iRAYPLE

GigE Area Scan Camera

User Manual

ZHEJIANG HUARAY TECHNOLOGY CO., LTD. V2.0.0

Foreword

Applicable Model

This manual is applicable to all the iRAYPLE GigE area scan camera.

Applicable Scope

This manual is applicable to the engineer and technical personnel of industrial camera.

General

This manual introduces the product information, functions, installation, operations of the GigE area scan camera (hereinafter referred to as the “Camera”). Read carefully before using the camera, and keep the manual safe for future reference.

Required Documents

Please visit our official website to obtain the technical documents of the GigE area scan camera, such as appearance drawing, data sheet, structure drawing, application software, etc.

Safety Instructions

The following categorized signs and words with defined meaning might appear in the Manual.

Table 1-1 Signal word description

Signal Word	Description
 DANGER	Indicates a high potential hazard which, if not avoided, will result in death or serious injury.
 WARNING	Indicates a medium or low potential hazard which, if not avoided, could result in slight or moderate injury.
	Indicates a potential risk which, if not avoided, may result in property damage, data loss, lower performance, or unpredictable result.
	Provides methods to help you solve a problem or save you time.
	Provides additional information as the emphasis and supplement to the text.

Revision History

Table 1-2 Revision History

Version	Revision Content	Release Time
V2.0.0	• Deleted the content of 10GigE; Updated the name of user manual. • Re-adjusted the document frame and added new function descriptions.	Jan. 2025
V1.0.0	First Release	Jul. 2021

Important Safeguards and Warnings

This section introduces content covering the proper handling of the industrial cameras, hazard prevention, and prevention of property damage. Read carefully before using the device, comply with the guidelines when using it, and keep the manual safe for future reference.

Electrical Requirements

- Strictly comply with the local electrical safety code and standards, and check whether the power supply is correct before operating the device.
- When selecting the power adapter, make sure the power supply meets the SELV (Safety Extra Low Voltage) requirements, and rated voltage conforms to the IEC60065, IEC60950-1 or IEC62368-1 standard. The requirements of the power supply are subject to the device label.
- Please ensure that the power adapter is powered off when performing the operations of connecting, disconnecting, wiring, removing, etc. Do not operate those behaviors with power; otherwise, there will be a danger of electric shock.
- An emergency disconnect device must be installed during installation and wiring at a readily accessible location for emergency power cut-off.
- Prevent the line cord from being trampled or pressed, especially the plug, power socket and the junction.
- Unless otherwise specified, do not connect the device to two or more kinds of power supplies, to avoid damage to the device.
- Please be informed of the power supply requirements for the device, and operate the device within the rated range of power input and output.

Storage and Installation

- Do not aim the lens at strong light sources (such as lamplight, and sunlight) when focusing it, to avoid reducing the lifespan of the CMOS sensor, and causing overbrightness.
- When using a laser beam device, avoid exposing the device surface to laser beam radiation; otherwise, it may cause damages to the CMOS sensor.
- Please transport, store and use the device in the proper temperature and humidity range. Do not place the device in a humid, dusty, extremely hot, and cold site that has strong electromagnetic radiation or unstable illumination.
- Pack the camera with packaging materials provided by its manufacturer or materials with the same quality before transporting it. Avoid heavy pressure, severe vibration and immersion during transportation, storage, and installation.
- Do not drip or splash liquid onto the device, and make sure that there is no object filled with liquid on the device to prevent liquid from flowing into it.
- Protect indoor devices from rain and dampness to avoid electric shocks and fires breaking out.
- Do not block the ventilation opening near the device to avoid heat accumulation.
- The device must be installed in a location that only professionals can access, to avoid the risk of non-professionals becoming injured from accessing the area while the device is working. Professionals must have full knowledge of the safeguards and warnings of using the device.

Operation and Maintenance

- Before unpacking, please check whether the packaging is intact, damaged, damp, serious deformation, etc.
- When unpacking, please check whether the equipment and related accessories are missing, inconsistent model, damaged, rusted, water ingress, etc.

- When using the camera, please do not touch the housing and the heat sink devices of the camera to avoid burning.
- When running camera, please do not touch the terminals of the camera and supporting devices to avoid electric shock.
- When running the camera, if there is any abnormal situations, such as smoke or peculiar smell, please cut off the power and contact our after-sales service department as soon as possible.
- Do not clean and maintain the camera when it is powered on.
- Please clean device body with a piece of soft dry cloth. If the dirt is difficult to remove, please use a clean soft cloth with a small amount of neutral detergent to gently wipe it off, and then wipe it dry. Don't use detergent with strong abrasiveness and volatile solvents like ethyl alcohol, benzene, and diluent; otherwise, the coating on the surface of device will be damaged and the performance of the radar will be degraded.
- Do not disassemble or modify the camera by yourself. Do not directly touch the image sensor with your hand. If the camera is not working properly, please contact out aftersales service department for handling the problems. The functional abnormalities or component damage caused by misoperations or not comply with the relevant regulations are not within the scope of the camera quality assurance services.
- Use the accessories suggested by the manufacturer. Installation and maintenance must be performed by qualified professionals.

Table of Contents

Foreword I
Important Safeguards and Warnings III
1 Overview and Precautions 1
1.1 Overview 1
1.2 Features 1
1.3 Networking 1
1.4 Environment Requirements 2
1.5 Avoid EMI and ESD 2
1.6 Heat Dissipation 3
1.6.1 Environment and Device Temperature 3
1.6.2 Internal Heat Dissipation 4
1.6.3 External Heat Dissipation 4
1.7 Device Cleaning 6
1.7.1 Housing Cleaning 6
1.7.2 Filter Cleaning 7
2 Appearance and Interface 8
2.1 Appearance 8
2.2 Interface Definition 13
2.2.1 Network Interface 13
2.2.2 I/O Interface 14
2.3 Indicator Status 17
3 Camera and Client Software 18
3.1 Install Camera 18
3.1.1 Installation Preparation 18
3.1.2 Camera and Accessories Installation 18
3.2 MVSDK Installation and Environment Configurations 19
3.2.1 MVSDK Installation 19
3.2.2 Environment Configuration 22
3.3 Client Operation 25
3.3.1 Device Connection 25
3.3.2 Client Software Layout 27
4 I/O Wiring and Electrical Characteristics 30
4.1 Opto-Isolated Input 30
4.1.1 Opto-Isolated Input Circuit 30
4.1.2 Input Current and Input Voltage 31
4.1.3 Trigger Delay and Input Signal Amplitude 31
4.2 Opto-Isolated Output 32

4.2.1 Opto-Isolated Output Circuit....32
4.2.2 Output Delay and External Current Voltage....33
4.2.3 Output Conducting Voltage Drop and Output Current....34
4.2.4 Opto-isolated Interface as Transistor Output....35
4.3 Configurable GPIO....36
4.3.1 GPIO as Input....36
4.3.2 GPIO as Output....37
4.4 External Wiring....40
4.4.1 Wiring of Opto-Isolated Input....40
4.4.2 Wiring of Opto-Isolated Output....44
4.4.3 Configurable GPIO Wiring....47
5 Shutter and Exposure....49
5.1 Shutter....49
5.1.1 Global Shutter....49
5.1.2 Rolling Shutter....49
5.2 Exposure Mode....51
5.2.1 Non-overlapping Exposure....51
5.2.2 Overlapping Exposure....52
6 Image Acquisition and Data Transmission....53
6.1 Acquisition Mode....53
6.2 Acquisition Start and Frame Start....53
6.2.1 Acquisition Start....53
6.2.2 Frame Start....54
6.2.3 Trigger Parameter Settings....54
6.3 Dual Trigger Mode....57
6.4 Burst Mode....57
6.5 Input Control and Output Control....58
6.5.1 Line Selection and Line Mode....58
6.5.2 Level Inversion and Status Display....58
6.5.3 Output Line Signal Source Setting....59
6.5.4 Strobe Module....62
6.5.5 Fill Light Mode and Time Setting....63
6.5.6 Hardware Line Type and Filtering....65
6.5.7 User Output Selection....66
6.6 Exposure....67
6.7 Resulting Frame Rate....68
6.8 Multi-Frame Average....69
6.9 Lossless Compression....69
6.10 Packet Size....69
6.11 Packet Interval....70

6.12 Frame Transmission Delay....70
7 Pixel Format and Image Processing....72
7.1 Pixel Bit....72
7.2 Pixel Format....72
7.3 Resolution and ROI....74
7.4 Binning....76
7.4.1 Mono Camera....76
7.4.2 Color Camera....77
7.4.3 Binning Mode and Mode Combination....78
7.5 Scaling....79
7.6 Mirroring....80
7.7 Test Image....80
7.8 Gain....82
7.8.1 Total Gain....83
7.8.2 Auto Gain....83
7.8.3 Digital Gain....84
7.8.4 Brightness....84
7.9 Black Level....84
7.10 Light Source Preset....85
7.11 White Balance....86
7.12 Gamma Correction....87
7.13 Sharpness....88
7.14 Denoise....88
7.15 Pseudocolor Elimination....88
7.16 Hue and Saturation....89
7.17 Contrast....90
7.18 FFC....91
7.19 Six-Axis Adjustment....91
7.20 HDR....93
7.21 LUT....93
7.22 Color Conversion Control....94
7.22.1 RGB to YUV....94
7.22.2 CCM....94
8 Auto Functions and Polling Control....96
8.1 Auto Function Control....96
8.2 Parameter Polling....97
8.2.1 Functions Supporting Polling....98
8.2.2 Functional Block Diagram....98
8.2.3 Parameter Polling Application Instruction....99
8.2.4 Cautions....100

9 Event Monitor, Counter and Timer....101
9.1 Event Monitor....101
9.2 Counter and Timer....103
9.2.1 Counter....103
9.2.2 Timer....104
9.2.3 Counter as External Trigger Source....106
10 Device Control and Other Functions....108
10.1 Device Control....108
10.2 Transport Layer Control....109
10.3 User Set....113
10.3.1 Save User-Defined Parameters....113
10.3.2 Load User-Defined Parameters....113
10.3.3 User Set Default....113
10.4 Chunk Data Control....114
10.5 File Open and File Save....114
10.6 Multi-Cast....115
10.7 Firmware Upgrade....117
11 FAQ and Technical Support....119
11.1 FAQ (Frequently Asked Question)....119
11.1.1 MV Viewer Cannot Search the Camera....119
11.1.2 MV Viewer Failed to Connect Cameras....119
11.1.3 Image is Black When Acquiring Images....119
11.1.4 Hardware Trigger Cannot be Performed....120
11.1.5 Image Orientation is Incorrect....120
11.1.6 Network Bandwidth is Only 100 Mbps....120
11.1.7 Camera Lost Connection During Running....120
11.2 Technical Support....121
Appendix 1 Device Parameter Index....122
Appendix 1.1 DeviceControl....122
Appendix 1.2 ImageFormatControl....123
Appendix 1.3 AcquisitionControl....123
Appendix 1.4 AutoFunctionControl....124
Appendix 1.5 DigitalIOControl....125
Appendix 1.6 EventControl....126
Appendix 1.7 LUTControl....126
Appendix 1.8 AnalogControl....127
Appendix 1.9 Transport Layer Control....127
Appendix 1.10 User Set Control....129
Appendix 1.11 ChunkDataControl....129
Appendix 1.12 ColorTransformationControl....130

Appendix 1.13 CounterAndTimerControl..... 130
Appendix 1.14 ISPControl.....130
Appendix 1.15 SequencerFPGAControl.....131
Appendix 2 Legal Information.....133

1 Overview and Precautions

1.1 Overview

GigE area scan camera adopts high-performance photosensitive chip to transmit image data via GigE network in real time. The data transmission capacity conforms to the GigE Vision protocol and GenICam standard which can meet various industrial automation needs, and we have rich experience for providing solutions to global enterprises in various industries, such as electronic semiconductors, consumer electronics, new energy, FPD detection, logistics, etc. The GigE area scan camera is a perfect choice with high stability, high reliability, and high-cost performance. Also, we provide you our self-developed client software MV Viewer to facilitate you using the camera.

1.2 Features

- Global shutter and rolling shutter.
- Powerful ISP algorithm.
- High image quality and high cost-effective.
- The data transmission distance of GigE interface can be up to 100 meters.
- Supports multiple trigger modes, such as software trigger, external trigger and free run.
- Supports multiple image data formats, such as ROI, mirror, etc.
- Supports automatic and manual adjustment of exposure value, gain, black level, etc.
- Supports ISP functions, such as Gamma correction, LUT, etc.
- Supports wide voltage input.
- Conform to the GigE Vision protocol and GenICam standard.
- Some models of camera support the PoE power supply.

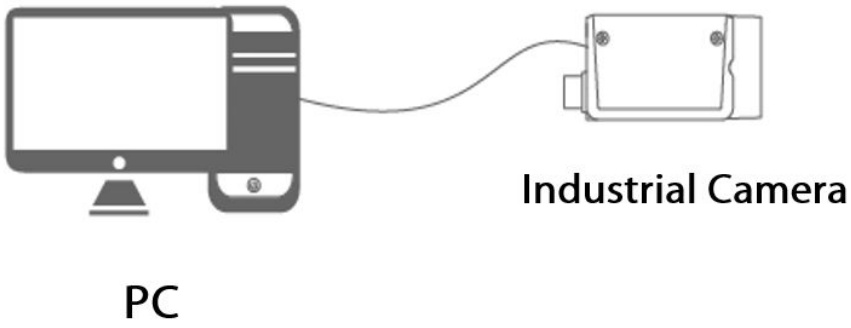
For detailed parameters, see the corresponding technical specifications.

1.3 Networking

The standard networking method of GigE area scan camera is point-connection, which means there is no need to add any network media between host PC and camera.

One host PC can connect multiple cameras through multiple network interfaces or switches.

Figure 1-1 Networking diagram of GigE area scan camera



1.4 Environment Requirements

The GigE area scan camera is an electronic device. Please store it properly and keep it away from the hot, humid, acid, and alkaline materials and environments. If necessary, please perform the isolation and protective measures to avoid corrosion damage to the internal components. The storage requirements related to the temperature and humidity are as follows:

- Storage Temperature: -30°C ~ +80°C (–40 °F ~ +185 °F).
- Storage Humidity: 20% ~ 80%, non-condensing.

DANGER

Do not install it in an environment where water or other liquids can potentially make it wet. Otherwise, it might cause the fire or electric shock. Therefore, install the device indoors and stably, and leave enough space for heat dissipation at four sides of the device.

For detailed parameters, see the corresponding technical specifications.

1.5 Avoid EMI and ESD

In the actual conditions, there might be some equipment generating EMI. The camera will might be influenced by EMI (Electro-Magnetic Interference) and ESD (Electro-static Discharge). Serious EMI and ESD can lead to false triggering or sudden stop of image acquiring. EMI and ESD will also bring instability to image quality, and interfere the reliability of image transmission between camera and PC. In order to avoid the problems mentioned above caused by EMI and ESD, users are recommended to take the following precautions:

- We recommend you use the high-quality shielded cables, and please check the shielding layer is intact. It can play a good effect on shielding EMI and ESD.
- Appropriate cable length is important. If the cable length is longer than expected, please fold the redundant part like number '8' instead of looping it.
- The power cables and data cables should be wired separately and parallel to each other.
- Avoid paralleling the cables with the cables which have high current and voltage inside, such as the cables of stepper motor drive and solenoid valve. Do not place the camera cables close to the interfering devices mentioned above.
- Connect all the grounding (GND) wires to a single point. For example, a distribution board can be used to connect the grounding wires of the whole system to a single point. This is done to

avoid plenty of ground circuits (which are a major cause of EMI problems). For example, a distribution board can be used to connect the grounding wires of the whole system to a single point. Connect all the grounding (GND) wires to a single point. For example, a distribution board can be used to connect the grounding wires of the whole system to a single point. This is done to avoid plenty of ground circuits (which are a major cause of EMI problems).

- Adopt a line filter for the main power supply of the camera, or a separate power supply for the camera is recommended.
- Please keep the camera and corresponding cable away from the device generating sparks, such as brushed motors, relays, etc. A metal shielding shell is recommended if necessary.
- The humidity in the installation environment shall be properly controlled. Dry air is easy to produce ESD.
- The unused terminals in the camera cable need to be insulated and wrapped, and cannot be exposed and suspended.

1.6 Heat Dissipation

When the temperature of camera exceeds the reasonable range, it will affect the photosensitive element inside the camera and the image quality. Therefore, this section introduces working temperature range of camera and installation requirements to help achieve better heat dissipation effect and improve the image quality.

1.6.1 Environment and Device Temperature

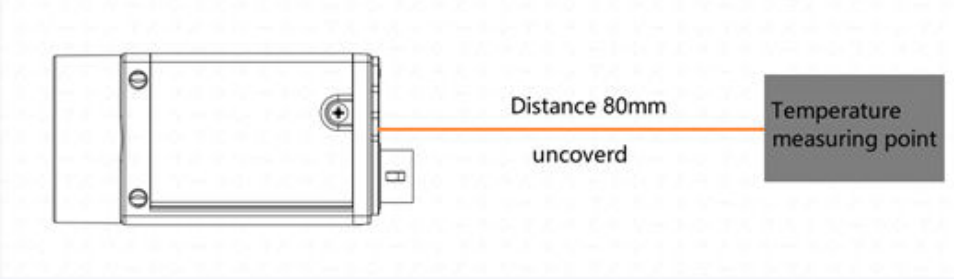
1.6.1.1 Environment Temperature

The environment temperature means that the allowed maximum environment temperature which can meet the normal operating requirement of camera without any additional measures and devices to improve the heat dissipation efficiency. The camera can run normally and stably in this environment temperature, and it should meet the heat dissipation requirement of all electronic components inside the camera.

1.6.1.2 Temperature Measurement Requirements

The measurement point and camera should be in the same environment. The environment temperature should be uniform. There is no any object between the measurement point and the camera. The measurement point is 80mm away from the enclosure of the camera. The temperature measurement result after complying with the above requirements is the camera working temperature. The diagram of temperature measurement point is as follows.

Figure 1-2 Diagram of temperature measurement poin



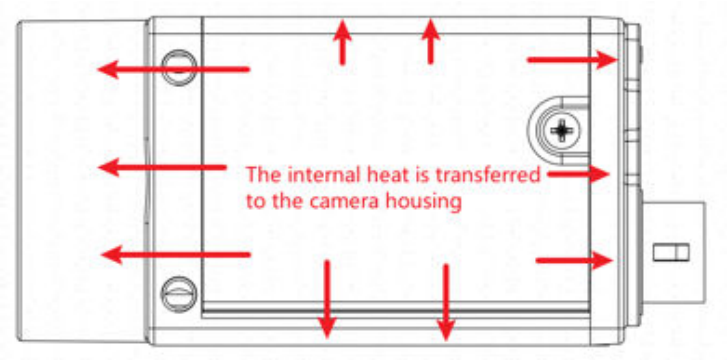
1.6.1.3 Enclosure Temperature

The enclosure temperature indicates the temperature of enclosure surface of camera, which is conducted from the internal electronic components. This is a normal manifestation of the normal operation of the camera conducting the internal temperature to the enclosure surface.

1.6.2 Internal Heat Dissipation

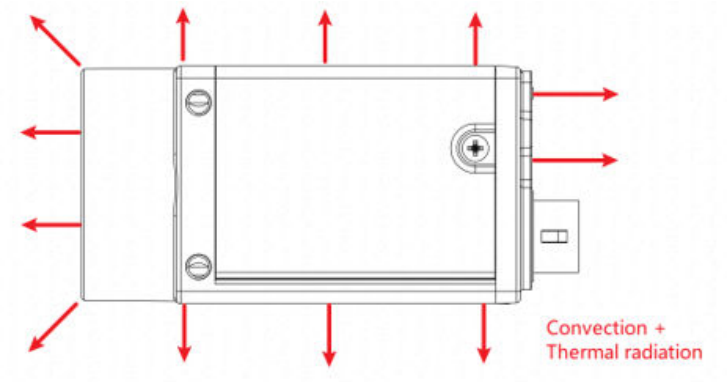
To guarantee the normal operating of the internal components of camera, our internal heat dissipation design of camera meets every environment temperature requirement of internal components in the technical specifications to give you the best performance. The internal electronic components conduct the heat to the enclosure by heat dissipation materials. The diagram of heat dissipation of camera is as follows.

Figure 1-3 Diagram of heat dissipation of camera



The heats are dissipated from camera enclosure to the environment through the convection and thermal radiation when there are no any auxiliary heat dissipation measures, or the cameras are working in the environment without external heat dissipation devices. In this case, the enclosure temperature of camera will gradually increase until the temperature reaches the state of thermal equilibrium. The diagram of convection and thermal radiation of camera enclosure is as follows.

Figure 1-4 Diagram of convection and thermal radiation of camera enclosure



1.6.3 External Heat Dissipation

1.6.3.1 Assembling Set Heat Dissipation

In most cases, we recommend you use the mounting block and screws to fix the camera with the platform.

In this way, the most heat generated by camera will be conducted to the mounting block and mounting platform.

Figure 1-5 Heat dissipation path of mounting platform

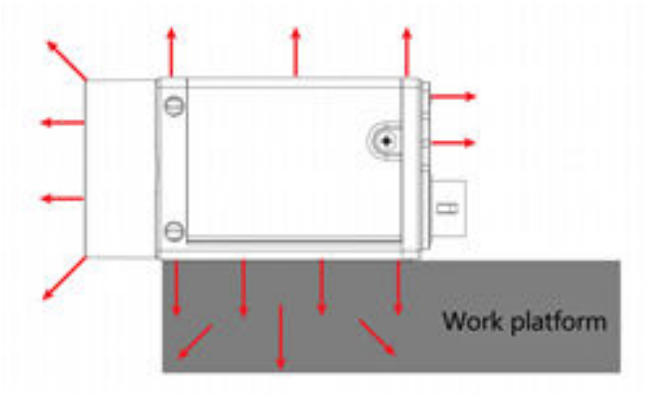
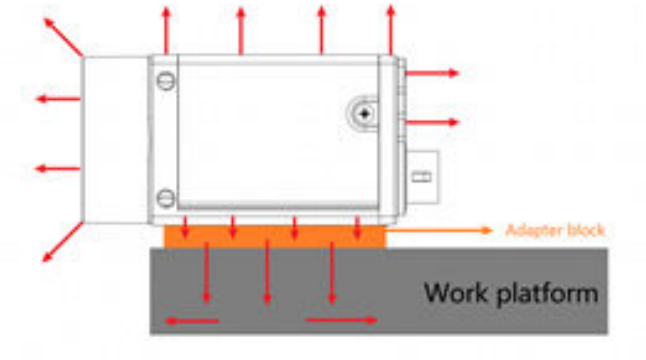


Figure 1-6 Heat dissipation path of mounting block



1.6.3.2 Factors Influencing Camera Heat Dissipation

Material

The mounting platform and adapter installed with camera shall adopt high thermal conductivity, such as copper, aluminum, stainless steel, or other metal materials. Compared with the materials with low thermal conductivity, such as plastic, rubber etc., the heat dissipation efficiency of metal materials is much higher.

Contact Area

The contact area between the camera and the mounting adapter and platform should be as large as possible. The flatness of the installation part should be within 0.1 mm, in case the actual contact surface is not completely close, affecting the heat dissipation effect.

Heat Dissipation Path

The heat dissipation path of the installation part should be as short as possible. Avoid installing on the sheet metal with multiple bending or on the external structures with multiple adapters. The situations shown in the diagrams below will affect the heat dissipation effect of camera.

Figure 1-7 Installation Diagram 1

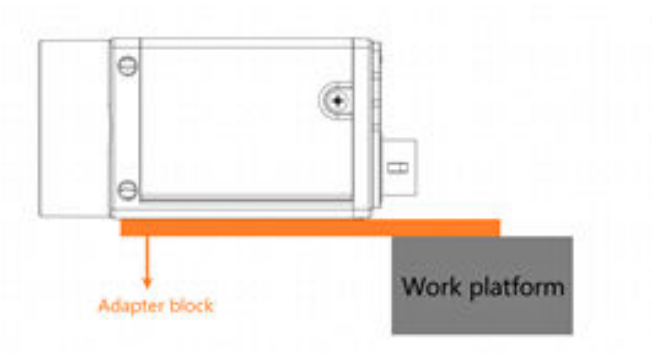
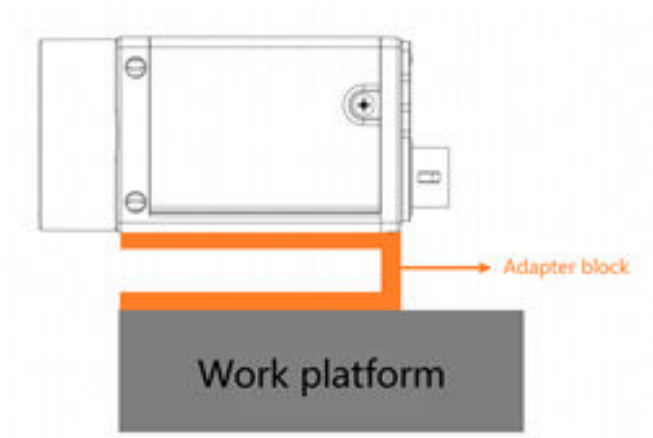


Figure 1-8 Installation Diagram 2



1.6.3.3 Auxiliary Heat Dissipation

If the mounting block or mounting platform is low-thermal conductivity,

- Using external fans to increase the air flow to lower the environment temperature around the cameras.
- Using air conditioners to lower the environment temperature around the cameras to increase the heat dissipation efficiency.

1.7 Device Cleaning

1.7.1 Housing Cleaning

Please perform the housing cleaning in an enclosed room. If you need to remove the lens, please keep the lens facing down and unscrew the lens manually, and then immediately install the original lens cover or anti-dust cover on the camera. Please follow the requirements in the below:

- Please make sure the power of the camera is disconnected.

- Do not use any solvents or diluent that will corrode the housing of the camera. The clean water or other neutral and mild solvents are recommended.
- Use the soft and dry cleaning cloth, such as cotton cloth, that will not cause static electricity when cleaning.
- Soak the cleaning cloth with the clean water or neutral solvent, wring it out moderately, wipe the stains on the camera, and finally use the dry and clean cloth to wipe it again.
- Do not power the camera when the shell of the camera is still wet.
- Do not use the compressed air to blow the camera, it can potentially contaminate the optical components.
- Please do not remove the cover on the lens when you store the camera, and place the camera with the lens side down.

1.7.2 Filter Cleaning

Avoid cleaning the filter of camera by principle. If there are stains on the filter, such as dust, we recommend you use the dust-removing stick to clean the filter. Please follow the procedures below to clean the filter:

Procedure

Step 1 Please make sure the power of the camera is disconnected.

Step 2 Take a clean dust-removing stick, and don't touch the sticky side at the top of the dust-removing stick with your finger.

Step 3 Tilt the dust-removing stick about 45° and lightly tap the surface of filter to clean the stains.

Step 4 Rotate the dust-removing stick and repeatedly clean the stains. The dust-removing stick shall be discarded after being used 10 times.

Step 5 If there are still stains on the filter, please repeat the Step 1 ~ Step 4 until the filter is clean.

Do not disassemble the industrial camera to clean the surface of the sensor. If you cannot clean the filter by yourself or there are stubborn stains, please contact us.

2 Appearance and Interface

2.1 Appearance

The appearance of camera is vary depending on the device model. You can check the specifications in the table below and click the diagram location described in the table to jump to the corresponding diagram.

Table 2-1 Camera specification description

No.	Series	Dimension	Interface	Type	Location
1	A Series	29mm *29mm *42mm	GigE	Area Scan Camera	Figure 2-1
2	A Series	29mm *29mm *29mm			Figure 2-2
3	A Series	29mm *29mm *42mm (fixed holes on four sides)			Figure 2-3
4	AH&010	29mm *29mm *42mm (fixed holes on four sides)			Figure 2-4
5	AE&010	29mm *29mm *42mm			Figure 2-5
6	AH&000	29mm *29mm *42mm (fixed holes on four sides)			Figure 2-6
7	AE&000	29mm *29mm *42mm			Figure 2-7
8	A Series	29mm *44mm *58mm			Figure 2-8
9	-	72mm *72mm	GigE with M58 Mount		Figure 2-9
10	-	72mm *72mm	GigE with F Mount		Figure 2-10
11	-	Vertical Board-Level	GigE	Industrial-grade Camera	Figure 2-11
12	-	Side-Mounted Board-Level			Figure 2-12

If you want to acknowledge the detailed dimensions of GigE area scan cameras, please refer to the technical specifications.

Figure 2-1 A series GigE area scan camera (29mm*29mm*42mm)

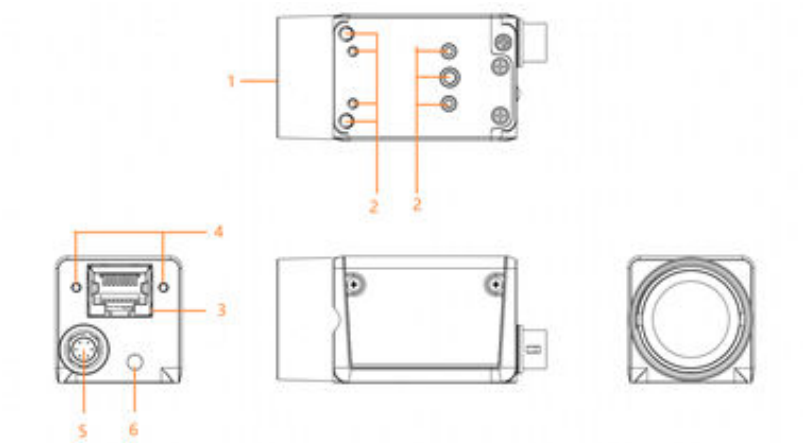


Figure 2-2 A series GigE area scan camera (29mm*29mm*29mm)

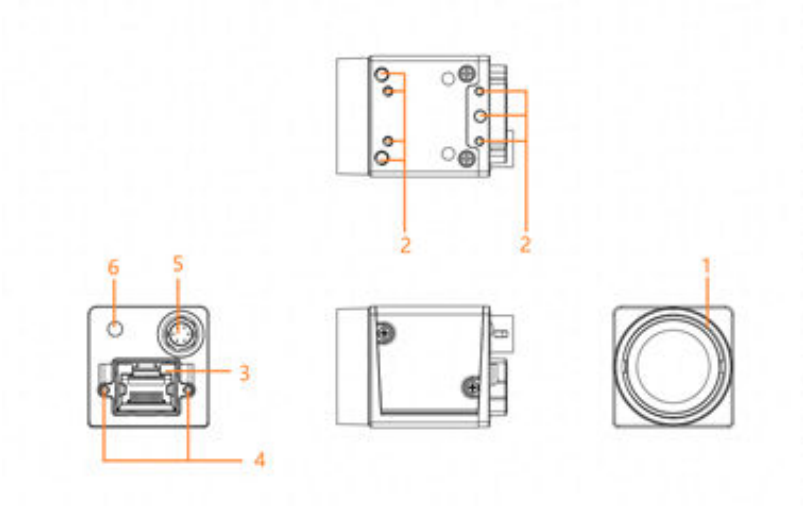


Figure 2-3 A series GigE area scan camera (29mm*29mm*42mm, fixed holes on four sides)

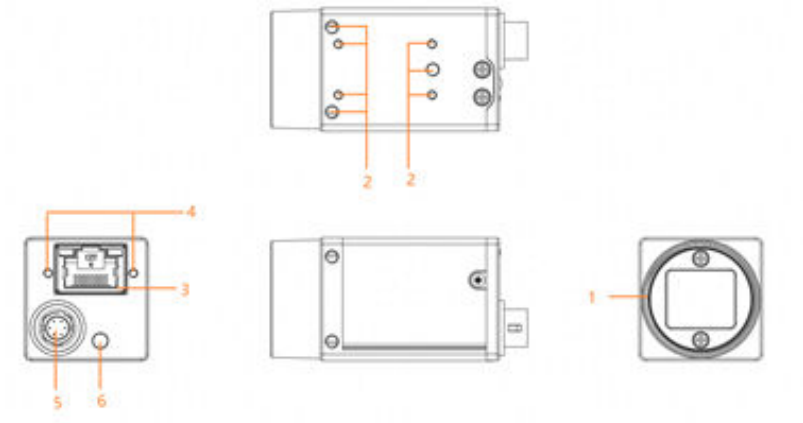


Figure 2-4 AH&010 series GigE area scan camera (29mm*29mm*42mm, fixed holes on four sides)

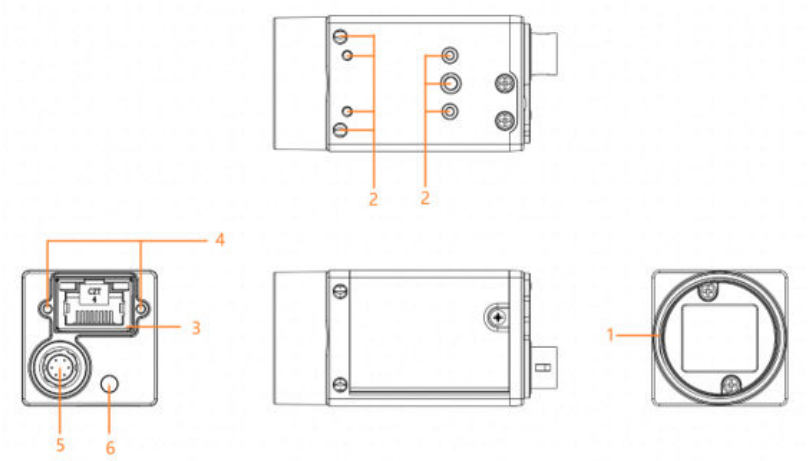


Figure 2-5 AE&010 series GigE area scan camera (29mm*29mm*42mm)

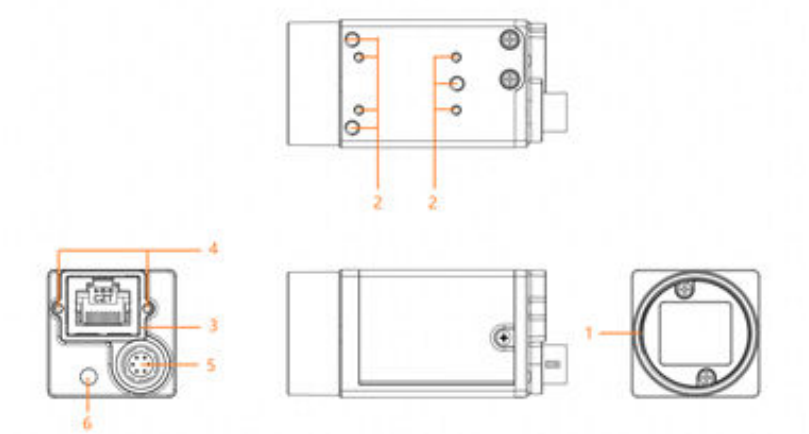


Figure 2-6 AH&000 series GigE area scan camera (29mm*29mm*42mm, fixed holes on four sides)

