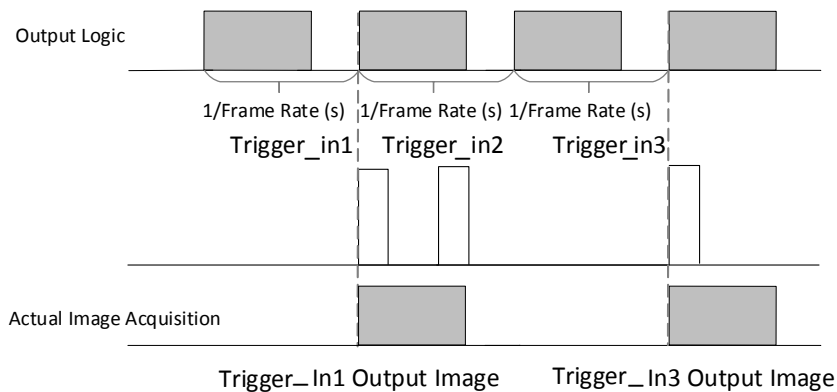
The trigger cache function allows the device to save and process new signal during trigger stage, and the device can save and process three trigger signals at most. Go to **Acquisition Control** → **Trigger Cache Enable**, and enable **Trigger Cache Enable**.



**Figure 8-18 Set Trigger Cache**

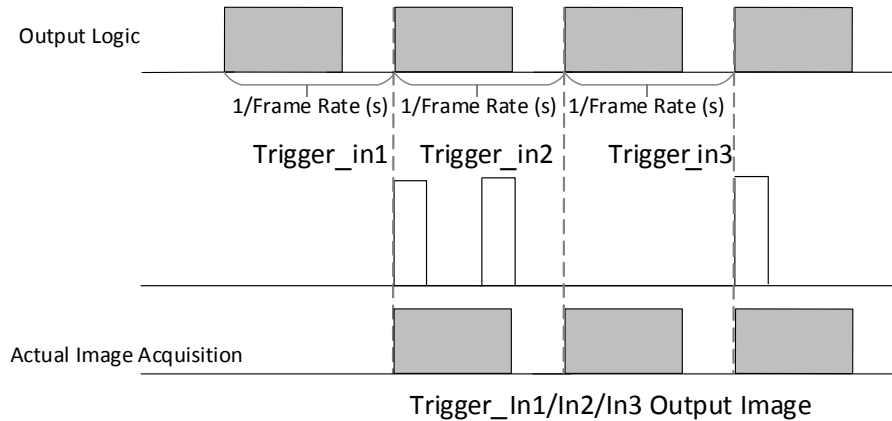
For example, if the device receives the 2nd trigger signal when it is processing the 1st trigger signal, and the result will be different depending on whether **Trigger Cache Enable** is enabled or not.

- The 2nd trigger signal will be filtered without processing if **Trigger Cache Enable** is disabled.



**Figure 8-19 Second Frame Filtered**

- The 2nd trigger signal will be saved if **Trigger Cache Enable** is enabled.



**Figure 8-20 Second Frame Created Normally**

## Note

The two sequence diagrams above use rising edge as trigger activation.

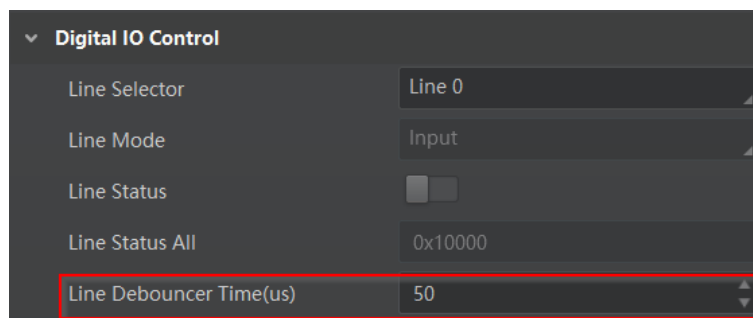
## Set Trigger Debouncer

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

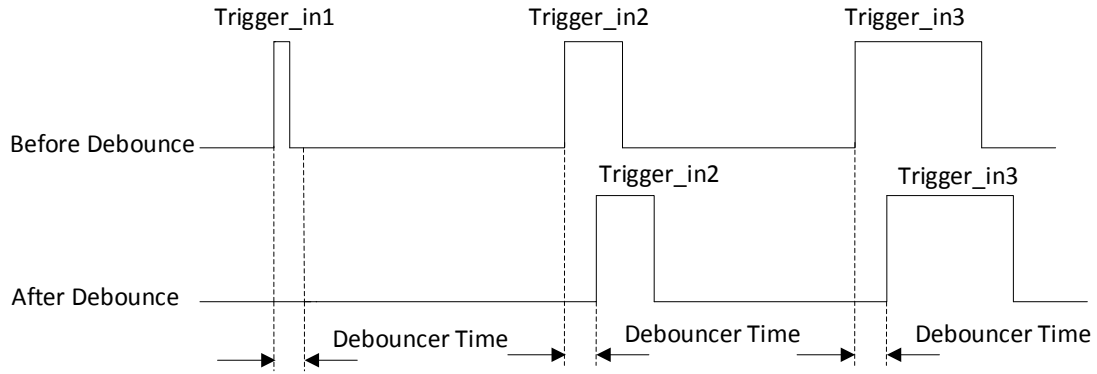
Go to **Digital IO Control** → **Line Debouncer Time**, and enter **Line Debouncer Time** according to actual demands. The range of **Line Debouncer Time** is from 0  $\mu\text{s}$  to 1000000  $\mu\text{s}$ .

## Note

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



**Figure 8-21 Set Trigger Debouncer**



**Figure 8-22 Sequence Diagram of Trigger Debouncer**

---

**Note**

The sequence diagrams above use rising edge as trigger activation.

---



## Chapter 9 Trigger Output

### 9.1 Select Output Signal

The device has one opto-isolated output (Line 1), and one bi-directional I/O (Line 2) that can be configured as output signal. The steps for configuring Line 2 as output signal as follows.

#### Steps

1. Go to **Digital IO Control** and select **Line 2** as **Line Selector**.
2. Select **Strobe** as **Line Mode**.

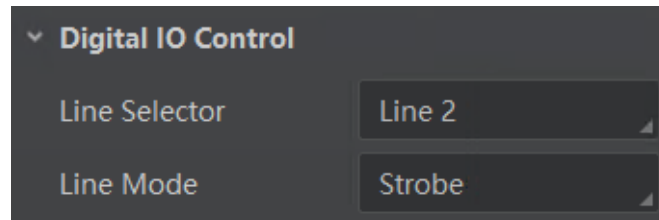


Figure 9-1 Set Line 2 as Output Signal

### 9.2 Set Output Signal

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 **Digital IO Control** → **Line Inverter**, and enable it.

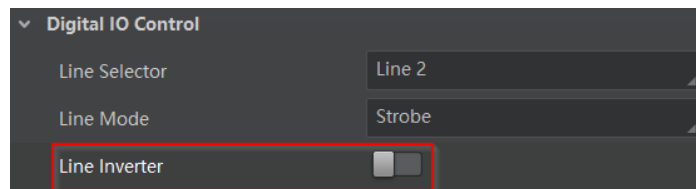


Figure 9-2 Enable Line Inverter

---

#### Note

The line inverter function is disabled by default.

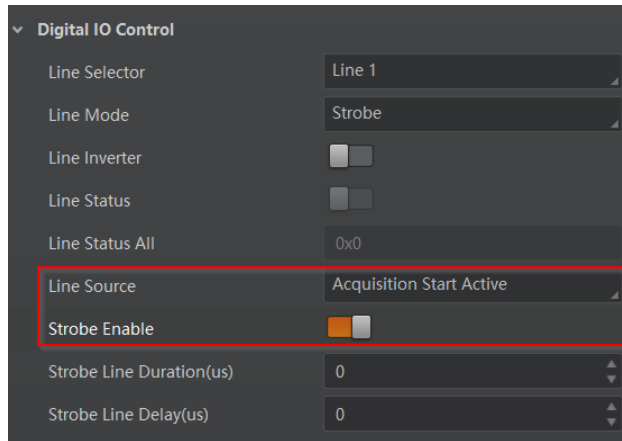
---

## 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.

### Steps

1. Go to **Digital IO Control** → **Line Source**, and select **Line Source** according to actual demands.
2. Enable **Strobe Enable**.



**Figure 9-3 Enable Strobe Signal**

The supported line sources are as follows:

**Table 9-1 Line Source Description**

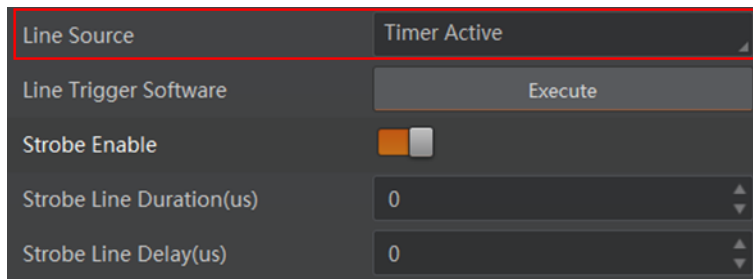
Line Source	Description
Exposure Start Active	The device outputs signals to external devices when it starts exposure.
Exposure End Active	The device outputs signals to external devices when it stops exposure.
Acquisition Start Active	The device outputs signals to external devices when it starts acquiring images.
Acquisition Stop Active	The device outputs signals to external devices when it stops acquiring images.
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.
Frame Trigger Wait	The device is currently waiting for a frame start trigger.
Frame Start Active	The device outputs signals to external devices when it starts doing the capture of a frame.

Line Source	Description
Frame End Active	The device outputs signals to external devices when it stops doing the capture of a frame.
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.

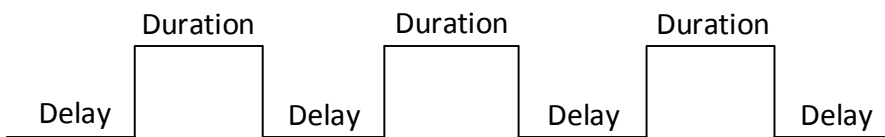
**Note**

The specific line sources may differ by device models.

If **Timer Active** is selected as **Line Source**, you can click **Execute** in **Line Trigger Software**, and enter **Strobe Line Delay** according to actual demands. The device will output signals whose duration is configured in **Strobe Line Duration**.



**Figure 9-4 Timer Active Parameters**



**Figure 9-5 Sequence Diagram of Timer Active**

### Set Strobe Line Duration

After enabling strobe signal, you can set its duration. Go to **Digital IO Control** → **Strobe Line Duration**, and enter it according to actual demands.



Figure 9-6 Set Strobe Line Duration

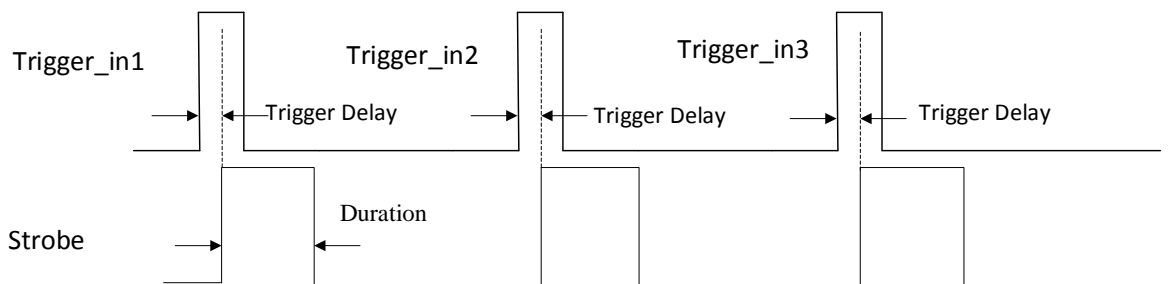


Figure 9-7 Sequence Diagram of Strobe Line Duration

**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 the configured value you set.

### Set Strobe Line Delay

The strobe line delay function allows the device to output signal in a delay time. Go to **Digital IO Control** → **Strobe Line Delay**, and enter it according to actual demands. The range of **Strobe Line Delay** is from 0  $\mu$ s to 10000  $\mu$ s.

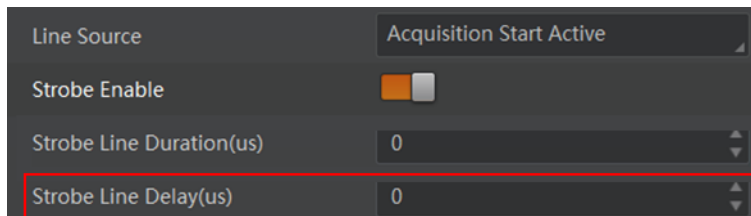


Figure 9-8 Set Strobe Line Delay

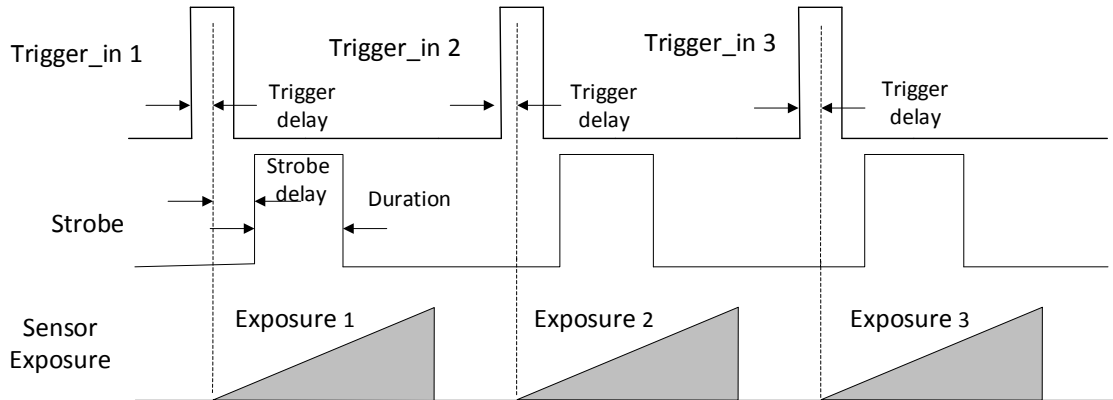


Figure 9-9 Sequence Diagram of Strobe Line Delay

### 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.

Click **Digital IO Control** → **Strobe Line Pre Delay**, and enter **Strobe Line Pre Delay** according to actual demands.

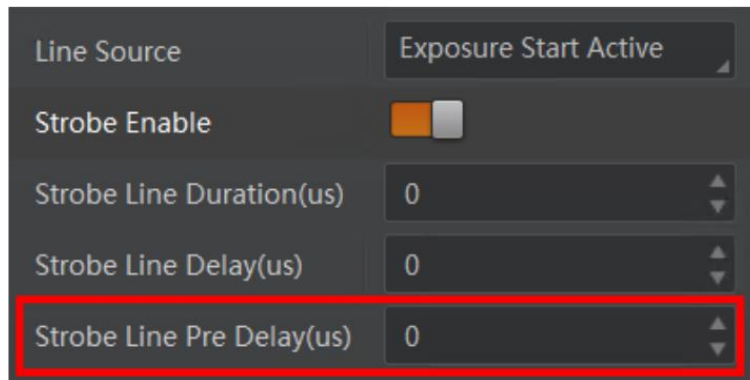
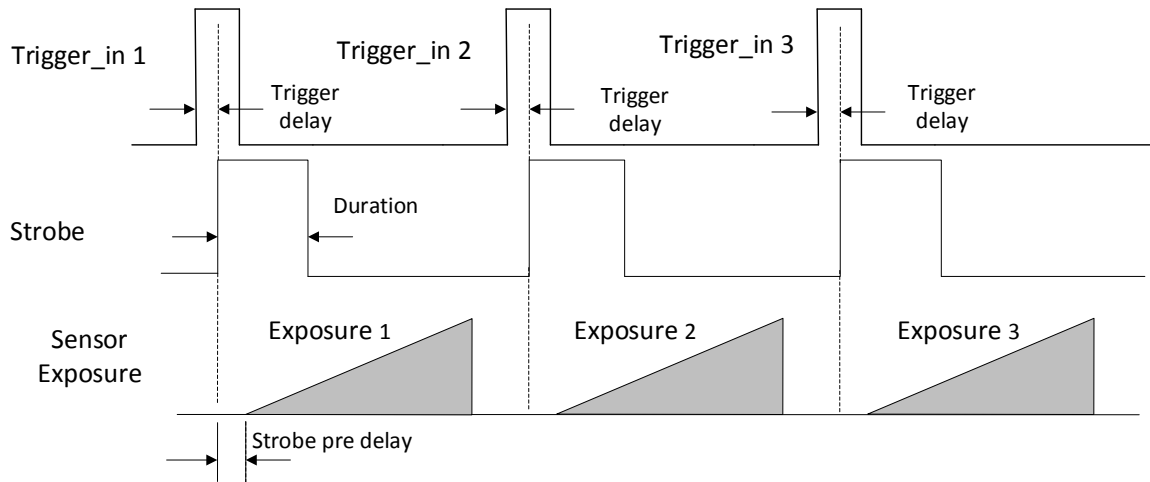


Figure 9-10 Set Strobe Pre Line Delay

The sequence diagram of strobe line pre delay is shown below.



**Figure 9-11 Sequence Diagram of Strobe Pre Line Delay**

# Chapter 10 I/O Electrical Features and Wiring

The device has one opto-isolated input signal (Line 0), one opto-isolated output signal (Line 1), and one bi-directional non-isolated I/O signal (Line 2). This section introduces the I/O electrical features and wiring.

## 10.1 Input Signal

The device's Line 0 is opto-isolated input signal, and its internal circuit is as follows.

**Note**

- The maximum input current of Line 0 is 25 mA.
- Make sure that the input voltage is not from 1 VDC to 3.3 VDC as the electric status between these two values are not stable.
- The breakdown voltage is 30 VDC. Keep voltage stable.

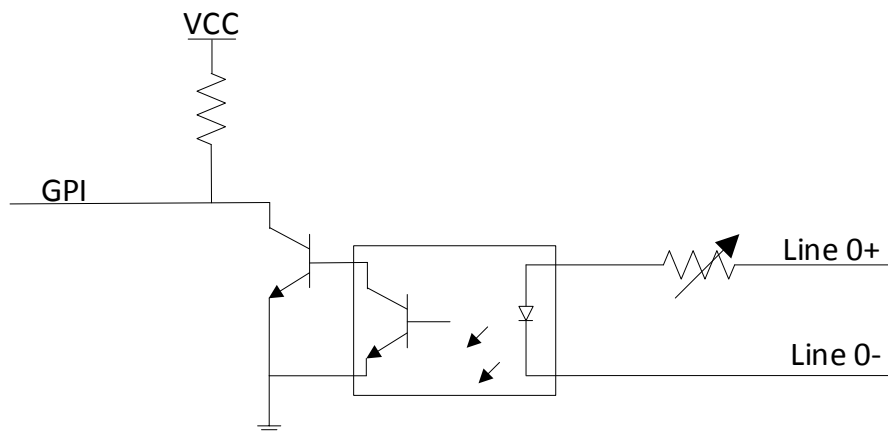


Figure 10-1 Internal Circuit of Input Signal

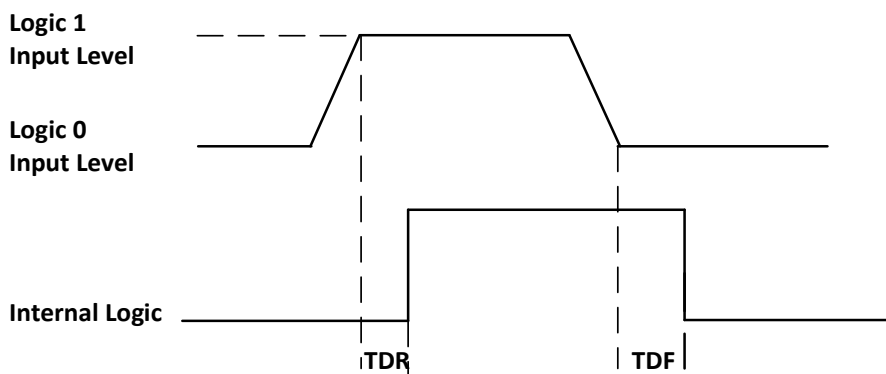


Figure 10-2 Input Logic Level

**Table 10-1 Input Electrical Feature**

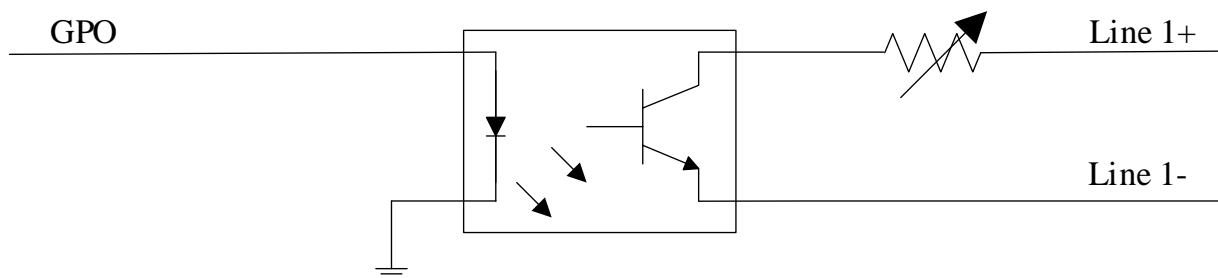
Parameter Name	Parameter Symbol	Value
Input Logic Level Low	VL	0 VDC to 1 VDC
Input Logic Level High	VH	3.3 VDC to 24 VDC
Input Falling Delay	TDF	16.8 $\mu$ s to 22 $\mu$ s
Input Rising Delay	TDR	1.8 $\mu$ s to 4.6 $\mu$ s

## 10.2 Output Signal

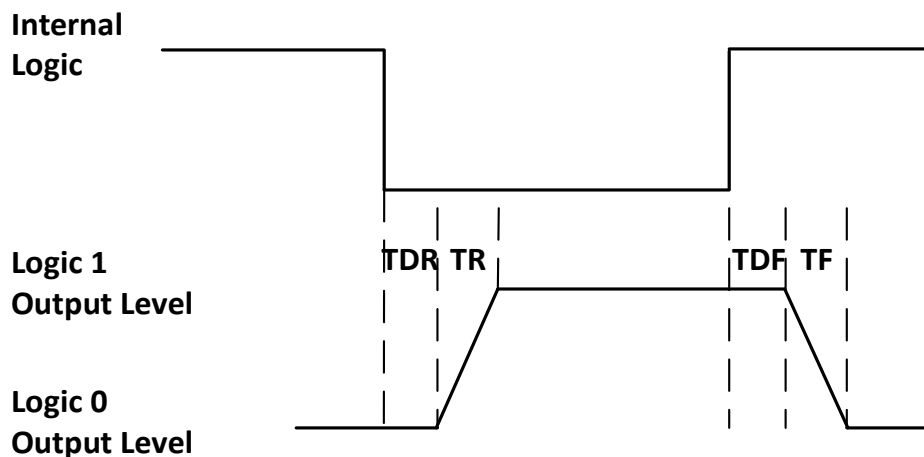
The device's Line 1 is opto-isolated output signal, and its internal circuit is as follows.

**Note**

The maximum output current of Line 1 is 25 mA and output impedance is 40  $\Omega$ .



**Figure 10-3 Internal Circuit of Output Signal**



**Figure 10-4 Output Logic Level**



Opto-isolated output electric feature is shown below when the external voltage is 3.3 VDC and the external resistance is 1 K $\Omega$ .

**Table 10-2 Output Electrical Feature**

Parameter Name	Parameter Symbol	Value
Output Logic Level Low	VL	575 mV
Output Logic Level High	VH	3.3 VDC
Output Rising Time	TR	8.4 $\mu$ s
Output Falling Time	TF	1.9 $\mu$ s
Output Rising Delay	TDR	15 $\mu$ s to 60 $\mu$ s
Output Falling Delay	TDF	3 $\mu$ s to 6 $\mu$ s

With different external voltage and resistance, the corresponding current and the parameter of output logic level low are shown below.

**Table 10-3 Parameters of Output Logic Level Low**

External Voltage	External Resistance	VL	Output Current
3.3 VDC	1 K $\Omega$	575 mV	2.7 mA
5 VDC	1 K $\Omega$	840 mV	4.1 mA
12 VDC	2.4 K $\Omega$	915 mV	4.6 mA
24 VDC	4.7 K $\Omega$	975 mV	4.9 mA

## 10.3 Bi-Directional Signal

The device has one bi-directional non-isolated I/O signal (Line 2), and you can set it as input signal or output signal according to demands. Its internal circuit is as follows.

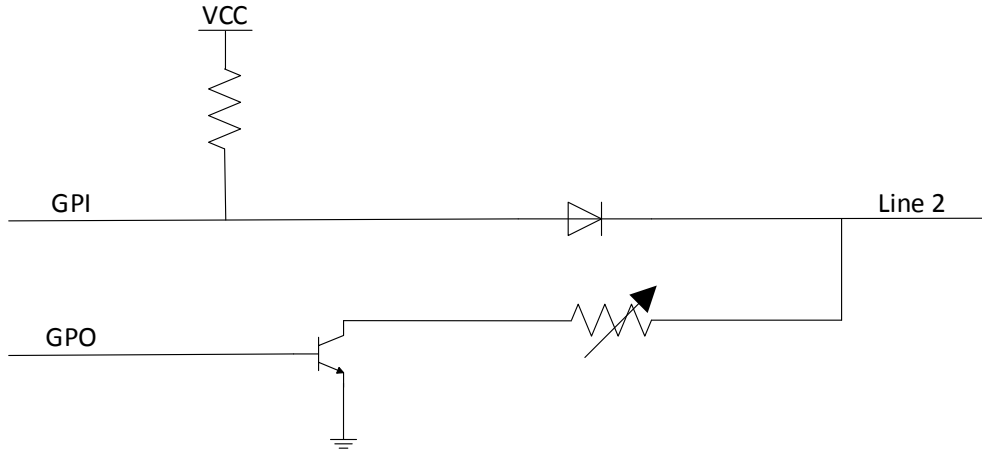


Figure 10-5 Internal Circuit of Bi-Directional Signal

### Configured as Input Signal

**Note**

- Make sure that the input voltage is not from 0.3 VDC to 3.3 VDC as the electric status between these two values are not stable.
- The breakdown voltage is 30 VDC. Keep voltage stable.
- To prevent damage to GPIO pin, connect GND first and then input voltage into Line 2.

With the condition of 100  $\Omega$  resistance and 5 VDC voltage, the logic level and electrical feature of configuring Line 2 as input signal are shown below.

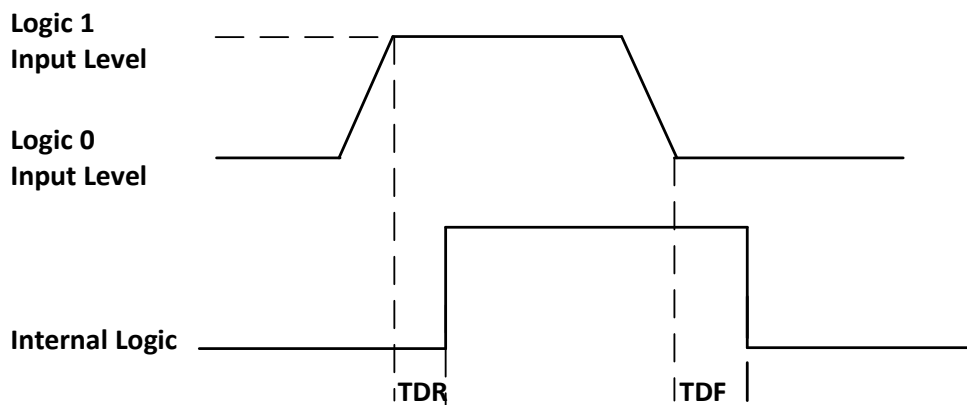


Figure 10-6 Input Logic Level

**Table 10-4 Input Electrical Feature**

Parameter Name	Parameter Symbol	Value
Input Logic Level Low	VL	0 VDC to 0.3 VDC
Input Logic Level High	VH	3.3 VDC to 24 VDC
Input Falling Delay	TDF	< 1 $\mu$ s
Input Rising Delay	TDR	< 1 $\mu$ s

**Configured as Output Signal**

**Note**

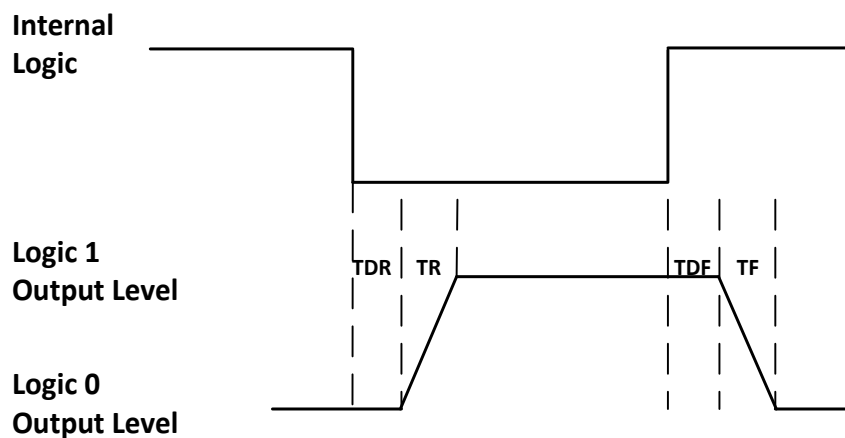
The maximum current is 25 mA and the output impedance is 40  $\Omega$ .

The relation among external voltage, resistance and the output level low is shown below.

**Table 10-5 Parameters of Output Logic Level Low**

External Voltage	External Resistance	VL (GPIO2)
3.3 VDC	1 K $\Omega$	160 mV
5 VDC	1 K $\Omega$	220 mV
12 VDC	1 K $\Omega$	460 mV
24 VDC	1 K $\Omega$	860 mV
30 VDC	1 K $\Omega$	970 mV

When the voltage of external resistance (1 K $\Omega$ ) is pulled up to 5 VDC, the logic level and electrical feature of configuring Line 2 as output are shown below.



**Figure 10-7 Output Logic Level**

**Table 10-6 Output Electrical Feature**

Parameter Name	Parameter Symbol	Value
Output Rising Time	TR	0.06 $\mu$ s
Output Falling Time	TF	0.016 $\mu$ s
Output Rising Delay	TDR	0 $\mu$ s to 4 $\mu$ s
Output Falling Delay	TDF	< 1 $\mu$ s

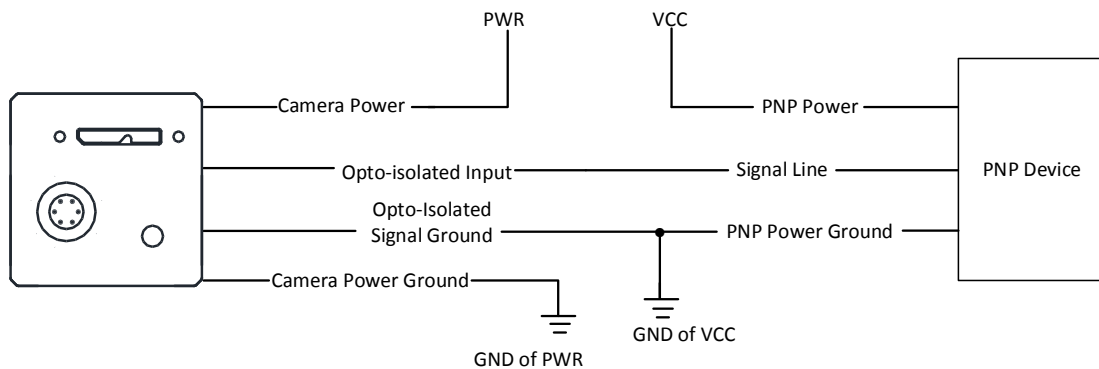
## 10.4 Input Signal Wiring

The device has different appearances with varied models. Here we take type II device as an example to introduce input signal wiring.

### Note

Input signal wiring may differ by the external device type.