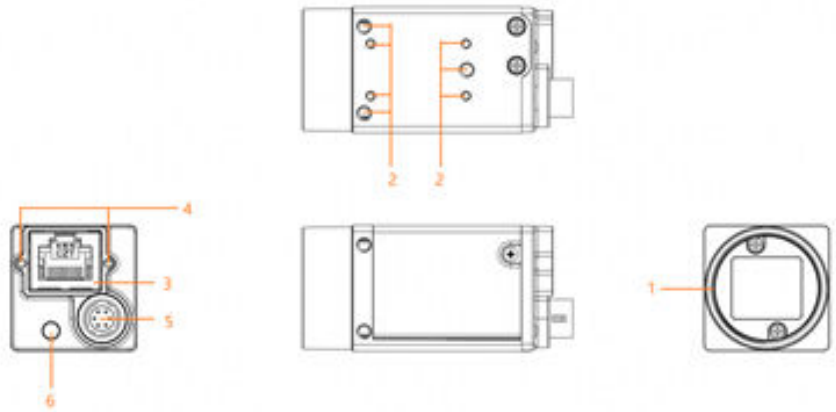


Figure 2-7 AE&000 series GigE area scan camera (29mm*29mm*42mm)

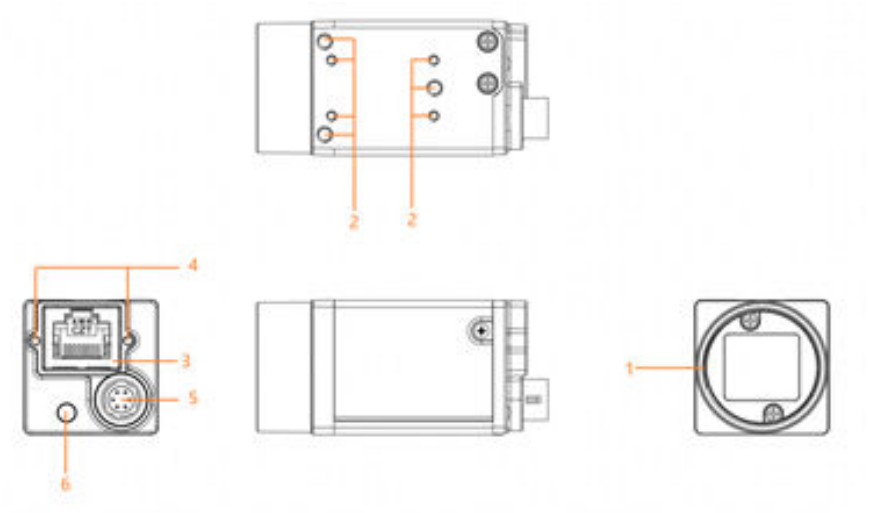


Figure 2-8 A series GigE area scan camera (29mm*44mm*58mm)

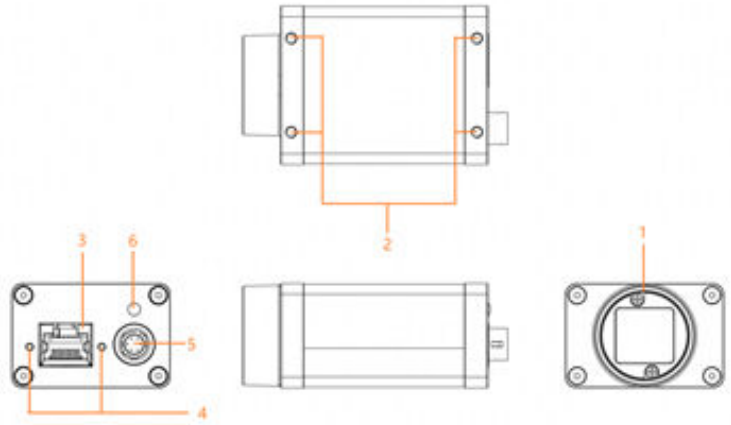


Figure 2-9 M58-mount GigE area scan camera (72mm*72mm)

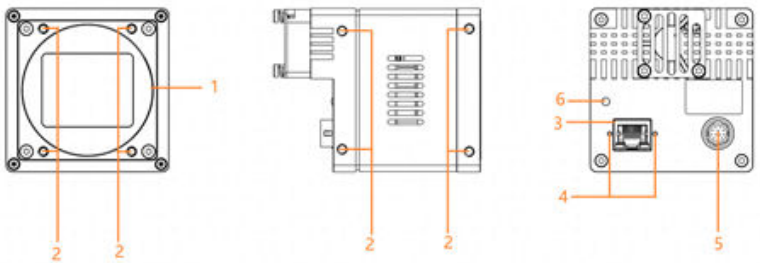


Figure 2-10 F-mount GigE area scan camera (72mm*72mm)

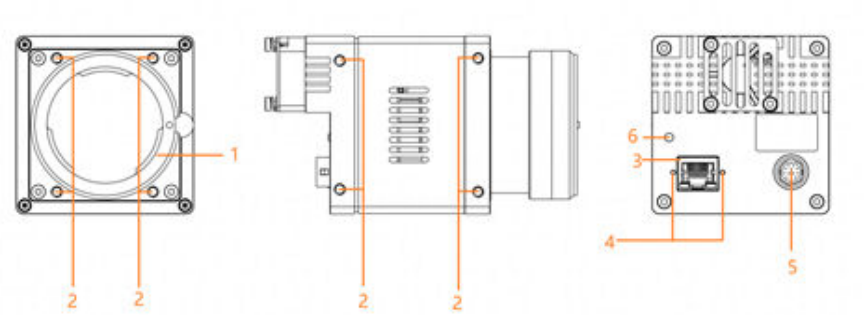


Figure 2-11 GigE board-level camera (Vertical)

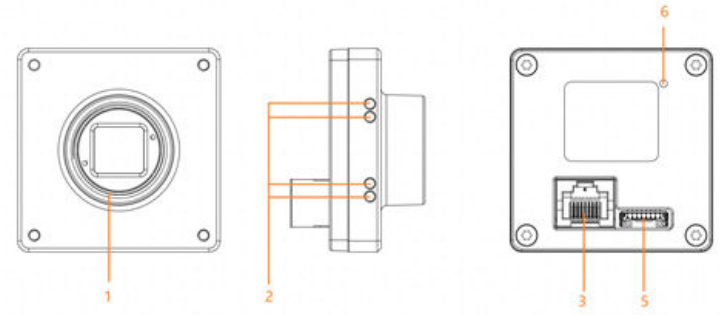
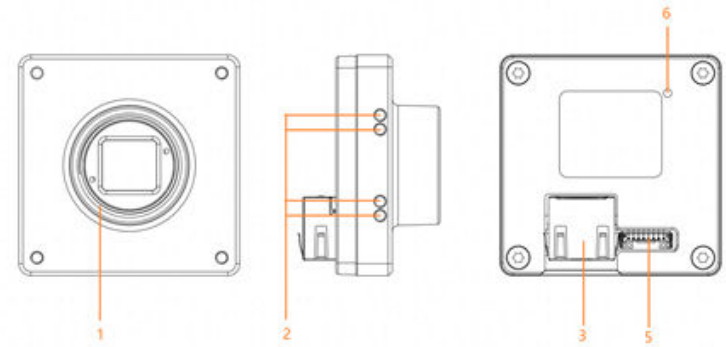


Figure 2-12 GigE board-level camera (Side-mounted)



The appearance descriptions of GigE area scan camera is as follows.

Table 2-2 Appearance description of GigE area scan camera

No.	Interface	Description
1	Lens Mount	For mounting the lenses. If you want to acknowledge the detailed specifications of lenses, please refer to the technical specifications.
2	Mounting Screw Holes	For mounting and fixing the camera. The screw holes are distributed on the four sides of camera, and the screw specifications involved include M2, M3 and M4. If you want to acknowledge the detailed specifications of screws, please refer to the technical specifications.

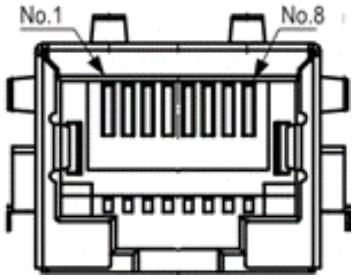
No.	Interface	Description
3	GigE Interface	For transmitting data.
4	Network Cable Screw Holes	The M2 fastening screw holes are for fixing the network cable which connects to the camera to avoid the image acquisition abnormalities caused by interface loosening.
5	Power Supply and I/O Interface	To supply power, I/O connection, serial port, etc. The interface is divided into 6-core, 12-core, and 8-core. The detailed descriptions of interface definitions, please refer to the **2.2 Interface Definition**.
6	Indicator Light	To indicate the running status of camera. The detailed descriptions of indicator lights, please refer to the **2.3 Indicator Status**.

2.2 Interface Definition

2.2.1 Network Interface

GigE area scan camera adopts standard RJ-45 network interface to connect the network cable. The pins diagram of RJ-45 cable is as follows. Please pay attention to the network interface orientation of camera. The orientation of it may vary depending on the camera models.

Figure 2-13 RJ-45 network pins diagram



Signal definitions of RJ-45 are described in the table below.

Table 2-3 Signal definitions of RJ-45 description

Pin No.	Direction	Description
1	Bidirectional	MX1+ (DA+)
2	Bidirectional	MX1- (DA-)
3	Bidirectional	MX2+ (DB+)
4	Bidirectional	MX3+ (DC+)
5	Bidirectional	MX3- (DC-)
6	Bidirectional	MX2- (DB-)
7	Bidirectional	MX4+ (DD+)
8	Bidirectional	MX4- (DD-)

Do not use the electric screwdriver, please manually fasten the fixing screws on the RJ-45 connector. Do not fasten the screws too tightly to avoid damaging the network connector. The torque should not exceed 0.15 Nm.

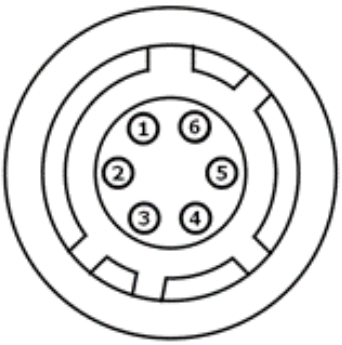
We recommend you use CAT 5e or CAT 6 cables with shielding function to maintain a high transmission rate.

2.2.2 I/O Interface

2.2.2.1 6-Core Connector

You shall use 6-core cable to connect the external I/O and power supply. We recommend you use the Hirose HR10A-7R-6PB or other cables with same quality. The line sequence diagram of the 6-core I/O cable is as follows.

Figure 2-14 Line sequence diagram of the 6-core I/O cable



The signal definitions of 6-core I/O cable are described in the table below.

Table 2-4 6-Core I/O interface signal definition

Pin No.	Color	Name	Description
1	Blue	-	+9 VDC~+24 VDC. For supplying the power to the camera.
2	Red	Line1	Opto-Isolated Input
3	Gray	Line2	GPIO (non-isolated software can configure the input and output)
4	Black	Line0	Opto-isolated output
5	Green	OPT_GND	Opto-isolated ground
6	Brown	-	DC power ground of camera and signal ground of GPIO.

For PoE-powered cameras, when both PoE and external adapter are powering the camera at the same time, the camera will preferentially use the adapter power.

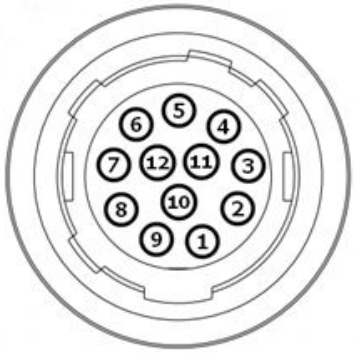
⚠

We recommend you use Hirose HR10A-7P-6S connector or connector with same specifications and quality. Using an improper connector may cause damages to the interface of camera.

2.2.2.2 12-Core Connector

You shall use 12-core cable to connect the external I/O and power supply. The recommend connector model on camera is HR10A-10R-12PB or other connectors with same quality. The line sequence diagram of the 12-core I/O interface is as follows.

Figure 2-15 Diagram of line sequence of 12-core I/O interface



The signal definitions of 12-core I/O interface are described in the table below.

Table 2-5 12-Core I/O interface signal definition

Pin	Color	Name	Description
1	Black	-	Power ground of camera and signal ground of RS-232.
2	Red	-	+14 VDC~+24 VDC. The power of camera.
3	Blue-white	RXD_RS-232	For receiving data by serial port
4	Green-White	TXD_RS-232	For sending data by serial port
5	Gray	Line3	Opto-Isolated Input
6	White	Line4	Opto-Isolated Input
7	Brown	Line5	Opto-Isolated Input
8	Orange	OPT_IN_GND	Opto-isolated input ground. Do not connect it with power ground.
9	Blue	Line0	Opto-Isolated Input
10	Green	Line1	Opto-Isolated Input
11	Purple	Line2	Opto-Isolated Input
12	Yellow	OPT_OUT_GND	Opto-isolated output ground. Do not connect it with the power ground.

The color definitions of power I/O cable is only suitable for auxiliary cables of iRAYPLE camera.

The recommend connector model of cable is HR10A-10P-12S or other connectors with same quality. Using the improper connector may cause damages to the interface of camera.

The diagram and detailed procedures of plugging and unplugging the 12-core cable are as follows.

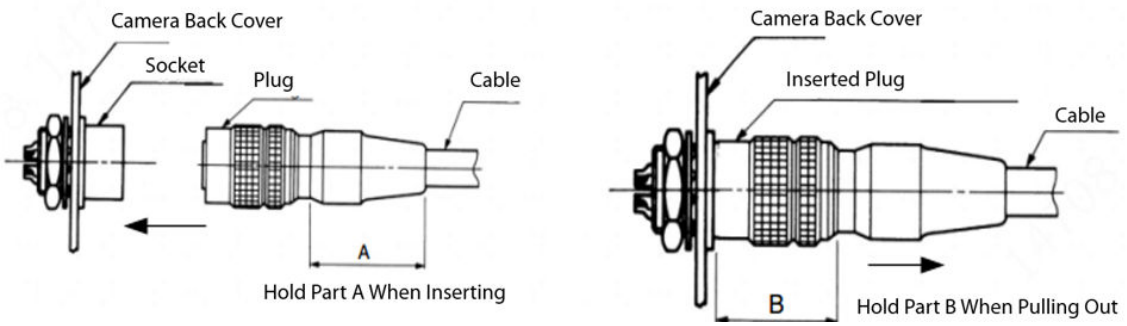
Procedure

Step 1 Before plugging the cable, please align guide groove of the connector, then pinch the black rubber part of connector (A) to insert it vertically. When you hear a 'click' sound, it means the plug is inserted in place.

Step 2 If you need to unplug the connector, pinch the metal part of connector (B) to pull it out vertically and firmly.

Step 3 Turn off the power before plugging or unplugging the connector to avoid damaging the device and cable.

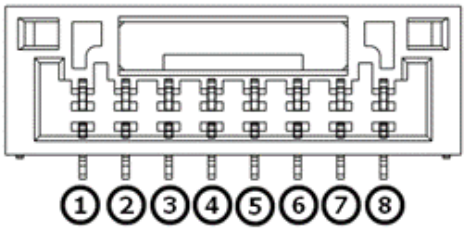
Figure 2-16 Diagram of plugging and unplugging the 12-core cable



2.2.2.3 8-Core Connector

The board-level camera adopts the 8-core vertical connector with 1.25mm spacing to connect the external I/O and power supply. The line sequence diagram of the 8-core I/O interface of camera is as follows.

Figure 2-17 Line sequence diagram of the 8-core I/O interface



The signal definitions of 8-core I/O interface are described in the table below.

Table 2-6 8-Core I/O interface signal definition

Pin No.	Direction	Name	Description
1	-	-	+9 VDC~+24 VDC. The power of camera.

Pin No.	Direction	Name	Description
2	-	-	Power ground and signal ground of GPIO.
3	I/O	Direct_IO	GPIO (non-isolated software can configure the I/O)
4	0	Line0	Opto-isolated output
5	I	Line1	Opto-Isolated Input
6	-	OPT_GND	Optocoupler isolated ground
7	I	GPIO_IN	Reserved for the GPIO input.
8	0	GPIO_OUT	Reserved for the GPIO output.

Please hang the pins or connect them to the ground when the pins are not used. Do not connect to the power supply to avoid damaging the camera.

2.3 Indicator Status

The indicator status description of the GigE area scan camera is as follows.

Table 2-7 Indicator status description

Status	Indicator Status		Description
Normal	Red	Fast Flashing Red	The device is starting.
	Blue	Low Solid Blue	The address has been allocated, and the application software API is not connected to the device.
		High Solid Red and Blue	The application software API is connected to the device, free-run mode, no image transmission.
		Fast Flashing Blue	The application software API is connected to the device, free-run mode, image transmission is detected.
		Slow Flashing Blue	Trigger mode.
	Red⇄Blue	Flashing Red and Blue	Firmware upgrading.
Abnormal	Red	Solid Red	The device is abnormal, such as no bit stream, firmware upgrade failure.
		Slow Flashing Red	Network disconnection

3 Camera and Client Software

3.1 Install Camera

3.1.1 Installation Preparation

Before installation, please prepare the products described in the list.

Table 3-1 Device and accessories description

No.	Name	Quantity	Description
1	GigE Area Scan Camera	1	The camera which you purchased.
2	I/O Power Cable	1	I/O power cable needs to be purchased separately according to the technical specifications. The common I/O power cables include 6-core, 12-core and 8-core (only for the board-level camera).
3	DC Switched-Mode Power Supply/Adapter	1	DC switched-mode power supply/adapter needs to be purchased separately according to the technical specifications. The common power supply or adapter includes 12V-1A, 24V-2.5A, etc.
4	GigE Cable	1	GigE cable needs to be purchased separately. We recommend you use the CAT 5e or CAT 6 GigE network cable.
5	Lens	1	Lens needs to be purchased separately according to the technical specifications. If the lens does not match the camera, the adapter ring is also required.
6	Lens Adapter Ring	1	The adapter ring needs to be purchased separately. The common adapter ring models include M58 to F, M58 to C, etc.

- The quantity of the accessories mentioned in the table is only for one camera.
- The recommended accessories mentioned in the table is a standard list. You can select or omit the accessories based on your needs.

3.1.2 Camera and Accessories Installation

Please follow the procedures below to install your camera and accessories.

Procedure

Step 1 Remove the original lens cover or anti-dust cover on camera, and select a suitable lens to install it on the camera. If the lens interface does not match the camera's, you can install an lens adapter ring between them.

Step 2 After installing the lens, fix the camera on the installation position. The installation position shall be ventilated, and the additional heat dissipation components or fans are recommended to use to improve the heat dissipation efficiency.

Step 3 Connect the Gigabit network cable to the camera and the network card of PC, or to the switch and then connect it to the network card of the PC.

Step 4 Connect the I/O power cable to the power supply interface, DC switch power supply and other external devices. Some devices support the PoE power supply. If you adopt the PoE to power the device, the DC switch power supply can be omitted.

You can refer to the technical specifications to check whether your device supports PoE power supply function.

3.2 MVSDK Installation and Environment Configurations

3.2.1 MVSDK Installation

In order to facilitate users to use our cameras, we provide the client software MV Viewer. This section takes the operation system of the 64-bit Windows 10 as an example to introduce how to install the MV Viewer.

The operation system requirements are as follows.

- Windows 7/10/11 32/64-bit
- Linux 32/64-bit
- MacOS Arm 64-bit (Sequoia 15.x or above)
- Android 4.4 ~ Android 9.0

- Please visit our official website to obtain the latest installation package of MV Viewer.
- Download Path: **Support** > **Download Center** > **Machine Vision** > **Software**.

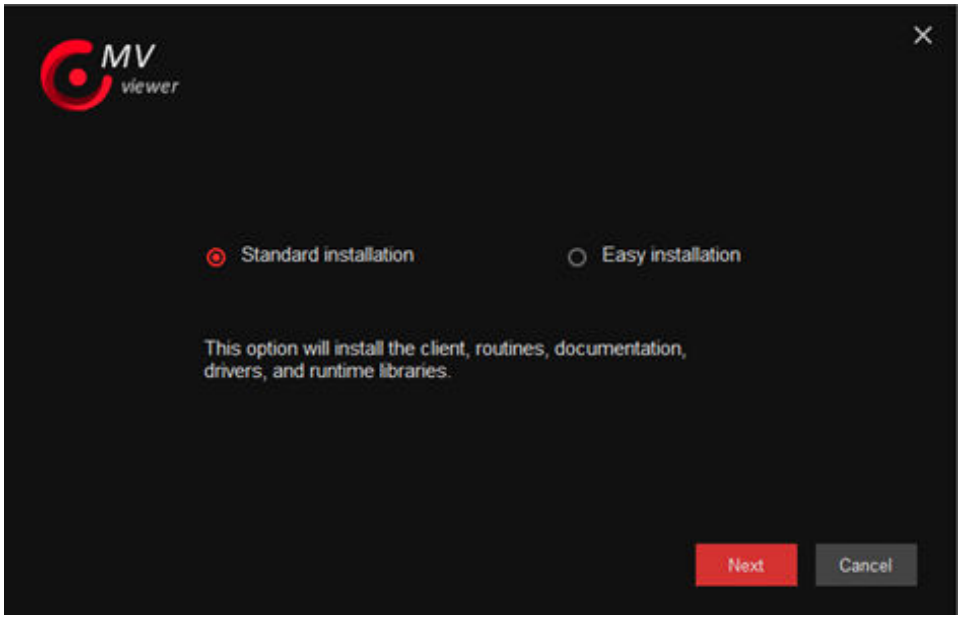
The detailed procedures of client installation are as follows.

Procedure

Step 1 Double-click the installation package, and the installation interface of the MV Viewer will pop up. If this is your first time to install the MV Viewer, we recommend you to select the **Standard Installation**.

- Standard Installation: It will install the client, routines, help documents, drives and runtime library.
- Easy Installation: It will only install the runtime library and drives.

Figure 3-1 Standard installation

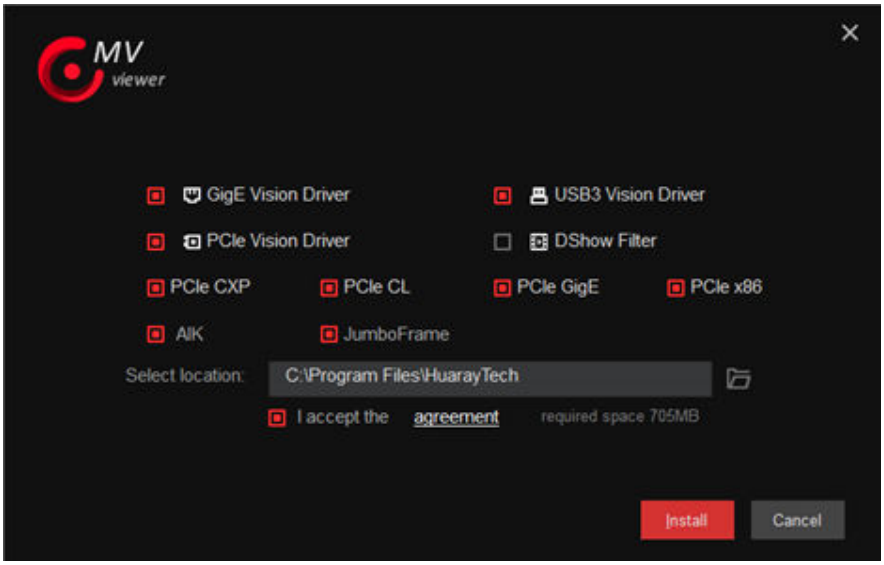


Step 2 Configure the installation path and select the drivers to be installed. All drivers are selected by default except the **DShow Filter**.

- Driver Selection: The options include **GigE** , **USB3**, **PCIe** and **DShow Filter**.
- Click **Nic Jumbo Frame Enable** to improve the network transmission performance of the client.
- After selecting the **GigE** , **CXP**, **PCIe CL** and **PCIe GigE**, client can enumerate the acquisition card of the corresponding interface. User can select the acquisition card as needed.
- After selecting the **PCIe x86**, client will enumerate the cameras with x86 system.
- The AIK is a plug-in which is used to support the third-party client software**VisionPro**.

- After selecting the **PCIe Vision Driver** , the options of **PCIe CXP, PCIe CL, PCIe GigE, PCIe x86** will be available.
- PCIe CXP, PCIe CL, PCIe GigE are only available to our self-developed drivers of acquisition card.
- After selecting the **GigE Vision Driver** , the **Nic Jumbo Frame Enable** will be available.

Figure 3-2 Drive selection



Step 3 Click **Install** to start installation.

Step 4 After the installation is completed, click the **Finish**.

Figure 3-3 Installation complete

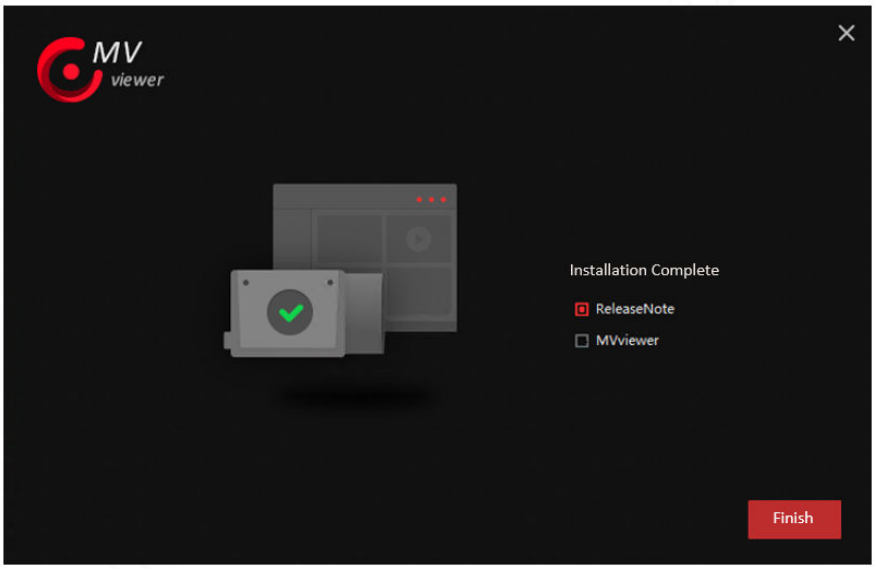
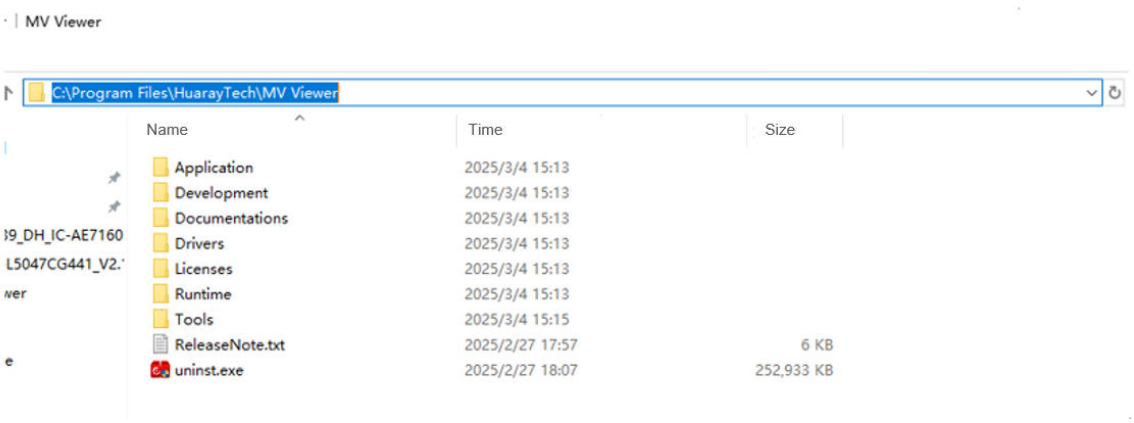


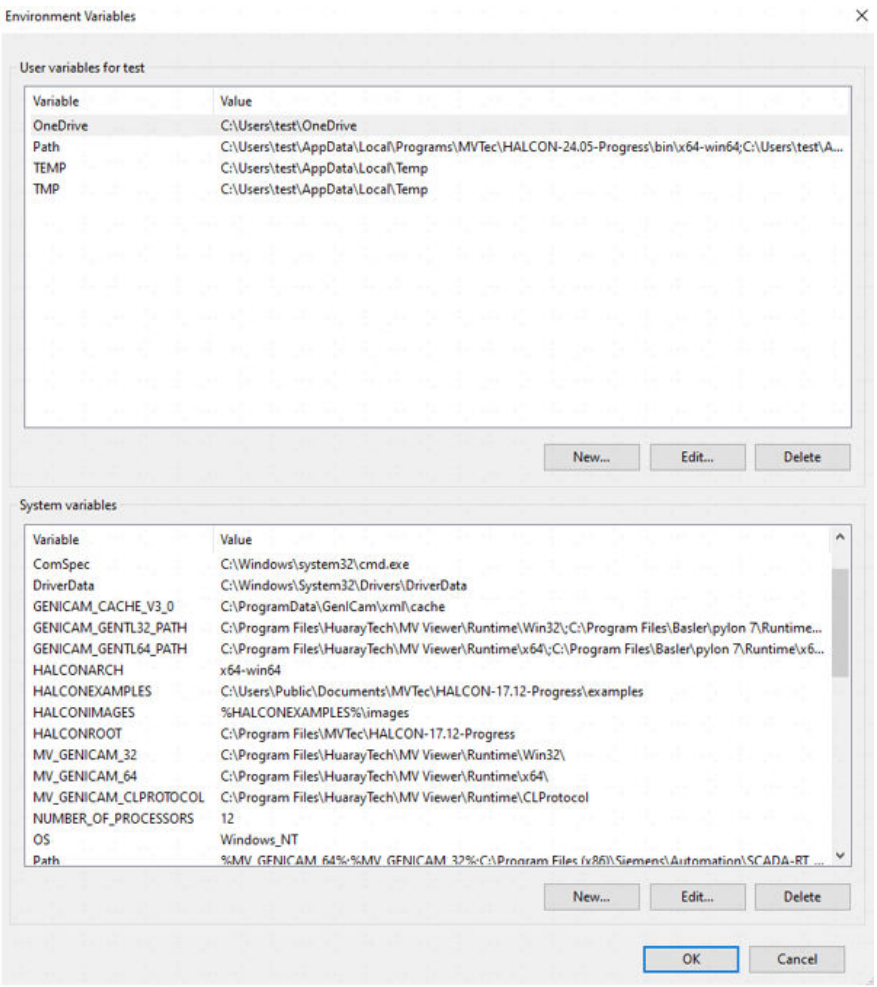
Figure 3-4 Directory of SDK files



3.2.2 Environment Configuration

To ensure the normal operation of the client and stability of the data transmission, the operating environment needs to be configured before running the client software.

Figure 3-5 Environment variables



3.2.2.1 Disable Firewall

The detailed procedures are as follows.

Procedure

Step 1 Take the operation system of the 64-bit Windows 10 as an example. Click **This PC** > **Properties** > **Control Panel** > **System and Security** > **Windows Defender Firewall**.

Step 2 Click the **Enable or turn off Window Defender Firewall**.

Step 3 Select **Disable Windows Defender Firewall** in every network setting.

Step 4 Click **OK**.

3.2.2.2 Set Static IP Address

Compared with dynamic IP, the static IP can shorten the device search time, so we recommend you adopt the static IP address. The detailed procedures are as follows.

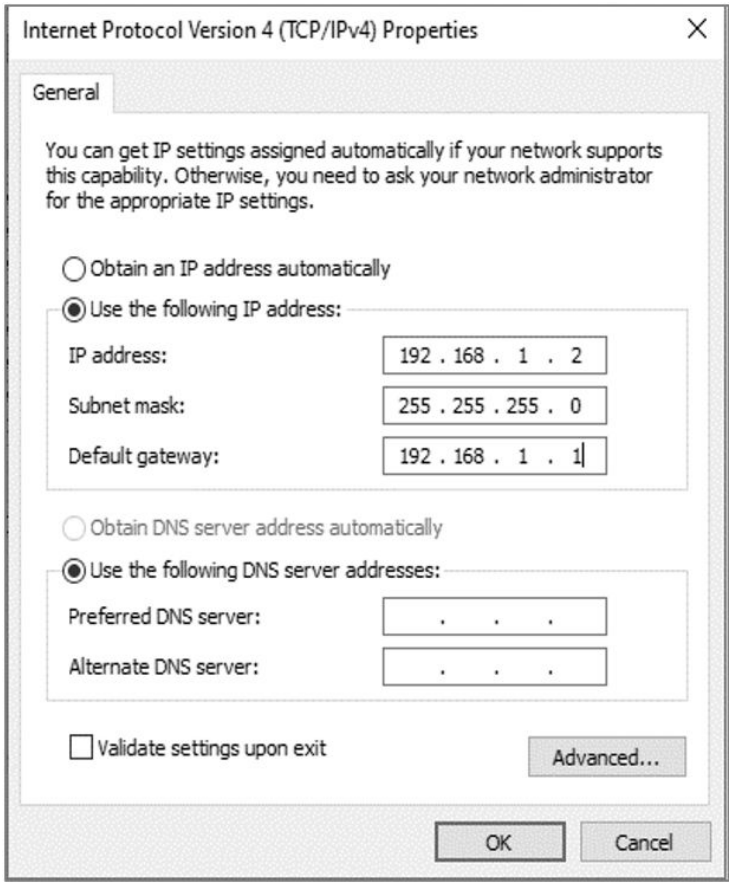
Procedure

Step 1 Click **Control Panel** > **Network and Internet** > **Network and Sharing Center** > **Change Adapter Configuration**.

Step 2 Connect the frame grabber to the camera.

Step 3 Configure the network port to use static IP, as shown in the figure below.