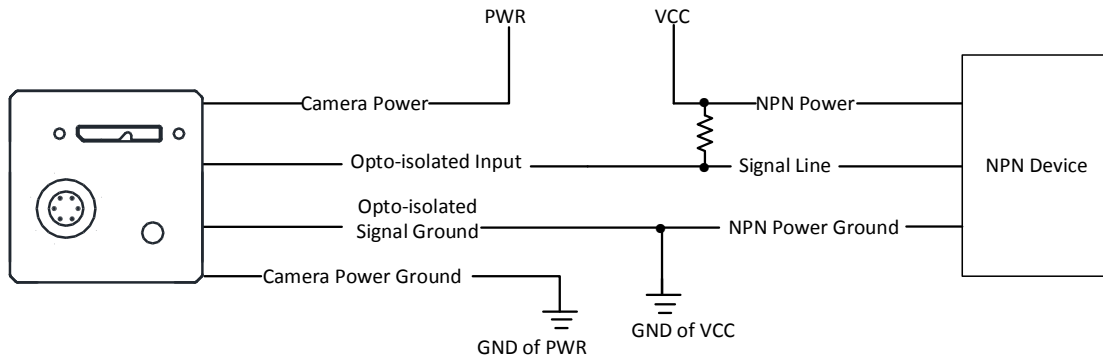
### PNP Device



**Figure 10-8 Input Signal Connects to PNP Device**

### NPN Device

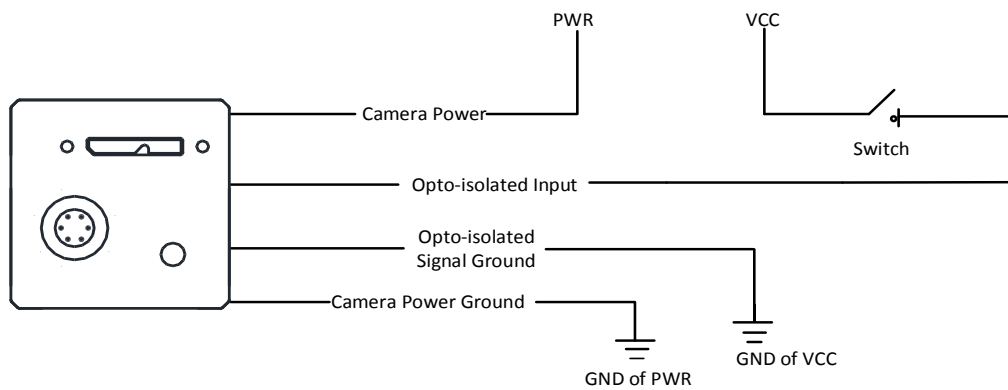
- If the VCC of NPN device is 24 VDC, it is recommended to use 4.7 K $\Omega$  pull-up resistor.
- If the VCC of NPN device is 12 VDC, it is recommended to use 1 K $\Omega$  pull-up resistor.



**Figure 10-9 Input Signal Connects to NPN Device**

## Switch

If the VCC of switch is 24 VDC, it is recommended to use 4.7 K $\Omega$  resistor to protect circuit.



**Figure 10-10 Input Signal Connects to Switch**

## 10.5 Output Signal Wiring

The device has different appearances with varied models. Here we take type II device as an example to introduce output signal wiring.

---

**Note**

Output signal wiring may differ by the external device type.

---

## PNP Device

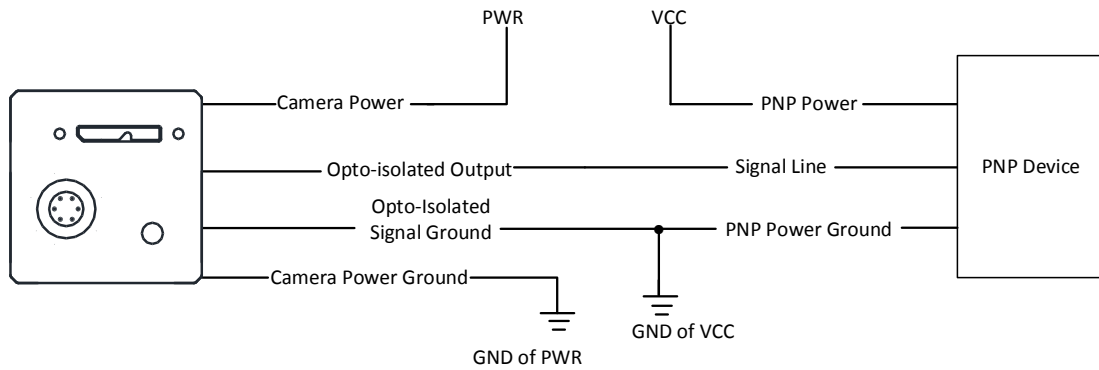


Figure 10-11 Output Signal Connects to PNP Device

## NPN Device

- If the VCC of NPN device is 24 VDC, it is recommended to use 4.7 K $\Omega$  pull-up resistor.
- If the VCC of NPN device is 12 VDC, it is recommended to use 1 K $\Omega$  pull-up resistor.

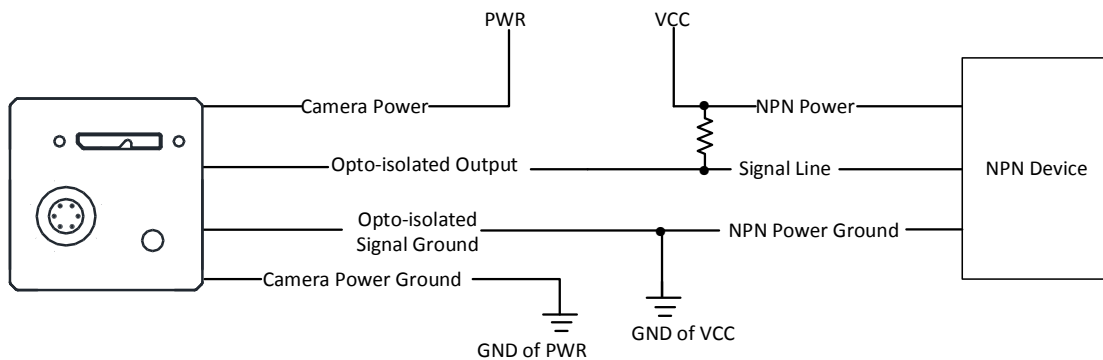


Figure 10-12 Output Signal Connects to NPN Device

## 10.6 Bi-Directional Signal Wiring

The device's Line 2 can be used as input signal and output signal. Here we take type II device as an example to introduce bi-directional signal wiring.

### Configured as Input Signal

The input signal wiring is shown below when the device's Line 2 is configured as input signal.

#### Note

Input signal wiring may differ by the external device type.

### PNP Device

It is recommended to use 330  $\Omega$  pull-down resistor.

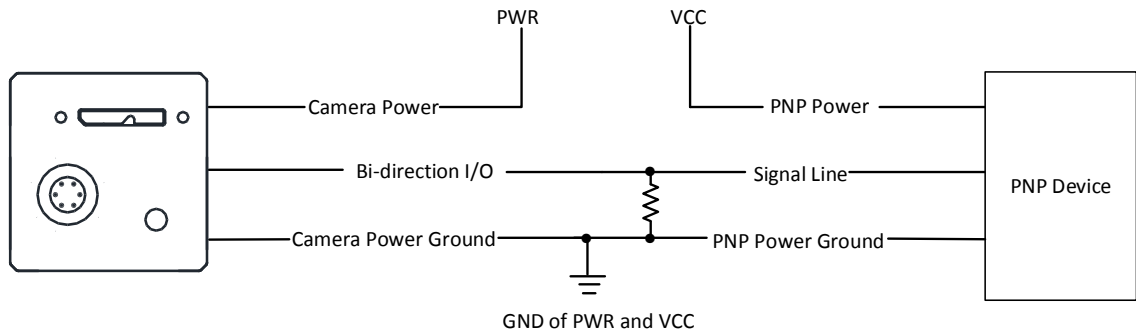


Figure 10-13 Input Signal Connects to PNP Device

### NPN Device

- If the VCC of NPN device is 24 VDC, it is recommended to use 4.7 K $\Omega$  pull-up resistor.
- If the VCC of NPN device is 12 VDC, it is recommended to use 1 K $\Omega$  pull-up resistor.

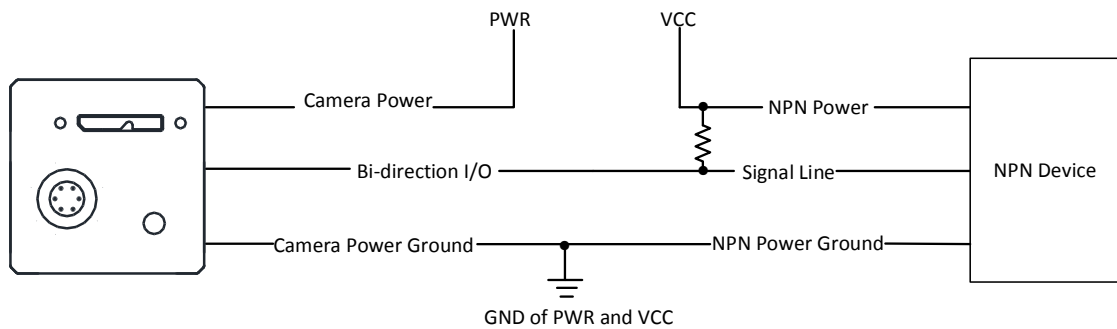


Figure 10-14 Input Signal Connects to NPN Device

## Switch

The switch value can provide low electrical level to trigger line 2.

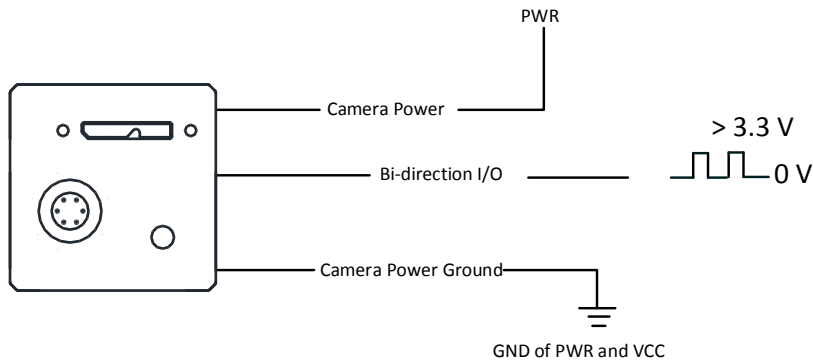


Figure 10-15 Input Signal Connects to Switch

## Configured as Output Signal

The output signal wiring is shown below when the device's Line 2 is configured as output signal.

### Note

Output signal wiring may differ by the external device type.

## PNP Device

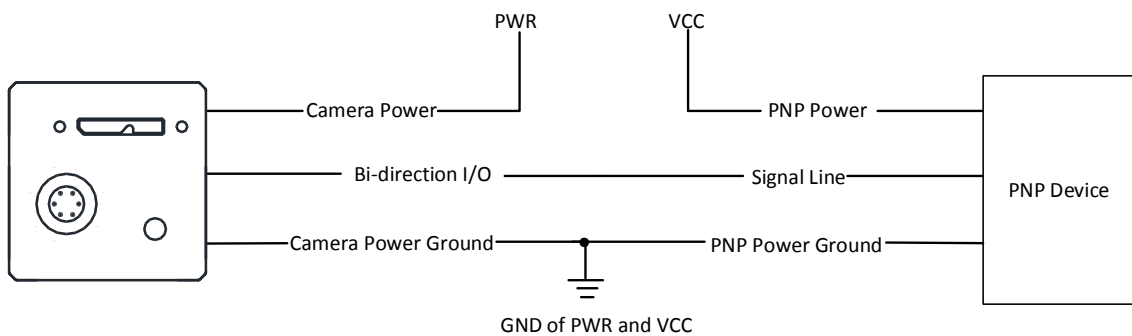
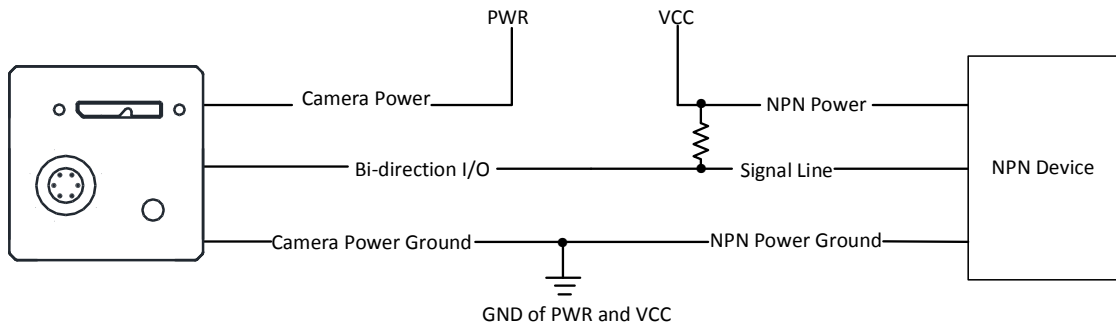


Figure 10-16 Output Signal Connects to PNP Device

## NPN Device

- If the VCC of NPN device is 24 VDC, it is recommended to use 4.7 K $\Omega$  pull-up resistor.
- If the VCC of NPN device is 12 VDC, it is recommended to use 1 K $\Omega$  pull-up resistor.





**Figure 10-17 Output Signal Connects to NPN Device**

# 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.

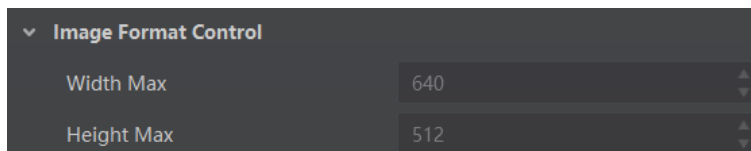


Figure 11-1 View Resolution

## 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 currently 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**, **Offset X**, and **Offset Y**.

---

### Note

The **Width** plus **Offset X** should not be larger than **Width Max**, and **Height** plus **Offset Y** should not be larger than **Height Max**.

---

- **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.

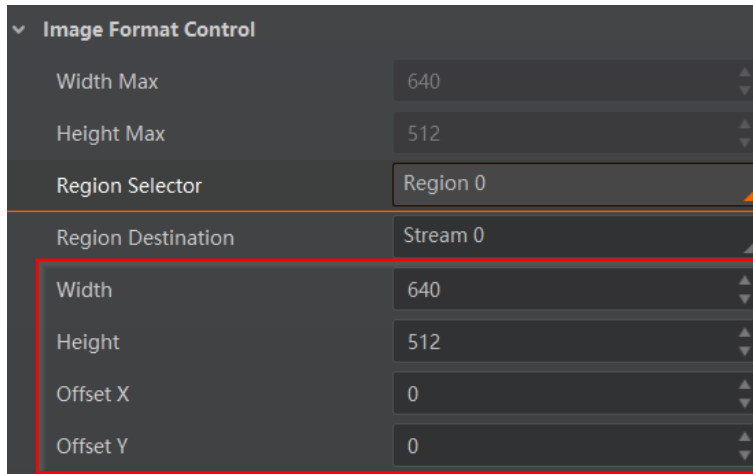


Figure 11-2 Set ROI

## 11.3 Set Image Reverse

### Note

- For different models of device, the image reverse function may be different, please refer to the actual one you got.
- Only when the device stops streaming, you can enable **Reverse Y**.

**Reverse X** refers to the image reverses in a horizontal way, and **Reverse Y** refers to the image reverses in a vertical way.

You can click **Image Format Control**, and enable **Reverse X** or **Reverse Y** according to actual demands.



Figure 11-3 Set Image Reverse

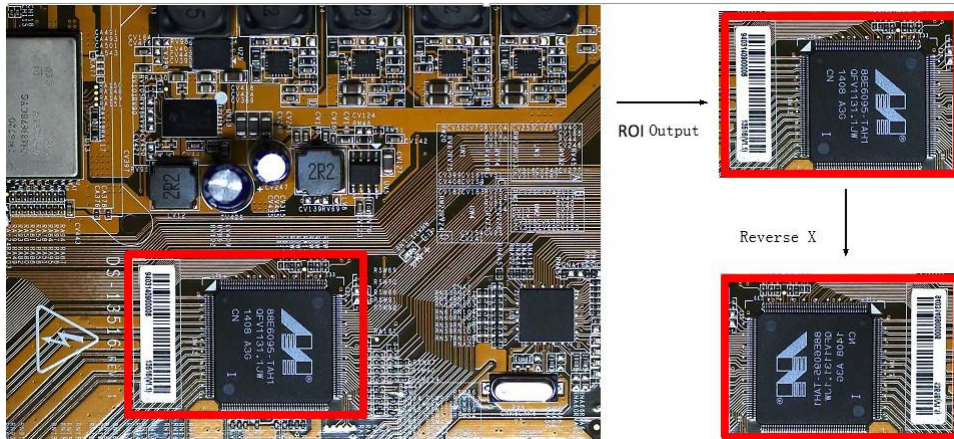


Figure 11-4 Image Reverse Comparison

## 11.4 Set Pixel Format

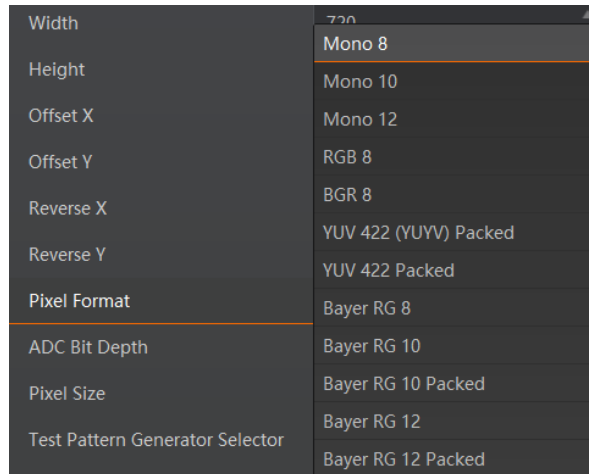
This function allows you to set the pixel format of the image data transmitted by the device. Go to **Image Format Control** → **Pixel Format**, and set **Pixel Format** according to actual demands.