Figure 3-6 Set static IP address



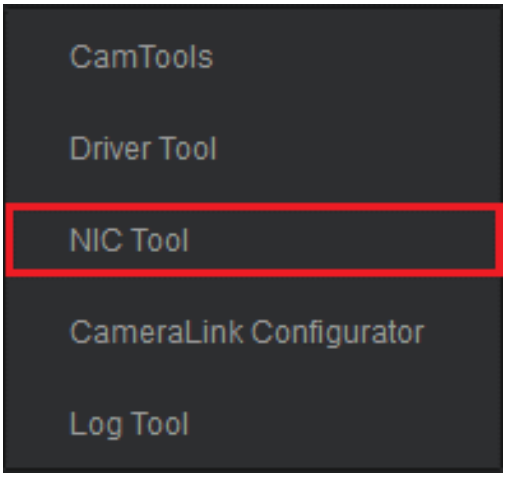
3.2.2.3 Enable NIC Jumbo Frame

The **Enable NIC Jumbo Frame** option is selected by default in the MV Viewer installation interface. User can follow the procedures to check whether it is enabled. If the Jumbo Frame is not enabled successfully, you can also enable it by following the procedures below.

Procedure

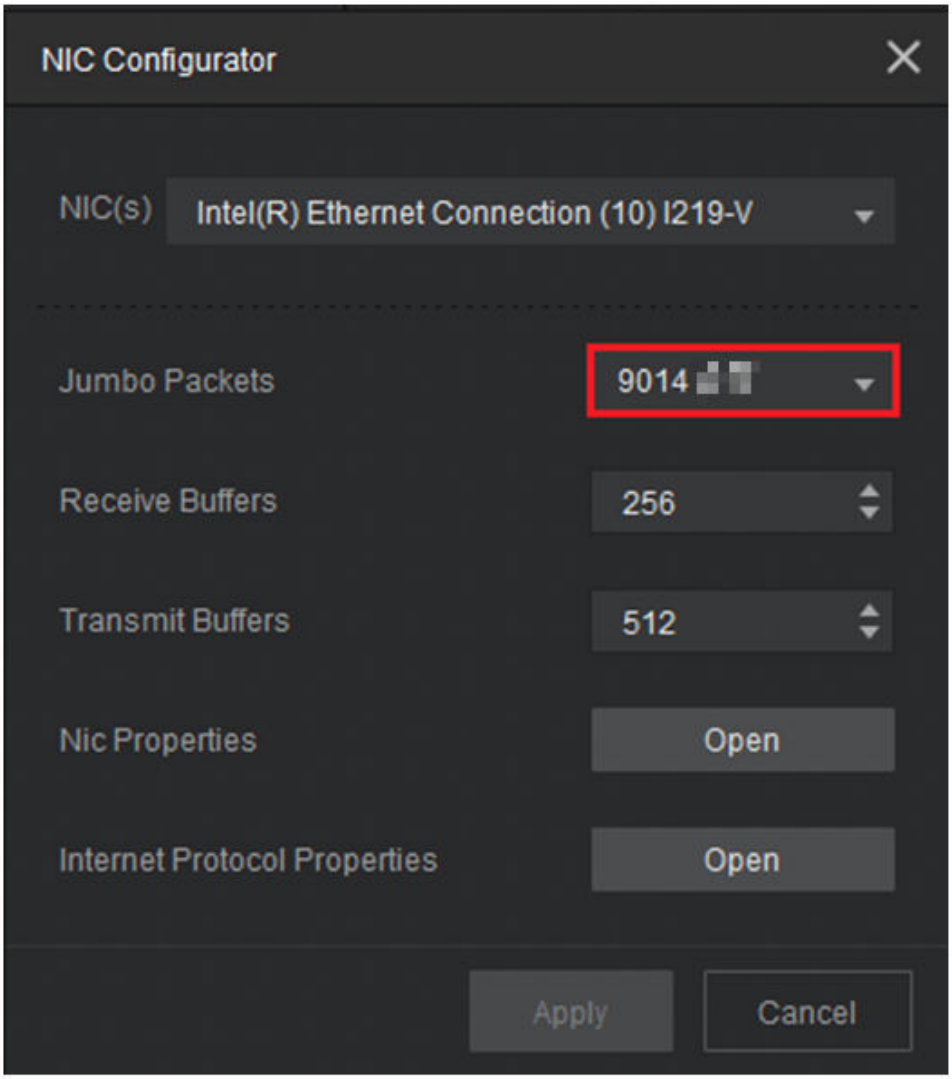
Step 1 Click **Tools** > **NIC Tool**, as shown in the figure below.

Figure 3-7 Nic Tool



Step 2 Select the **9014 Bytes** at the **Jumbo Frame**, and click **Apply**.

Figure 3-8 Set Jumbo Frame Packet



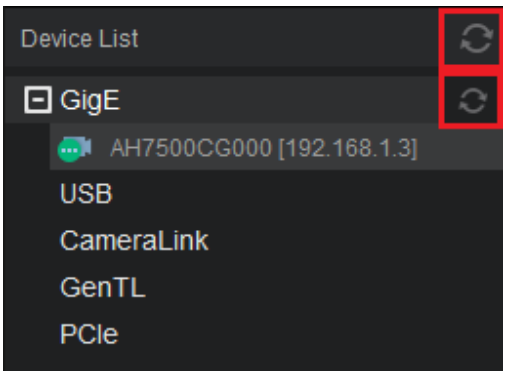
3.3 Client Operation

3.3.1 Device Connection

3.3.1.1 Find Device

Double-click MV Viewer to open it. The device list will display the enumerated devices automatically. Also, you can manually click the **Refresh** at the upper right of device list or right side of GigE category to find devices.

Figure 3-9 Refresh icon



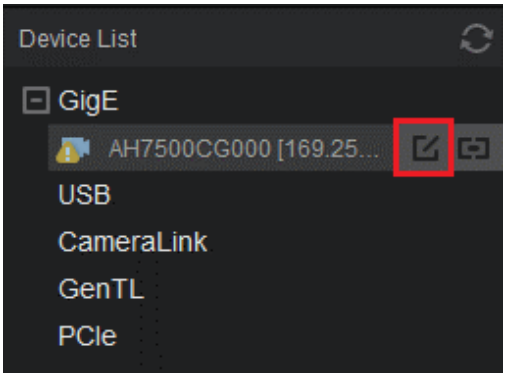
3.3.1.2 Set IP Address

If the camera is in the device list but cannot be connected, you shall configure the IP address of camera manually. The detailed procedures are as follows.

Procedure

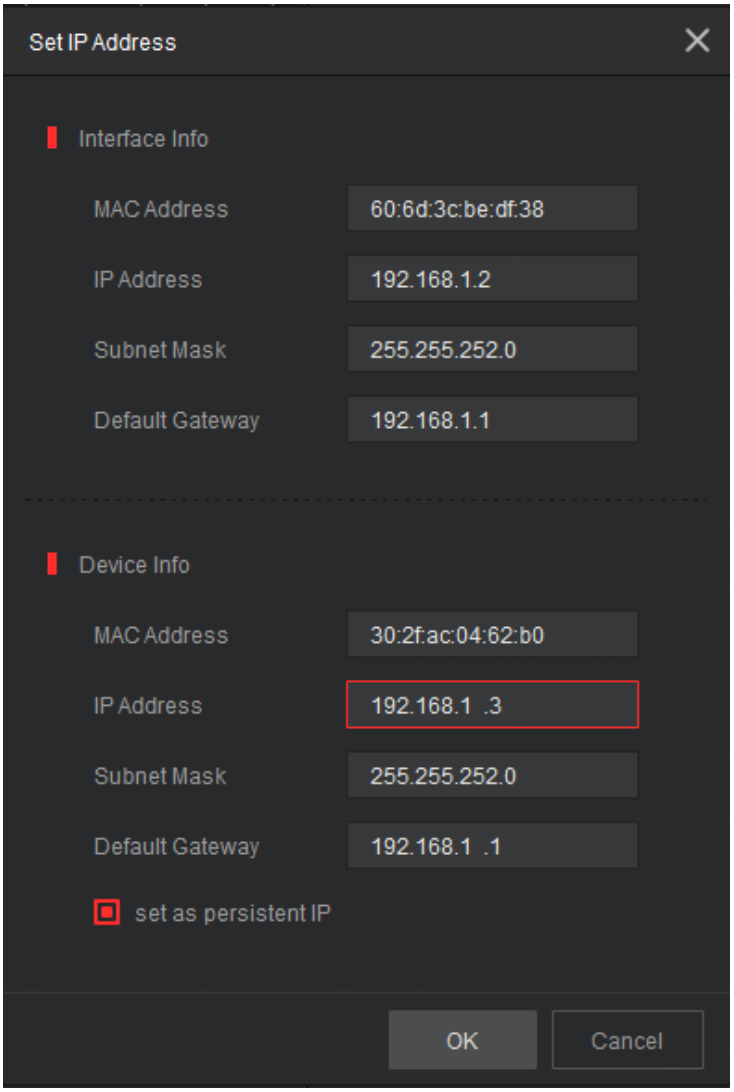
Step 1 Hang the mouse over the camera in the device list, and click the **Set IP** icon to enter the IP address configuration interface.

Figure 3-10 Set IP address



Step 2 Select the **Set as persistent IP** , set the IP address, subnet mask and default gateway of camera, and click **OK**.

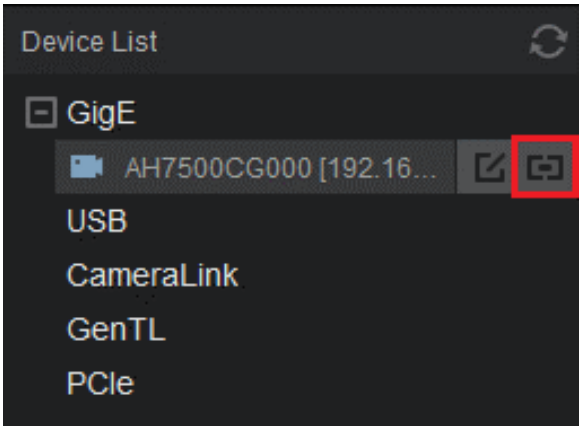
Figure 3-11 IP address configuration



3.3.1.3 Connect Device

Double-click the device in the list, or click **Connect** icon to complete the device connection. The hidden **Connect** icon will be displayed when you hang over the mouse on the device to be connected.

Figure 3-12 Connect device



3.3.2 Client Software Layout

After connecting the devices, the main interface of the MV Viewer will be like the figure below.

Figure 3-13 Main interface of MV Viewer

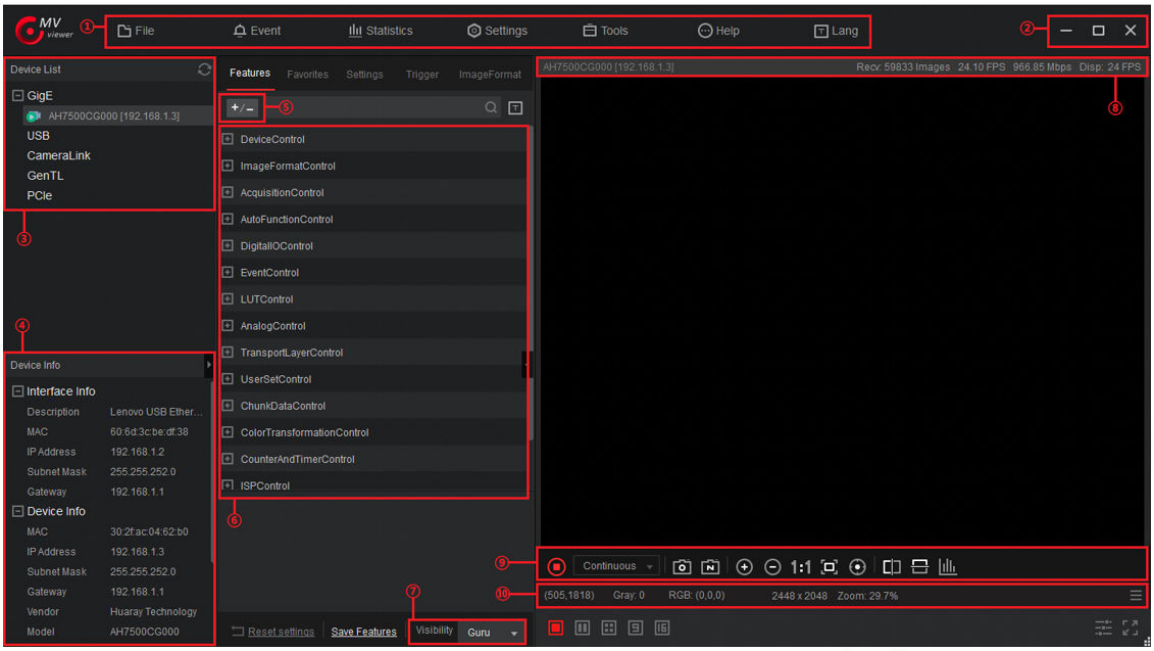
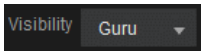
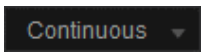


Table 3-2 Main interface description

No.	Name	Icon	Description
1	Menu Bar	—	The menu bar displays the function models, including the File, Event, Statistics, Settings, Tools, Help and Language. For more detailed operation instructions of the MV Viewer, please click “Help” in the menu bar.
2	Window Operation		Maximize/Restore/Minimize the window.

No.	Name	Icon	Description
			Close MV Viewer.
3	Device List		To manually refresh the information of the connected devices. Support Models: GigE, USB, CameraLink, GenTL and PCIe.
			Device to be connected.
			Device is connected.
			Device is occupied.
			Device cannot be connected, please manually configure the IP address of the device.
			To manually configure the IP address of the device.
			Connect/Disconnect the device.
4	Device Information	—	To display the interface information of the MV Viewer and the information of the camera.
5	Information Display		Expand/Collapse all the parameters.
6	Parameters	—	To configure the parameters based on your needs. The parameters shown in your MV Viewer may vary depending on the device model of device you are using.
7	Visibility		Click to select characters among **Beginner**, **Expert** or **Guru** from the drop-down list as needed. Each character corresponds to slightly different sets of parameters.
8	Streaming Information	—	To display the information of the data transmission, including the number of the acquired images, frame rate, bandwidth, and display frame rate.
9	Tool Bar		Start/Stop streaming.
			Click and select the streaming mode as needed, such as continuous, single frame and multiple frames. The streaming mode can only be changed when the streaming is paused.
			Save one image or multiple images.

No.	Name	Icon	Description
			Zoom in/out the image.
			Original Size/ Fit Screen/ Center. When the image is zoomed in/out, click  to restore the image size to the screen size.
			Vertically/Horizontally flip the image.
			To display the histogram information of the image, and analyzing the image according to the horizontal and vertical mean distribution diagram.
10	Image Information	—	To display the specific information of the image, including the cursor position, gray value, RGB value, resolution and zoom ratio.

4 I/O Wiring and Electrical Characteristics

4.1 Opto-Isolated Input

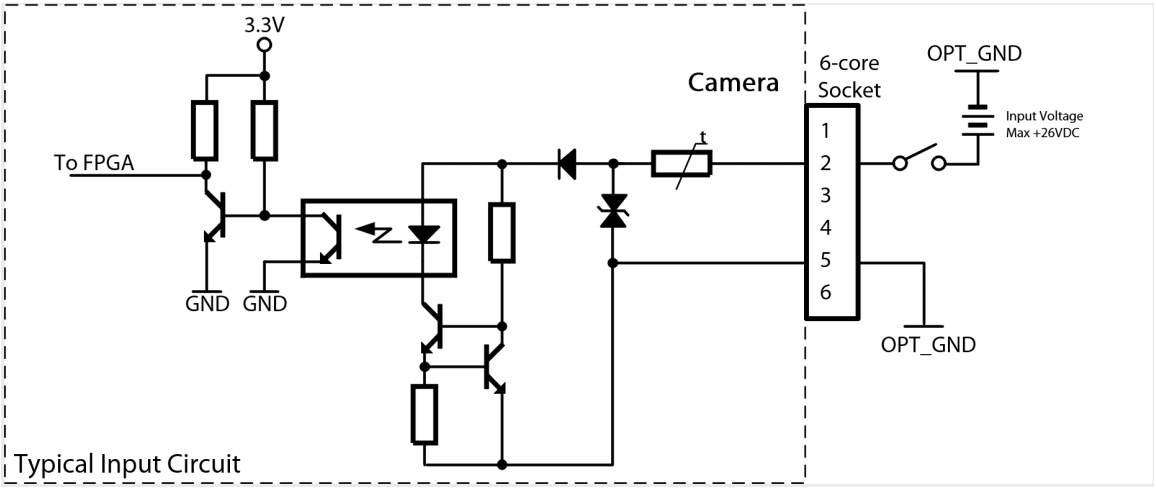
4.1.1 Opto-Isolated Input Circuit

The description of opto-isolated input circuit and the internal circuit diagram of opto-isolated input interface are as follows.

Table 4-1 Opto-isolator Input Circuit Description

Input Voltage	Description
+26 VDC	Extreme voltage. The input voltage cannot exceed the value. Otherwise, the device might be damaged.
+0 VDC ~ +24 VDC	Security working voltage range for I/O input.
+0 VDC ~ +1.4 VDC	Logic 0.
>+1.4 VDC ~ +2.2 VDC	The input status changes and the logic status is uncertain within this voltage range.
>+2.2 VDC	Logic 1.

Figure 4-1 Internal circuit diagram of opto-isolated input interface

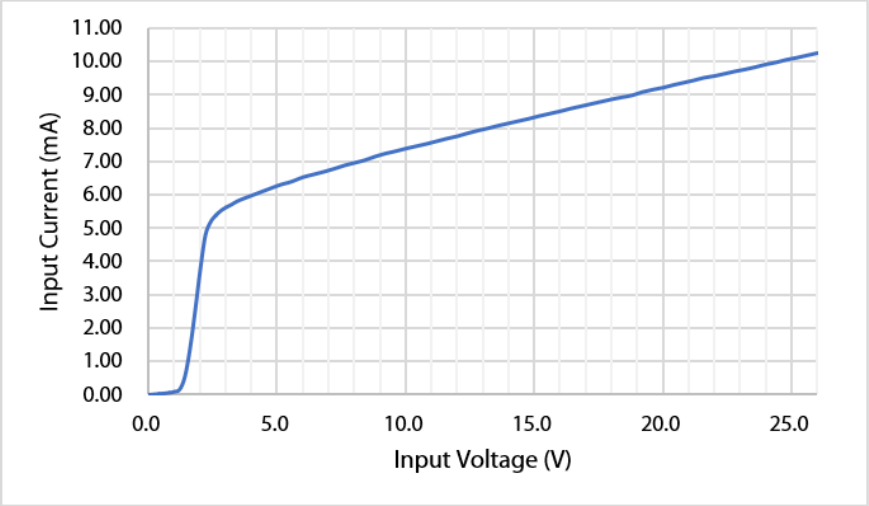


- The input voltage is the potential difference between the opto-isolated input (Line1) and opto-isolated signal ground (OPT_GND).
- There are two kinds of opto-isolated input circuits which include low speed and high speed. If you cannot figure which input circuit is high-speed type, please consult our technical specialist.
- This manual takes 6-core interface as an example to introduce the electrical features of I/O and wiring methods. The electrical features of I/O and wiring methods of 8-core and 12-core refer to the 6-core interface.

4.1.2 Input Current and Input Voltage

The relationship between the input current and input voltage of opto-isolated input interface is as follows.

Figure 4-2 Diagram of input current and input voltage of opto-isolated input interface



Values in the line chart are obtained at an environmental temperature of 25°C (77°F). Therefore, the actual values may vary among the different models of camera in the different environments.

4.1.3 Trigger Delay and Input Signal Amplitude

Signal delay diagram of opto-isolated input interface is as follows; the relationship between the input signal amplitude of opto-isolated input interface and the delay is described in the table below.

- Rising Edge Trigger Delay: The delay time from the 90% of external input signal amplitude to the 90% of FPGA pins input signal amplitude.
- Falling Edge Trigger Delay: The delay time from the 10% of external input signal amplitude to the 10% FPGA pins input signal amplitude.

Figure 4-3 Signal delay diagram of opto-isolated input interface

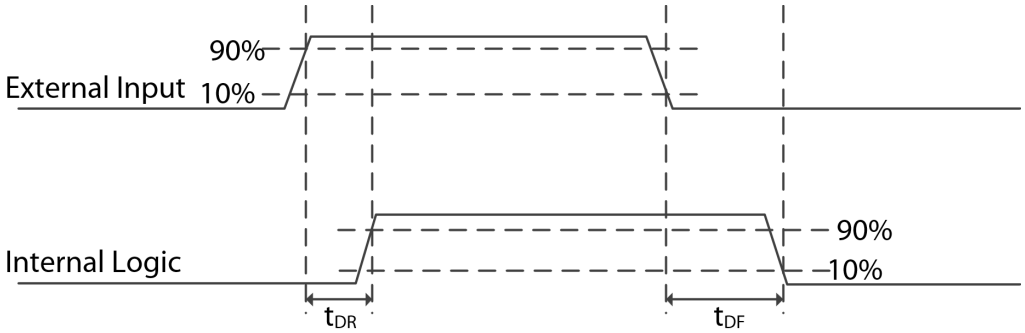


Table 4-2 Signal amplitude of the opto-isolator input and trigger delay

Input signal amplitude (Vp-p)	Rising Edge Trigger Delay tDR (us)	Falling Edge Trigger Delay tDF (us)
3.3	3.99	20.80
5	3.80	21.16
9	3.61	21.47
12	3.19	21.47
24	3.50	21.83

- The trigger delay measurement measures the delay value from external opto-isolated input interface to the FPGA input pins, which means the internal logic delay of the FPGA is not included.
- The shortest input positive pulse of opto-isolated input interface is 1.02 μs when the pulse amplitude is 3.3 V; the shortest input negative pulse of opto-isolated input interface is 20.97μs.
- Values in the table are obtained at an environmental temperature of 25°C (77°F). Therefore, the actual values may vary among the different models of camera in the different environments.

- Do not apply the voltage on the input terminals which exceeds the allowed maximum value.
- Do not replace the fuse by yourself. If the fuse blows due to the abnormalities, such as short circuit, please contact our after-sales to provide the maintenance service.

4.2 Opto-Isolated Output

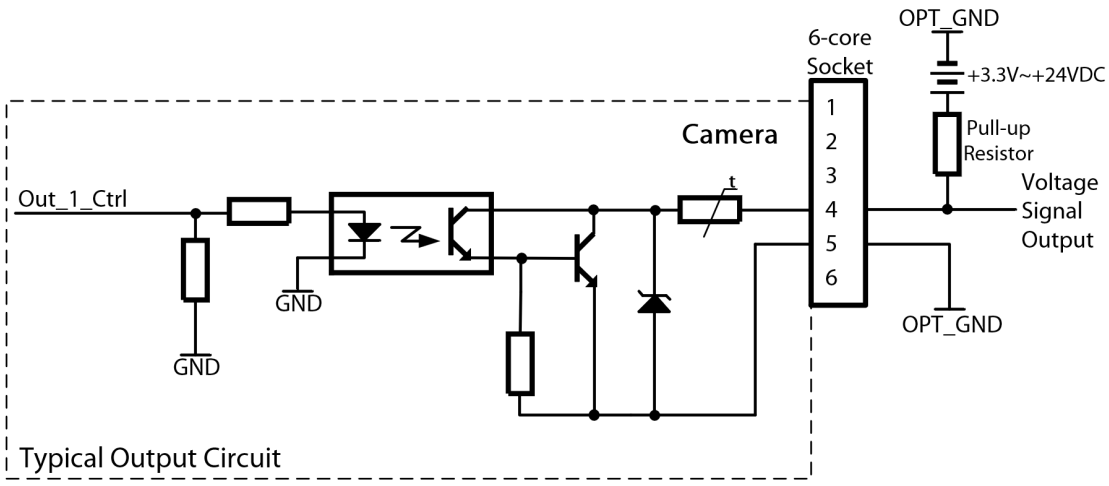
4.2.1 Opto-Isolated Output Circuit

The description of opto-isolated output circuit and the internal circuit diagram of opto-isolated output interface are as follows.

Table 4-3 Opto-isolated output circuit description

Voltage	Description
+26 VDC	Extreme voltage. The input voltage cannot exceed the value. Otherwise, the device might be damaged.
<+3.3 VDC	This voltage range may result in an error on I/O output.
+3.3 VDC ~ +24 VDC	Security working range for I/O output.

Figure 4-4 Internal circuit diagram of opto-isolated output



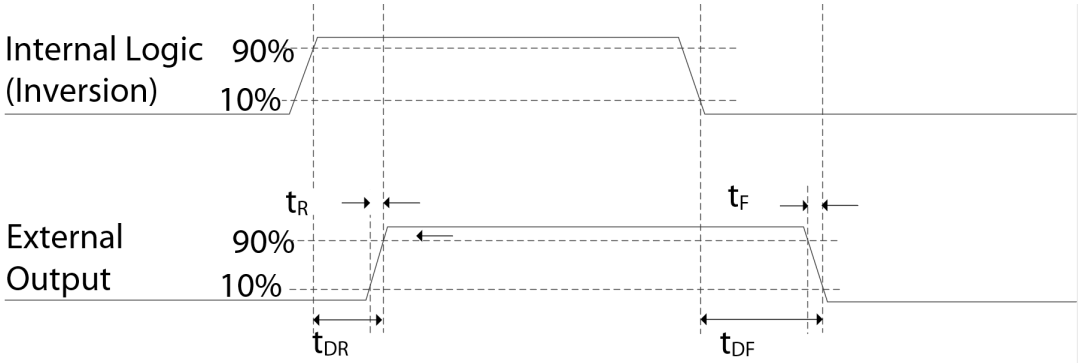
4.2.2 Output Delay and External Current Voltage

In some cases, a external pull-up resistor to the external power is needed to produce high-level output. The value of pull-up resistor is related to the external device and application scenarios, but the value cannot exceed the allowed maximum current of opto-isolated output interface. The larger the resistance value, the smaller the optocoupler conducting voltage drop, the more slowly the output wave changes and the weaker the control over external devices. For more details, please refer to the application document *AN15 Industrial Camera Opto-isolated Output Pull-up Resistor Selection Introductions*.

The maximum current of opto-isolated output is 50 mA. The signal delay diagram of opto-isolated output is as follows.

If the external pull-up resistance is adopted, the pull-up resistance and voltage shall be 1 kΩ at 3.3 V, 1 kΩ at 5 V, 2.4 kΩ at 12V, 4.7 kΩ at 24V.

Figure 4-5 Opto-isolated output signal delay diagram



The relationship between rising/falling time and rising/falling edge delay time when the pull-up resistance is 1kΩ are shown in the list below.

Table 4-4 Output signal delay and external power voltage

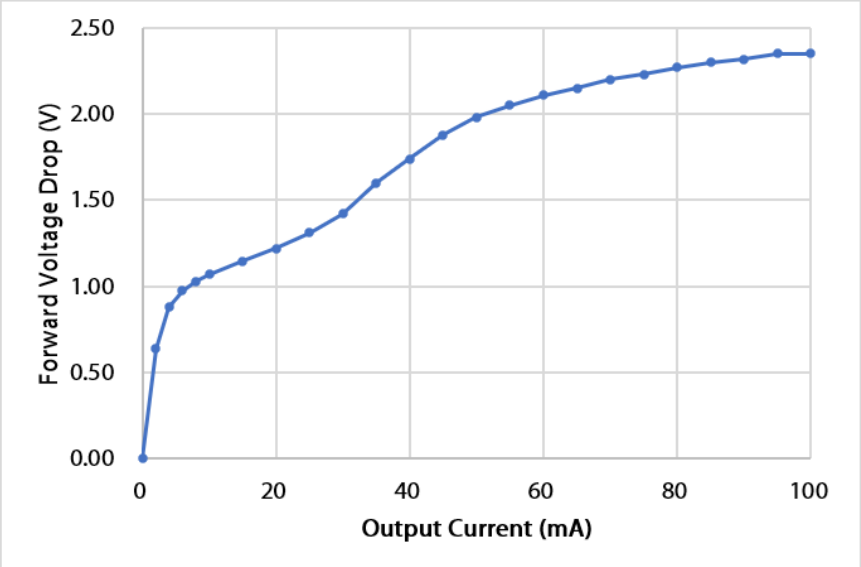
External Voltage (V)	Rising Time tR (us)	Falling Time tF (us)	Rising Edge Trigger Delay tDR (us)	Falling Edge Trigger Delay tDF (us)
5	19.70	3.20	39.9	8.06
12	24.06	5.22	44.8	11.8
24	30.11	8.10	44.8	53.2

- The output delay measurement measures the delay value from the FPGA output pins to the opto-isolated output pins, which means the internal logic delay of the FPGA is not included.
- Rising Time: The time for the output pulse to rise from 10% to 90%. Falling Time: The time for the output pulse to fall from 90% to 10%.
- Rising Edge Trigger Delay: The time from 10% of internal logic voltage to 90% of the output pulse voltage. Falling Edge Trigger Delay: The time from 90% of internal logic voltage to 10% of the output pulse voltage.
- Values in the line chart are obtained at an environmental temperature of 25°C (77°F). Therefore, the actual values may vary among the different models of camera in the different environments.

4.2.3 Output Conducting Voltage Drop and Output Current

The relationship between the opto-isolated conducting voltage drop and output current is described in the figure below.

Figure 4-6 Opto-isolated output conducting voltage drop and output current



- The value of conducting voltage drop is the voltage difference between the OPT_OUT (LINE0) and OPT_GND in the state of conducting.
- The maximum conducting voltage drop of opto-isolated output is 2.35V. This result is obtained under the maximum output current 100mA.

- Values in the figure are obtained at an environmental temperature of 25°C (77°F). Therefore, the actual values may vary among the different models of camera in the different environments.

4.2.4 Opto-isolated Interface as Transistor Output

The transistor output can be isolated with the internal circuit by using the opto-isolator. Therefore, the transistor output can be used as NPN output or PNP output. If the opto-isolator is as the PNP output, the opto-isolated input (Line1) is unavailable. NPN output and PNP output are as shown in the following figure.

Figure 4-7 Opto-isolated interface as NPN output

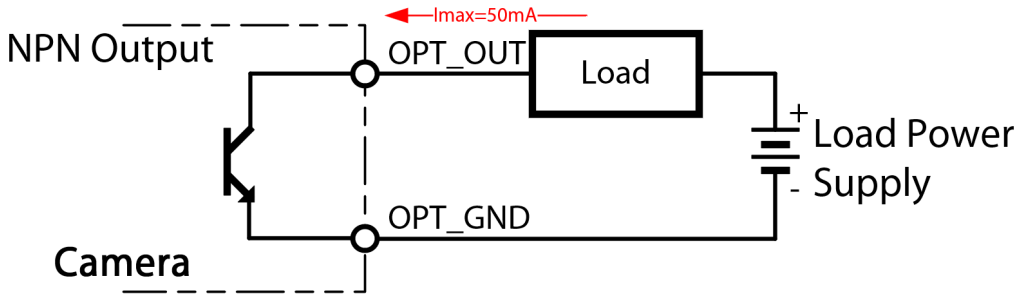
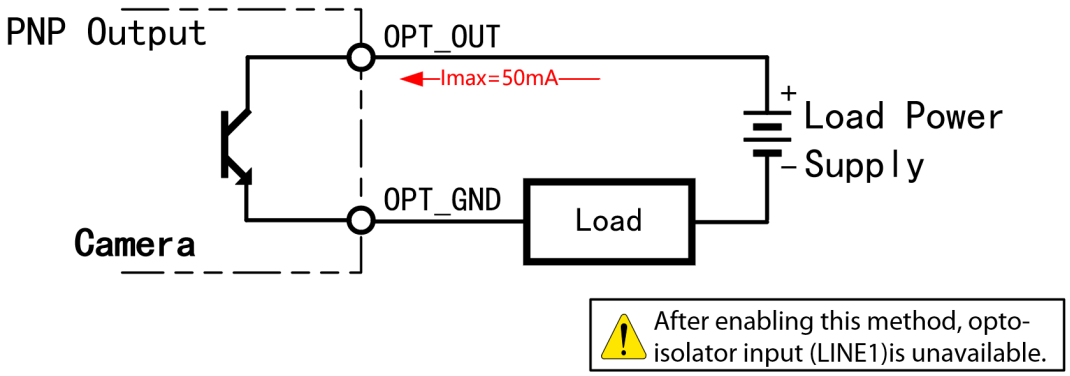
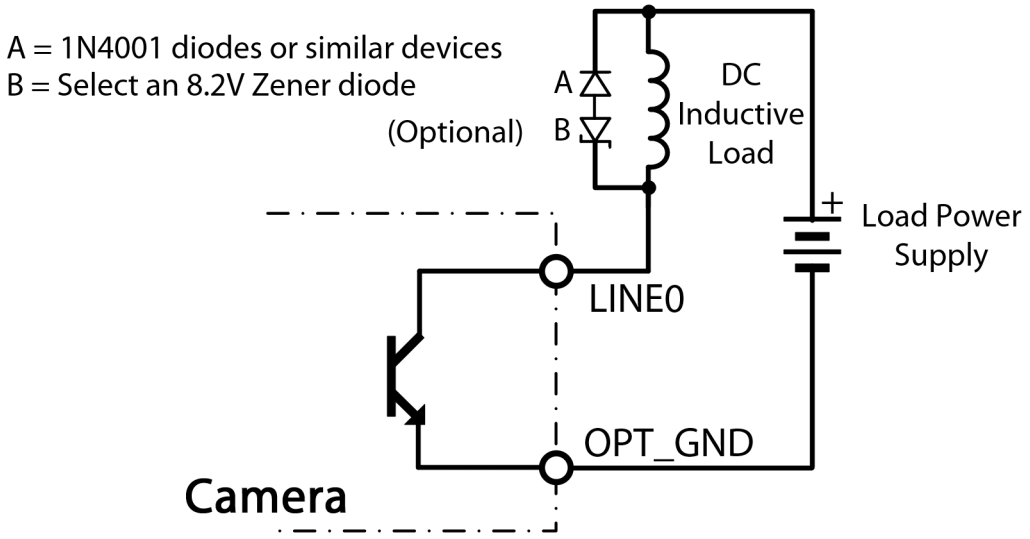


Figure 4-8 Opto-isolated interface as PNP output



- Do not apply the voltage or connect load on the output terminals of opto-isolator which exceeds the allowed maximum value 50 mA.
- Do not replace the fuse by yourself. If the fuse blows due to the overcurrent, such as short circuit, please contact our after-sales to provide the maintenance service.
- To drive the inductive load using camera output signals, such as relay, please use relay with built-in flyback diodes, or use common relay and add the flyback diodes. Otherwise, it may cause damage on the output interface. The figure below gives an example of a suppression circuit for DC inductive load. In most cases, the additional diodes A is sufficient, but if you request a faster shutdown speed, we recommend to add a Zener diode B to meet the current requirement of output circuit.