### Note

- The specific pixel formats may differ by device models.
- With different ADC bit depth, the pixel format and pixel size may differ.

Table 11-1 Pixel Format and Pixel Size

ADC Bit Depth	Pixel Format	Pixel Size (Bits/Pixel)
8	Mono 8, Bayer RG 8	8
12	Mono 8, Bayer 8	8
	Mono 10 Packed, Mono 12 Packed, Bayer 10 Packed, Bayer 12 Packed	12
	Mono 10/12, Bayer 10/12, YUV422Packed, YUV 422 (YUYV) Packed	16
	RGB 8, BGR 8	24



**Figure 11-5 Set Pixel Format**

With different ADC bit depths and pixel formats, the device's max. frame rate may differ. The larger the device's ADC bit depth value, the better the device's image quality, the lower the device's frame rate will be.

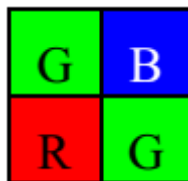
**Note**

The ADC bit depth function may differ by device models.

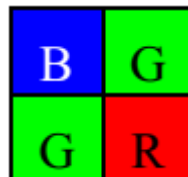
The default output data format of mono device is Mono 8. The default output data format of color device is Bayer 8, and it can be converted into RGB format via pixel interpolation algorithm. Bayer GR, Bayer GB, Bayer BG, and Bayer RG patterns are shown below.



**Figure 11-6 Bayer GR Pixel Pattern**



**Figure 11-7 Bayer GB Pixel Pattern**



**Figure 11-8 Bayer BG Pixel Pattern**

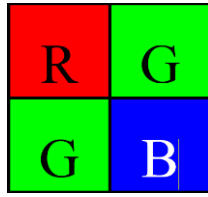


Figure 11-9 Bayer RG Pixel Pattern

## 11.5 Set Super Bayer

### Note

For different models of device, the super Bayer function may be different, please refer to the actual one you got.

In Bayer pixel format, the device supports Gamma function, LUT, contrast ratio, super palette control, and sharpness function after you enable **Super Bayer Enable**. Go to **Image Format Control** → **Super Bayer Enable**, and enable it according to actual demands.

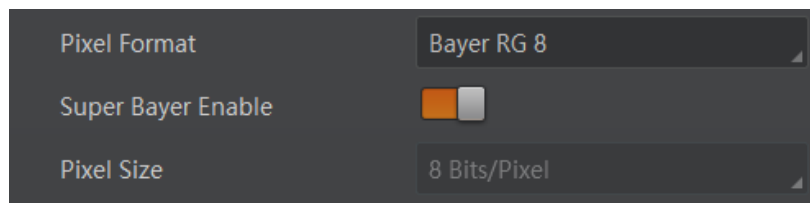


Figure 11-10 Set Super Bayer

## 11.6 Set Image Compression Mode

### Note

The function of the image compression is related with device models, firmware and pixel format, and the actual product you purchased should prevail.

Without affecting image quality, this function allows the device to compress data before transmitting to the external devices, and lower the usage of bandwidth.

Go to **Image Format Control** → **Image Compression Mode**, and select **HB** as **Image Compression Mode**. You can select **Compression** as **High Bandwidth Mode** according to actual demands. **Compression** only compresses the image data, and does not increase the frame rate.

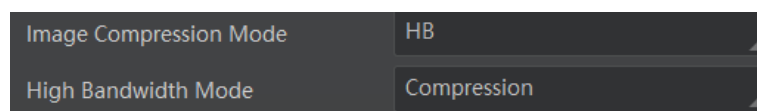
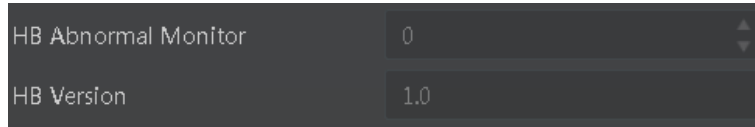


Figure 11-11 Set Image Compression Mode

You can view the image compression mode's related parameters like **HB Abnormal Monitor** and **HB Version** in the **Device Control** attribute.



**Figure 11-12 HB Abnormal Monitor and Version**

- HB abnormal monitor is used to monitor image stream condition. If the size of compressed image is larger than that of raw image under HB function, this parameter will increase. When this parameter increases rapidly, it is recommended to disable the image compression mode.
- HB version refers to the version of this function.

## 11.7 Set Test Pattern

---

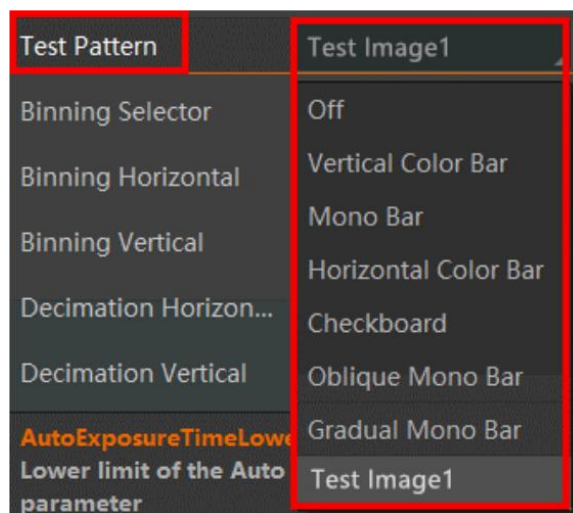
### Note

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 outputted image by the device is real-time image. If this function is enabled, the outputted image by the device is test image.

Go to **Image Format Control** → **Test Pattern Generator Selector** → **Test Pattern**, and set **Test Pattern** according to actual demands.



**Figure 11-13 Set Test Pattern**

The mono device offers 4 test patterns, including **Mono Bar**, **Checkboard**, **Oblique Mono Bar**, **Gradual Mono Bar**, and **Test Image 1**.

The color device offers 7 test patterns, including **Mono Bar**, **Checkboard**, **Oblique Mono Bar**, **Gradual Mono Bar**, **Vertical Color Bar**, **Horizontal Color Bar**, and **Test Image 1**.

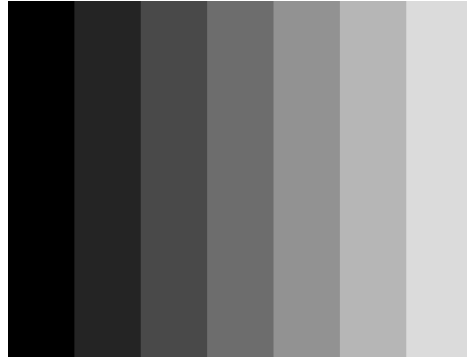


Figure 11-14 Mono Bar Test Pattern

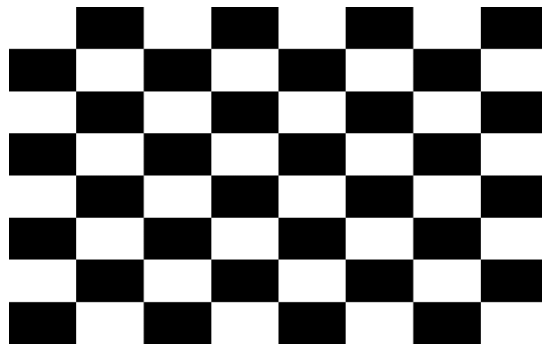


Figure 11-15 Checkboard Test Pattern

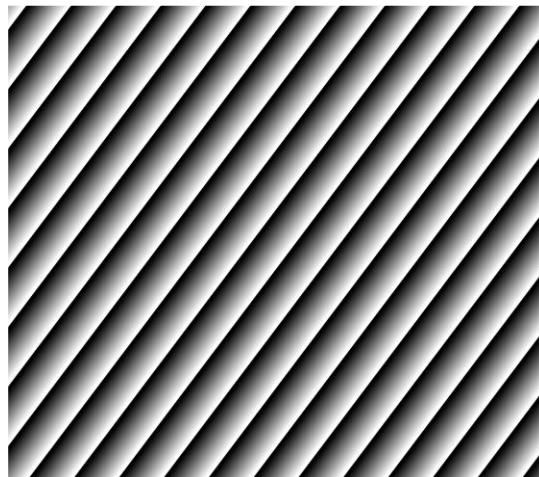
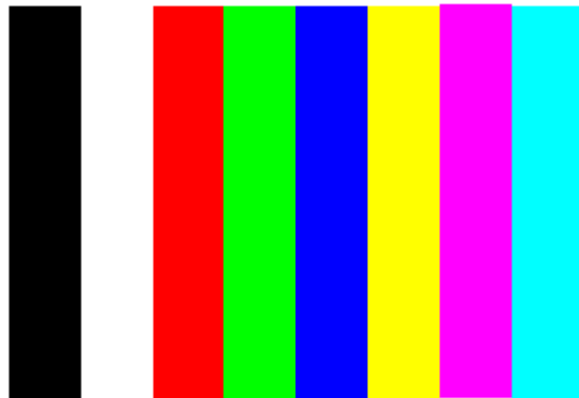


Figure 11-16 Oblique Mono Bar Test Pattern





**Figure 11-17 Gradual Mono Bar Test Pattern**



**Figure 11-18 Vertical Color Bar Test Pattern**



**Figure 11-19 Horizontal Color Bar Test Pattern**

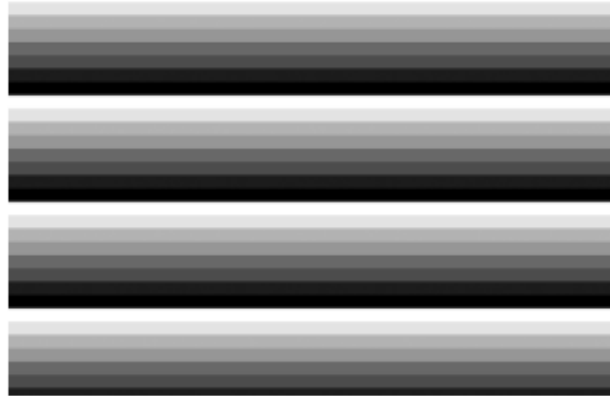


Figure 11-20 Test Image 1

---

**Note**

The pattern of the test image 1 may differ by device models.

---

## 11.8 Set Binning

---

**Note**

- **Binning Horizontal** is the image's width, and **Binning Vertical** is the image's height.
  - The binning related functions may differ by device models.
- 

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

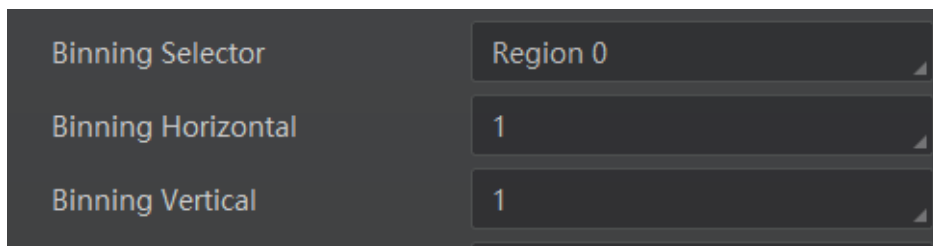


Figure 11-21 Set Binning

The device also supports binning mode function if the binning is  $2 \times 2$  and above. The binning mode defines how pixels are combined if the binning is  $2 \times 2$  and above. Click **Binning Mode**, and select **Sum** or **Average** according to actual demands.

- **Sum**: The values of the affected pixels are summed. This improves the signal-to-noise ratio, but also increases the device's response to light.
- **Average**: The values of the affected pixels are averaged. This greatly improves the signal-to-noise ratio without affecting the device's response to light.

Both binning modes (Sum and Average) reduce the amount of image data to be transferred.

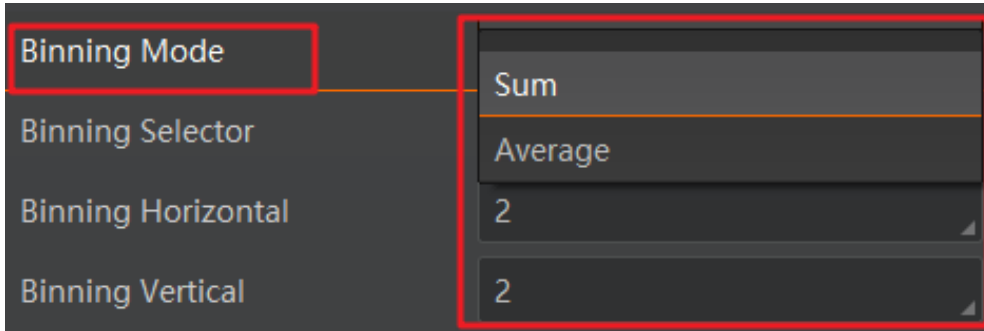


Figure 11-22 Set Binning Mode

---

 **Note**

Configuring binning mode is supported when the device is acquiring images.

---

## 11.9 Set Decimation

---

 **Note**

- **Decimation Horizontal** is the image's width, and **Decimation Vertical** is the image's height.
  - The decimation related functions may differ by device models.
- 

The decimation feature allows you to reduce the number of sensor pixel columns or rows that are transmitted by the device. This procedure is also known as subsampling. It reduces the amount of data to be transferred and may increase the device's frame rate. Click **Image Format Control**, and set **Decimation Horizontal** and **Decimation Vertical** according to actual demands.

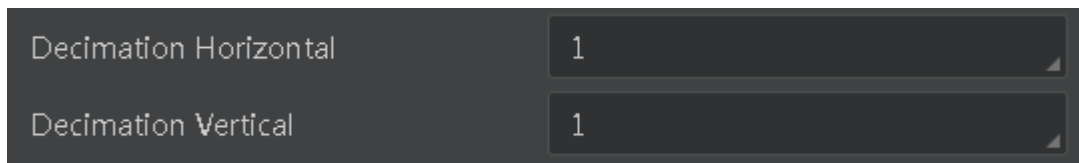


Figure 11-23 Set Decimation

## 11.10 Set Exposure Time Mode

### Note

- The exposure time mode may differ by device models.
- If the device you got does not support **Ultrashort** exposure time mode, and then there is no **Exposure Time Mode** parameter, and your device supports **Standard** exposure time mode only by default.

The device offers 2 types of exposure time modes, including **Ultrashort** mode and **Standard** mode. Go to **Acquisition Control** → **Exposure Time Mode**, and set **Exposure Time Mode** according to actual demands.

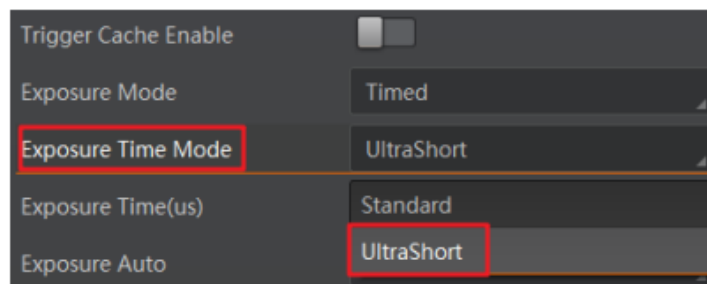


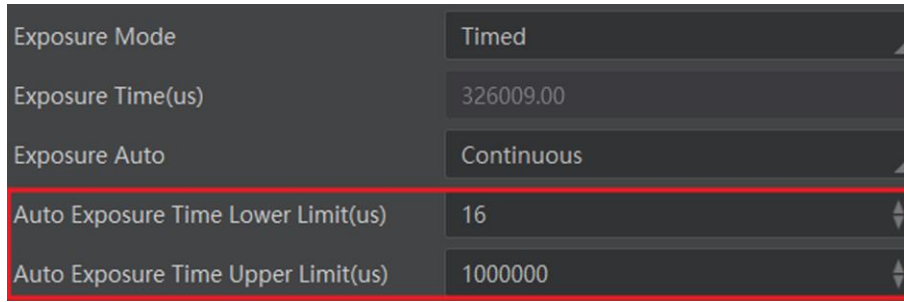
Figure 11-24 Set Exposure Time Mode

## 11.11 Set Exposure Auto

The device supports 3 types of exposure mode, including **Off**, **Once** and **Continuous**. Click **Acquisition 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 11-25 Set Exposure Time under Once or Continuous Mode**

---

### Note

- If the device is under **Continuous** exposure mode, once external trigger mode is enabled, the device will automatically switch to **Off** exposure mode.
  - Some models of the device do not support **Once** or **Continuous** exposure mode. You can enter **Exposure Time (μs)** directly.
- 

## 11.12 Set Sequencer Control and HDR

The device supports sequencer or HDR functions, which allow you to configure multiple groups of parameters to acquire images.

---

### Note

- The device cannot support sequencer and HDR functions at the same time.
  - The sequencer or HDR function may differ by device models.
- 

### 11.12.1 Set Sequencer

If the device supports sequencer, you can configure multiple groups of parameters like exposure time, gain, etc.

---

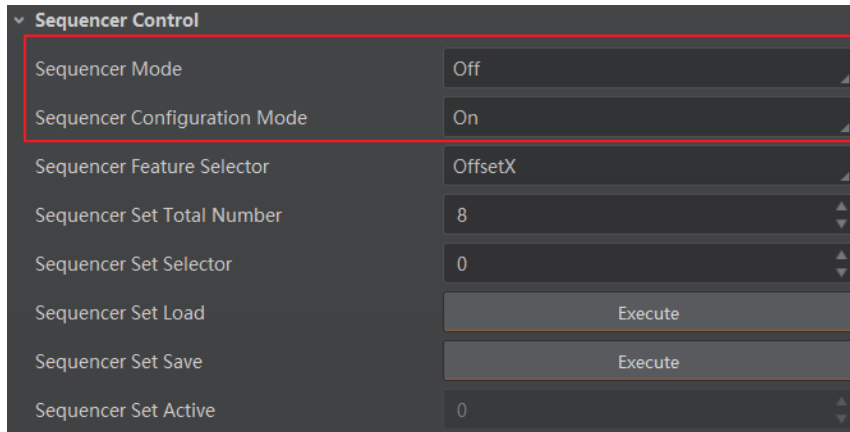
### Note

You cannot configure parameters like trigger width, exposure time mode during sequencer.

---

#### Steps

1. Go to **Sequencer Control**, select **Off** as **Sequencer Mode**, and **On** as **Sequencer Configuration Mode**.



**Figure 11-26 Set Sequencer Control**

2. Set **Sequencer Set Total Number** to configure how many groups to join sequencer according to actual demands.

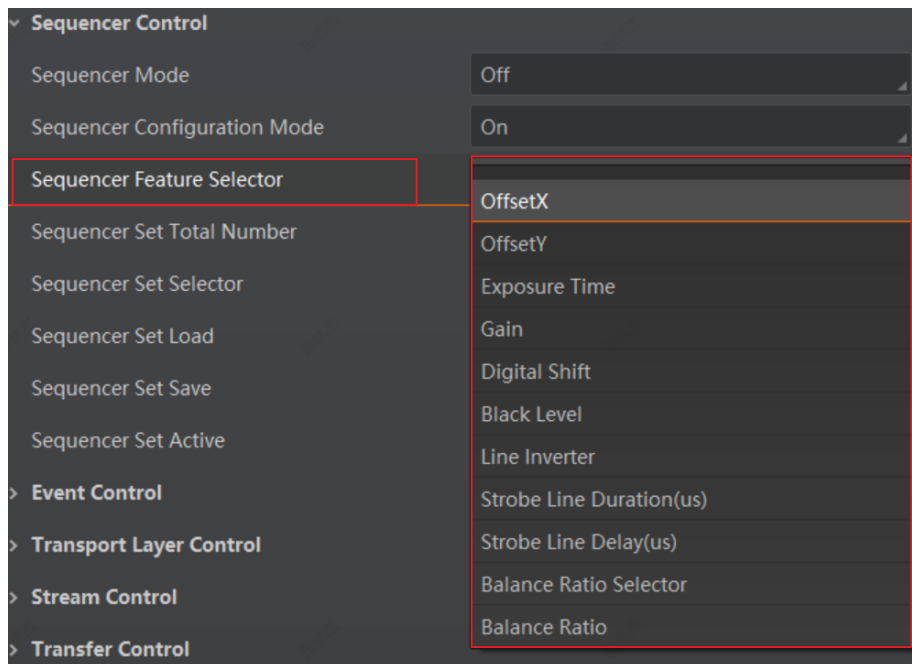
---

**Note**

Up to 8 groups of parameters can be configured.

---

3. Set **Sequencer Set Selector** to select one group of parameters, and set **Sequencer Feature Selector** to configure specific parameters.



**Figure 11-27 Sequencer Feature Selector**

---

**Note**

You should go to the corresponding parameters to set their detailed parameters.

---

- (Optional) Click **Execute** in **Sequencer Set Load** to load selected parameters in **Sequencer Set Selector**.
  - (Optional) Click **Execute** in **Sequencer Set Save** to save the selected group of parameters.
  - Repeat step 3 to step 5 to configure other group of parameters.
  - Select **On** as **Sequencer Mode** to start sequencer after configuration.
- 

### **Note**

You cannot configure detailed parameters of group of parameters once sequencer is started.

---

- (Optional) Click **Execute** in **Sequencer Restart** to let the sequencer start from the beginning group.

## 11.12.2 Set HDR

---

### **Note**

- The HDR function may differ by device models.
  - The device supports HDR (High Dynamic Range) function that the device acquires images based on customized settings, and each with its own exposure time and gain.
- 

### **Steps**

- Go to **Acquisition Control** → **HDR Enable**, and enable **HDR Enable**.
  - Select **0, 1,2** or **3** as **HDR Selector** according to actual demands.
  - Set corresponding **HDR Shutter** and **HDR Gain**.
- 

### **Note**

Up to 4 HDR groups can be configured.

---



**Figure 11-28 Set HDR**

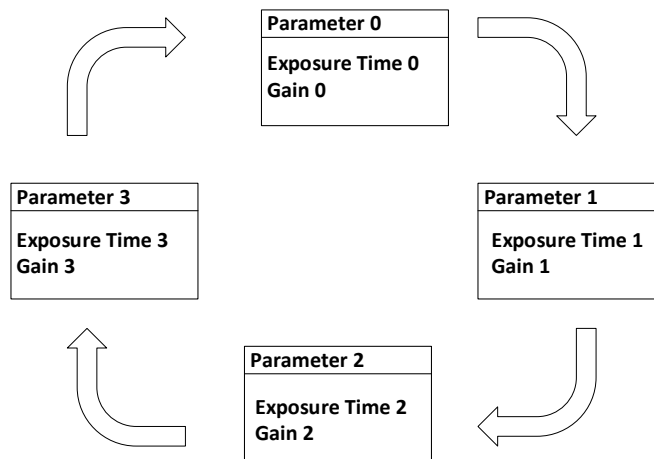


Figure 11-29 HDR Polling Demonstration

## 11.13 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.

### 11.13.1 Set Analog Gain

---

#### Note

- The analog gain parameter name may differ by device of different models or firmware. The analog gain parameter name can be **Preamp Gain** or **Gain** which have different settings method.
  - When the analog gain parameter is **Preamp Gain**, you can set it manually only.
-



## Preamp Gain

Go to **Analog Control** → **Preamp Gain**, and set **Preamp Gain** according to actual demands.

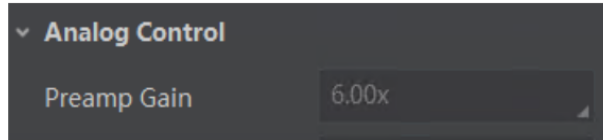


Figure 11-30 Set Preamp Gain

## Gain

The device supports 3 types of gain mode, including **Off**, **Once** and **Continuous**. Click **Analog Control** → **Gain Auto**, and select **Gain Auto** according to actual demands.

- **Off**: The device **adjusts** gain according to the value configured by user in **Gain**.
- **Once**: The device adjusts the gain automatically according to the image brightness. After adjusting, it will switch to **Off** mode.
- **Continuous**: The device **adjusts** the gain continuously according to the image brightness.

When the gain mode is set as **Once** or **Continuous**, the gain should be within the range of **Auto Gain Lower Limit (dB)** and **Auto Gain Upper Limit (dB)**.

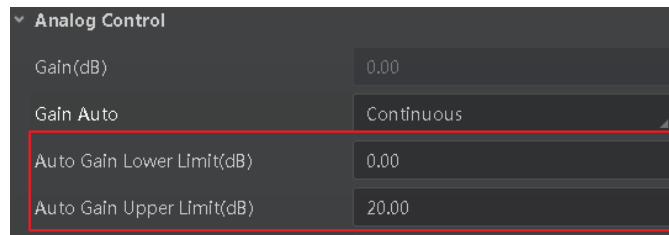


Figure 11-31 Set Gain under Once or Continuous Mode

---

### 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 gain.
  - Some models of the device do not support **Once** or **Continuous** gain mode. You can enter **Gain (dB)** directly.
-

### 11.13.2 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 **Analog Control**, enable **Digital Shift Enable**, and enter **Digital Shift** according to actual demands.

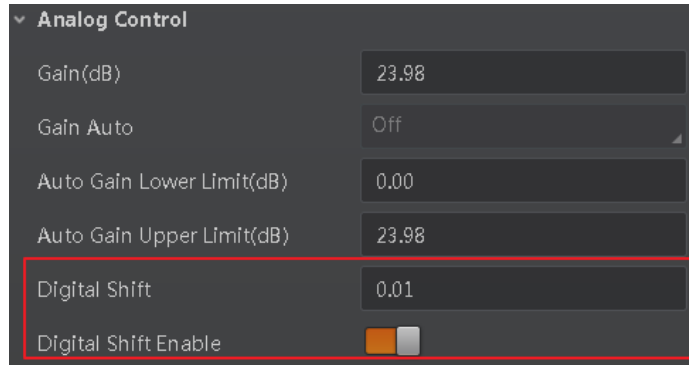


Figure 11-32 Set Digital Gain

---

#### Note

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.

---

### 11.14 Set Brightness

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

---

#### Note

- You should enable **Once** or **Continuous** exposure mode, or **Once** or **Continuous** gain 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, or **Once** or **Continuous** gain, the higher the brightness value, the brighter the image will be.
- 

Go to **Analog Control** → **Brightness**, and enter **Brightness** according to actual demand.

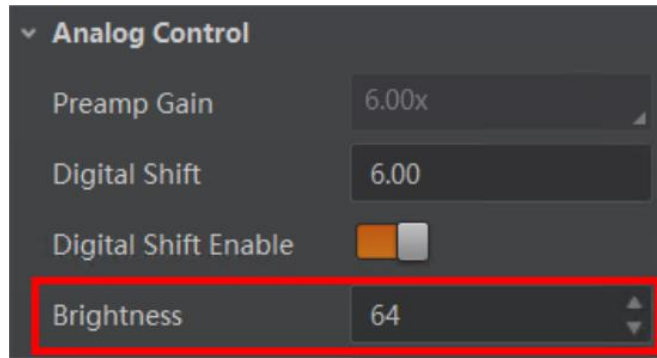


Figure 11-33 Set Brightness

## 11.15 Set Black Level

---

### Note

The black level may differ by device models.

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 **Analog Control** → **Black Level Enable**, enable **Black Level Enable**, and enter **Black Level** according to actual demands.

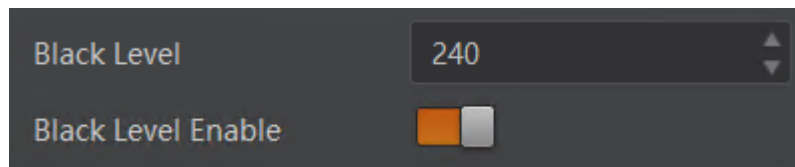


Figure 11-34 Set Black Level

## 11.16 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 **Analog Control** → **White Balance Auto**, and select **White Balance 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 16376, 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. It is recommended to set image brightness value between 120 and 160..
3. Select **Once** as **Balance White Auto**, and the device will automatically adjust white balance for once.

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 and Load User Set** for details.
  - If the light source and color temperature in environment change, you need to correct white balance again.
- 

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.

## 11.17 Set Gamma Correction

---

#### Note

- The Gamma correction function may differ by device models.
  - Regarding the color device in Bayer pixel format, you need to enable **Super Bayer Enable** first before using Gamma correction function.
-

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.

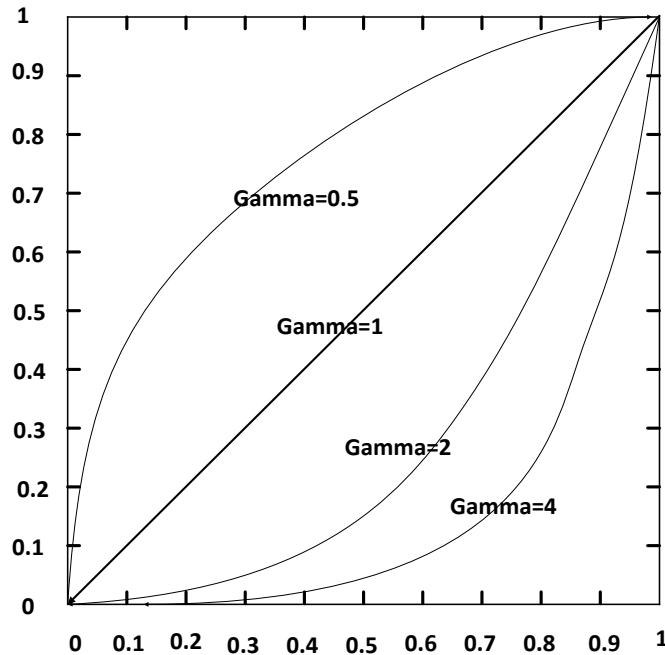


Figure 11-35 Set Gamma Correction

There are 2 types of Gamma correction, including **User** mode and **sRGB** mode.

### User Mode

#### Steps

1. Go to **Analog Control** → **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.

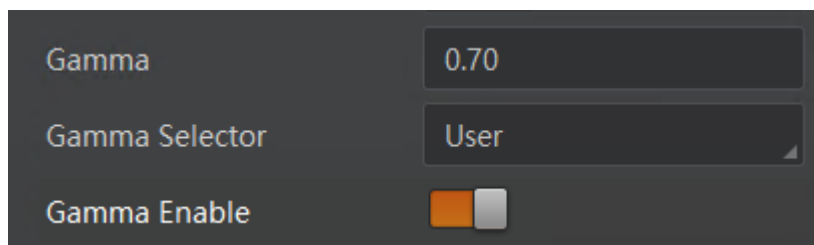


Figure 11-36 Set User Mode

## sRGB Mode

### Steps

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

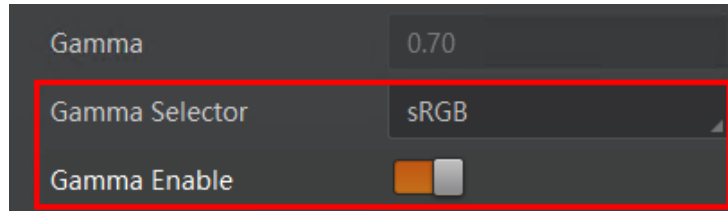


Figure 11-37 Set sRGB Mode

## 11.18 Set Sharpness

### Note

- The sharpness function may differ by device models.
- Regarding the color device in Bayer pixel format, you need to enable **Super Bayer Enable** first before using sharpness function.

The device supports sharpness function that can adjust the sharpness level of the image edge, You can set sharpness as shown below.

Go to **Analog Control** → **Sharpness Enable**, enable **Sharpness Enable**, and enter **Sharpness** according to actual demands.