Figure 4-9 Suppression circuit of DC inductive load



Do not directly connect the opto-isolated output interface of camera with to the tungsten lamp. Because the inrush current at the moment when the tungsten lamp is turned on is 10 times to 15 times its steady-state current, which exceeds the allowed maximum current of opto-isolated output interface. We recommend you use the replaceable plug-in intermediate relay, or add the surge limiter.

4.3 Configurable GPIO

4.3.1 GPIO as Input

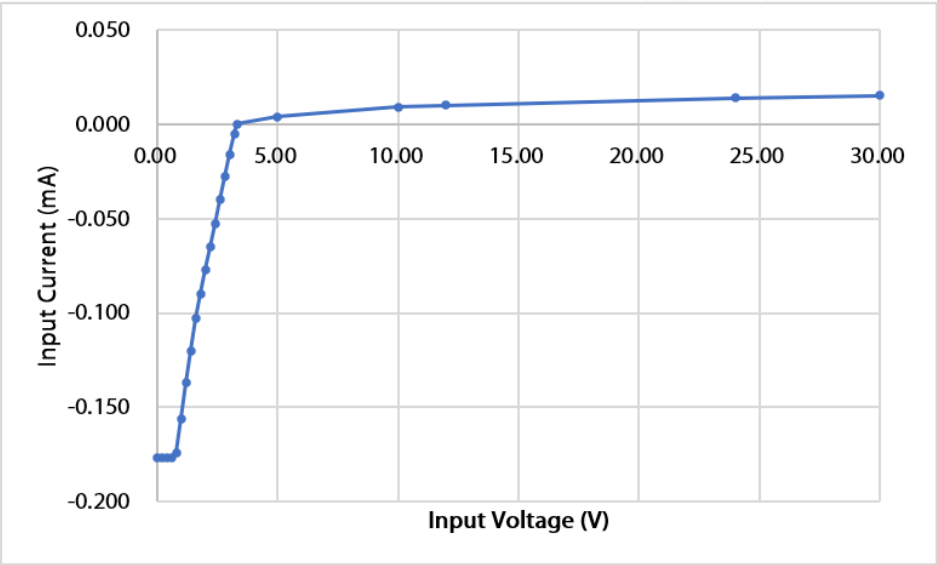
When GPIO is defined as the input, the input voltage description is as follows.

Table 4-5 GPIO input voltage description

Voltage	Description
+26 VDC	Extreme voltage. The input voltage cannot exceed the value. Otherwise, the device might be damaged.
+0 VDC~+24 VDC	Safe operating voltage input range (minimum 3.3 VDC when an external pull-up resistor exists).
+0 VDC~+0.8 VDC	Logic 0
> +0.8 VDC~+2.2 VDC	The input status changes and the logic status is uncertain within this voltage range.
>2.2 VDC	Logic 1

The relationship between the sink current and the external input voltage when GPIO is defined as the input is as follows.

Figure 4-10 GPIO input current versus input voltage



- Values in the line chart are obtained at an environmental temperature of 25°C (77°F). Therefore, the actual values may vary among the different models of camera in the different environments.
- The maximum sink current of GPIO input is 15 μA. This value is measured when the external input voltage is 30 V.

GPIO input signal amplitude versus trigger delay is as follows.

Table 4-6 GPIO input signal amplitude versus trigger delay

Input signal amplitude (Vp-p)	Rising Edge Trigger Delay tDR (us)	Falling Edge Trigger Delay tDF (us)
3.00	6.783	0.339
5.00	6.563	0.200
9.00	6.164	0.106
10.00	6.416	0.960

- The trigger delay measurement measures the delay value from external GPIO interface to the FPGA input pins, which means the internal logic delay of the FPGA is not included.
- The shortest input positive pulse is about 20 μs (typical value) supported by the GPIO input; the shortest input negative pulse is about 2 μs (typical value) supported by the GPIO input.
- The delay time of GPIO interface is less than that of the opto-isolated interface.

4.3.2 GPIO as Output

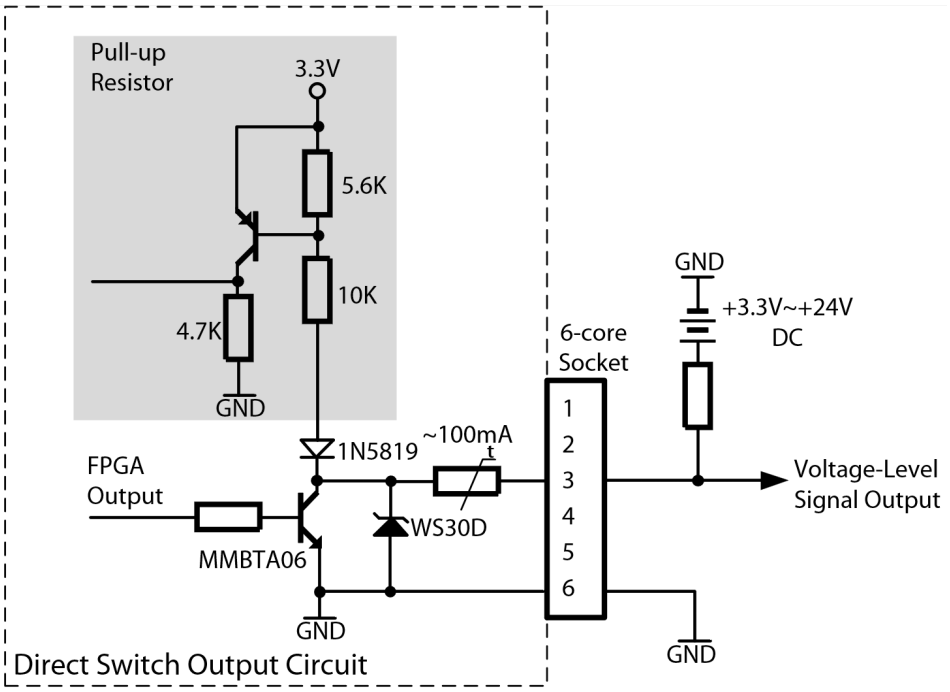
When GPIO is defined as the output, the output voltage description is as follows.

Table 4-7 GPIO output voltage description

Voltage	Description
+26 VDC	Limiting voltage. Output voltage cannot exceed the limit. Otherwise, the device might be damaged.
+3.3 VDC~+24 VDC	The security working voltage range in output mode
<3.3VDC	Possible error on I/O output.

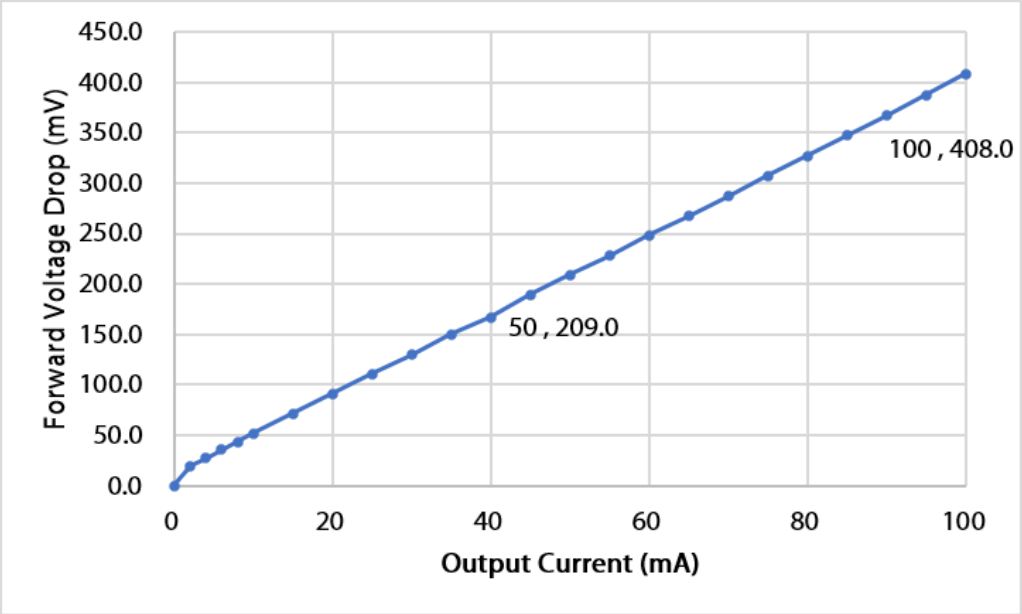
Up to 50 mA sink current when the GPIO port is used as output. The internal circuit diagram when GPIO is defined as the output is as follows.

Figure 4-11 GPIO output internal circuit diagram



The relationship between the GPIO output conducting voltage drop (the voltage drop between the GPIO and GND) and the output current (the current flowing into the GPIO pins).

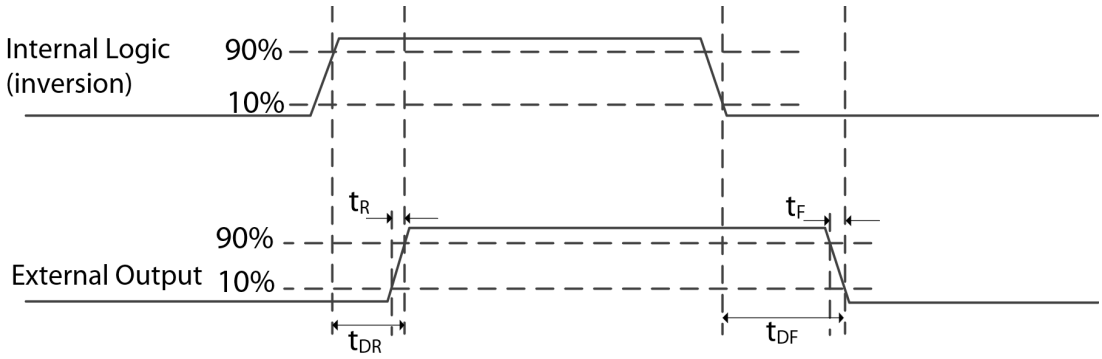
Figure 4-12 GPIO output conducting voltage drop versus output current



- Values in the line chart are obtained at an environmental temperature of 25°C. Therefore, the actual values may vary among the different models of camera in the different environments.
- The maximum conducting voltage drop is 0.41V (100 mA output current) when the GPIO is defined as the output.

The signal delay diagram of GPIO output is as follows.

Figure 4-13 Opto-isolated output signal delay diagram



The rising/falling time, and rising/falling edge trigger delay time are shown as below when the pull-up resistance is 470 Ω.

Table 4-8 GPIO output voltage versus delay time

External Voltage (V)	Rising Time tR (us)	Falling Time tF (us)	Rising Edge Trigger Delay tDR (us)	Falling Edge Trigger Delay tDF (us)
Null	-	-	5.43	0.35
5	0.16	0.02	1.80	39
12	0.22	0.04	2.37	71

- The output delay measurement measures the delay value from the FPGA output pins to the GPIO pins, which means the internal logic delay of the FPGA is not included.
- When no external pull-up resistor exists, the shortest output positive pulse is 11 μs and the shortest output negative pulse is 1 μs.
- The delay time of GPIO interface is less than that of the opto-isolated interface.

4.4 External Wiring

4.4.1 Wiring of Opto-Isolated Input

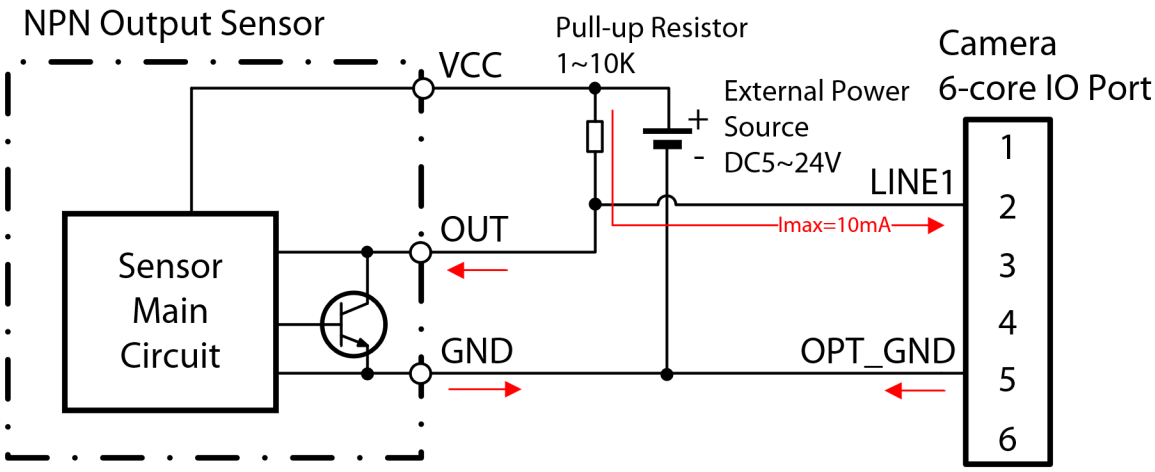
4.4.1.1 Application Example of Connect Camera with Sensor

Connect Sensor with NPN Output

- Method 1: Add Pull-up Resistor

  The opto-isolated input (Line1) and opto-isolated output (Line0) of camera are both available. The diagram of opto-isolated input connects to the sensor with NPN output is as follows.

  Figure 4-14 Diagram of opto-isolated input connects to the sensor with NPN output (1)

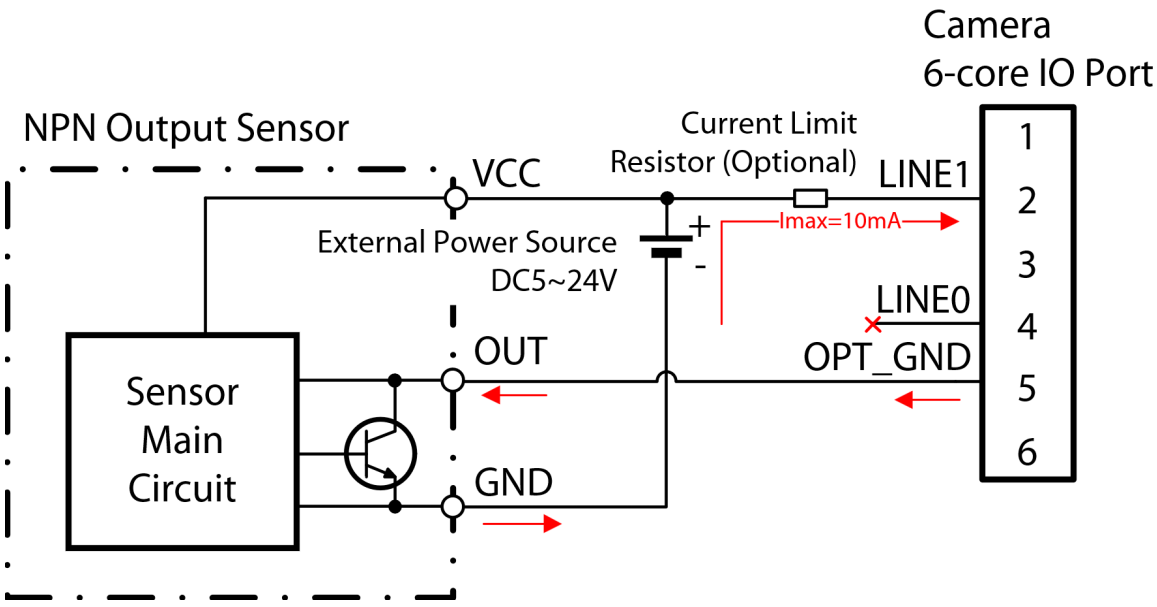


- If the range of pull-up resistance is 1kΩ~10kΩ, the resistance and voltage shall be 1 kΩ at 5 V, 2.4 kΩ at 12V, 4.7 kΩ at 24V.
- The input (Line1) logic state of camera is opposite to the output endpoint state of sensor. When the output state of sensor is “ON”, the transistor inside the sensor is turned on. Then, “OUT” and “GND” will be shorted, and the input (Line1) is low-level which corresponds to the logic value “0”. When the output state of sensor is “OFF”, the transistor is turned off. Then, “OUT” is pulled up to the external power supply by external resistance, and the input (Line1) is high-level which corresponds to the logic value “1”.
- The red arrow in the figure indicates the current direction.

- Method 2: Without Pull-up Resistor

The opto-isolated input (Line1) of camera is available only. The diagram of opto-isolated input connects to the sensor with NPN output is as follows.

Figure 4-15 Diagram of opto-isolated input connects to the sensor with NPN output (2)

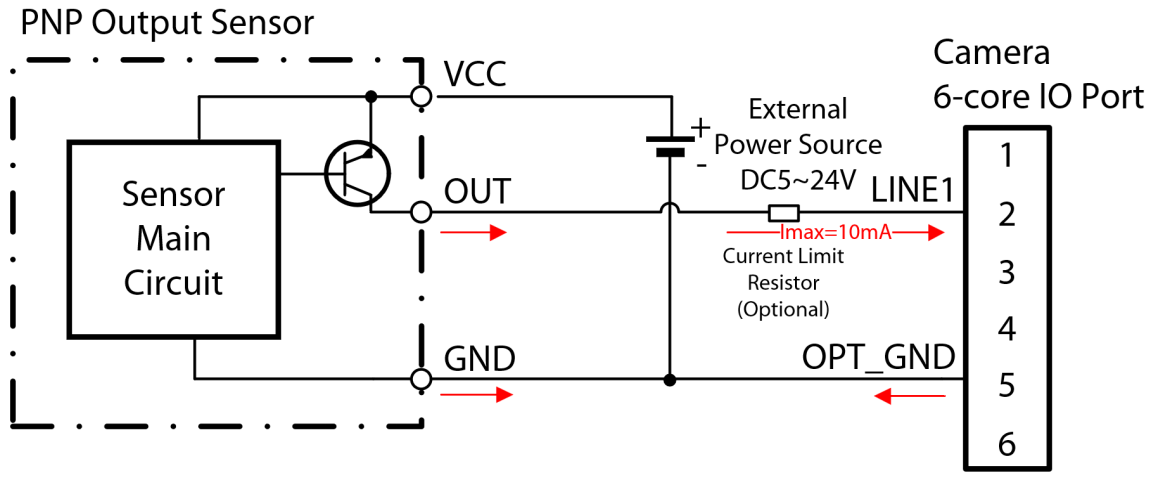


- Generally, the current limiting resistor can be omitted. When the external power supply is 24 V and the voltage is unstable, we recommend you connect a 1kΩ resistor in series on the input (Line1) to avoid overvoltage damage to the camera input circuit.
- The input (Line1) logic state of camera is identical to the output endpoint state of sensor. When the output state of sensor is "ON", the transistor inside the sensor is turned on, and the "OUT" and "GND" are shorted. The current supplied by external power supply flows into the Line1 through the current limiting resistor (optional). After the current passes through the opto-isolated input circuit inside the camera, it flows out from the "OPT_GND", and it passes through the transistor inside the sensor and flows back to the external power ground (GND).

Connect sensor with PNP output

The diagram of opto-isolated input connects to the sensor with PNP output is as follows.

Figure 4-16 Opto-isolator input connects to the sensor with PNP output

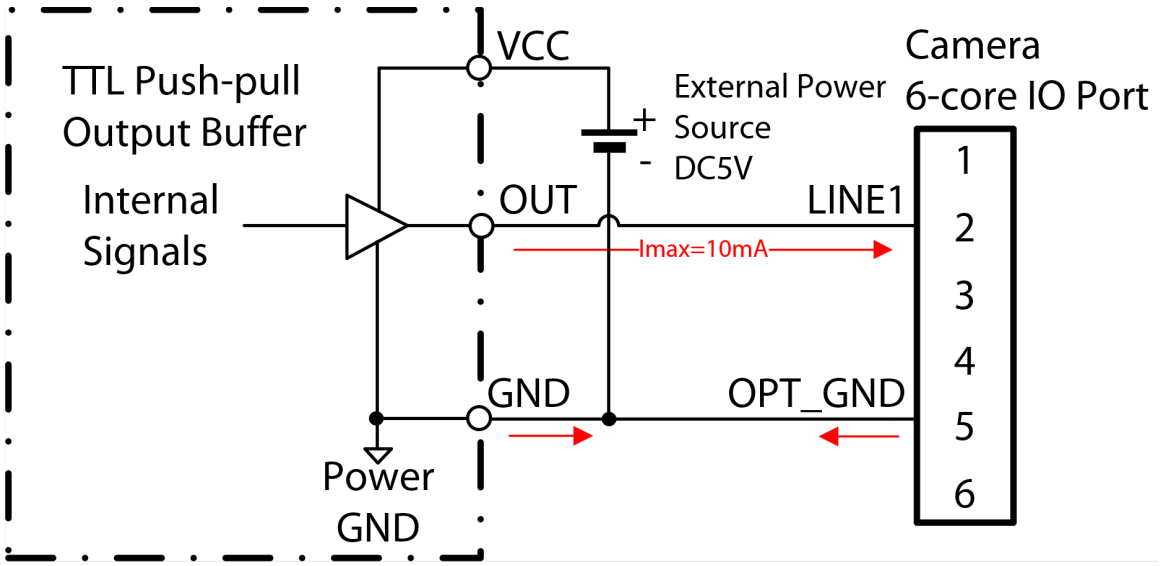


- Generally, the current limiting resistor can be omitted. When the external power supply is 24 V and the voltage is unstable, we recommend you connect a 1kΩ resistor in series on the input (Line1) to avoid overvoltage damage to the camera input circuit.
- The input (Line1) logic state of camera is identical to the output endpoint state of sensor. When the output state of sensor is "ON", the transistor inside the sensor is turned on, and the "VCC" and "OUT" are shorted. The current supplied by external power supply flows out from the "OUT" through the transistor inside the sensor, and then flows into the Line1 through the current limiting resistor (optional). After the current passes through the opto-isolated input circuit of camera, it flows out from the "OPT_GND", and back to the external power ground (GND).

Connect TTL Output

The opto-isolated input (Line1) and opto-isolated output (Line0) of camera are both available. The diagram of opto-isolated input connects to the TTL output is as follows.

Figure 4-17 Diagram of opto-isolated input connects to the TTL output



The TTL circuit can be the frame grabber or the sensor with complementary push-pull output.

4.4.1.2 Application Example of Connect Camera with PLC

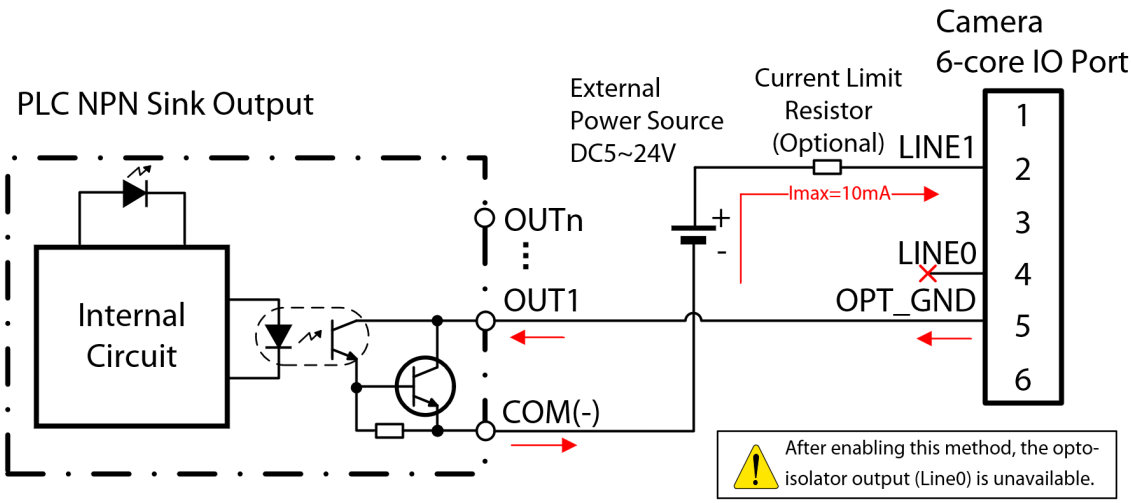
For the transistor-type PLC output circuit, the port of I/O circuit which outputs or provide current is called Source; the port of I/O circuit which input or flows in current is called Sink. The sink output adopts NPN transistor, and the source output adopts PNP or NPN transistor. The multi-group output of PLC share one common port (COM). The common port of sink output connects to the power ground (0V), and the common port of source output connects to the power supply (VCC).

Connect to Sink Output (Common Collector) of PLC

- Method 1: Without Pull-up Resistor

  The opto-isolated input (Line1) of camera is available only in this method. The diagram of opto-isolated input connects to the sink output of PLC is as follows.

Figure 4-18 Diagram of opto-isolated input connects to the sink output of PLC

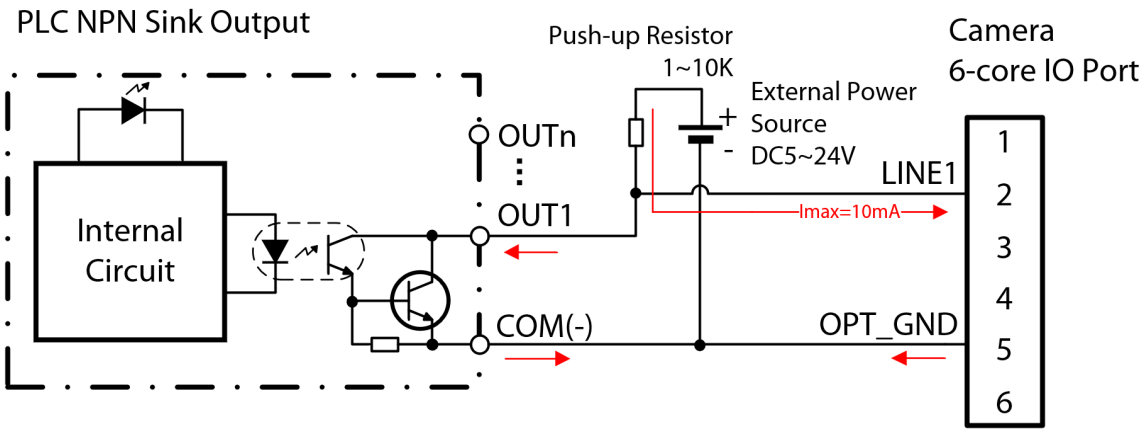


- The output circuit of PLC in the figure refers to the OMRON CP1E-E10. The COM is the common port, and the OUT1~OUTn are the output ports sharing the same common port.
- The opto-isolated output (Line0) of camera is unavailable when you adopt the wiring method in the figure above.
- Generally, the current limiting resistor can be omitted. When the external power supply is 24 V and the voltage is unstable, we recommend you connect a 1kΩ resistor in series on the input (Line1) to avoid overvoltage damage to the camera input circuit.

- Method 2: Add Pull-up Resistor

  The opto-isolated input (Line1) and opto-isolated output (Line0) of camera are both available. The diagram of opto-isolated input connects to the sink output of PLC is as follows.

Figure 4-19 Diagram of opto-isolated input connects to the sink output of PLC (2)

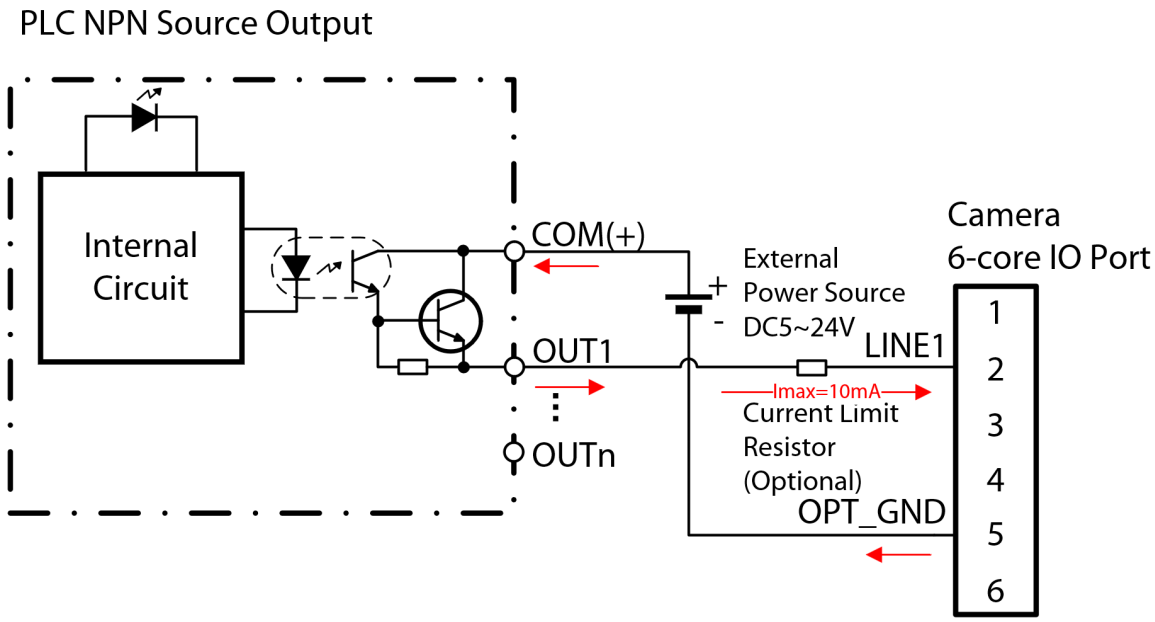


- The output circuit of PLC in the figure refers to the OMRON CP1E-E10. The COM is the common port, and the OUT1~INn are the output ports sharing the same common port.
- If the range of pull-up resistance is 1kΩ~10kΩ, the resistance and voltage shall be 1 kΩ at 5 V, 2.4 kΩ at 12V, 4.7 kΩ at 24V.
- The input logic state of camera is opposite to the output port state of sensor. The detailed descriptions, please refer to the"4.4.1.1 Application Example of Connect Camera with Sensor".

Connect to Source Output (Common Emitter) of PLC

The diagram of opto-isolated input connects to the source output of PLC is as follows.

Figure 4-20 Diagram of opto-isolated input connects to the source output of PLC



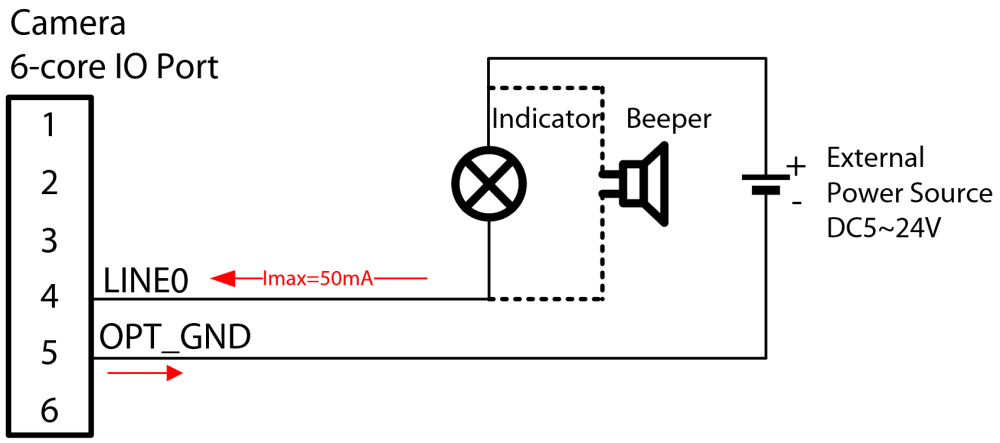
- The output circuit of PLC in the figure refers to the OMRON CP1E-E10. The COM is the common port, and the OUT1~OUTn are the input ports sharing the same common port.
- Generally, the current limiting resistor can be omitted. When the external power supply is 24 V and the voltage is unstable, we recommend you connect a 1kΩ resistor in series on the input (Line1) to avoid overvoltage damage to the camera input circuit.
- The input logic state of camera is identical to the output port state of sensor. The detailed descriptions, please refer to the section of Connect To PNP Output of Sensor in 4.4.1.1.

4.4.2 Wiring of Opto-Isolated Output

4.4.2.1 Opto-isolator as NPN Output Connects to Indicator and Buzzer

The diagram of opto-isolator as NPN output connects indicator is as follows.

Figure 4-21 Opto-isolator as NPN output connects indicator

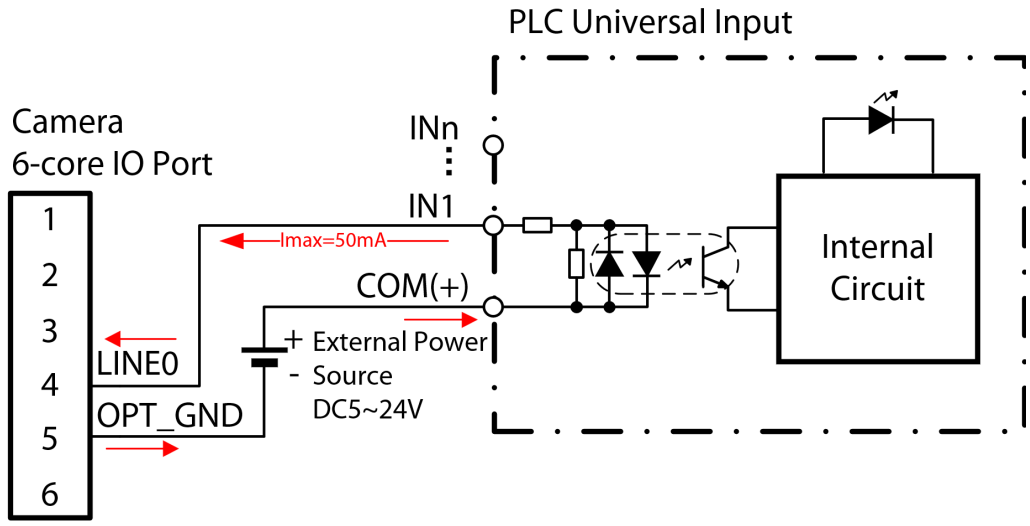


The red arrow in the figure indicates the current direction when the output of opto-isolator is in the conductive state (Logic 1).

4.4.2.2 Opto-isolator as NPN Output Connects to PLC Input

The diagram of the opto-isolator as NPN output connects to PLC input is as follows.

Figure 4-22 Diagram of the opto-isolator as NPN output connects to PLC input

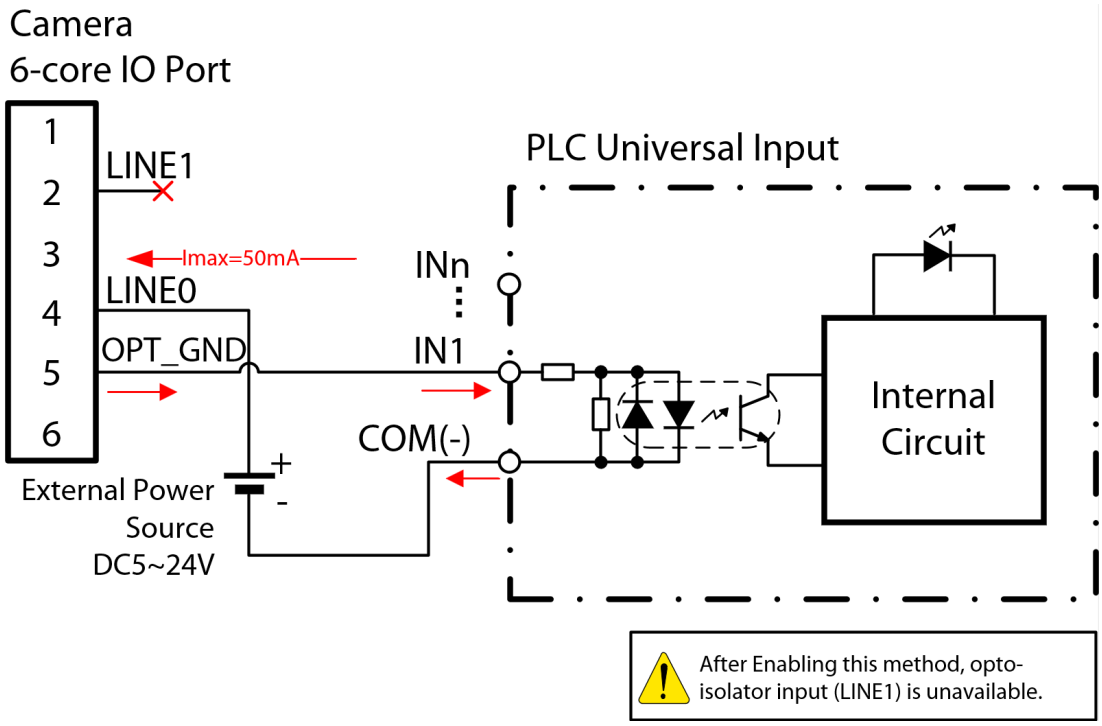


The input circuit of PLC in the figure refers to the OMRON CP1E-E10. The COM is the common port, and the IN1~INn are the input ports sharing the same common port.

4.4.2.3 Opto-isolator as PNP Output Connects to PLC Input

The diagram of the opto-isolator as PNP output connects to PLC input is as follows.

Figure 4-23 Diagram of opto-isolator as PNP output connects to PLC input

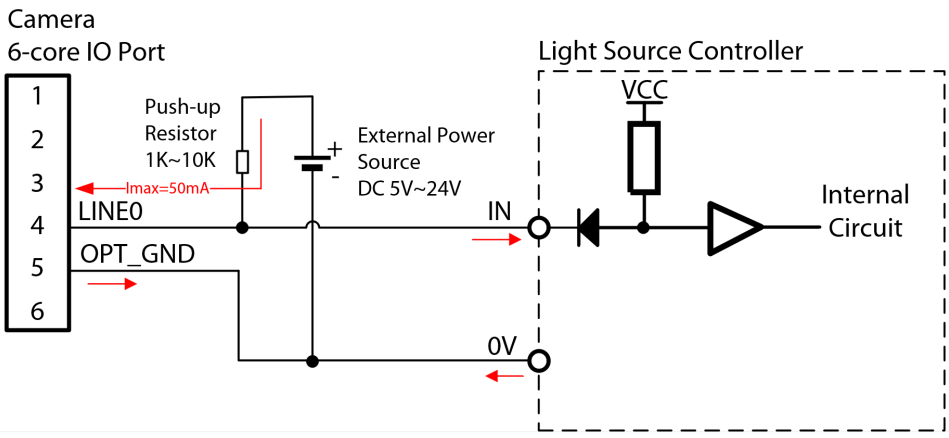


- The input circuit of PLC in the figure refers to the OMRON CP1E-E10. The COM is the common port, and the IN1~INn are the input ports sharing the same common port.
- The opto-isolated input (Line1) of camera is unavailable when you adopt the wiring method in the figure above.

4.4.2.4 Opto-isolator as NPN Output Connects Light Controller

The diagram of the opto-isolator as NPN output connects to light controller is as follows.

Figure 4-24 Diagram of the opto-isolator as NPN output connects to light controller



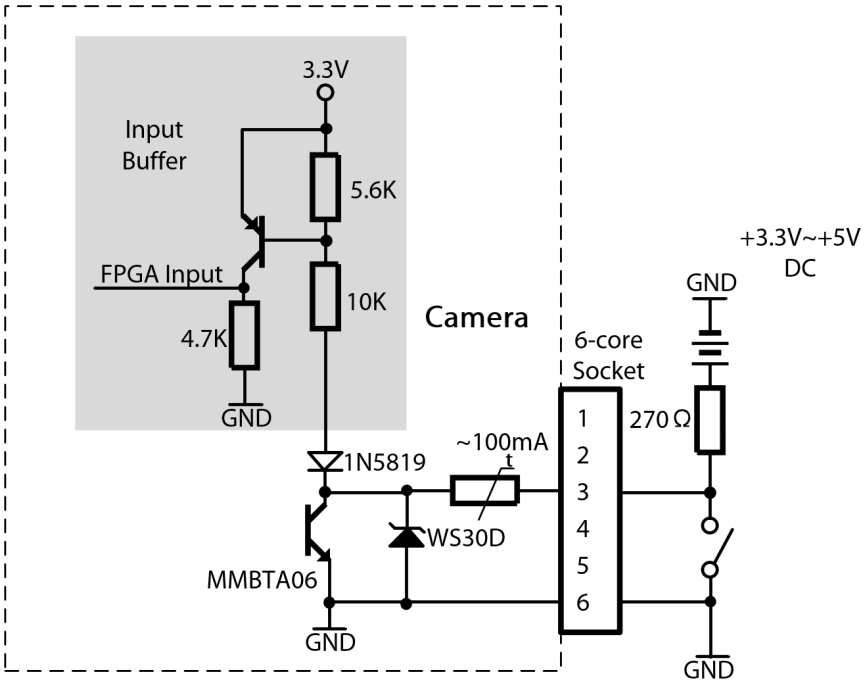
The resistance value range of the pull-up resistor is 1kΩ~10 kΩ. It is 1kΩ at 3.3V or 5V, 2.4kΩ at 12V, and 4.7kΩ at 24V. If the light controller has the built-in pull-up resistor, the external resistor is not needed.

4.4.3 Configurable GPIO Wiring

4.4.3.1 Application Example of GPIO As Input

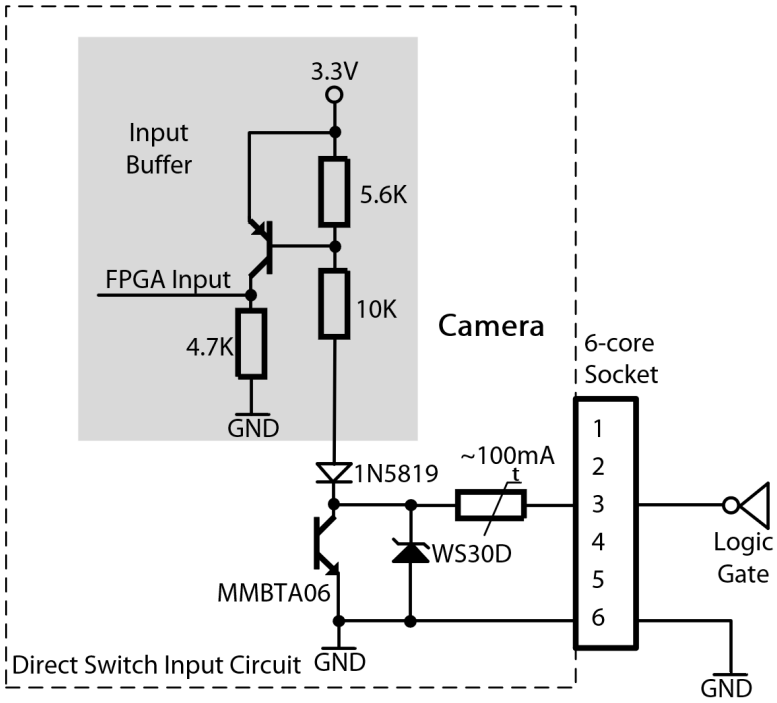
The diagram of GPIO as input connects to the mechanical switch is as follows.

Figure 4-25 GPIO As Input Connects to Mechanical Switch



The diagram of GPIO as input connects to the 5V TTL output is as follows.

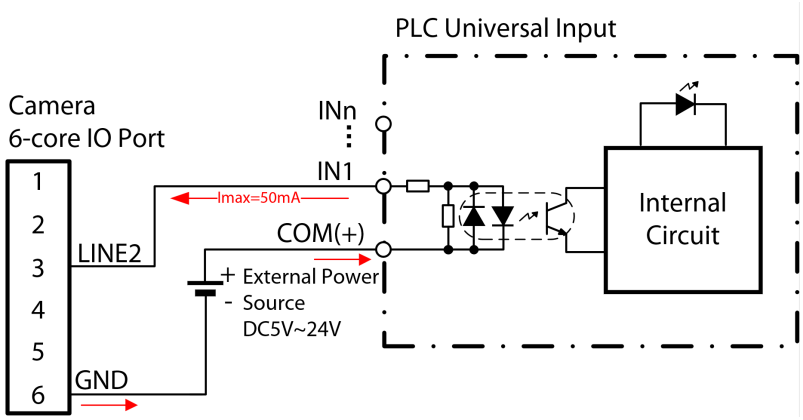
Figure 4-26 Diagram of GPIO as input connects to the 5V TTL output



4.4.3.2 Application of GPIO As Output

GPIO as output connects to the PLC input interface is as follows.

Figure 4-27 Diagram of GPIO as output connects to the PLC input interface



- Do not apply the voltage or connect load on the output terminals which exceeds the allowed maximum value.
- Do not replace the fuse by yourself. If the fuse blows due to the overcurrent, such as short circuit, please contact our after-sales to provide the maintenance service.
- Before you connect the external circuit, please define the GPIO as the proper direction, such as input or output. Do not change the direction of GPIO when the camera is running. The wrong direction may cause damages on the GPIO interface.
- Please do not use the GPIO interface in the environment with serious electrical interference. Because the GPIO interface is a non-isolated interface, which means it has no sufficient anti-interference performance. We recommend you use the opto-isolated input or output interface, such as Line1, Line0.

5 Shutter and Exposure

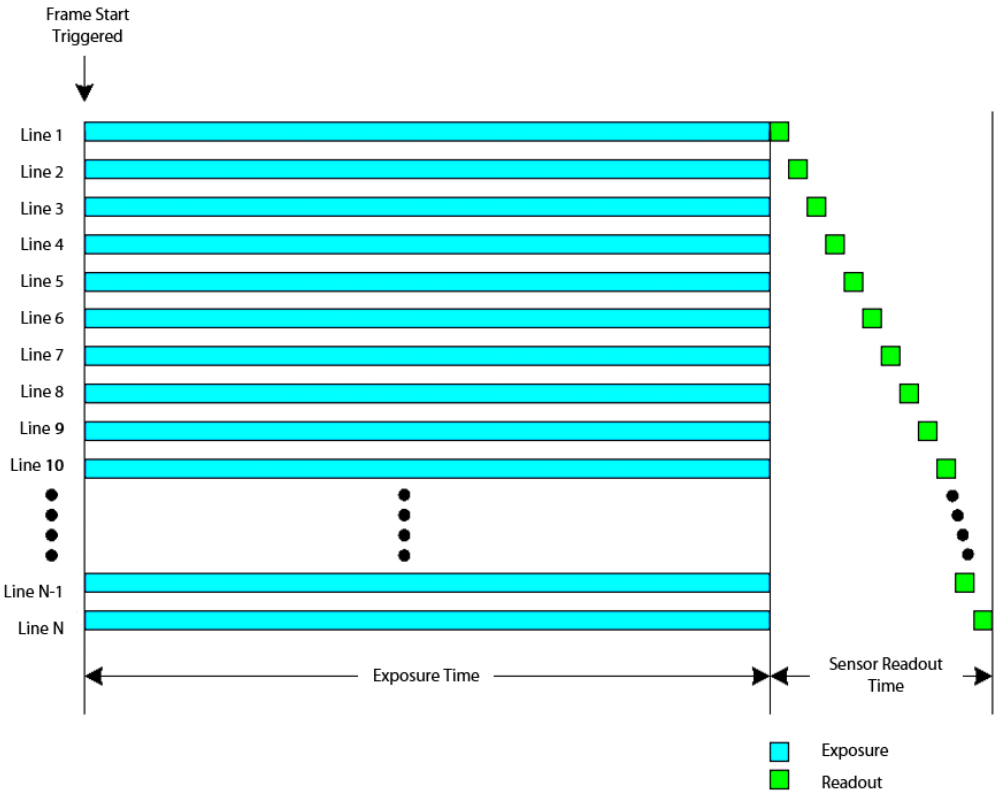
5.1 Shutter

The shutters of camera include global shutter and rolling shutter. Which kind of shutter the camera should use is mainly related to the characteristics of the sensor.

5.1.1 Global Shutter

The principle of global shutter is exposing the whole scene at the same time. All pixels of sensor start collecting the light simultaneously when camera start exposure. At the beginning of the exposure, the sensor starts collecting light; at the end of the exposure, the light collecting is stopped, and the sensor reads out the data of the image line by line, as shown in the figure below.

Figure 5-1 Global Shutter mode



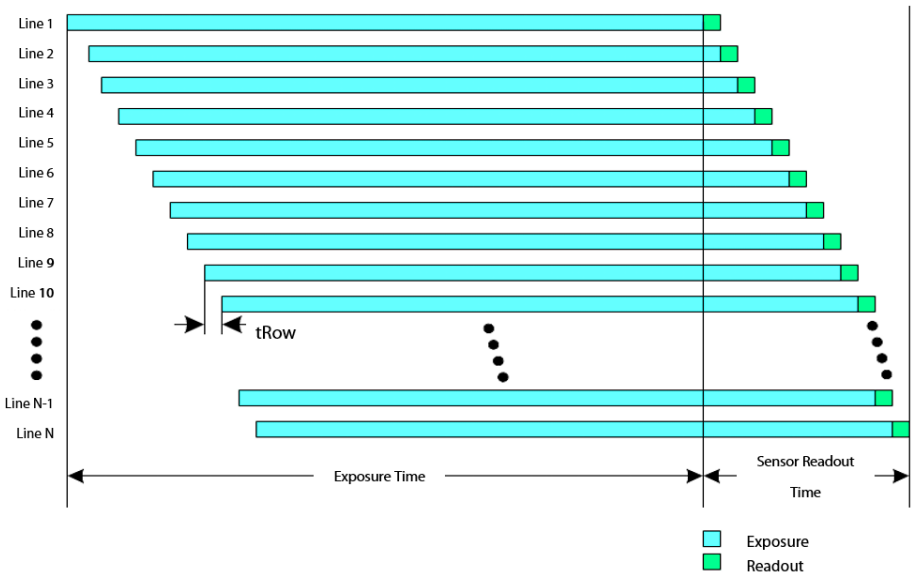
We recommend you use the global shutter mode when objects are moving quickly. This mode has no time difference in exposure and light collecting. However, the quantity limit of analog-to-digital converter (ADC) in single sensor restricts the rate of transmission and digitization for individual pixels, resulting in lower image acquisition speed and frame rates.

5.1.2 Rolling Shutter

The principle of rolling shutter is the line-by-line exposure of sensor. The sensor equips an ADC for each column of pixels, which can significantly shorten the conversion time to improve the frame rate of camera. At the beginning of exposure, the sensor scans objects line by line and performs

exposure line by line; after completing the exposure for each line, the data will be readout immediately, and after the data of current line is read, the data of next line will be read. The start time difference of exposure between two adjacent lines is the line data readout time, and the exposure time of each line equals to the readout time of each line. This cycle continues until all pixels are exposed and readout, as shown in the figure below.

Figure 5-2 Rolling shutter



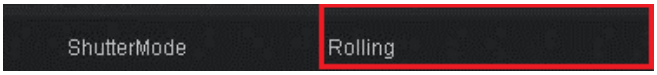
When camera scans the object when it is in the rolling shutter mode, some images will be distorted, smeared, swayed, etc. which is called Jelly Effect. Some cameras in the rolling shutter mode supports the global reset release shutter mode, and it is an optimized variant based on the rolling shutter mode. The global reset release shutter mode simulates the global exposure on the basis of rolling shutter exposure. It can expose all lines at the same time by using flash light, and end exposure from top line to bottom line which can effectively avoid the smearing, as shown in the figure below.

Figure 5-3 Global reset release shutter

For the global reset release shutter, the exposure start time of each line is the same, but the end time is different; therefore, the exposure time of each line will be slightly different.

- The supported shutter modes may vary depending on the device model and sensor. The detailed information, please refer to the corresponding technical specifications.
- The rolling shutter and global reset release shutter are both supported in some cameras, which is related to the characteristics of sensor. User can select the shutter mode in the **ShutterMode** under the **AcquisitionControl** based on your needs.

Figure 5-4 Set shutter mode



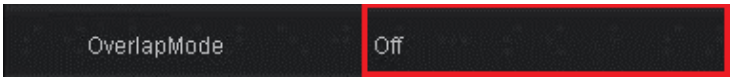
5.2 Exposure Mode

The frame acquisition process includes exposure and readout. Therefore, according to the overlapping relationship between the exposure time and readout time, the exposure modes include non-overlapped and overlapped.

The exposure mode is only available in some models, please refer to the actual conditions. User can configure the parameter of **OverlapMode** under the **AcquisitionControl**, as shown in the figure below.

Off is non-overlapped; **On** is overlapped.

Figure 5-5 Exposure mode



5.2.1 Non-overlapping Exposure

In the non-overlapping mode, camera completes the processes of exposure and data readout before starting the next frame acquisition. The new frame acquisition does not overlap any part of acquisition process of the previous frame. The diagrams of non-overlapping exposure mode in rolling mode and global mode are as follows.

Figure 5-6 Internal/External trigger non-overlapping exposure in Global mode

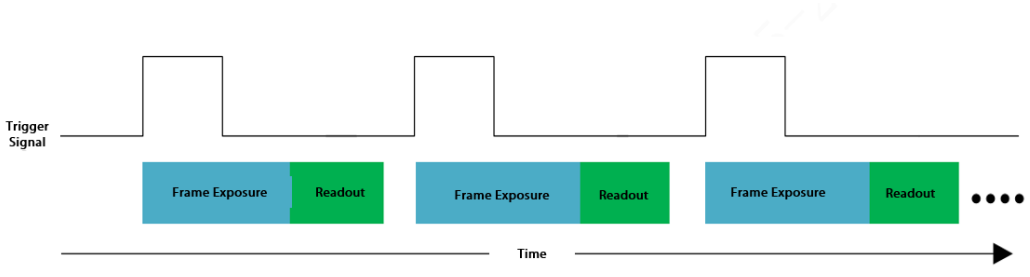
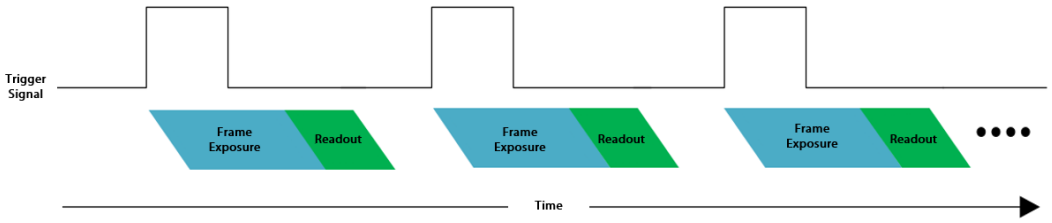


Figure 5-7 Internal/External trigger non-overlapping exposure in Rolling mode



5.2.2 Overlapping Exposure

In overlapping exposure mode, the camera starts the exposure to the next frame while camera is reading the data of previously acquired image from sensor. The diagrams of overlapped exposure mode in rolling mode and global mode are as follows.

Figure 5-8 Internal/External trigger overlapping exposure in Global mode

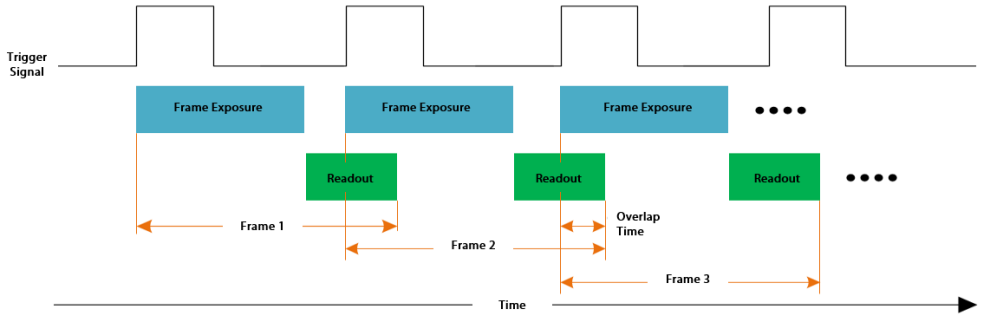
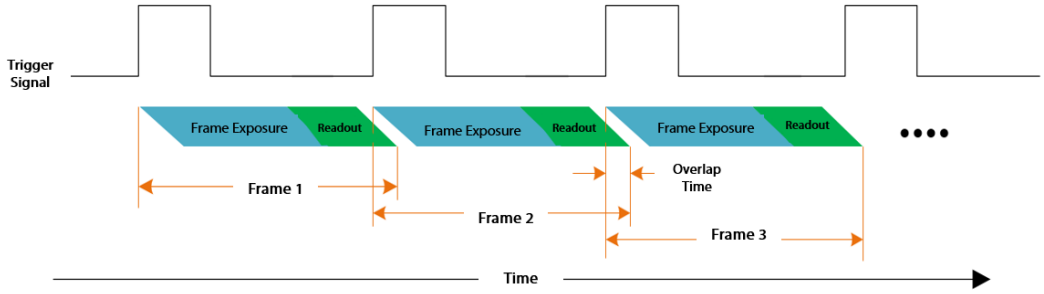


Figure 5-9 Internal/External trigger overlapping exposure in Rolling mode



Compared with non-overlapping exposure, the overlapping exposure can reduce the influence of exposure time on the image output time. The overlapping exposure frame cycle is less than or equal to the sum of the exposure time and frame readout time.

6 Image Acquisition and Data Transmission

6.1 Acquisition Mode

The options include SingleFrame, MultiFrame and Continuous.

Table 6-1 Acquisition mode description

Parameter	Description
SingleFrame	The camera only acquires one frame of image.
Continuous	• The camera keeps acquiring images. • Manual operation is required for stopping the acquiring.
MultiFrame	The number of images acquisition can be configured in the **AcquisitionFrameCount**. Range: 1~255. • The camera keeps acquiring images and stops when the number of acquired images reaches the set value. • You can manually stop acquiring before the set value is reached.

Click **AcquisitionControl** > **AcquisitionMode**to configure the acquisition mode.

Figure 6-1 Acquisition Mode

6.2 Acquisition Start and Frame Start

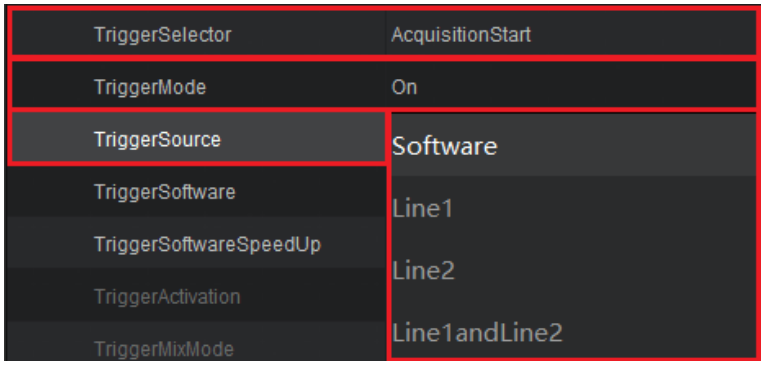
6.2.1 Acquisition Start

After the **TriggerSelector** is set to the **AcquisitionStart**, you can configure the related parameters of **FrameStart** to control the image acquisition.

The options of **TriggerMode** include **Off** and **On**. The default option is **Off**.

After the **TriggerMode** is set to **On**, user shall select the trigger source for the **AcquisitionStart** and send the corresponding trigger signals, and the related parameters of **FrameStart** should also be configured, the camera can work properly.

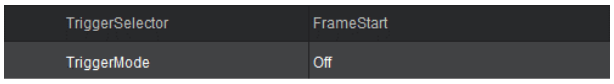
Figure 6-2 Set trigger source of the acquisition start



6.2.2 Frame Start

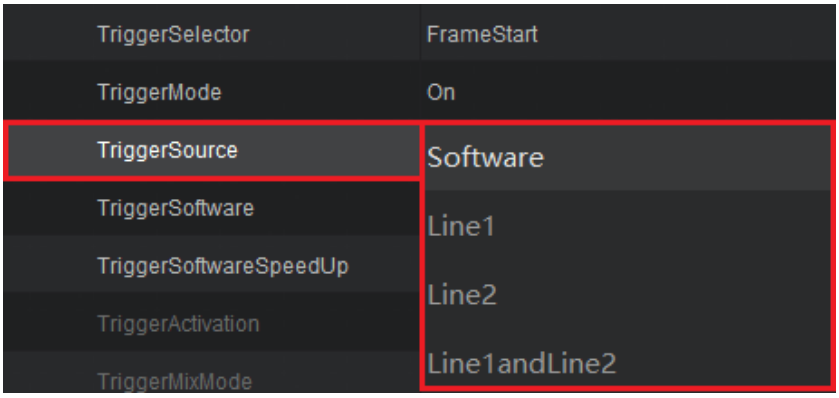
Before using the **FrameStart** , user shall set **TriggerMode** in the **AcquisitionStart** to **Off**, or set **TriggerMode** to **On** and the camera has received the trigger signals. The options in **FrameStart** include **Off** and **On**. It is **off** by default. When it is **off**, the camera will acquire images according to the set frame rate, not the trigger signals.

Figure 6-3 Set frame trigger



After setting the **TriggerMode** to **On**, user shall set the trigger source and send the trigger signals.

Figure 6-4 Set trigger source of the frame trigger



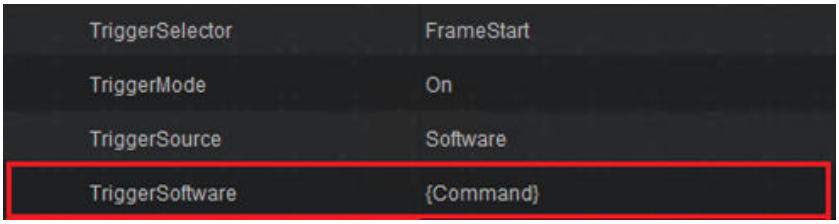
6.2.3 Trigger Parameter Settings

6.2.3.1 Trigger Source Setting

The descriptions of trigger source are as follows.

- After setting the **TriggerSource** to the **Software**, the **Command** on the right side of the **TriggerSoftware** needs to be clicked, and the software trigger command will be generated.

Figure 6-5 Software trigger command



- If the **TriggerSource** is set to the **Line1** or **Line2**, the camera will only respond to the trigger signal from the Line1 or Line2.
- If the **TriggerSource** is set to the **Line1andLine2**, the camera will respond to the trigger signal from the Line1 and Line2.

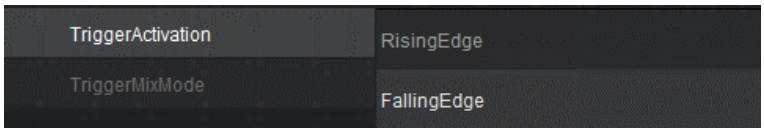
- The trigger sources may vary depending on the device model; therefore, the actual condition shall prevail.
- When the **TriggerSource** is set to the **Line1andLine2**, it is Dual Trigger mode. The details of Dual Trigger, please refer to the "6.3 Dual Trigger Mode".
- The other parameters related to the **TriggerSource** , please refer to the "6.5 Input Control and Output Control". User can sue the properties of **AcquisitionStart** and **FrameStart** to achieve the overall control of the image acquisition of camera.

6.2.3.2 Trigger Signal Activation

The descriptions of **TriggerActivation** are as follows.

- After the **TriggerSource** is set to the 'Line1' or 'Line2', user can set the **TriggerActivation** to 'RisingEdge' or 'FallingEdge', as shown in the figure below.

Figure 6-6 Set TriggerActivation



- After the **TriggerSource** is set to **Line1andLine2**, user can configure the valid edges of trigger signals of 'Line1' and 'Line2' in the **TriggerMixMode**.

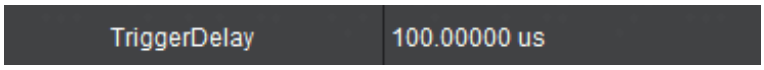
Figure 6-7 Set TriggerMixMode

6.2.3.3 Trigger Delay

User can configure the parameter **TriggerDelay** to achieve the delay effect, as shown in the figure below.

- Unit: us.
- Range: 0s~1s.

Figure 6-8 Set TriggerDelay



6.2.3.4 Trigger Signal Cache

After enabling the **TriggerCacheEnable**, camera caches the external trigger signals. The maximum cache capacity is 8. This function is for the instantaneous fluctuations in the frequency of the external trigger signal, as shown in the figure below.

Figure 6-9 Set TriggerCacheEnable

6.2.3.5 Light Trigger Delay

This function is only available after the **FrameStart** is enabled, and it delays the trigger signals of fill light. The improper value of the **LightTriggerDelay** will cause the abnormalities of light filling.

- Unit: us.

- Range: 0~1000000.

6.3 Dual Trigger Mode

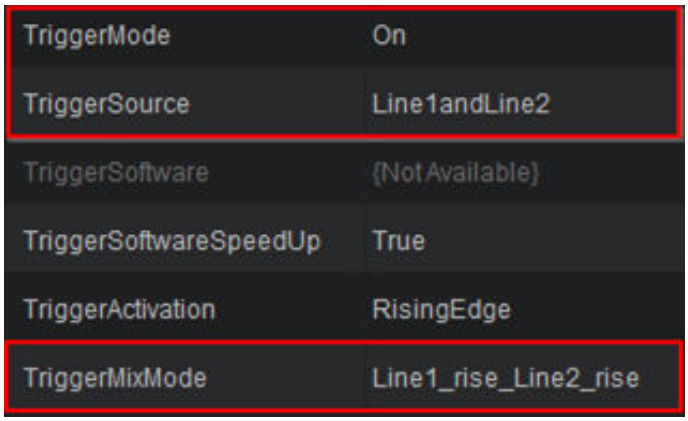
The trigger source of **Dual Trigger** can be Line1 or Line2. The dual trigger mode can be effective only when the trigger mode is enabled, and the **ExposureMode** is set to **Timed**. This mode should be used in conjunction with the **TriggerMixMode**.

Procedure

Step 1 Set the **TriggerMode** under the **AcquisitionControl** to **On**.

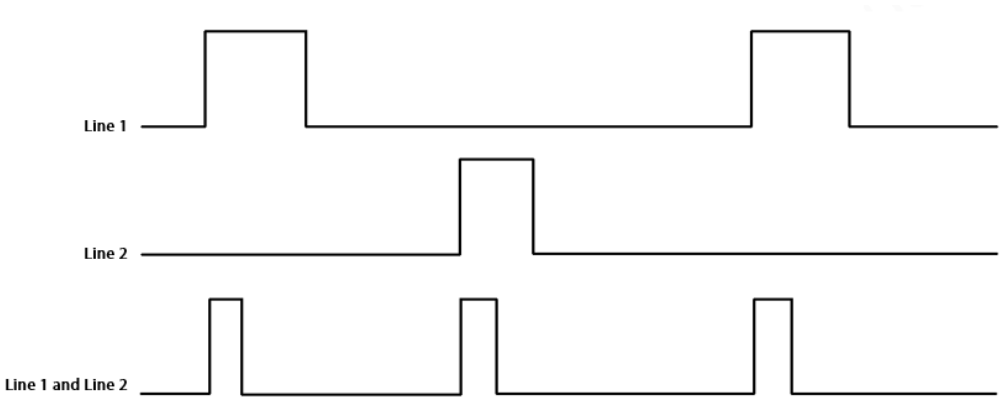
Step 2 Set the **TriggerSource** to **Line1andLine2**.

Figure 6-10 Set dual trigger mode



Step 3 Set the **TriggerMixMode** to **Line1_rise_Line2_rise**. The sequence diagram is as follows.

Figure 6-11 DualTrigger timing diagram (Line1_rise_Line2_rise)

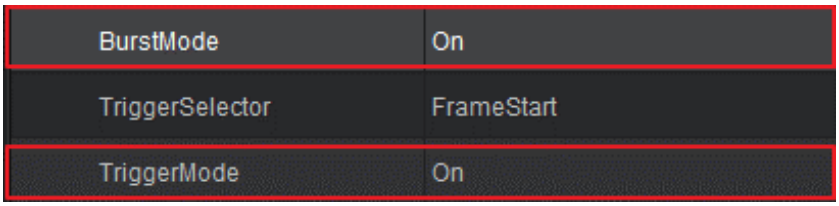


6.4 Burst Mode

The **BurstMode** is a function of making image acquisition faster and perform data transmission according to the bandwidth rate. After disabling this function, the acquisition frame rate of camera equals to the bandwidth transmission rate. When theoretical frame rate (Resulting Frame Rate) is limited by the network bandwidth, user can enable the burst mode to increase the acquisition rate, the sensor will acquire images at a higher frame rate, and the images will be stored in the DDR and be transmitted according to the transmission rate of bandwidth. If the sensor keeps acquiring images at the higher frame rate after enabling the burst mode, when the stored image capacity is greater than the DDR capacity, the image stored before will be overwritten.

User can set the **BurstMode** under the **AcquisitionControl** to **On**. This function is only available when the trigger mode is enabled.