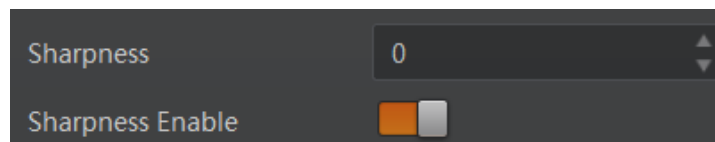


Figure 11-38 Set Sharpness

## 11.19 Set Digital Noise Reduction

### Note

- The digital noise reduction function may differ by device models.
- 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 **Analog Control** → **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.

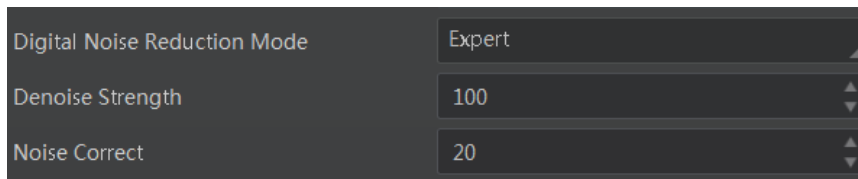


Figure 11-39 Set Digital Noise Reduction

## 11.20 Set Contrast Ratio

### Note

- The contrast ratio function may differ by device models.
- Make sure that the live view is enabled, and Gamma correction and LUT function is disabled before using the contrast ratio function.
- Regarding the color device in Bayer pixel format, you need to enable **Super Bayer Enable** first before using contrast ratio function.
- The range of **Contrast Ratio** is from 0 to 100.

The device supports the contrast ratio function that adjusts the intensity of light and darkness and color. The larger the contrast ratio, and more clear the image is. Go to **Analog Control**, enable **Contrast Ratio Enable**, and set **Contrast Ratio** according to actual demands.

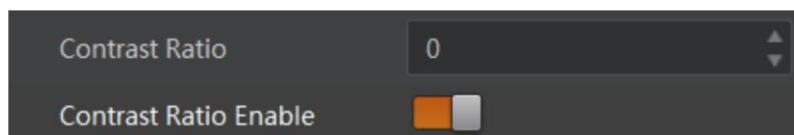


Figure 11-40 Set Contrast Ratio

## 11.21 Set AOI

### Note

- The AOI function may differ by device models.
- AOI 1 is used when the device is in once or continuous exposure mode, and AOI 2 is used when the 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 **Analog Control** → **Auto Function AOI Selector**, and select **AOI 1** or **AOI 2 Auto Function AOI Selector**.
2. Enter **Auto Function AOI Width**, **Auto Function AOI Height**, **Auto Function AOI Offset X**, and **Auto Function AOI Offset Y** 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**.

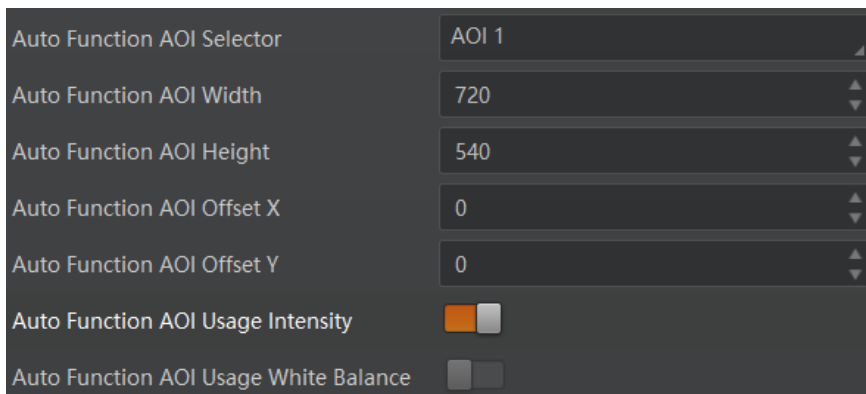


Figure 11-41 Set AOI

## 11.22 Set Color Transformation Control

### Note

- The function of color transformation control is only available for color devices.
- Currently, **RGB to RGB** is available for **Color Transformation Selector** only.

The color transformation control is used to restore color and eliminate the overlap in the color channels. Two methods are available to set color transformation control.

- Method 1: Go to **Color Transformation Control**, select **Color Transformation Value Selector**, and set **Color Transformation Value** according to actual demand.



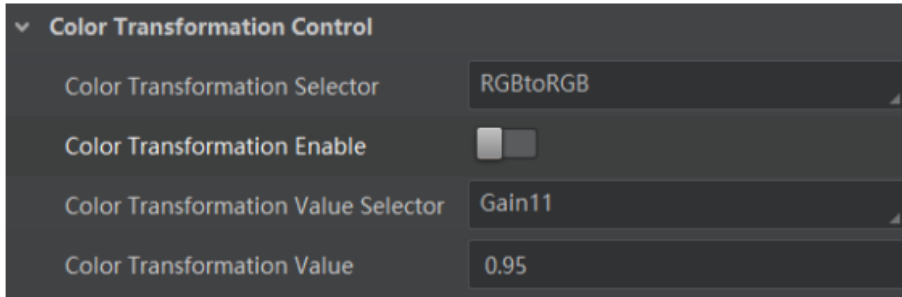


Figure 11-42 Method 1

- Method 2: Go to **Color Transformation Control**, enable **Color Transformation Enable**, set **Hue** and **Saturation** to adjust **Color Transformation Value**.

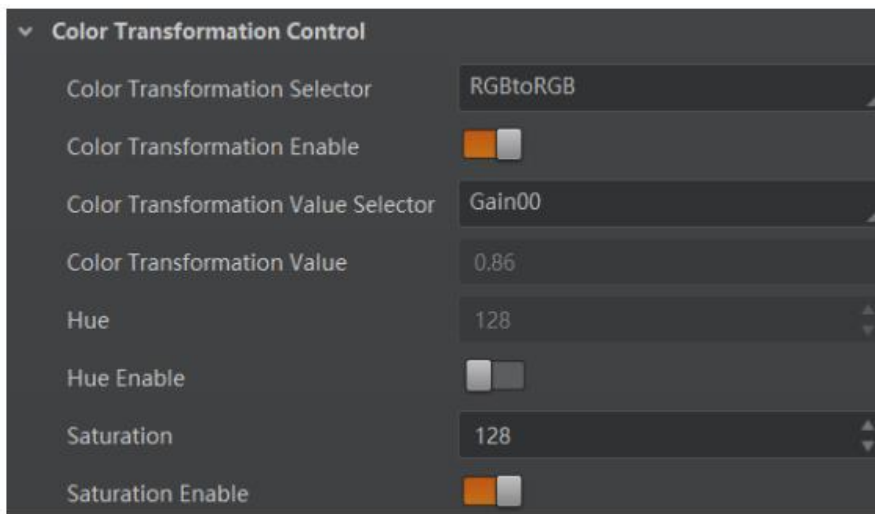


Figure 11-43 Method 2

## 11.23 Set Hue

---

### Note

- The hue function is only available for color devices.
  - In Bayer and Mono pixel format, hue function is not supported.
- 

Adjusting the hue shifts the colors of the image.

### Steps

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

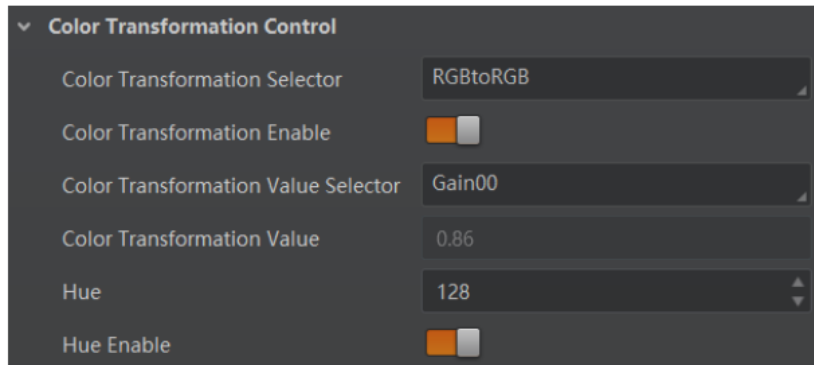


Figure 11-44 Set Hue

## 11.24 Set Saturation

---

### Note

- The saturation function is only available for color devices.
  - In Bayer and Mono pixel format, hue function is not supported.
- 

Adjusting the saturation changes the colorfulness of the colors. A higher saturation, for example, makes colors easier to distinguish.

### Steps

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

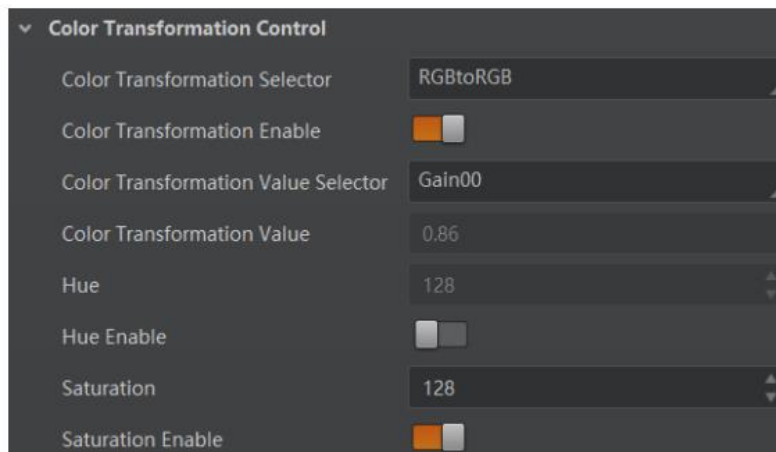


Figure 11-45 Set Saturation

## 11.25 Set Super Palette Control

### Note

- The function of super palette control may differ by device models.
- Regarding the color device in Bayer pixel format, you need to enable **Super Bayer Enable** first before using super palette control function.

The super palette control function allows you to select different color areas in the image to set customized hue and saturation values.

### Steps

1. Go to **Super Palette Control**, and enable **Super Palette Enable**.
2. Select **Super Palette Selector**.

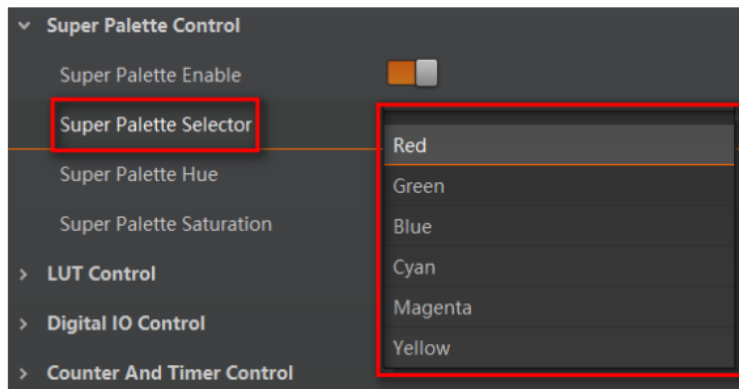


Figure 11-46 Super Palette Selector

3. Set corresponding **Super Palette Hue** and **Super Palette Saturation** according to actual demands.

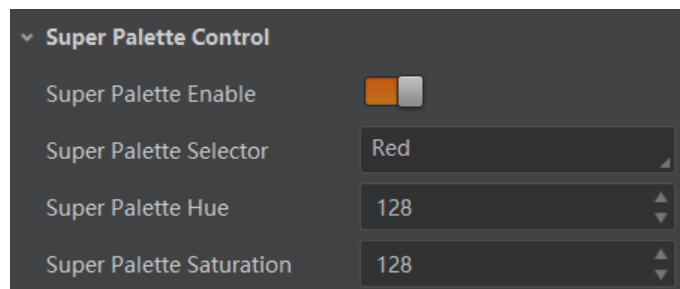


Figure 11-47 Set Super Palette Control

## 11.26 Set LUT

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

### Note

- You cannot use Gamma correction function and LUT function at the same time.
- The parameter of **LUT Save** may differ by device models. If the device has no **LUT Save**, the settings you configured will be saved in the device in real time.
- For different models of device, the **LUT Index** and **LUT Value** range may differ, please refer to the actual one you got.
- Regarding the color device in Bayer pixel format, you need to enable **Super Bayer Enable** first before using LUT function.

### 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.

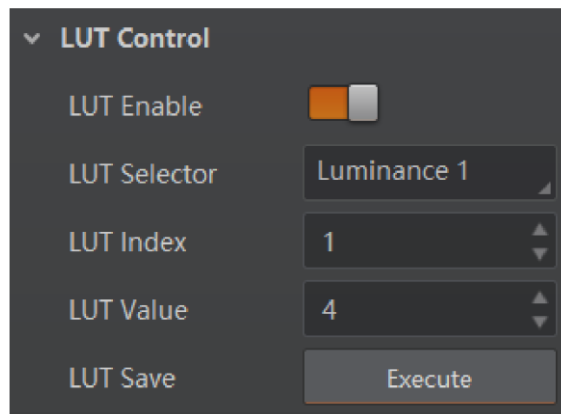


Figure 11-48 Set LUT

## 11.27 Set Shading Correction

### Note

The specific shading correction types that devices support and configuration methods may differ by device models.

---

The device supports shading correction function that improves the image uniformity when you acquire a non-uniformity image due to external conditions. The supported shading correction type includes LSC correction, FPNC correction, and PRNUC correction.

### 11.27.1 LSC Correction

LSC correction stands for Lens Shading Correction that eliminates non-uniform illumination brought by lens.

**Steps:**

1. Go to **Shading Correction**, and select **LSC Correction** as **Shading Selector**.
2. Click **Execute** in **Activate Shading** to let the client software automatically calculate.
3. Enable **LSC Enable**.

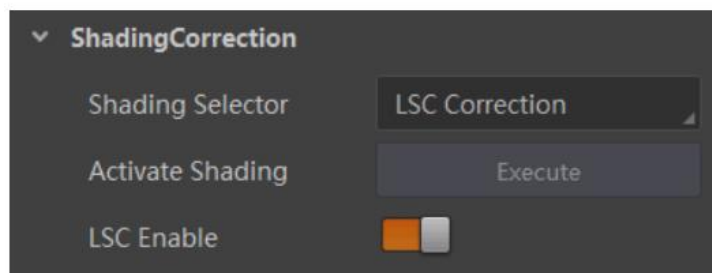


Figure 11-49 LSC Correction

---

**Note**

LSC correction should be executed in full resolution. If you are only interested in a certain region of the image, you can set a Region of Interest (ROI) instead.

---

### 11.27.2 Other Corrections

Other corrections include FPNC correction and PRNUC correction. Go to **Shading Correction**, and enable **NUC Enable**. The **FPNC Enable** and **PRNUC Enable** will be automatically enabled or disabled according to the device's condition.

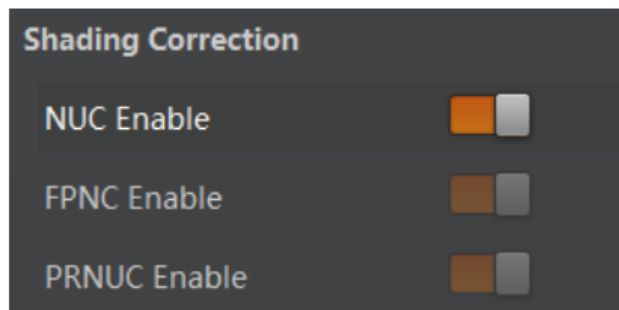


Figure 11-50 Other Corrections

## Chapter 12 Other Functions

### 12.1 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 Parameters of Device Control**

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 Version	Read Only	It is the device version.
Device Firmware Version	Read Only	It is the device firmware version and FPGA version.
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. <ul style="list-style-type: none"> <li>• If User ID is empty, the client software displays the device model.</li> <li>• If you set it, the client software displays the User ID you set.</li> </ul>
Maximum Device Response Time	Read Only	It is the device max. response time. If it has no response after this time, the device is disconnected.
Device Manifest Table Address	Read Only	It is the ID of GenICam XML that the device selects.
Device SBRM Address	Read Only	It is the base address register.

## USB3.0 Area Scan Camera User Manual

Parameter	Read/Write	Description
Device Timestamp	Read Only	It is the device timestamp.
Device Timestamp Latch	Read & Write	Click <b>Execute</b> to get the device timestamp.
Device Timestamp Increment	Read Only	It is the max. value of the device timestamp.
Device Timestamp	Read Only	It is the device timestamp.
Device Protocol Endianness	Read Only	It is the device protocol endianness.
Device Implementation Endianness	Read Only	It is the device operating endianness.
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.
USB Speed Mode	Read Only	It is the speed mode of USB interface, including High Speed (USB2.0) and Super Speed (USB3.0).
Device Connection Status	Read Only	It is the device connection status.
Device Link Throughput Limit Mode	Read & Write	It controls if the <b>Device Link Throughput Limit</b> is active. When disabled, lower level TL specific features are expected to control the throughput. When enabled, <b>Device Link Throughput Limit</b> controls the overall throughput.
Device Link Throughput Limit (Bps)	Read & Write	It limits the maximum bandwidth of the data that will be streamed out by the device on the selected link. If necessary, delays will be uniformly inserted between transport layer packets in order to control the peak bandwidth.
Device Link Current Throughput	Read Only	It is the current transmission bandwidth.
Device Command Timeout	Read Only	If the device has no response after this time, the device is disconnected or command timeout.
Device Sensor Throughput Limit	Read & Write	It controls device flow, and can be set according to actual bandwidth to avoid image lose.

Parameter	Read/Write	Description
Device Command Timeout	Read Only	It is the device max. response time.
Device Stream Channel Count	Read Only	It is the quantity of device stream channel.
Device Reset	Read & Write	Click <b>Execute</b> to reset the device.
Device Temperature Selector	Read & Write	It selects device component temperature.
Device Temperature	Read Only	It displays the temperature of the device component you selected.
Find Me	Read & Write	Click <b>Execute</b> to let red indicator flash once, and find device.
Device Max Throughput (bps)	Read Only	It is the maximum flow of device operation.
Device PJ Number	Read Only	It is the device's project number.
HB Abnormal Monitor	Read Only	It monitors image stream condition.
HB Version	Read Only	It is the version of the image compression mode.

## 12.2 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

The white balance is only available for the color device.

**Table 12-2 Image Embedding Information**

Image Embedding Information	Byte	Data Format
Timestamp	4	Refer to figure 12-1.
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 $\mu$ s.



Image Embedding Information	Byte	Data Format
Brightness Info	4	Ranges from 0 to 4095.
White Balance	8	R/G/B occupies 2 bytes each. Value Range: 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 1 <sup>st</sup> byte is input, and each bit corresponds to 1 input. The 2 <sup>nd</sup> byte is output, 3 <sup>rd</sup> and 4 <sup>th</sup> bytes are reserved.
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.

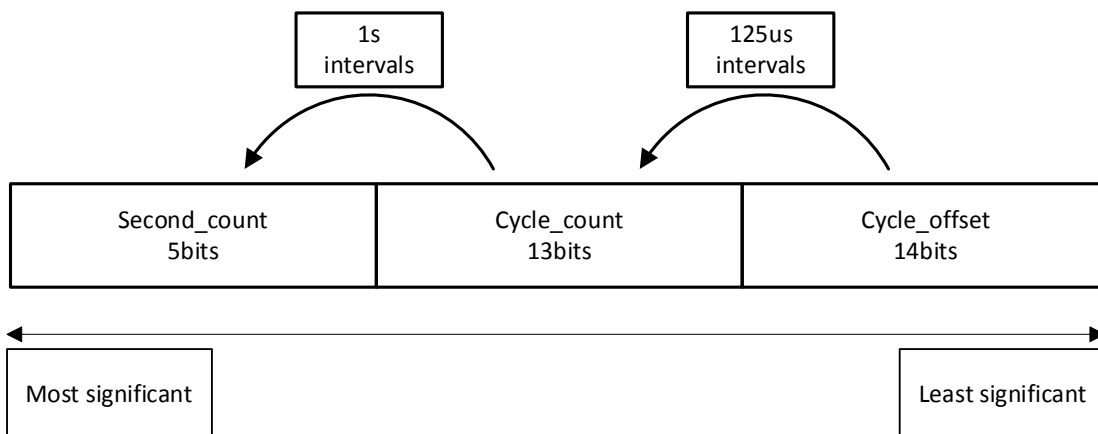
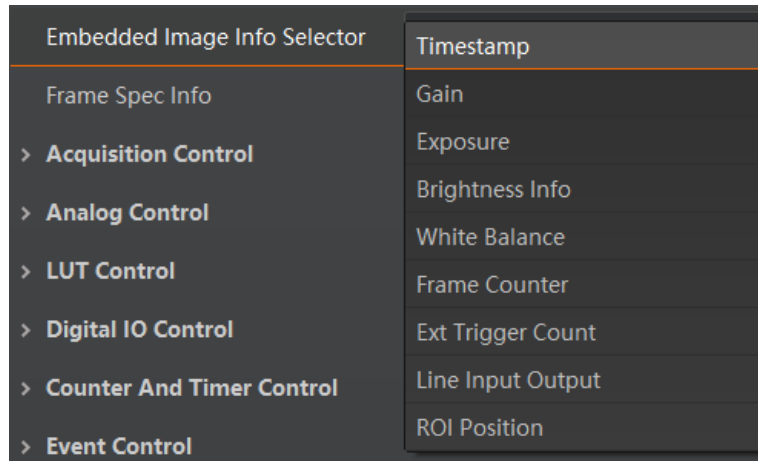


Figure 12-1 Data Format of Timestamp

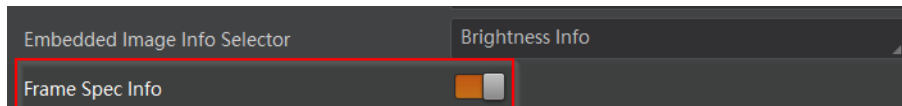
**Steps**

1. Go to **Image Format Control** → **Embedded Image Info Selector**, and select **Embedded Image Info Selector** according to actual demands.




**Figure 12-2 Select Embedded Image Info Selector**

2. Enable **Frame Spec Info** to add watermark into images.



**Figure 12-3 Enable Frame Spec Info**

3. (Optional) Repeat steps above to add multiple watermarks.

4. Click  on the control toolbar of the client software to view specific watermark information.

---

### Note

The watermark is embedded into the starting position of the first line of image data. If the ROI is small and the first line of image data is insufficient to embed information, the information will be embedded into the second line of image data.

---

## 12.3 Event Control

---

### Note

- The event control function may differ by device models or firmware.
  - The specific events may differ by device models.
- 

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.

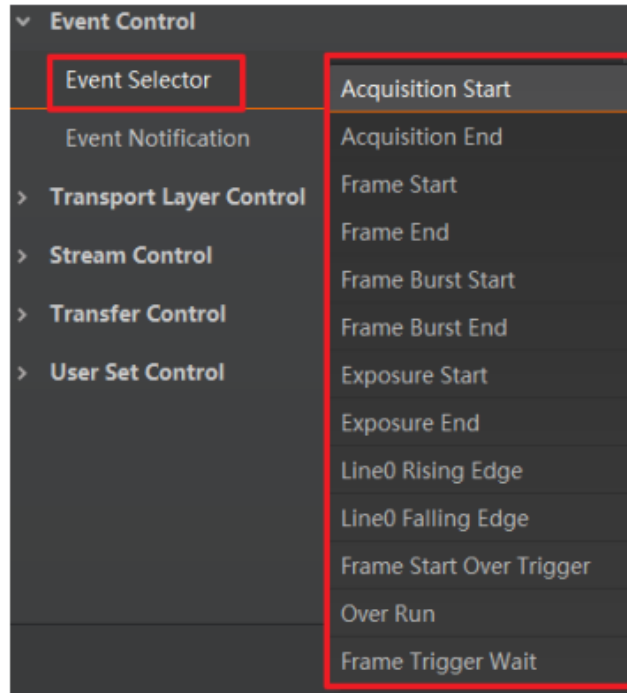


Figure 12-4 Event Selector

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

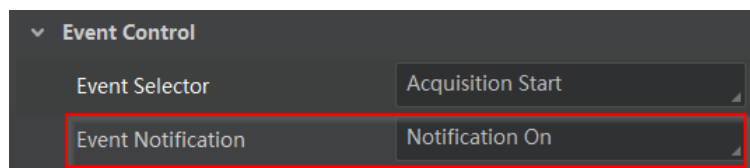


Figure 12-5 Set Event Control

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

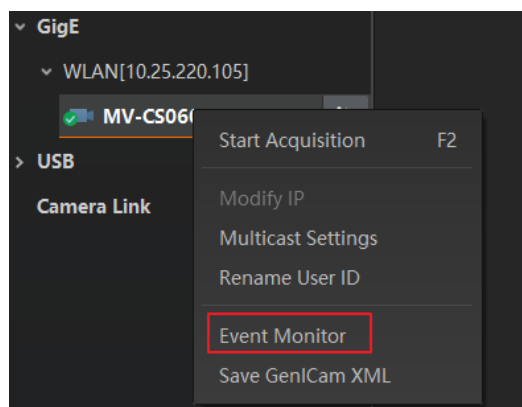
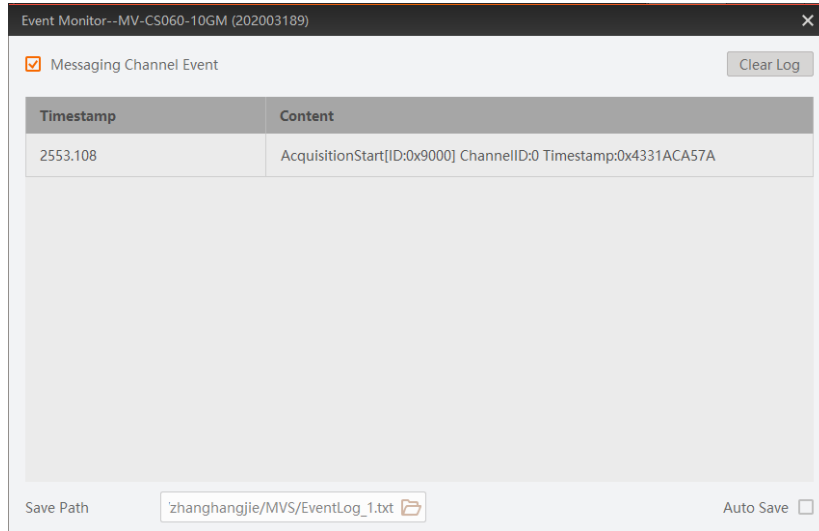


Figure 12-6 Event Monitor

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



**Figure 12-7 Event Monitor Window**

## 12.4 Transport Layer Control

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

---

### Note

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

---

**Table 12-3 Parameters of Transport Layer Control**

Parameter	Read/Write	Description
Paylode Size	Read Only	It is the device's load size.
GenCP Version Major	Read Only	It is the major version in GenCP version.
GenCP Version Minor	Read Only	It is the minor version in GenCP version.
U3V Version Major	Read Only	It is the major version in U3V version.
U3V Version Minor	Read Only	It is the minor version in U3V version.
U3VCP SIRM Available	Read Only	It sets whether the device supports one flow interface at least.
U3VCP EIRM Available	Read Only	It sets whether the device supports one event interface at least.
U3VCP IIDC2 Available	Read Only	It sets whether the device supports IIDC2 register mapping.
U3V Max Command	Read Only	It is the device max. command transmission length.

Parameter	Read/Write	Description
Transfer Length		
U3V Max Acknowledge Transfer Length	Read Only	It is the device max. data transmission length.
U3V Number Of Stream Channels	Read Only	It is the quantity of stream channel.
U3V SIRM Address	Read Only	It is the mapping address of SIRM.
U3V SIRM Length	Read Only	It is the length of each SIRM.
U3V EIRM Address	Read Only	It is the mapping address of EIRM.
U3V EIRM Length	Read Only	It is the length of each EIRM.
U3V Current Speed	Read Only	It is the current USB linking speed.

## 12.5 U3V Protocol Control

You can go to **Stream Control** to view USB transfer size, transfer times, final 1 value and final 2 value.

### Note

The specific parameters of stream control may differ by device models.

**Table 12-4 Parameters of Stream Control**

Parameter	Read/Write	Description
U3V SI Payload Transfer Size	Read Only	It is the batch transmission size of stream data.
U3V SI Payload Transfer Count	Read Only	It is the batch transmission times of stream data.
U3V SI Payload FinalTransfer1 Size	Read Only	It is the Final 1 size of stream data.
U3V SI Payload FinalTransfer2 Size	Read Only	It is the Final 2 size of stream data.

## 12.6 Transfer Control

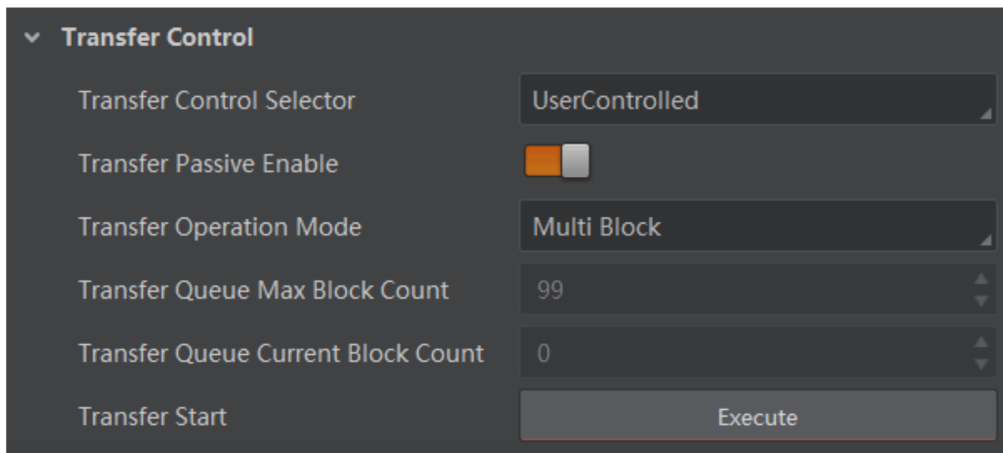
You can go to **Transfer Control** to view the device’s transfer sources, transfer mode, queue information, etc.

 **Note**

The specific parameters of transfer control may differ by device models.


### 12.6.1 User Controlled Transfer Control

The parameters of user controlled transfer control are shown below.



**Figure 12-8 User Controlled Transfer Control**

**Table 12-5 Parameters of User Controlled Transfer Control**

Parameter	Read/Write	Description
Transfer Control Selector	Read & Write	It selects the transfer mode. <ul style="list-style-type: none"> <li>● Basic: In this mode, the device sends images to the client software directly after acquiring images.</li> <li>● User Controlled: In this mode, the device saves images in its internal cache first, and then sends to the client software after acquiring images.</li> </ul>
Transfer Passive Enable	Read & Write	The transfer passive node will be displayed if it is enabled. <p> <b>Note</b></p> <ul style="list-style-type: none"> <li>● You should select <b>User Controlled</b> as <b>Transfer Control Selector</b> first.</li> <li>● Make sure that the device’s <b>Trigger Mode</b> is <b>On</b>.</li> </ul>

Parameter	Read/Write	Description
Transfer Operation Mode	Read & Write	It is the transfer operation mode: <ul style="list-style-type: none"> <li>• Single Block: Click <b>Execute</b> in <b>Transfer Strat</b> to let the device transfer one image each time.</li> <li>• Multi Block: Click <b>Execute</b> in <b>Transfer Strat</b> to let the device transfer multiple images in cache.</li> </ul>
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 Start	Read and write	Click <b>Execute</b> to let the device transfer images.

## 12.6.2 Basic Transfer Control

### Note

The device supporting image compression mode has parameters of basic transfer control.

The parameters of basic transfer control are shown below.

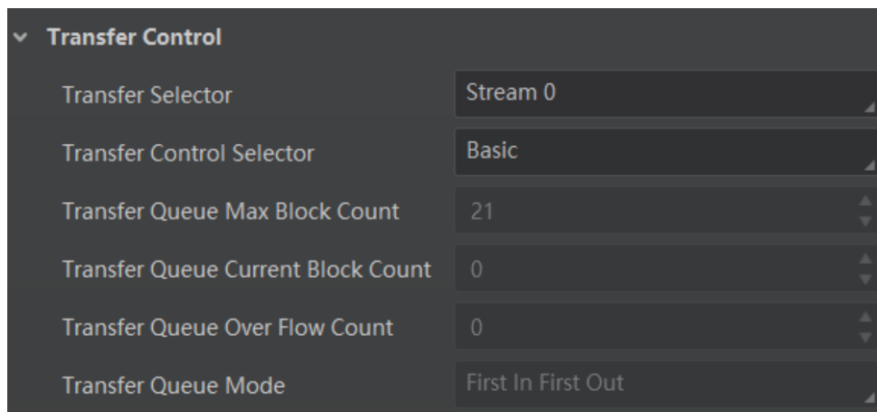


Figure 12-9 Basic Transfer Control

Table 12-6 Parameters of Basic Transfer Control

Parameter	Read/Write	Description
Transfer Selector	Read & Write	It selects the transfer source.
Transfer Control Selector	Read & Write	It selects the transfer mode.
Transfer Queue Max Block Count	Read Only	It displays the max. image quantity that the device's memory can save before the compression.