Figure 6-12 Set burst mode

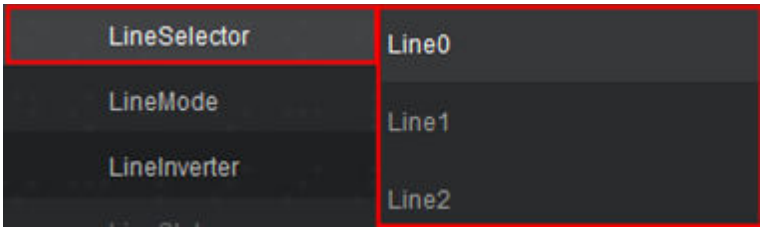


6.5 Input Control and Output Control

6.5.1 Line Selection and Line Mode

There are three I/O lines available for the camera, namely **line0 (opto-isolated output)** , **line1 (opto-isolated input)**, and **line2 (opto-isolated input or output)**.

Figure 6-13 Set LineSelector



The line0 has only the output mode. The line1 has only the input mode. The line2 has the input mode and output mode.

Figure 6-14 Set LineMode

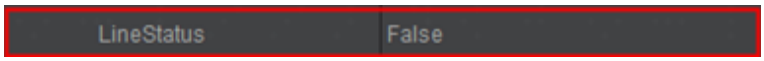
6.5.2 Level Inversion and Status Display

User can invert the level of trigger input signal or output signal in **LineInverter** , and the signal of each line can be set separately. When user set the **LineInverter** to **True**, the level of trigger input signal or output signal will be inverted, which means the high-level signal will be inverted into low-level signal. The **LineInverter** is **False** by default.

Figure 6-15 Set line inverter

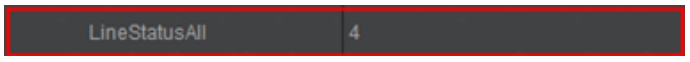
When the input signal and output signal of the selected line is low level, the **LineStatus** will be **False**; When the input signal and output signal of the selected line is high level, the **LineStatus** will be **True**. Line status is as shown in the following figure.

Figure 6-16 Line status display



The **LineStatusAll** can obtain the status of all lines, and display it in the **LineStatus**. The status display of all lines is as shown in the figure below.

Figure 6-17 Status of all lines

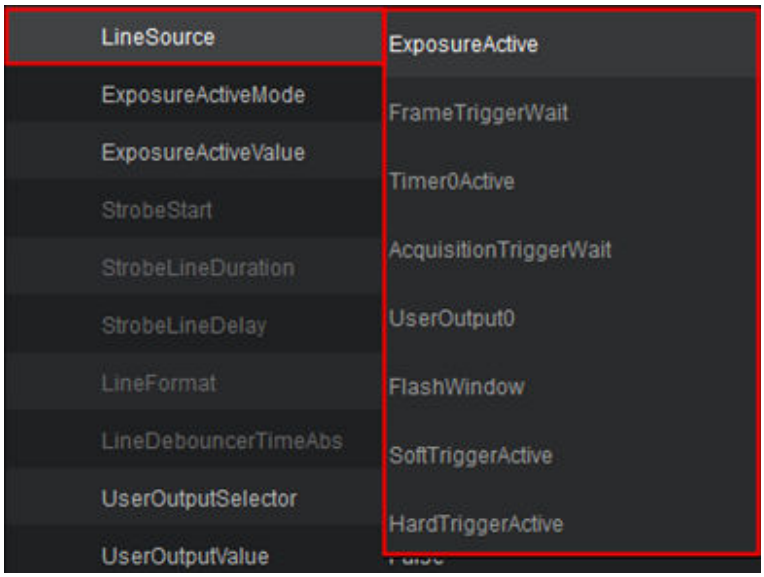


The bit0 represents the displayed status is of line0; bit1 represents the displayed status is of line1; bit2 represents the displayed status is of line2.

6.5.3 Output Line Signal Source Setting

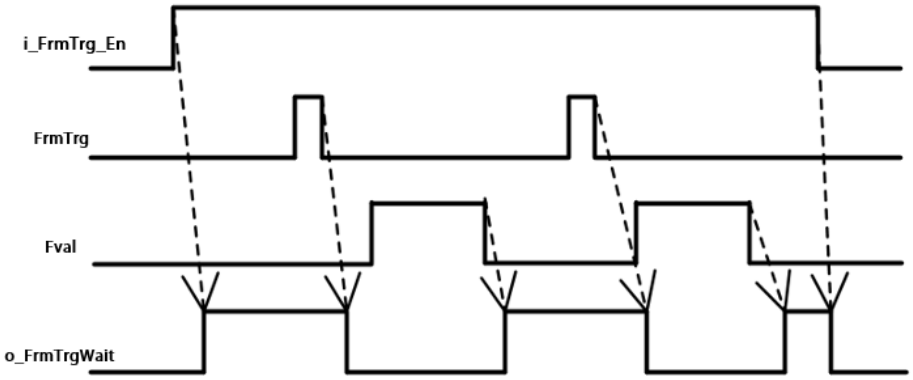
User can select the signal source of output line in the **LineSource** . When the**LineMode** is set to input, the **LineSource** is grayed out. The options of **LineSource** are shown in the figure below. Typically, when the line0 or line2, the output line, is set to the output mode, the **LineSource** is used to define the type of light filling signals.

Figure 6-18 Set LineSource



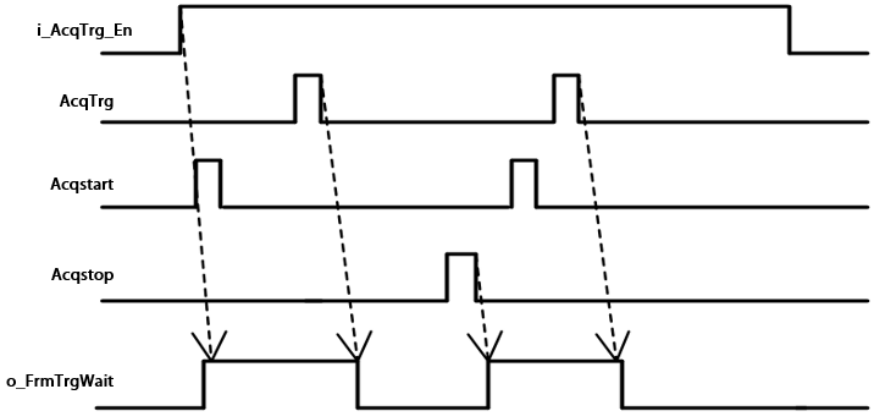
- ExposureActive: The signals will be pulled up or down in accordance with the signals that control the exposure of sensor. This means that when sensor starts exposure, the signals are pulled up; when sensor stops exposure, the signals are pulled down.
- FrameTriggerWait: The output signals are effective only when the **TriggerSelector** is set to **FrameStart**, and the **Trigger Mode** is set to **On**. The default high level is pulled down when the external trigger signal is received. After the corresponding number of frames are outputted, the low level is pulled up, as shown in the figure below.

Figure 6-19 Diagram of output line signals in frame trigger wait



- Timer0Active: To output the corresponding the pulse signals according to the user-defined timer. The detailed information about timer, please refer to the "9.2.2 Timer".
- AcquisitionTriggerWait: This output signal is effective only when the **Trigger Selector** is set to **AcquisitionStart**, and the **Trigger Mode** is set to **On**. When starting streaming, the default high level is pulled down when the external trigger signal is received. After the command of **AcquisitionStop** is received, the low level is pulled up, as shown in the figure below.

Figure 6-20 Diagram of output line signals in acquisition frame wait

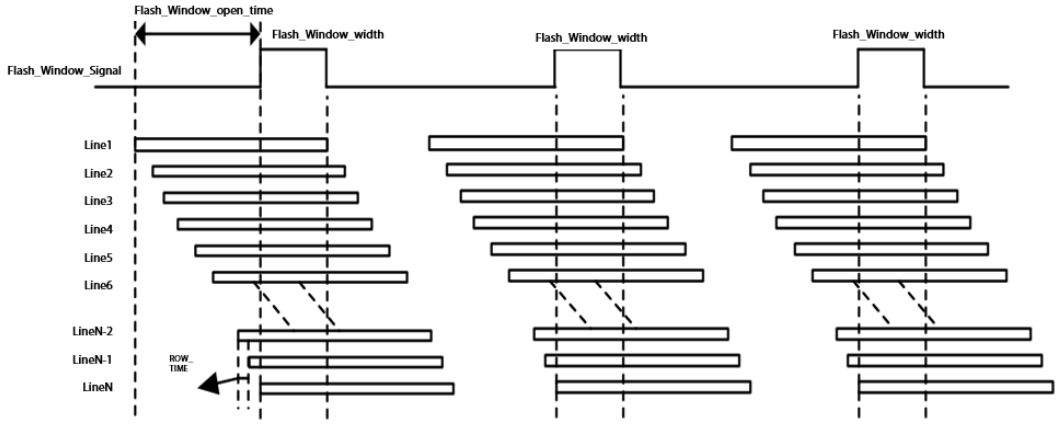


- UserOutput0/UserOutput1: The output status of the user-defined signals. The default status is low, and it should be used with the parameters of **User OutputSelector** and **UserOutputValue**. The output status is inversed when the **UserOutputValue** is set to **True**.

  Line0 corresponds to the **UserOutput0** ; Line2 corresponds to the **UserOutput1** when Line2 is defined as the output.
- FlashWindow: The camera outputs the pulse signals of all lines which are in the exposure period in the sensor during frame acquisition according to the calculation. This function is available only in the rolling shutter mode.

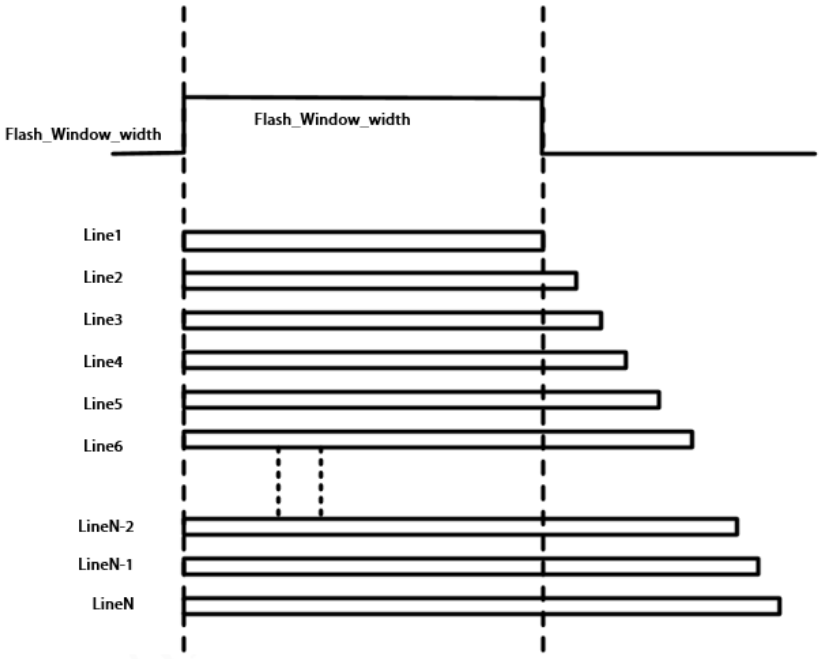
  The signal output diagram of **Flashwindow** when the **ShutterMode** is set to **Rolling** is as follows.

Figure 6-21 Signal output diagram of Flashwindow in Rolling mode



The signal output diagram of **Flashwindow** when the **ShutterMode** is set to **GlobalResetRelease** is as follows.

Figure 6-22 Signal output diagram of Flashwindow in GlobalResetRelease mode



- SoftTriggerActive: When the signals of **StrobeStart** take effect, it outputs the corresponding pulse signals to the external device through I/O interface according to the generated event.
- HardTriggerActive: When the hardware trigger signals take effect, it outputs the corresponding pulse signals to the external device through I/O interface according to the generated event.

The relevant variables and formulas are described in the table below. For detailed information about the Strobe configurations, please refer to "6.5.4 Strobe Module".

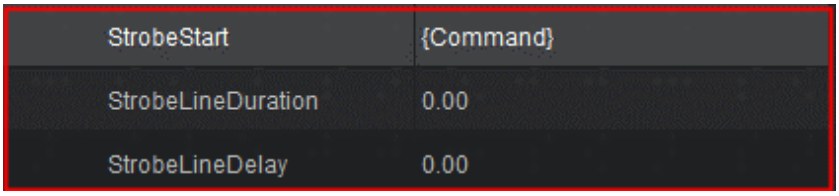
Table 6-2 Variable and formula description

Variable	Formula
Flash_Window_open_time	ROW_TIME (row readout time) x (ROI Height - 1)
Flash_Window_width	Exposure time - ROW_TIME (row readout time) x (ROI Height - 1)
Min.exposure time for flash window in rolling shutter mode	Exposure time > ROW_TIME (row readout time) x (ROI Height - 1)

6.5.4 Strobe Module

The related parameters of strobe module are as shown in the figure below.

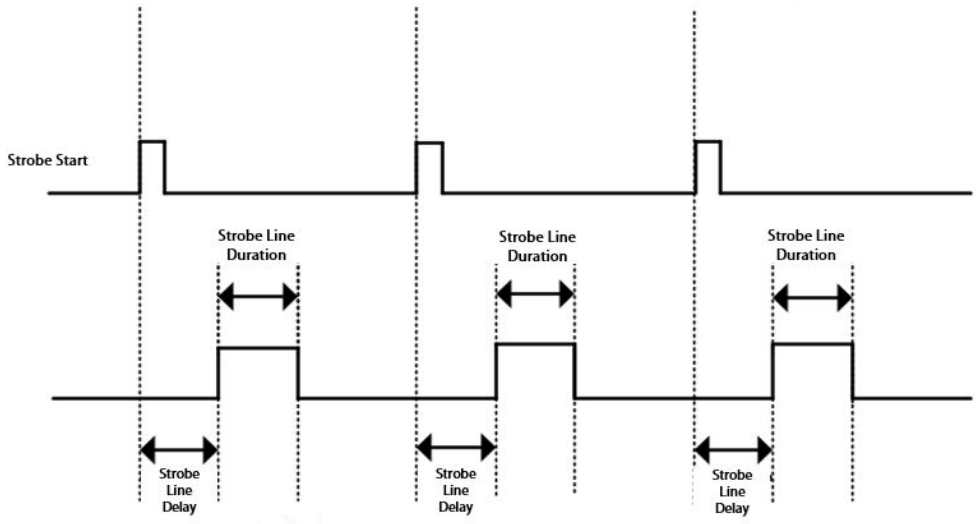
Figure 6-23 Set strobe module



- After the **LineSource** is set to the **SoftTriggerActive**, when you click the **Command** in **StrobeStart**, it will generate an event of **SoftTriggerActive**, and then output the strobe signals of the corresponding pulse to the external devices through I/O interface according to the configured values of the **StrobeLineDuration** and **StrobeLineDelay**, as shown in the figure below.

The value range of **StrobeLineDuration** and **StrobeLineDelay** is 0us~1000000us.

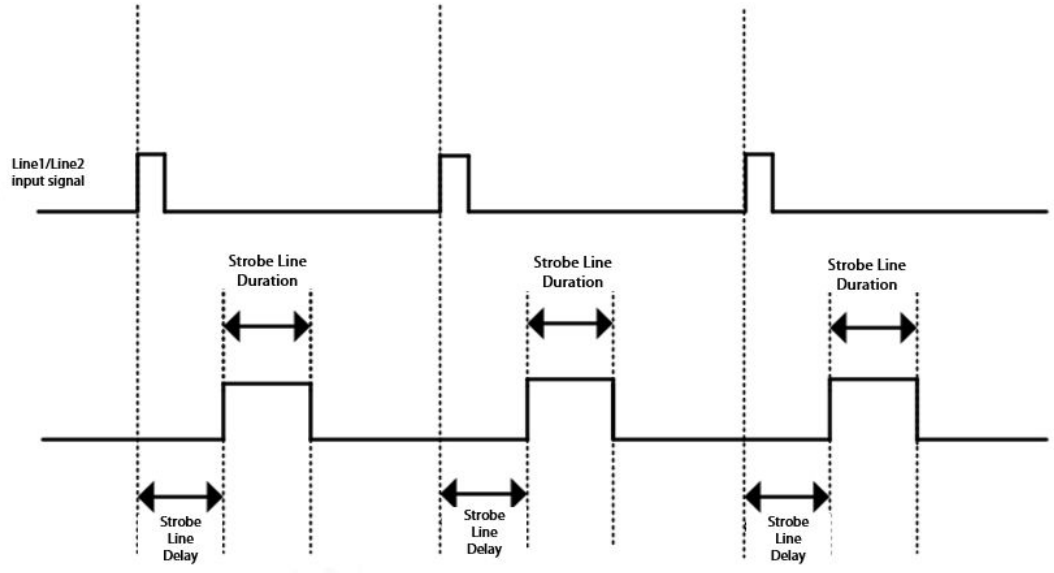
Figure 6-24 Diagram of strobe signals in software trigger



- After the **LineSource** is set to the **HardTriggerActive**, the **StrobeStart** will be grayed out. When the input signals of hardware trigger (Line1 or Line2) take effect, it will generate an event of **HardTriggerActive**, and then output the strobe signals of the corresponding pulse to the

external devices through I/O interface according to the configured values of the **StrobeLineDuration** and **StrobeLineDelay**.

Figure 6-25 Diagram of strobe signals in hardware trigger



6.5.5 Fill Light Mode and Time Setting

User can select the light mode in the **ExposureActiveMode** , and this function is available only when the **LineSource** is **ExposureActive**.

Figure 6-26 Set ExposureActiveMode

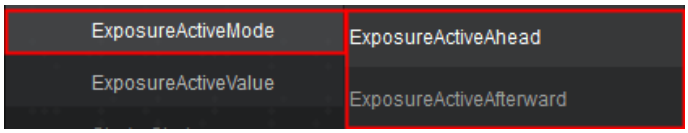
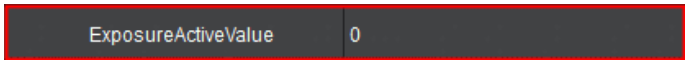


Figure 6-27 Set ExposureActiveValue



- The **ExposureActiveAhead** refers to light filling being performed in advance, while the **ExposureActiveAfterward** refers to the light filling is performed later.
- User can set the advance time or delay time in the **ExposureActiveValue**. The parameter range is 0us~10000us, and the default value is 0.

The following diagrams are the sync light filling, advance light filling and delayed light filling.

Figure 6-28 Sync light filling

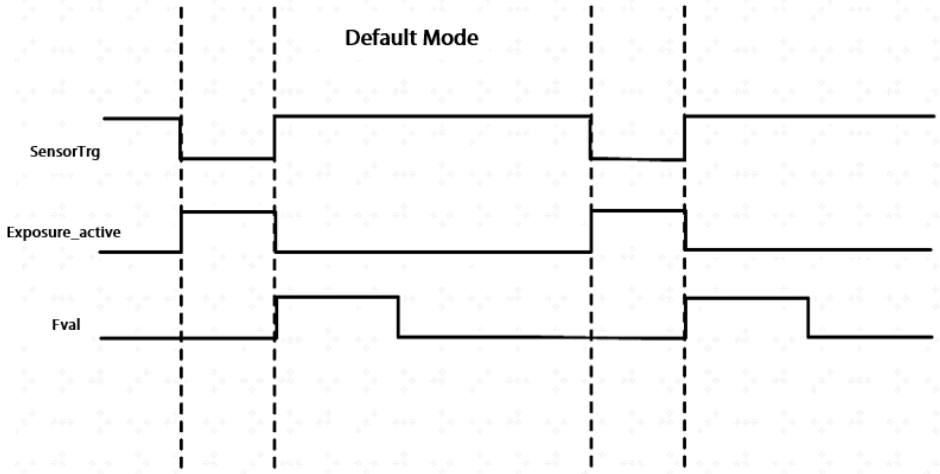


Figure 6-29 Advance light filling

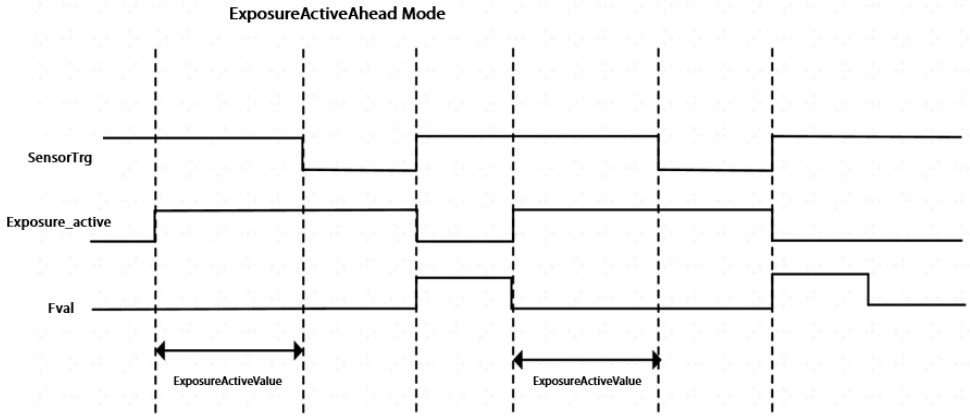
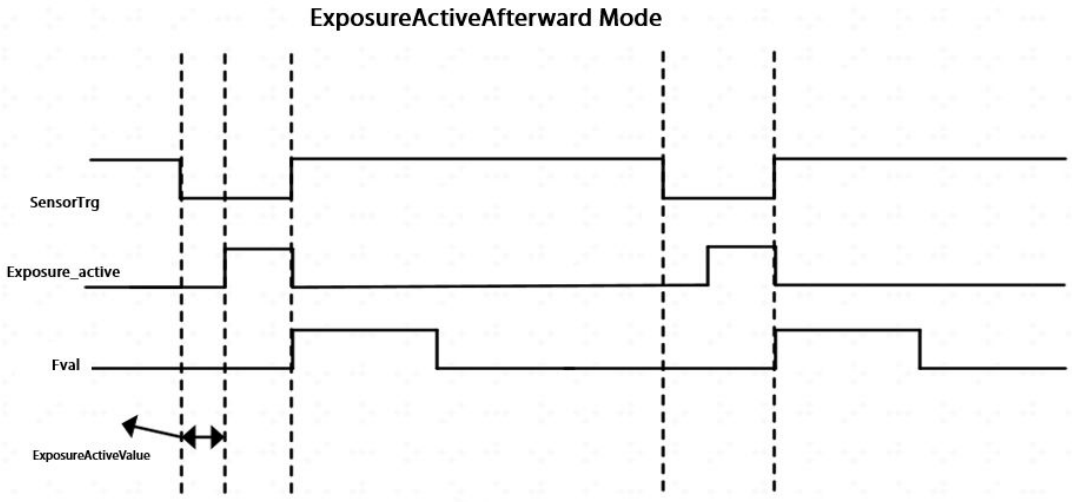


Figure 6-30 Delayed light filling

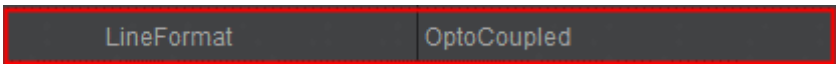


6.5.6 Hardware Line Type and Filtering

6.5.6.1 Hardware Line Definition

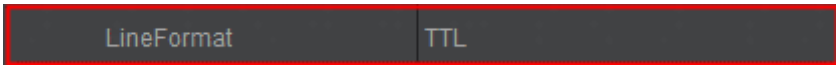
When the **LineSelector** is set to the **Line0** or **Line1**, the **LineFormat** is defined as the **OptoCoupled** automatically, as shown in the figure below.

Figure 6-31 OptoCoupled type



When the **Line Selector** is set to the **Line2**, **LineFormat** is defined as the **TTL** automatically which can be configured as input or output.

Figure 6-32 TTL type



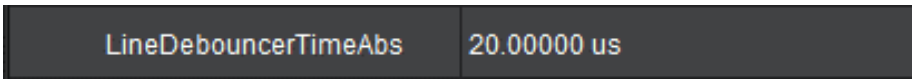
6.5.6.2 Filtering

User can set the parameters of filtering in the **LineDebouncerTimeAbs** . This function is effective only when the **LineMode** is set to **input**, which means that the **LineSelector** is set to **line1**, or the **LineSelector** is set to **line2** and in the **input** mode.

The signal glitches in the external trigger signals may cause the false triggering of camera. The parameter **LineDebouncerTimeAbs** can filter out the signal glitches that the cameras do not need.

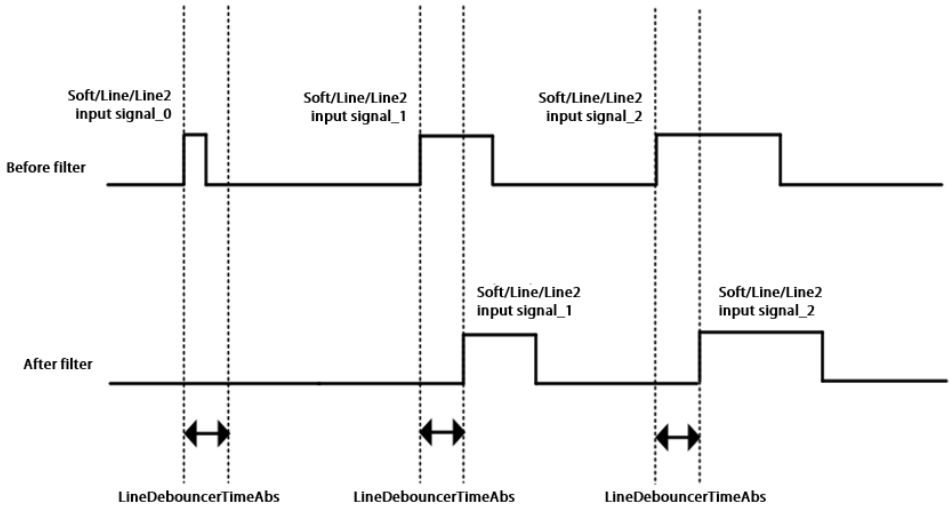
User can find the **LineDebouncerTimeAbs** under the **DigitalIOControl**. The value range is 0μs~1000000μs (0s~1s).

Figure 6-33 Set LineDebouncerTimeAbs



When the time value of **LineDebouncerTimeAbs** is greater than that of trigger signals, the trigger signals will be ignored. The timing sequence diagram is as follows.

Figure 6-34 Filtering and trigger signal timing sequence diagram



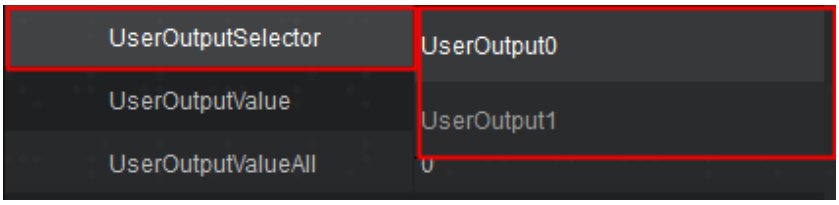
6.5.7 User Output Selection

The parameters **UserOutputSelector** is effective only when the **LineMode** is set to **output**, which means that the **LineSelector** is set to **line0**, or the **LineSelector** is set to **line2** and in the **output** mode.

The options of **UserOutputSelector** include **UserOutput0** and **UserOutput1**.

- When the LineSelector is line0 and the LineSource is UserOutput0, the UserOutput0 is the user-defined output signals of line0.
- When the LineSelector is line2 and the LineSource is UserOutput1, the UserOutput1 is the user-defined output signals of line2.

Figure 6-35 Set UserOutputSelector



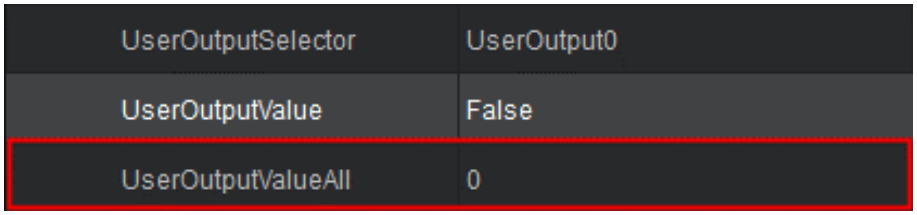
The default value of **UserOutputValue** is **False**. When it is set to **True**, the user-defined value will be performed the negation operation, that is, '0' becomes '1'. The **UserOutputValue** is as shown in the figure below.

Figure 6-36 Set UserOutputValue (1)

The **UserOutputValueAll** can obtain the status of all user-defined signals, and implement numeric display based on 2-bit binary encoding. The **UserOutputValue** is as shown in the figure below.

The bit0 refers to the status of UserOutput0; bit1 refers to the status of UserOutput1.

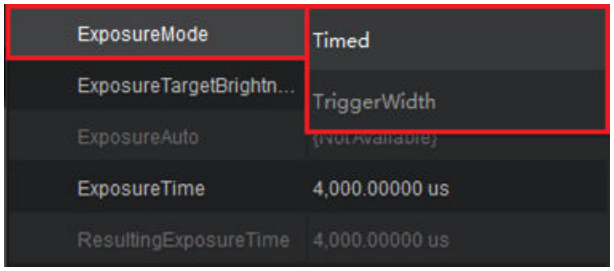
Figure 6-37 Set UserOutputValue (2)



6.6 Exposure

The exposure time can be configured through the modes of **Timed** and **TriggerWidth** in the **ExposureMode**.

Figure 6-38 Exposure mode selection



- Timed: The exposure time is controlled by the set values in the **ExposureAuto** and **ExposureTime**.
- TriggerWidth: The exposure time is controlled by the duration of level signal. In this mode, the parameters of **ExposureAuto** and **ExposureTime** will be invalid.

  The TriggerWidth mode is available when the **TriggerMode** is on, and the **TriggerSource** is **Line1** or **Line2**.

The exposure modes are **Off** , **Once**, and **Continuous**. The descriptions of exposure modes are in the list below.

Table 6-3 Exposure modes description

Parameter	Description
Off	To adjust the exposure based on the set value in the **ExposureTime**.
Once	Run the auto exposure once for a period and then stops based on the environment.
Continuous	Automatically and continuously adjust the exposure according to the environment.

ResultingExposureTime is for displaying the current exposure time of camera in real time.

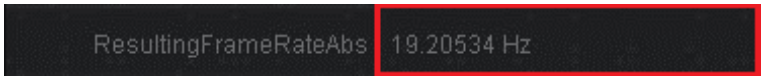
The range of exposure time value may vary depending on the device model, please refer to the corresponding technical specifications.

6.7 Resulting Frame Rate

Frame rate is an important metric of a camera, and it represents the number of images the camera outputs per second. The higher the frame rate, the smoother the video streaming; the lower the frame rate, the more stuck the video streaming, and the more obvious the jumping change of image content.

ResultingFrameRateAbs refers to the supported frame rate of camera based on the current parameters and transmission rate.

Figure 6-39 Set ResultingFrameRateAbs



The value in the **ResultingFrameRateAbs** depends on the following factors.

Table 6-4 Influential factors description

Item	Description
Resolution	The higher resolution means that one frame of image includes more pixels, larger data amount and lower frame rate of the transmission.
Pixel Format	The byte size of the pixels may vary depending on the different image formats. The larger the byte size, the larger the data amount and the lower the frame rate of camera.
Exposure Time	The exposure process as a part of imaging can be controlled by users. The longer the exposure time, the lower the frame rate.
Frame Readout Time	The frame readout time as a part of imaging is limited by sensor. The longer the readout time, the lower the frame rate.
Bandwidth	The bandwidth determines the upper limit of the frame rate. The greater the bandwidth, the more data can be transmitted per unit time, resulting in a higher frame rate.
Lossless Compression	After enabling the lossless compression, the video streaming data amount can be reduced, which can increase the frame rate to a certain extent.

- iRAYPLE cameras give priority to the exposure time, which means that if the exposure time is greater than the reciprocal of frame rate, it will give priority to reducing the frame rate instead of limiting the maximum exposure time.
- If the lossless compression function is enabled, the images after performing lossless compression must be analyzed with the MV Viewer.

The detailed procedures of setting the maximum frame rate of camera are as follows.

Procedure

Step 1 Stop streaming.

Step 2 Set the value of frame rate in the **AcquisitionFrameRate** under the **AcquisitionControl**.

Step 3 Set the **AcquisitionFrameRateEnable** under the **AcquisitionControl** to **True**. If the user-defined value of **AcquisitionFrameRate** is less than the value of **ResultingFrameRateAbs**, the value of **AcquisitionFrameRate** will be updated as the value of **ResultingFrameRateAbs**.

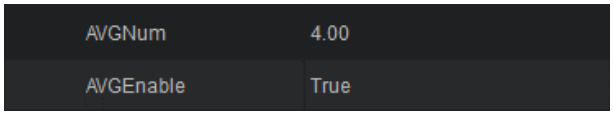
Step 4 Start streaming, as shown in the figure below.

Figure 6-40 User-defined maximum frame rate

6.8 Multi-Frame Average

The multi-frame average performs average on multiple images produced by sensor to improve the image quality. After enabling this function, the frame rate will be reduced to the previous 1/N. The 'N', an integer, is the number of the images which are averaged. The related parameters of multi-frame average are shown in the figure below.

Figure 6-41 Set multi-frame average

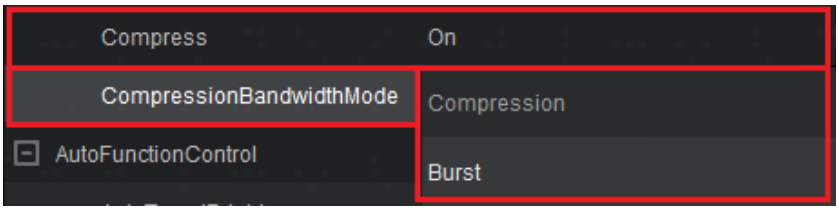


6.9 Lossless Compression

After enabling the lossless compression, the camera performs the lossless compression on the acquired images according to the complexity of the scene to reduce the data amount transmitted on the network. Therefore, it can increase the maximum transmission rate while the transmission bandwidth remains unchanged.

This function can be used with burst mode to further improve the instantaneous frame rate of the camera. The related parameters of lossless compression are shown in the figure below.