Parameter	Read/Write	Description
Transfer Queue Current Block Count	Read Only	It displays current image quantity saved by the memory.
Transfer Queue Over Flow Count	Read & Write	It is the image quantity discarded by FPGA.
Transfer Queue Mode	Read & Write	It is the operating mode of memory queue.

## 12.7 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.

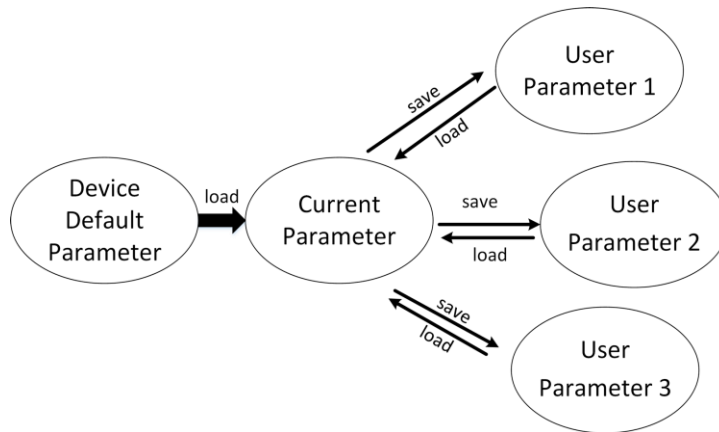


Figure 12-10 Parameter Relation

### Note

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

### 12.7.1 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.
3. View **User Set Save Status**:
  - Saving: User parameters are being saved.



- Ready: User parameters have been saved.

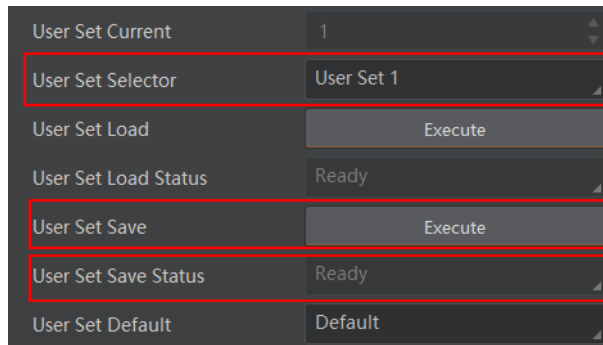


Figure 12-11 Save User Set

## 12.7.2 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.
3. View **User Set Load Status**:
  - Saving: User parameters are being loaded.
  - Ready: User parameters have been loaded.
  - Failed: Saving user parameters failed.

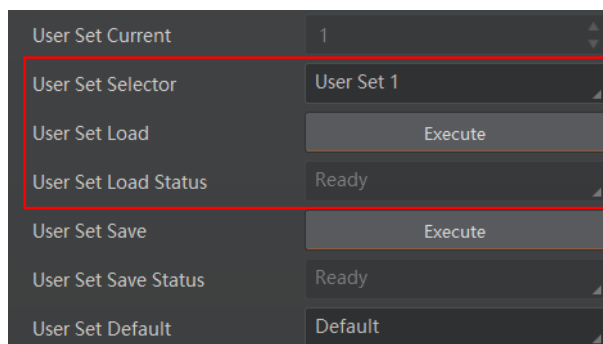


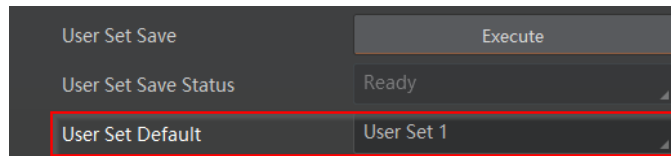
Figure 12-12 Load User Set

### 12.7.3 Set User Default

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

**Note**

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



**Figure 12-13 Set User Default**

## 12.8 Update Firmware

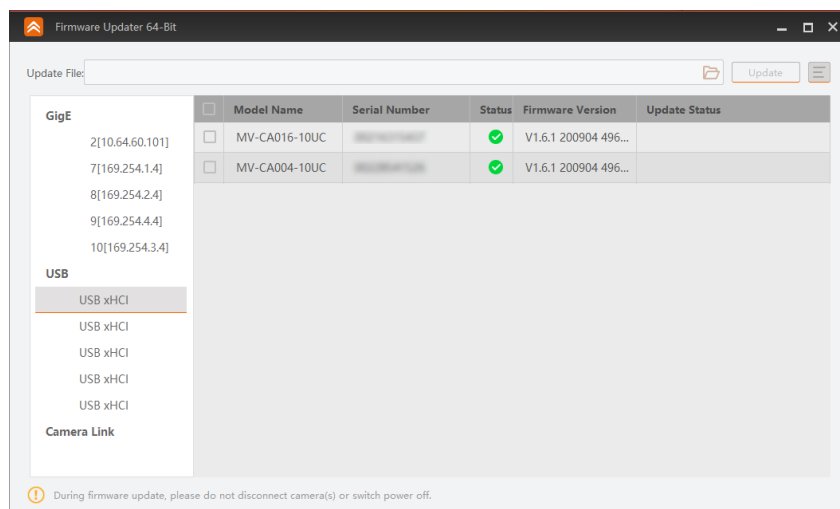
The device supports updating firmware via the MVS client software.

**Note**

- Make sure that the power cable and others are properly connected.
- Use the firmware package of the corresponding device model for updating.

**Steps**

1. Go to **Tool > Firmware Updater** to open the update window.
2. Select corresponding device type like GigE, USB, or Camera Link.
3. Check  to select the device you want to update.
4. Click  to select update files (.dav files) in the local PC.
5. Click **Update** to start updating.



**Figure 12-14 Update Firmware**

### **Note**

- The device will reboot 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?

#### Reason

- The device is not powered on.
- Incorrect USB cable connection.

#### Solution

Check the device's power supply connection by observing the device's indicator, and check USB cable connection.

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

#### Reason

- Incorrect installation of the MVS client software.
- The USB3.0 driver is not installed successfully.

#### Solution

Install the MVS client software or the USB3.0 driver again.

### 13.3 Why the live view is back?

#### Reason

- The device's lens aperture is not removed.
- The device exception occurs.

#### Solution

- Remove the device's lens aperture.
- Power off and restart the device.

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

### **Reason**

- The trigger mode is not enabled or the device is not triggered.
- Incorrect trigger wiring.

### **Solution**

- Enable the trigger mode and make sure that the selected trigger source matches with the corresponding I/O signal.
- Check if the input of trigger signal and wiring are correct or not.

## **13.5 Why the device cannot get images required by the algorithm although live view and trigger signal are normal?**

### **Reason**

Incorrect output format of images.

### **Solution**

Check the image format required by the algorithm, and adjust the output format of images in the client software.

## Appendix A Device Parameter Index

Table Appendix A-1 Device Parameter Index

Attribute	Parameters	Section
Device Control	Device Type	Section Device Control
	Device Scan Type	
	Device Vendor Name	
	Device Model Name	
	Device Manufacturer Info.	
	Device Version	
	Device Firmware Version	
	Device Serial Number	
	Device User ID	
	Maximum Device Response Time	
	Device Manifest Table Address	
	Device SBRM Address	
	Device Timestamp	
	Device Timestamp Latch	
	Device Timestamp Increment	
	Device Timestamp	
	Device Protocol Endianness	
	Device Implementation Endianness	
	Device Uptime (s)	
	Board Device Type	
	USB Speed Mode	
	Device Connection Status	
	Device Link Throughput Limit Mode	
	Device Link Throughput Limit (Bps)	
Device Link Current Throughput		
Device Command Timeout		

Attribute	Parameters	Section
	Device Sensor Throughput Limit	
	Device Command Timeout	
	Device Stream Channel Count	
	Device Reset	
	Device Temperature Selector	
	Device Temperature	
	Find Me	
	Device Max Throughput (bps)	
	Device PJ Number	
	HB Abnormal Monitor	
	HB Version	
Image Format Control	Width Max	Section View Resolution
	Height Max	
	Region Selector	Section Set ROI
	Width	
	Height	
	Offset X	
	Offset Y	
	Reverse X	Section Set Image Reverse
	Reverse Y	
	Pixel Format	Section Set Pixel Format
	Pixel Size	
	ADC Bit Depth	
	Super Bayer Enable	Set Super Bayer
	Image Compression Mode	Section Set Image Compression Mode
	High Bandwidth Mode	
	Test Pattern Generator Selector	Section Set Test Pattern
	Test Pattern	
	Binning Selector	Section Set Binning
Binning Horizontal		

Attribute	Parameters	Section
	Binning Vertical	Section Set Decimation
	Binning Mode	
	Decimation Horizontal	
	Decimation Vertical	
	Embedded Image Info Selector	
	Frame Spec Info	
Acquisition Control	Acquisition Mode	Section Set Acquisition Mode
	Acquisition Start	
	Acquisition Stop	
	Acquisition Burst Frame Count	Section Set Trigger Related Parameters
	Acquisition Frame Rate	Section Set Frame Rate
	Acquisition Frame Rate Control Enable	
	Resulting Frame Rate	
	Overlap Mode	Section Set Overlap Mode
	Trigger Selector	Section Set Trigger Source
	Trigger Mode	
	Trigger Software	
	Trigger Source	
	Trigger Activation	
	Trigger Delay ( $\mu$ s)	
	Trigger Cache Enable	Section Sensor Shutter Mode
	Sensor Shutter Mode	Section Set Exposure Time Mode
	Exposure Time Mode	Section Set Exposure Auto
	Exposure Mode	
	Exposure Time ( $\mu$ s)	
	Exposure Auto	
	Auto Exposure Time Lower Limit ( $\mu$ s)	



Attribute	Parameters	Section
	Auto Exposure Time Upper Limit ( $\mu$ s)	
	HDR Enable	Section Set HDR
	HDR Selector	
	HDR Shutter ( $\mu$ s)	
	HDR Gain	
Analog Control	Preamp Gain	
	Gain (dB)	
	Gain Auto	
	Auto Gain Lower Limit	
	Auto Gain Upper Limit	
	Digital Shift	Section Set Digital Gain
	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	
	Sharpness	Section Set Sharpness
	Sharpness Enable	
	Digital Noise Reduction Mode	Section Set Digital Noise Reduction
	Denoise Strength	
	Noise Correct	
	Contrast Ratio	Section Set Contrast Ratio
	Contrast Ratio Enable	
	Auto Function AOI Selector	Section Set AOI

Attribute	Parameters	Section
	Auto Function AOI Width	
	Auto Function AOI Height	
	Auto Function AOI Offset X	
	Auto Function AOI Offset Y	
	Auto Function AOI Usage Intensity	
	Auto Function AOI Usage White Balance	
Color Transformation Control	Color Transformation Selector	Section Set Color Transformation Control
	Color Transformation Enable	
	Color Transformation Value Selector	
	Color Transformation Value	
	Hue	
	Hue Enable	
	Saturation	
Super Palette Control	Super Palette Enable	Section Set Super Palette Control
	Super Palette Selector	
	Super Palette Hue	
	Super Palette Saturation	
LUT Control	LUT Selector	Section Set LUT
	LUT Enable	
	LUT Index	
	LUT Value	
	LUT Save	
Shading Correction	Shading Selector	Section Set Shading Correction
	Activate Shading	
	NUC Enable	
	FPNC Enable	
	PRNUC Enable	
	LSC Enable	
Digital IO Control	Line Selector	Section Trigger Output

Attribute	Parameters	Section
	Line Mode Line Inverter Line Status Line Status All Line Debouncer Time (μs) Line Source Strobe Enable Strobe Line Duration (μs) Strobe Line Delay (μs) Strobe Line Pre Delay (μs)	
Counter and Timer Control	Counter Selector Counter Event Source Counter Reset Source Counter Reset Counter Value Counter Current Value	Section Set and Execute Counter Trigger
Sequencer Control	Sequencer Mode Sequencer Configuration Mode Sequencer Feature Selector Sequencer Set Total Number Sequencer Set Selector Sequencer Set Load Sequencer Set Save Sequencer Set Active Sequencer Restart	Section Set Sequencer Control and HDR
Event Control	Event Selector Event Notification	Section Event Control
Transport Layer Control	Payload Size GenCP Version Major GenCP Version Minor	Section Transport Layer Control

Attribute	Parameters	Section
	U3V Version Major	
	U3V Version Minor	
	U3VCP SIRM Available	
	U3VCP EIRM Available	
	U3VCP IIDC2 Available	
	U3V Max Command Transfer Length	
	U3V Max Acknowledge Transfer Length	
	U3V Number Of Stream Channels	
	U3V SIRM Address	
	U3V SIRM Length	
	U3V EIRM Address	
	U3V EIRM Length	
	U3V Current Speed	
	Stream Control	
U3V SI Payload Transfer Count		
U3V SI Payload FinalTransfer1 Size		
U3V SI Payload FinalTransfer2 Size		
U3V SI Payload Transfer Size		
Transfer Control	Transfer Control Selector	Section Transfer Control
	Transfer Passive Enable	
	Transfer Operation Mode	
	Transfer Selector	
	Transfer Control Selector	
	Transfer Queue Max Block Count	
	Transfer Queue Current Block Count	
	Transfer Queue Over Flow Count	
Transfer Queue Mode		
User Set Control	User Set Current	Section User Set Customization
	User Set Selector	

Attribute	Parameters	Section
	User Set Load	
	User Set Save	
	User Set Save Status	
	User Set Default	

## Appendix B Revision History

Table Appendix B-1 Revision History

Version	Document No.	Revision Date	Revision Details
V2.3.1	UD31198B	Dec. 5, 2022	<ul style="list-style-type: none"> <li>● Add section Set Super Bayer.</li> <li>● Modify section Set Binning.</li> <li>● Modify section Set Gamma Correction.</li> <li>● Modify section Set Sharpness.</li> <li>● Modify section Set Contrast Ratio.</li> <li>● Modify section Set Super Palette Control.</li> <li>● Modify section Set LUT.</li> </ul>
V2.3.0	UD30198B	Sep. 16, 2022	<ul style="list-style-type: none"> <li>● Modify section Safety Instructions.</li> <li>● Modify section Set Pixel Format.</li> <li>● Add section Set Sequencer Control and HDR.</li> <li>● Modify section Transfer Control.</li> </ul>
V2.2.0	UD28477B	May. 13, 2022	<ul style="list-style-type: none"> <li>● Modify Section Appearance.</li> <li>● Modify Section I/O Connector and Indicator.</li> <li>● Add Section Set Overlap Mode.</li> <li>● Modify Section Enable Strobe Signal.</li> <li>● Modify Section Set Analog Gain.</li> <li>● Add Section Set Contrast Ratio.</li> <li>● Add Section Set Super Platte Control.</li> </ul>
V2.1.0	UD22554B	Jan. 4, 2021	<ul style="list-style-type: none"> <li>● Modify Section Appearance.</li> <li>● Modify Section Enable Strobe Signal.</li> <li>● Add Section Set Image Compression Mode.</li> <li>● Add Section Set Digital Noise Reduction.</li> <li>● Add Section Set Color Adjustment.</li> <li>● Modify Section Device Control.</li> <li>● Add Section Transfer Control.</li> </ul>
V1.6.1	UD21438B	Sep. 21, 2020	<ul style="list-style-type: none"> <li>● Add Section Overview.</li> <li>● Modify Section Appearance.</li> <li>● Modify Section Check Driver.</li> <li>● Add Section Sensor Shutter Mode.</li> <li>● Modify Section Set External Trigger Source.</li> <li>● Add Section Set Anyway Trigger.</li> <li>● Modify Section Enable Strobe Signal.</li> <li>● Modify Section Set Pixel Format.</li> <li>● Modify Section Test Pattern.</li> <li>● Add Section Exposure Time Mode.</li> <li>● Add Section U3V Protocol Control.</li> </ul>
V1.0.0	UD13016B	Jan. 9, 2019	Original version.



See Far, Go Further