Figure 6-42 Set lossless compression



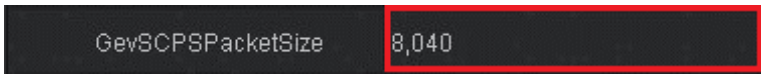
6.10 Packet Size

The packet size indicates the size of data packet in stream channel between the camera and host PC. User can configure the packet size properly to optimize the network performance which can reduce the transmission delay and improve the throughput ensuring the reliability of data transmission.

The parameter of **GevSCPSPacketSize** is under the **TransportLayerControl**. During camera initialization, the packet size negotiation will be performed between PHY chip of camera and the

network card of host PC, and the negotiation result will be default value of the **GevSCPSPacketSize**.

Figure 6-43 Packet size parameter



- The maximum packet size of standard Ethernet frame is 1500 bytes; therefore, when the value needs to be larger than the 1500, the jumbo frame function should be enabled.
- For high-latency network, user can reduce the packet size to reduce the transmission delay; for high-bandwidth network, user can increase the packet size to reduce the data transmission intensity and improve the throughput.

6.11 Packet Interval

User can enable this function to control the bandwidth at which the camera transmits the image stream data. The packet interval means that it inserts the idle clocks between the adjacent data packets transmitted in the stream channel, and each clock creates an 8ns interval. Increasing the packet interval can reduce the occupancy on the network bandwidth from the camera, and probably lower the acquisition rate of the camera.

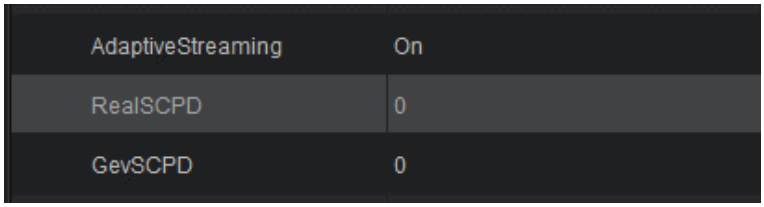
Figure 6-44 Packet Interval formula

$$T\_delay = Delay\_pkt * 8\text{ns}$$

T_delay means the packet delay time; *Delay_pkt* means the packet interval, i.e., SCPD.

User can set the packet interval in the **GevSCPD** under the **TransportLayerControl**.

Figure 6-45 Set packet interval



User also can set the **AdaptiveSreaming** to **On** to optimize the data transmission process. After configuring this parameter, the value displayed in the **RealSCPD** is the actual SCPD value of the device.

6.12 Frame Transmission Delay

User can delay the sending time of the first packet of image data in the **GevSCFTD**, as shown in the figure below.

It is 0 by default, and the value range is 0ns~1250000000ns.

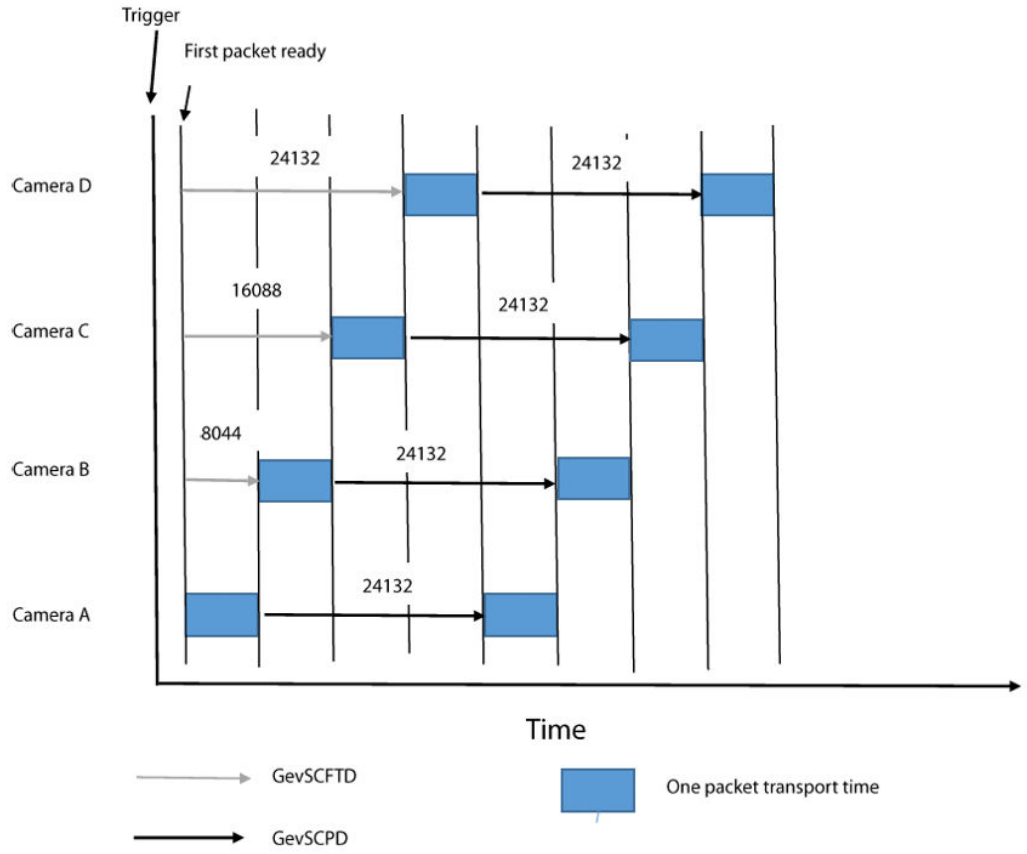
Figure 6-46 Set GevSCFTD

GevSCFTD	0

If one switch is connected with multiple cameras at the same time, when these cameras send GVSP stream data packets to the switch simultaneously after receiving the trigger signals at the same time, the network card will bear much instantaneous network pressure. If the configuration of network card is not high enough for this situation, the retransmission and drop frames may occur. User can use **GevSCFTD** to set different FTD value for every camera to stagger the data packet sending times to reduce the instantaneous network pressure.

Usually, we recommend you set the FTD value as the size of a gvsp packet. Take **GevSCPSPacketSize** is 8044 as an example, if one switch is connected with four cameras including Camera A, Camera B, Camera C and Camera D, the **GevSCFTD**values of these four cameras should be 0, 8044, 10688 and 24132, and the **GevSCPD**value of four cameras should be 24132, as shown in the figure below.

Figure 6-47 Diagram of stagger the data packet sending times for 4 cameras

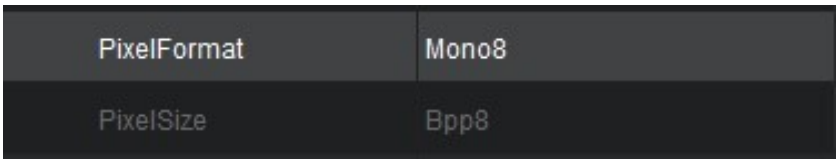


7 Pixel Format and Image Processing

7.1 Pixel Bit

The pixel bits of different pixel formats may vary. Take the pixel format **Mono8** as an example, the pixel bit of it is as follows.

Figure 7-1 Pixel bit of Mono8 format



The pixel bits of different pixel formats of GigE area scan camera are described in the table below.

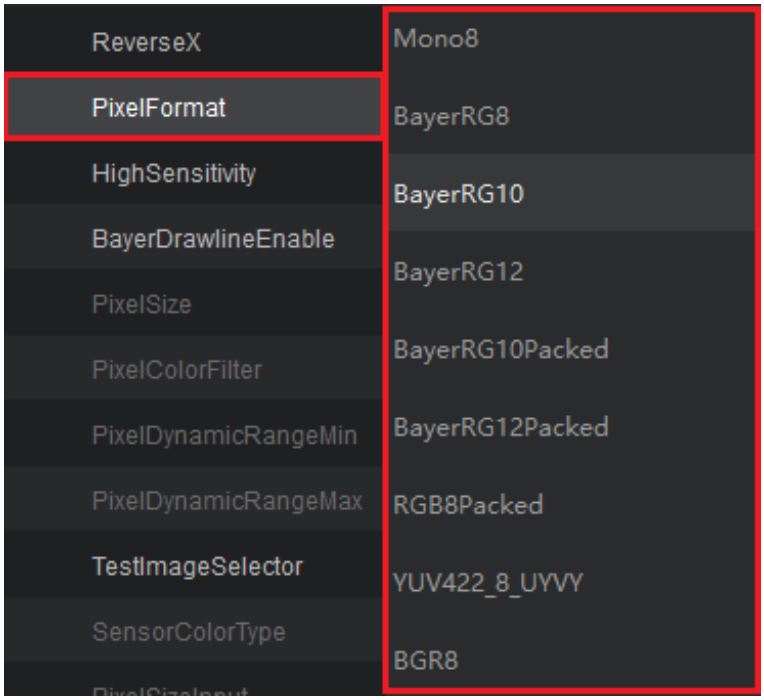
Table 7-1 Pixel Format and Pixel Bit

Format	Size (bits/pixel)
Mono 8, Bayer 8	8
Mono 10 Packed, Mono 12 packed, Bayer 10 Packed, Bayer 12 packed	12
Bayer 10, Bayer 12, YUV422_8_UYVY, YUV422_8	16
RGB8, BGR8	24

7.2 Pixel Format

The GigE area scan camera supports many pixel formats. Different models and configurations have different pixel formats. For more details, please refer to the technical specifications. The pixel format selection in MV Viewer is shown in the figure below.

Figure 7-2 Set pixel format



The pixel format patterns of color camera in MV Viewer are as follows.

Figure 7-3 BayerRG pixel pattern

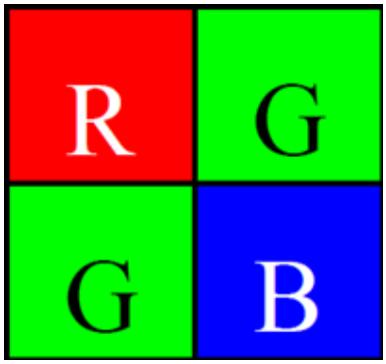


Figure 7-4 BayerBG pixel pattern

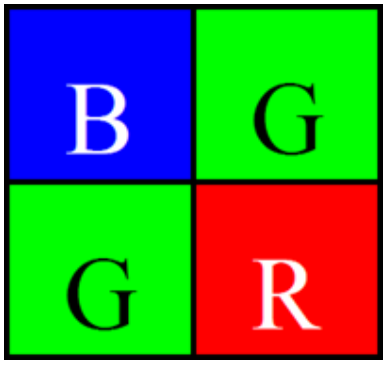


Figure 7-5 BayerGR pixel pattern

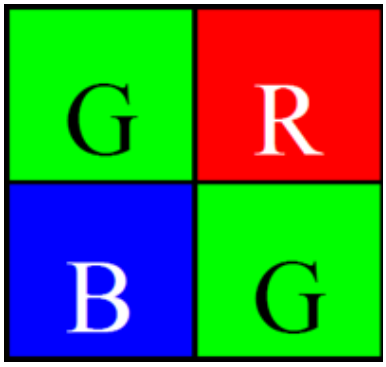
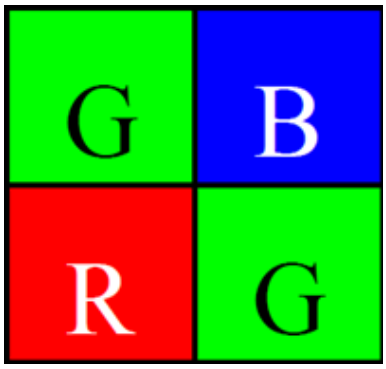


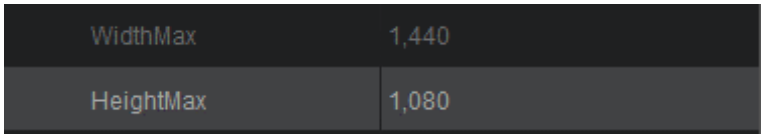
Figure 7-6 BayerGB pixel pattern



7.3 Resolution and ROI

The image will be produced at the maximum resolution under the default configuration of the camera. The maximum resolution of camera can be checked in the parameters of **WidthMax** and **HeightMax** under the **ImageFormatControl**. See the following figure:

Figure 7-7 Maximum resolution

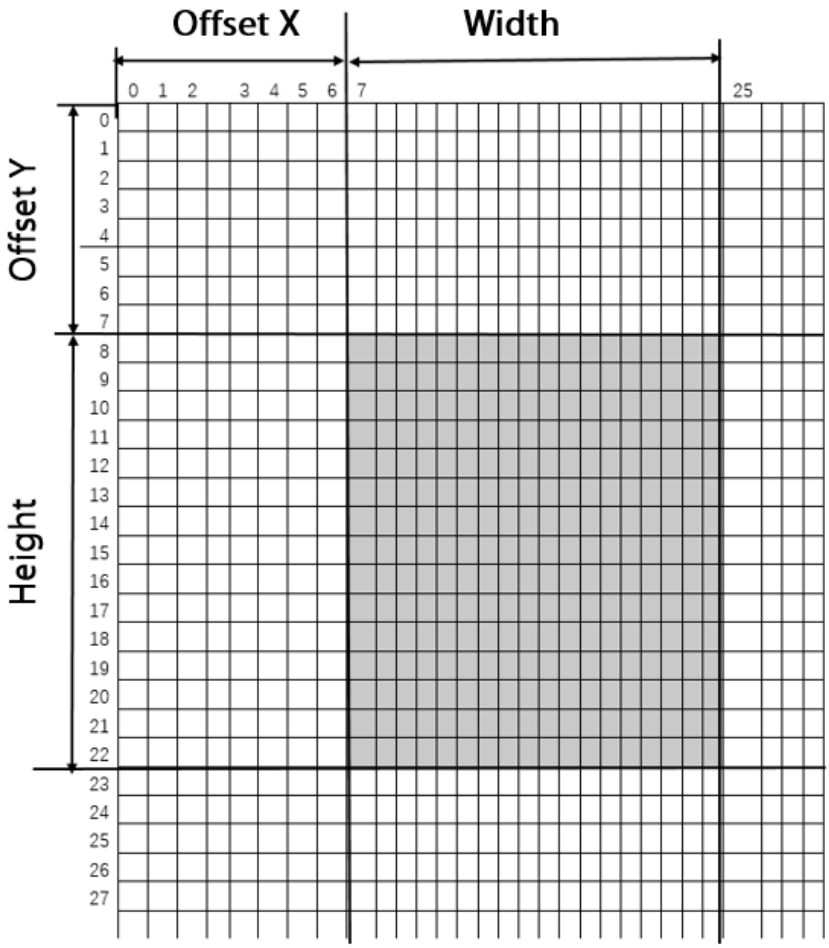


- **WidthMax** means that the maximum resolution of camera at the width direction.
- **HeightMax** means that the maximum resolution of camera at the height direction.

ROI (Region of Interest) allows users to specify a certain part of the image by adding the recognition frame box and to output the pixel information of the specified recognition area. See the following figure:

The location and size of the ROI can be defined by configuring the parameters including **OffsetX** , **OffsetYWidth**, and **Height**.

Figure 7-8 ROI configuration diagram



User can configure the following four parameters under the **ImageFormatControl** to draw a ROI.

Figure 7-9 Parameters of ROI description

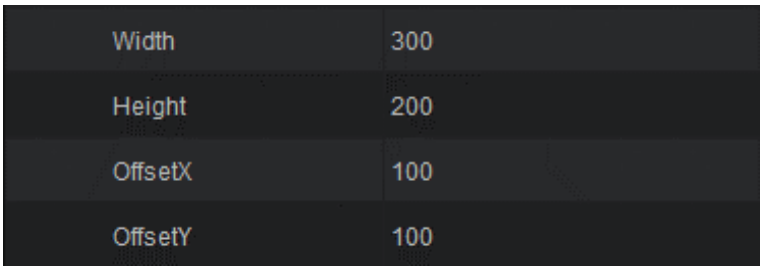


Table 7-2 Description

Parameter	Description
Width	The resolution of the ROI at the X direction.
Height	The resolution of the ROI at the Y direction.
OffsetX	The X coordinate of the starting point in the upper left corner of the ROI.

Parameter	Description
OffsetY	The Y coordinate of the starting point in the upper left corner of the ROI.

- The sum of **Width** and **OffsetX** shall not greater than the **WidthMax**.
- The sum of **Height** and **Offset Y** shall not greater than the **HeightMax**.
- The stepping of parameters mentioned above may vary depending on the device model. Please refer to the actual parameters on your software client.

7.4 Binning

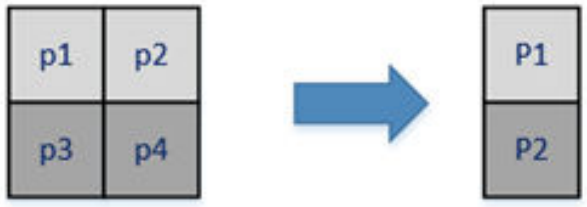
The binning function can merge multiple pixels into one pixel, which means it can lower the resolution and improve the image brightness or signal-to-noise ratio while the scene of image remains unchanged.

7.4.1 Mono Camera

7.4.1.1 Set Binning to 2 in Horizontal

For the mono cameras, when user set the **Binning** to '2' in horizontal direction, the 'p1' and 'p2' are merged to generate the pixel 'P1'; the 'p3' and 'p4' are merged to generate the pixel 'P2', as shown in the figure below.

Figure 7-10 Diagram of set binning to 2 in horizontal



7.4.1.2 Set Binning to 2 in Vertical

For the mono cameras, when user set the **Binning** to '2' in vertical direction, the 'p1' and 'p3' are merged to generate the pixel 'P1'; the 'p2' and 'p4' are merged to generate the pixel 'P2', as shown in the figure below.

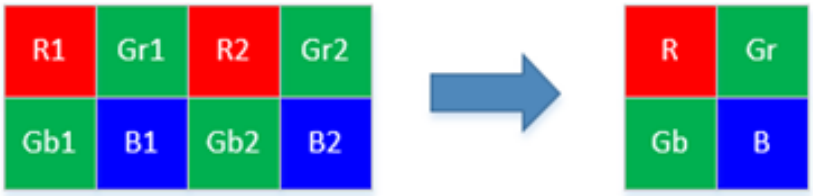
Figure 7-11 Diagram of set binning to 2 in vertical

7.4.2 Color Camera

7.4.2.1 Set Binning to 2 in Horizontal

For the color cameras, when user set the **Binning** to '2' in horizontal direction, the 'R1' and 'R2' are merged to generate the pixel R; the 'Gr1' and 'Gr2' are merged to generate the pixel 'Gr'; the 'Gb1' and 'Gb2' are merged to generate the pixel 'Gb'; the 'B1' and 'B2' are merged to generate the pixel 'B', as shown in the figure below.

Figure 7-12 Diagram of set binning to 2 in horizontal



7.4.2.2 Set Binning to 2 in Vertical

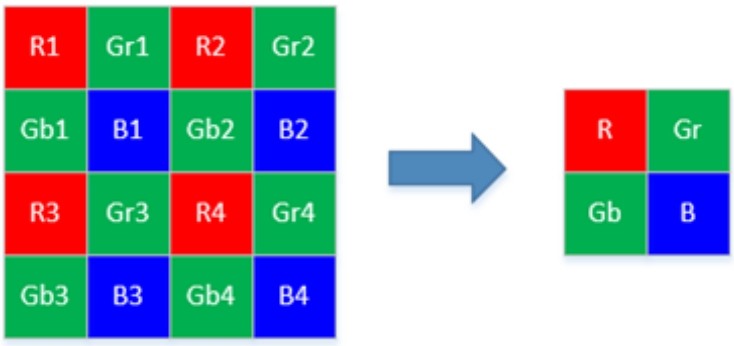
For the color cameras, when user set the **Binning** to '2' in vertical direction, the 'R1' and 'R2' are merged to generate the pixel R; the 'Gr1' and 'Gr2' are merged to generate the pixel 'Gr'; the 'Gb1' and 'Gb2' are merged to generate the pixel 'Gb'; the 'B1' and 'B2' are merged to generate the pixel 'B', as shown in the figure below.

Figure 7-13 Diagram of set binning to 2 in vertical

7.4.2.3 Set Binning to 2 in Horizontal and Vertical

For color cameras, when user set the **Binning** to '2' in horizontal and vertical directions, the 'R1' 'R2' 'R3' and 'R4' are merged to generate the pixel 'R', and so on to generate other pixels.

Figure 7-14 Diagram of set binning to 2 in horizontal and vertical



7.4.3 Binning Mode and Mode Combination

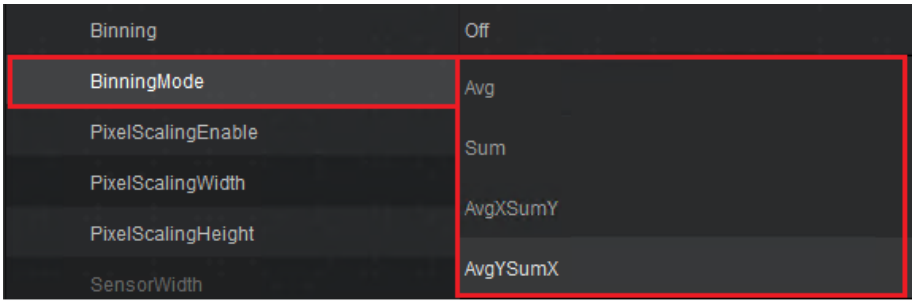
There are four modes of **Binning**, which are described in the table below.

Table 7-3 Binning mode description

Mode	Description
Avg	Average
Sum	Summation
AvgXSumY	To average the pixels at the horizontal direction; to sum the pixels at the vertical direction.
AvgYSumX	To sum the pixels at the horizontal direction; to average the pixels at the vertical direction.

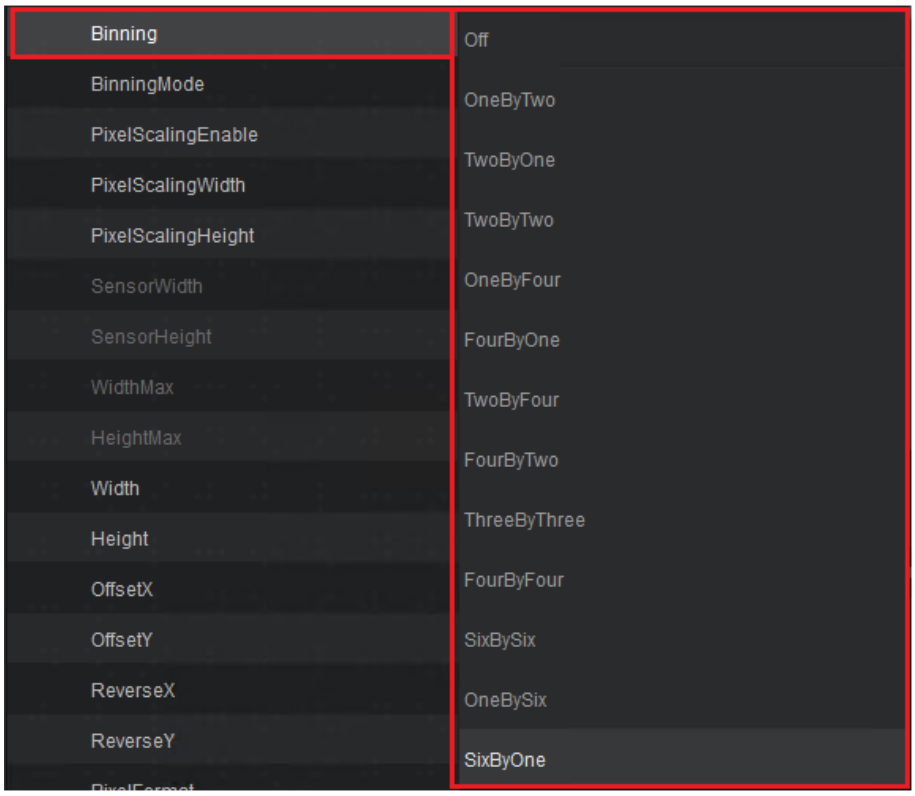
The parameter of **BinningMode** is shown in the figure below.

Figure 7-15 Set Binning mode



There are a variety of combinations in horizontal and vertical directions to choose from the **Binning**.

Figure 7-16 Binning combinations



some combinations shown in the figure above may not be supported in some device models. The actual conditions shall prevail.

7.5 Scaling

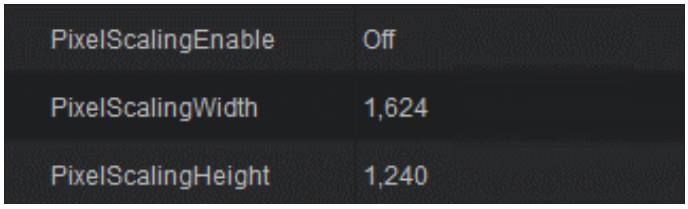
The scaling function combines the adjacent pixels by algorithm while the FoV of image is unchanged, effectively reducing the image resolution and increasing the frame rate. User can set the scaling in the **ImageFormatControl**.

Procedure

Step 1 Set the **PixelScalingEnable** to **On** to enable scaling function.

Step 2 Set the target resolution after image reduction in the **PixelScalingWidth** and **PixelScalingHeight**.

Figure 7-17 Set scaling



The scaling function is available in some models only, so the actual condition shall prevail.

7.6 Mirroring

The mirroring modes include the X-axis and Y-axis, and user can set the mirroring mode in the **ReverseX** and **ReverseY** under the **ImageFormatControl**.

Figure 7-18 Set mirroring mode

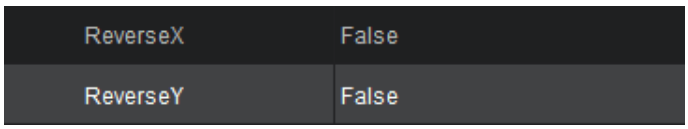


Table 7-4 Mirroring modes description

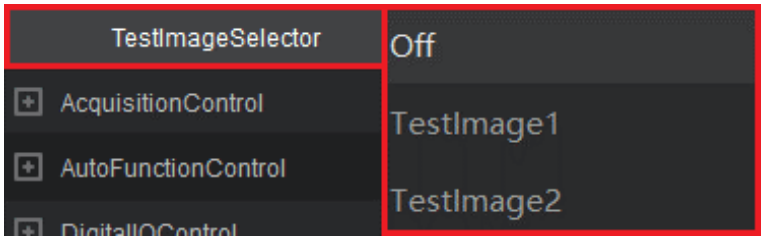
Parameter	Description
ReverseX	To mirror the image in X-axis (horizontal).
ReverseY	To mirror the image in Y-axis (vertical)

The scenes before and after performing the mirroring function is unchanged in the ROI mode. The actual condition shall prevail.

7.7 Test Image

User can enable test image function, and select image pattern to troubleshoot abnormalities. The test image function is disabled by default. User can select different test image in the **TestImageSelector** under the **ImageFormatControl**. See the following figure:

Figure 7-19 Select test image



The test images displayed in the below may vary depending on the device model, please refer to the actual condition.

Figure 7-20 Test image 1

Figure 7-21 Test image 2

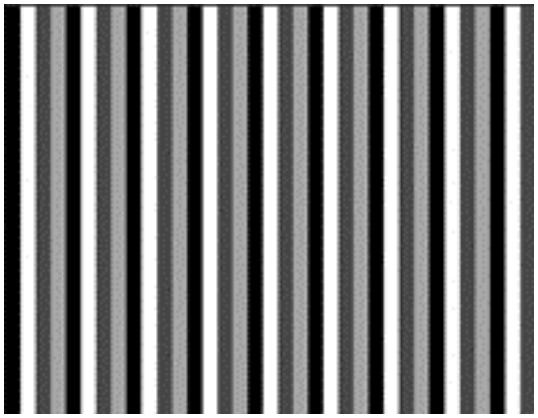


Figure 7-22 Test image 3

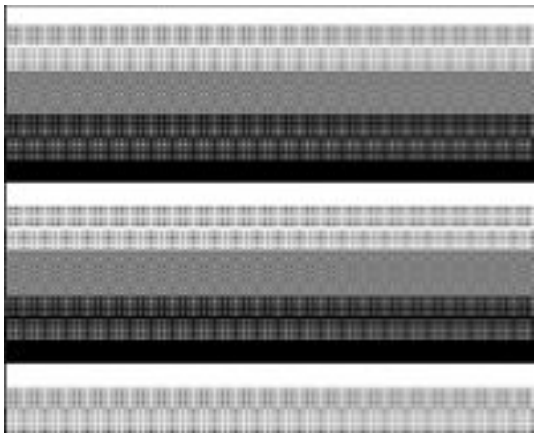


Figure 7-23 Test image 4

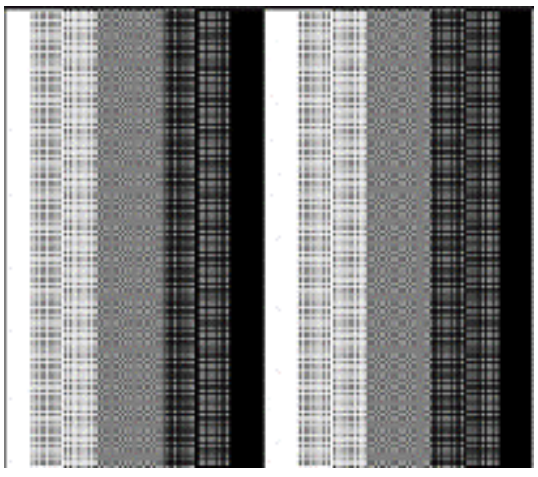


Figure 7-24 Test image 5

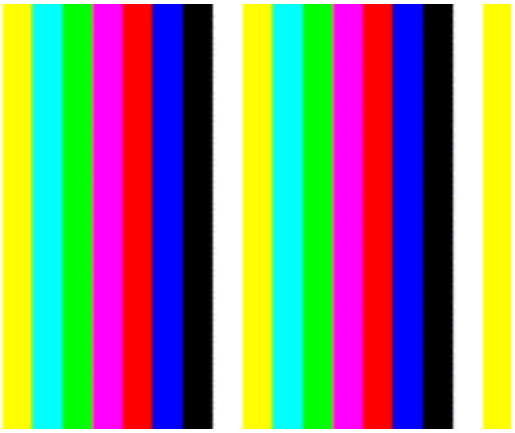
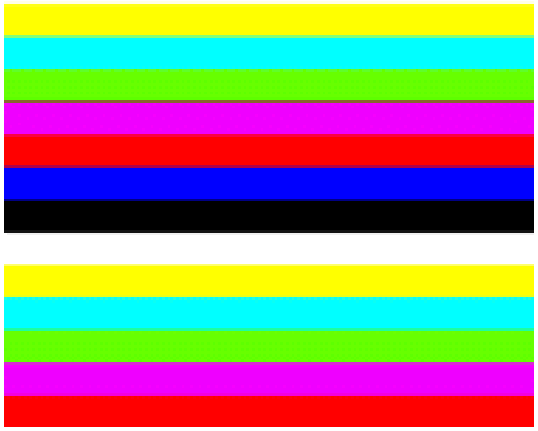


Figure 7-25 Test image 6



7.8 Gain

The gain function includes analog gain and digital gain. The analog gain can amplify the analog signals outputted by sensor, and the digital gain can amplify the signals after converting analog signals to digital signals. The greater the gain value, the higher the brightness of image, and the image noise will be increased, which affects the image quality. If you need to increase the image brightness, we recommend you increase the exposure time of camera first. If the increase of exposure time does not meet your demand, you can increase the gain value. The following diagrams display the image effect when the gain value is 1 and 2.

Figure 7-26 Image effect when gain value is 1

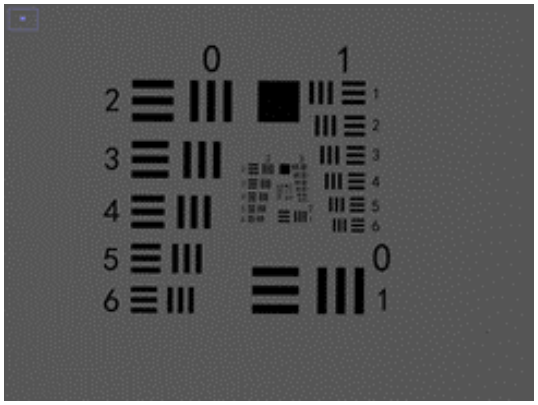
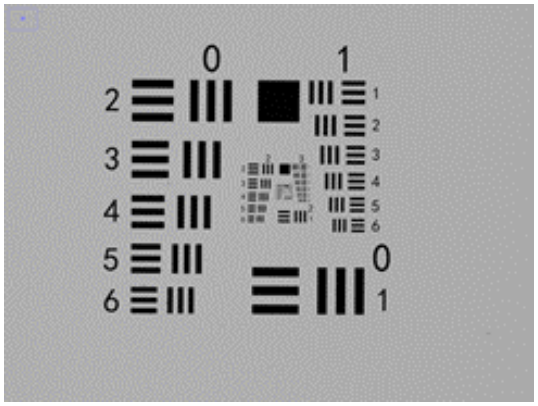


Figure 7-27 Image effect when gain value is 2



7.8.1 Total Gain

The parameter **GainRaw** is the total gain of camera, which includes analog gain and digital gain. For example, when you set the **GainRaw** as the '6.4', the total gain is 6.4 times, of which the analog gain is 3.2 times and the digital gain is 2 times. After setting the **GainRaw**, camera automatically matches the closest analog gain, ensuing that the camera uses the analog gain first.

7.8.2 Auto Gain

The gain modes include **Off** , **Once** and **Continuous**. The descriptions of gain modes are shown in the table below.

Figure 7-28 Gain mode

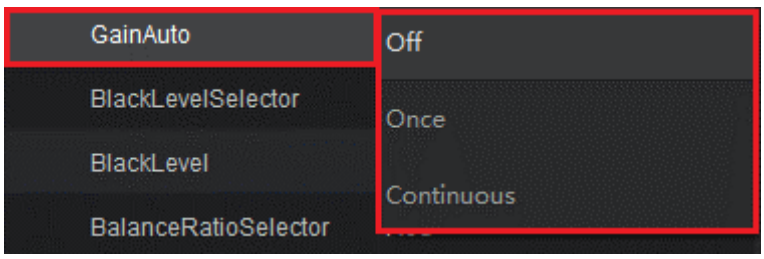


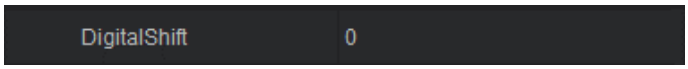
Table 7-5 Gain mode description

Parameter	Description
Off	Adjust the gain based on the set value of **GainRaw**.
Once	Run the auto gain once for a period and then stops according to the environment.
Continuous	Automatically and continuously adjust the gain according to the environment.

7.8.3 Digital Gain

The **DigitalShift** is the digital gain, which is disabled by default. The parameter range is 0~4. For example, if you set the value as X, the digital gain will be 2^X. The larger the value, the brighter the image and the more noise. User can configure the value in the parameter of **DigitalShift** under the **ISPControl**.

Figure 7-29 Digital Shift



7.8.4 Brightness

GigE area scan camera supports another way to adjust the digital gain, namely **Brightness** . The parameter range is 0~100, and the default value of 50 means one times gain. User can enter the non-integral number to adjust the brightness of image in **Brightness** under the **ISPControl**.

Figure 7-30 Set brightness

7.9 Black Level

Black level helps you adjust the gray value offset of the output data. The gray value offset determines the average gray value when the sensor is not sensitive. Different ADC bit depth modes corresponds to different black level parameter range of the camera. The actual condition shall prevail. If you need to configure the black level manually, the procedures are as follows.

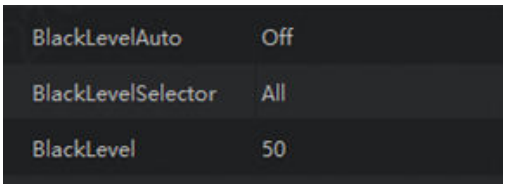
Procedure

Step 1 Set the **BlackLevelAuto** under the **AnalogControl** to **Off**.

Step 2 Enter the black level value in the **BlackLevel**, which is for eliminating the influence of sensor dark current.

The relevant parameters of black level are as shown in the figure below.

Figure 7-31 Set BlackLevel



The options of black level include **Off** , **Once** and **Continuous**, the details are described in the table below.

Table 7-6 Black Level description

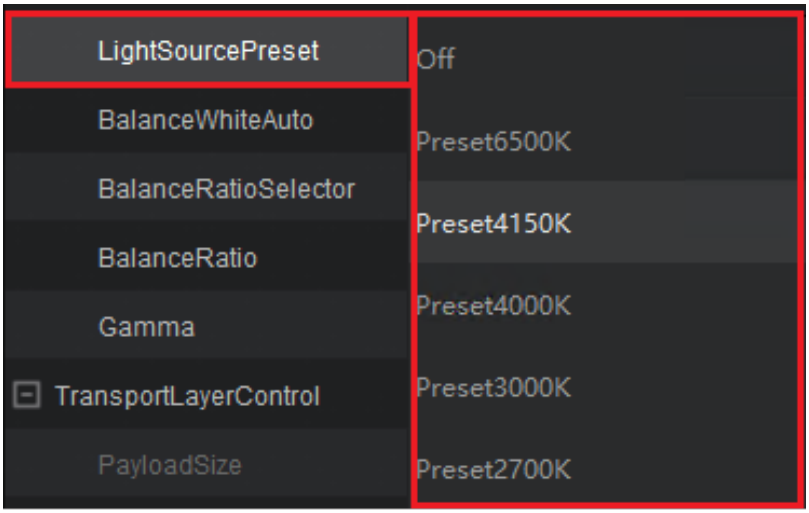
Parameter	Description
Off	Adjust the black level based on the set value of **BlackLevel**.
Once	Run the auto black Level once for a period and then stops according to the environment.
Continuous	Automatically adjust the black level according to the environment.

- The default values of black level may vary depending on the device models, the actual condition shall prevail.
- The black level will change with the temperature rising; therefore, we recommend you obtain the black level value when the temperature is constant.

7.10 Light Source Preset

The light sources of camera with different color temperatures are preset, and they are related to the functions of white balance, gamma correction, CCM, etc. User can set the **LightSourcePreset** under the **AnalogControl**.

Figure 7-32 Set light source preset



The light source preset is available in some models only. The actual condition shall prevail.

7.11 White Balance

The images obtained by color camera in different light source environments may have color cast. For example, the images are too blue under fluorescent lamp, and too yellow under incandescent lamp. The reason is that different light sources have different color temperatures. To ensure the white area of image can remain white at different color temperature, the color camera supports the white balance function. This function corrects the color cast by adjusting the intensity of red R, green G and blue B. User can configure these three parameters in the **WhiteBalance** under the **AnalogControl**.

The modes of white balance include Off, Once and Continuous.

Table 7-7 White Balance mode description

Parameter	Description
Off	User can manually debug the values of Red, Green, Blue in the **BalanceRatioSelector** and **BalanceRatio**.
Once	Runs white balance adjustment automatically for a period and then stops based on the current situation.
Continuous	Automatically adjust the white balance according to the environment.

When the color effect of the image is different from the actual situation, you can enable the white balance to calibrate it. The detailed procedures are as follows.

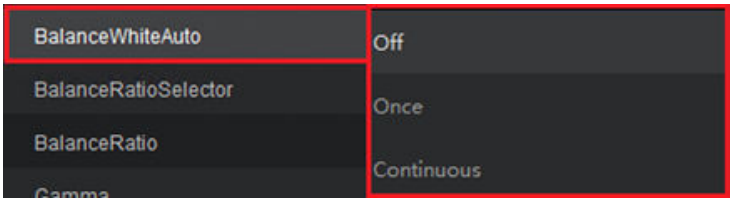
Procedure

Step 1 Prepare one white paper and put it within the camera's FoV, so that the white paper fills the whole field of view.

Step 2 Set the exposure gain preferentially. The recommend range of image brightness is 80~160.

Step 3 Set the **BalanceWhiteAuto** to the **Continuous** or **Once** to perform the auto white balance correction, as shown in the figure below.

Figure 7-33 Set BalanceWhiteAuto



After finishing the procedures above, if the corrected effect is still different from the actual condition, you can perform white balance correction manually. The detailed procedures are as follows.

Step 4 Set **BalanceWhiteAuto** to **Off**, that is, manual mode.

Step 5 Find the value of R, G, and B components, which are 1.0 in **BalanceRatio**, and observe the values of R/G/B and then adjust the values of other two components to make channels of R, G, and B of the image consistent. At this time, the white balance of image should be consistent with the actual condition.

- After the white balance correction is completed, we recommend you save the user-defined parameters to avoid the parameters reset after restarting the camera.

- If the light source and color temperature in the environment are changed, you need to readjust the white balance.

7.12 Gamma Correction

The most output of sensor is liner with the light intensity irradiating on the photosensitive surface of chip, however, the gamma correction is a non-liner mapping, which makes the original image outputted from sensor more in line with the perception of the human eye after gamma correction. The mapping relationship of gamma correction can be expressed by the formula in the below.

Figure 7-34 Gamma correction formula

$$Y_{corrected} = \left(\frac{Y_{uncorrected}}{Y_{max}}\right)^{\gamma} \times Y_{max}$$

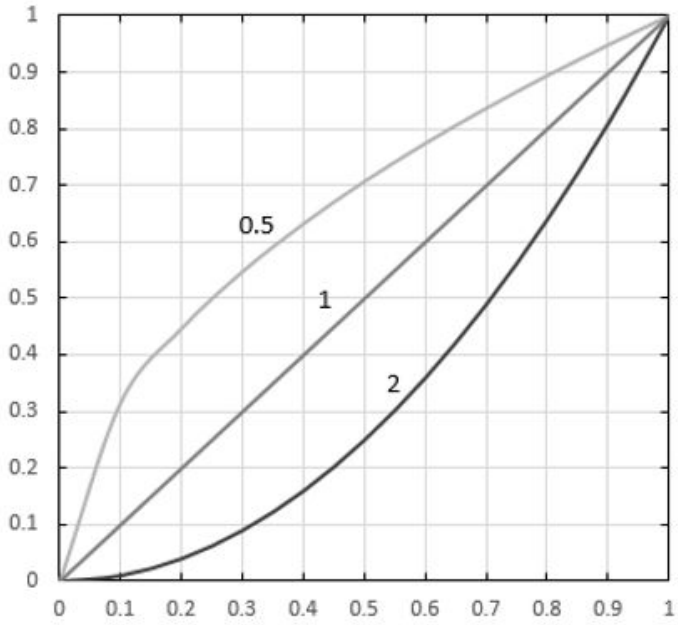
The parameter of **Gamma** is under the **AnalogControl**. The value range is 0~3.99998, as shown in the figure below.

Figure 7-35 Set gamma correction

Gamma	0.45455

When the value of gamma is '1', the image brightness remains unchanged; when the value of gamma is between '0' and '1', the image brightness is increased; when the value of gamma is greater than '1', the image brightness is lowered, as shown in the chart below.

Figure 7-36 Gamma correction line chart



7.13 Sharpness

The sharpness function can adjust the sharping degrees of edges of contents in image to improve the image clarity. The detailed procedures of setting sharpness are as follows.

Procedure

Step 1 Enable or disable the sharpness function in the **SharpnessEnabled** under the **ISPControl**.

Step 2 After enabling the sharpness function, you can set the values in the **Sharpness**. The value range is 0~100, as shown in the figure below.

Figure 7-37 Set Sharpness

7.14 Denoise

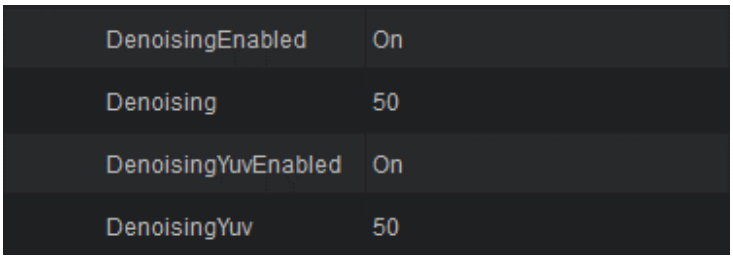
Some devices support denoise function, which can reduce the image noises to achieve the edge-preserving smoothing and improve signal-to-noise ratio and image quality. The detailed procedures of setting denoise are as follows.

Procedure

Step 1 Enable or disable the denoise function in the **DenoisingEnabled** or **DenoisingYuvEnabled** under the **ISPControl**.

Step 2 After enabling the denoise function, you can set the values in the **Denoising** or **DenoisingYuv**. The value range is 0~100, as shown in the figure below.

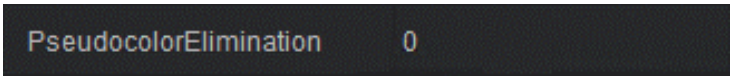
Figure 7-38 Set denoise



7.15 Pseudocolor Elimination

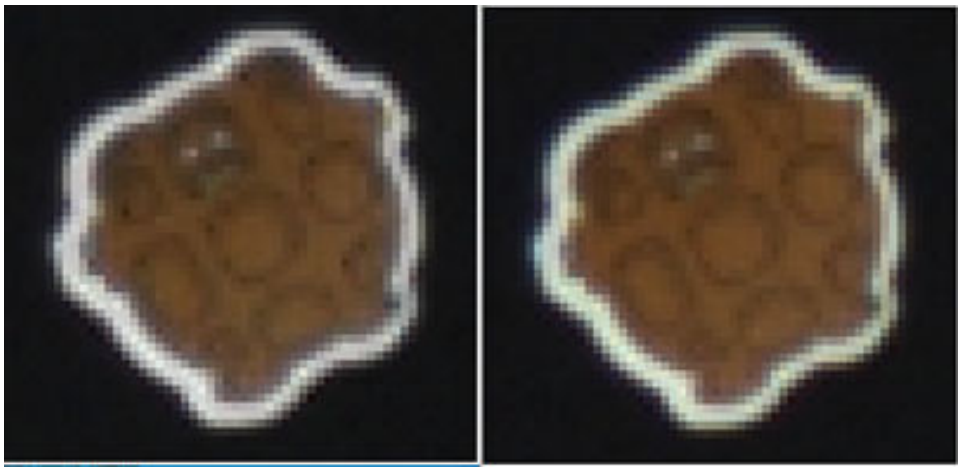
The pseudocolor elimination can solve the “edge false colors” problem caused by lens refraction or other lights, and solve the color cast problem caused by the algorithm, such as interpolation, etc. Therefore, this function can effectively reduce the color error in the image to improve the color fidelity and image definition. User can set the value in the **PseudocolorElimination** under the **ISPControl**.

Figure 7-39 Set pseudocolor elimination



User can set the value of pseudocolor elimination in the **PseudocolorElimination**. The diagrams of pseudocolor elimination effects when value is 10 and 0 are as follows.

Figure 7-40 Diagrams of pseudocolor elimination effects when value is 10 and 0



- The pseudocolor elimination is available in some models only. The actual device shall prevail.
- The pseudocolor elimination is only available in RGB, BGR, Bayer and YUV pixel formats of color camera.

7.16 Hue and Saturation

User can adjust the hue and saturation to the overall color of image produced by color camera in the **Hue** and **Saturation** under the **ISPControl**, as shown in the figure below.

Figure 7-41 Set hue and saturation

The diagram of effect comparison of different hues is as follows.

Figure 7-42 Diagram of effect comparison of different hues

The diagram of effect comparison of different saturations is as follows.

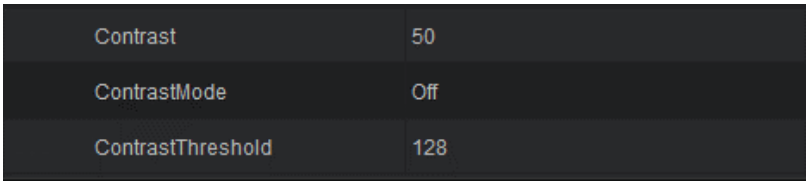
Figure 7-43 Diagram of effect comparison of different saturations

The hue and saturation are available in some models only. The actual device shall prevail.

7.17 Contrast

The **Contrast** is supported by some camera models. This function can adjust the difference level between the light and dark areas in the image. The greater the contrast, the more pronounced the difference. The **Contrast** is in the **ISPControl**, as shown in the figure below.

Figure 7-44 Parameters of contrast



User can adjust the difference level of contrast in **Contrast**.

User can set the contrast mode in **ContrastMode**, the contrast modes are described in the following table.

Table 7-8 Contrast mode description

Parameter	Description
Off	It will adjust the contrast based on the set value of **Contrast**.
Once	Automatically adjust the contrast once for a period and then stops according to the environment.
Continuous	Automatically and continuously adjust the contrast according to the environment.

User can set the transition points of stretching and compression for adjusting the image contrast in **ContrastThreshold**.

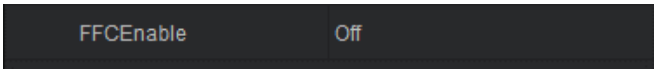
- The contrast function is available in some models. The actual device shall prevail.
- The auto-contrast function is available for mono model devices.
- The name of parameters in different device models may vary. For example, the **Contrast** may be called **ContrastValue**, and **ContrastThreshold** may be called **ContrastPivotValue**. Please refer to the actual condition.
- The **ContrastType** is available in some models. This parameter can provide the brightness mapping relationships functions for contrast, including “linear” and “S-curve”.

7.18 FFC

User can use the **FFCEnable (Flat Field Correction)** to eliminate the problem of uneven image brightness caused by uneven illumination, sensor fixed noise and uneven response. This function is available in some device models only. User can find the FFC function on the **CamTools** which is included in the MV Viewer. Open the**CamTools**, and click the tab of FFC. User can follow the tooltips to complete the corresponding operations.

After performing the FFC, the **FFCEnable** under the **ISPControl** is available which is to enable the correction parameters of FFC, as shown in the figure below.

Figure 7-45 Set FFCEnable



The images before and after FFC are shown in the below.

Figure 7-46 Before FFC

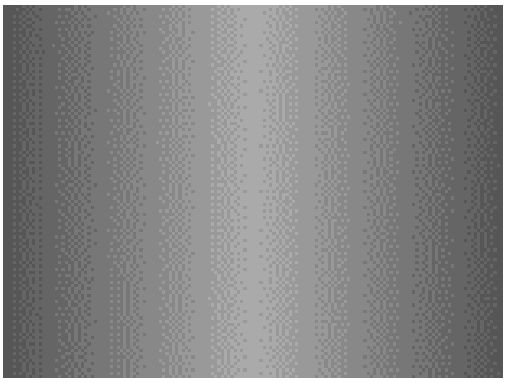


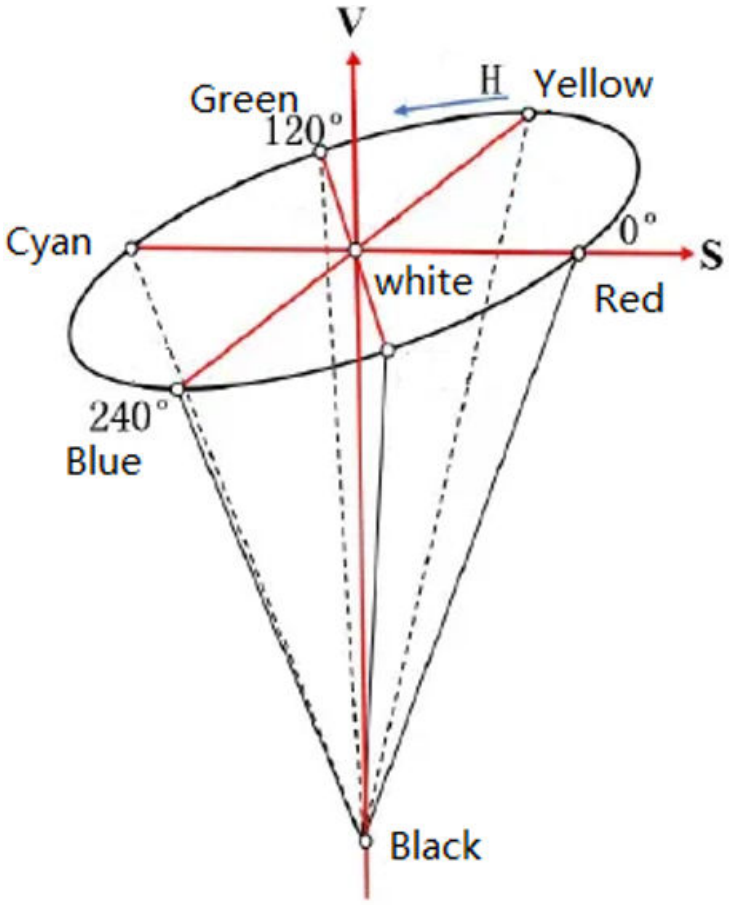
Figure 7-47 After FFC

- The **FFCEnable** is available in some models. The actual condition shall prevail.
- The **FFCEnable** can only be performed at the full resolution. If the camera is not at the full resolution, you should restore it before making corrections.

7.19 Six-Axis Adjustment

The **ColorAdjustmentSelector** under the **ISPControl** can adjust the hue and saturation of different color regions of image, which facilitates users to quickly adjust the image color based on the actual demands. HSV diagram is as follows.

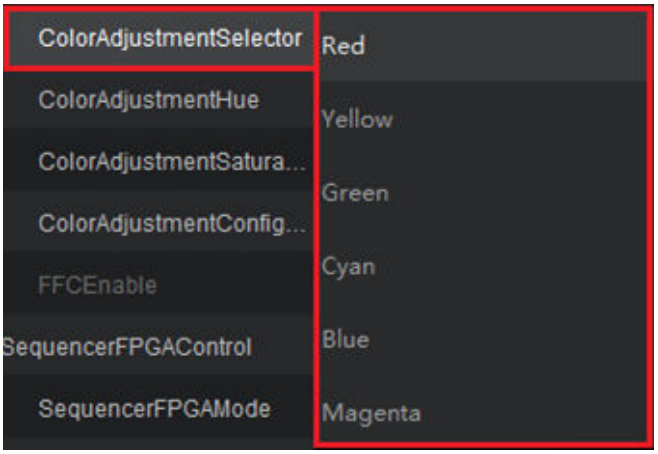
Figure 7-48 HSV



Procedure

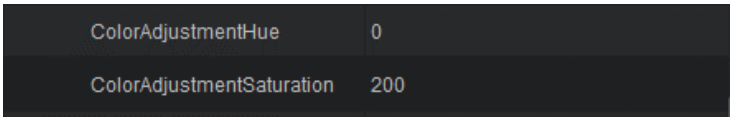
Step 1 Select the color region to be adjusted in the **ColorAdjustmentSelector** based on the actual demands.

Figure 7-49 Select color region



Step 2 Modify the values of selected color region in the **ColorAdjustmentHue** and **ColorAdjustmentSaturation**.

Figure 7-50 Modify hue and saturation values



Step 3 Reset all parameters of 6-axis adjustment to the default, you can click the **ColorAdjustmentConfiguretionReset**, as shown in the figure below.

Figure 7-51 Set ColorAdjustmentConfiguretionReset

- The 6-axis adjustment is available in some models only. The actual condition shall prevail.
- It is only available in RGB, BGR, Bayer and YUV pixel formats of color camera.

7.20 HDR

User can use this function to improve the clear imaging capabilities of camera in scenes with significant contrast between light and dark. Click **ISPControl** > **HDRControl** > **ClearHDR**.

Figure 7-52 Set ClearHDR

The HDR function is available in some models only. The actual condition shall prevail.

7.21 LUT

The LUT is a grayscale mapping table. User can set the user-defined grayscale mapping relations flexibly, such as stretching and compressing the brightness range of ROI. The relevant parameters of LUT are shown in the figure below.

The detailed procedures of setting LUT are as follows.

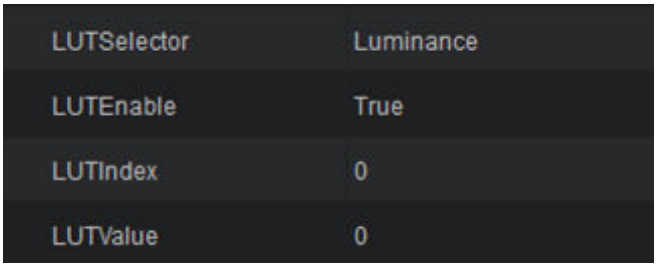
Procedure

Step 1 Enable or disable the LUT in the **LUTEnable** under the **LUTControl**.

Step 2 Set the original grayscale values to be mapped in the **LUTIndex**.

Step 3 Set the target grayscale value to be mapped in the **LUTValue** , and the value ranges of **LUTValue** and **LUTIndex** are the same.

Figure 7-53 Set LUT



- The LUT function is available in some models only. The actual condition shall prevail.
- Gamma correction and LUT can both adjust the gray mapping relations; therefore, these two functions cannot be enabled at the same time.
- The value range of **LUTIndex** depends on the ADC bit depth of sensor. 10bit: 0 ~ 1023; 12bit: 0~4095.

7.22 Color Conversion Control

7.22.1 RGB to YUV

Before the image is outputted in the YUV format, the color components of RGB will be multiplied with the conversion matrix to provide the proper color space which satisfies the user's expectations. User can set the relevant parameters in the **ColorTransformationControl**, as shown in the figure below.

The detailed procedures are as follows.

Procedure

Step 1 Set the **ColorTransformaionSelector** to **RGBtoYUV**.

Step 2 Set the **ColorTransformaionEnable** to **True** to enable this function.

Step 3 Configure the parameters of conversion matrix in the **ColorTransformaionValueSelector** and **ColorTransformaionValue**.

Figure 7-54 Set RGBtoYUV conversion

- The **RGBtoYUV** is available in some models only, so the actual condition shall prevail.
- The descriptions about the options of **ColorTransformationValueSelector** are as follows.
  - **Gain00** , **Gain01**, **Gain02** and **offset0** refer to the Y component.
  - **Gain10** , **Gain11**, **Gain12** and **offset1** refer to the U component of green pixels.
  - **Gain20** , **Gain21**, **Gain22** and **offset2** refer to the V component of blue pixels.

7.22.2 CCM

After performing the white balance on the image, it may have different degrees of color deviation. You can enable the CCM function to correct the color to the standard values. It multiplies each RGB component with the correction matrix to correct the color.

Figure 7-55 CCM formula

$$\begin{bmatrix} R_{out} \\ G_{out} \\ B_{out} \end{bmatrix} = \begin{bmatrix} Gain_{00} & Gain_{01} & Gain_{02} \\ Gain_{10} & Gain_{11} & Gain_{12} \\ Gain_{20} & Gain_{21} & Gain_{22} \end{bmatrix} * \begin{bmatrix} R_{in} \\ G_{in} \\ B_{in} \end{bmatrix} + \begin{bmatrix} offset0 \\ offset1 \\ offset2 \end{bmatrix}$$

You can configure the relevant parameters in the **ColorTransformationControl**, as shown in the figure below.

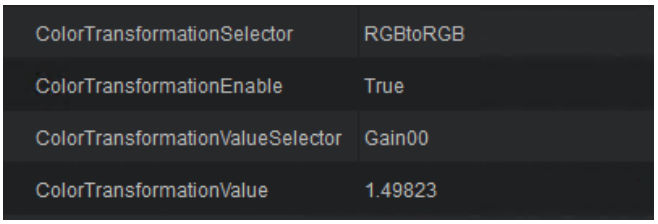
Procedure

Step 1 Set the **ColorTransformaionSelector** to **RGBtoRGB**.

Step 2 Set the **ColorTransformaionEnable** to **True** to enable this function.

Step 3 Configure the parameters of correction formula in the **ColorTransformaionValueSelector** and **ColorTransformaionValue**.

Figure 7-56 Relevant parameters of CCM



- The CCM is available in some models only, so the actual condition shall prevail.
- The descriptions about the options of **ColorTransformationValueSelector** are as follows.
  - **Gain00** , **Gain01**, **Gain02**, and **offset0** refer to the R component of red pixels.
  - **Gain10** , **Gain11**, **Gain12**, and **offset1** refer to the G component of green pixels.
  - **Gain20** , **Gain21**, **Gain22**, and **offset2** refer to the B component of blue pixels.

8 Auto Functions and Polling Control

8.1 Auto Function Control

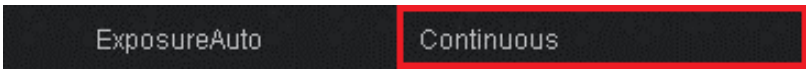
iRAYPLE cameras support the exposure auto adjustment, gain auto adjustment, target brightness setting, etc. User can set parameter adjustment range of relevant parameters under the **AutoFunctionControl** , and use **AutoFunctionROIControl** to statistic the data in ROI area and calculate parameters in the auto adjustment modes. The detailed procedures are as follows.

Procedure

Step 1 Set the value of **AutoTargetBrightness** as for the reference value of target brightness of exposure auto adjustment and gain auto adjustment. The default value is 50.

Step 2 Select the parameters that needs to enable the auto adjustment functions. Take the exposure auto adjustment as an example, set the **ExposureAuto** under the **AcquisitionControl** to **Once** or **Continuous**, as shown in the figure below.

Figure 8-1 Enable exposure auto adjustment



Step 3 Set the values of **AutoExposureTimeLowerLimit** and **AutoExposureTimeUpperLimit** under the **AutoFunctionControl** for limiting the exposure auto adjustment range, so that the result of adjustment can be maintained in the set range.

Figure 8-2 Modify exposure auto adjustment range

Step 4 After starting the image acquisition, the image brightness will be adjusted automatically when the environment brightness is changed. The target brightness value for reference is the set value of the **AutoTargetBrightness** . The final exposure value of image is limited by the set range of the **ResultingExposureTime**, as shown in the figure below.

Figure 8-3 Final exposure value

Step 5 User can obtain the parameters in the specific ROI area by setting the **AutoFunctionROIControl**. The relevant parameters are shown and described in the figure and table below.

Figure 8-4 Parameters of AutoFunctionControl

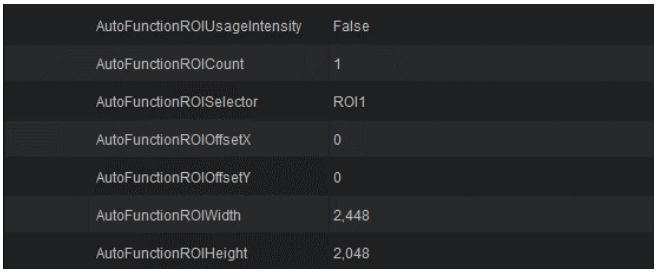


Table 8-1 Parameters description

Parameter	Description
AutoFunctionROIUsageIntensity	To enable the auto function control of ROI. After enabling, it will obtain the parameters from the specific ROI area; after disabling, it will obtain the parameters from the full image for parameters calculation.
AutoFunctionROICount	To set the numbers of the ROI areas, which means the parameters obtainment can be performed in one ROI area and multiple ROI areas for calculating the auto adjustment parameters.
AutoFunctionROISelector	Select the ROI area needs to be configured. User can configure each ROI area with different values of width, height, offsetX and offsetY to adjust different range of ROI area.
AutoFunctionROIOffsetX	To set the value of offsetX.
AutoFunctionROIOffsetY	To set the value of offsetY.
AutoFunctionROIWidth	To set the value of Width.
AutoFunctionROIHeight	To set the value of Height.

Step 6 After starting the image acquisition, check the image effect. If the **AutoFunctionROIUsageIntensity** is enabled, the auto functions of ROI area will be valid; if it is disabled, the auto functions of ROI area will invalid, and the obtained parameters is from the full image.

- Currently, user can configure only one ROI area.
- User can set auto adjustment strategies only when the exposure and gain auto adjustment functions are enabled in the **AutoFunctionProfile** . The **MinimizeGain** refers to the principle of minimum gain; the **MinimizeExposuerTime** refers to the principle of minimum exposure.
- The operations of gain auto adjustment and exposure auto adjustment is similiar.

8.2 Parameter Polling

User can configure multiple groups of polling parameters to acquire images in the **SequencerFPGAControl**. This function is mainly for the scenes with multiple lighting conditions.

8.2.1 Functions Supporting Polling

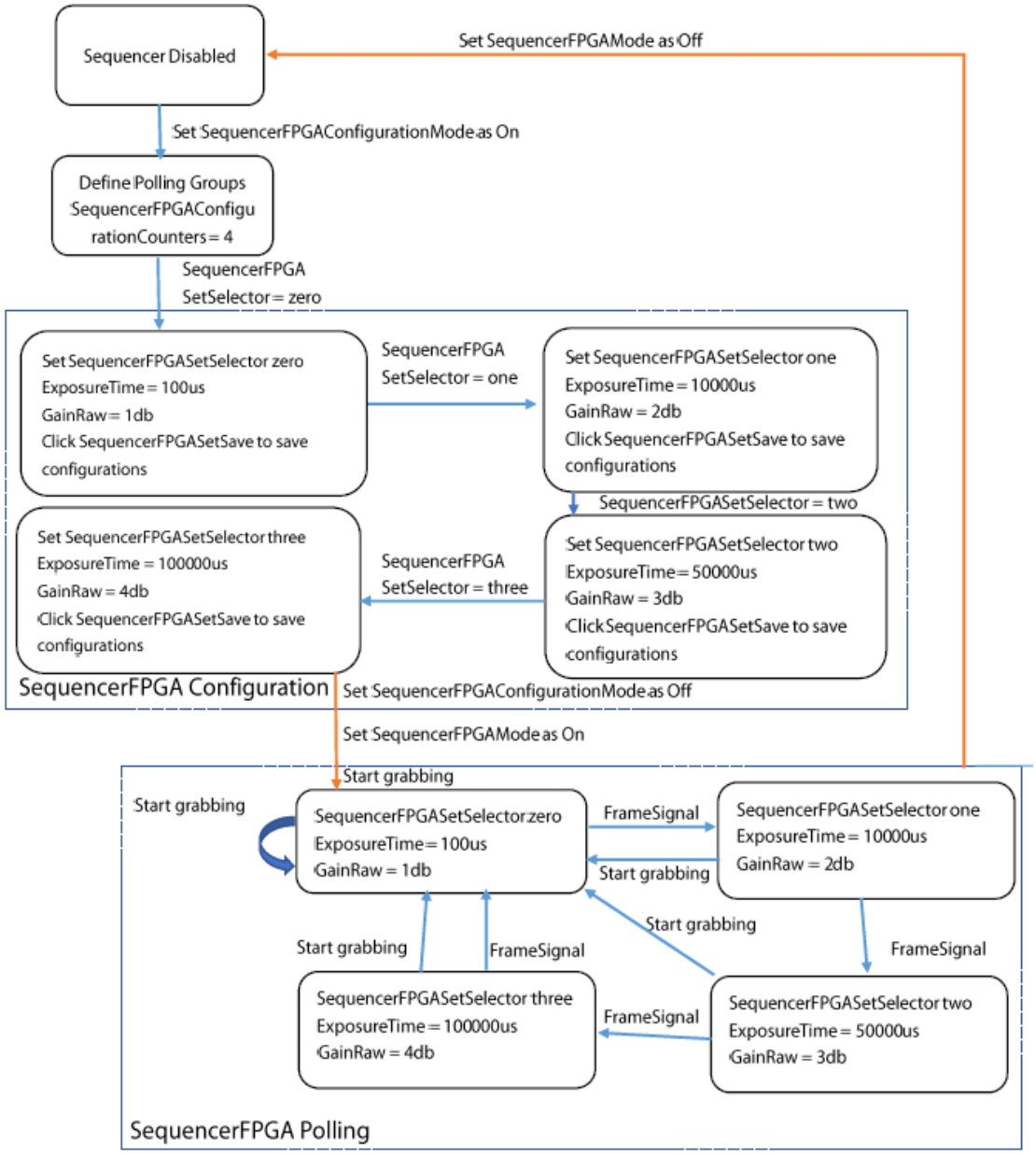
The functions supporting polling of camera include binning, scaling, resolution and ROI, frame rate, exposure time, gain, black level, white balance, 6-axis adjustment, etc.

The functions supporting polling may vary depending on the device model, the actual condition shall prevail.

8.2.2 Functional Block Diagram

Taking 4 groups of polling parameters as an example.

Figure 8-5 Functional block diagram of parameter polling



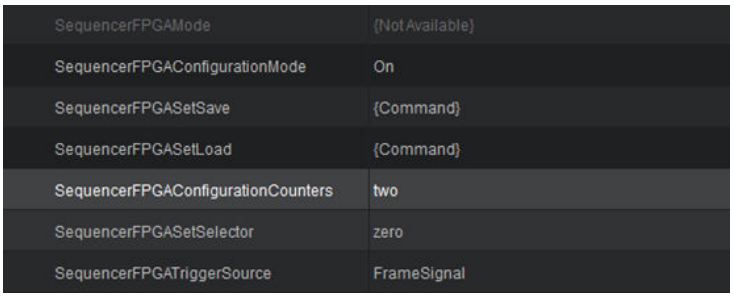
8.2.3 Parameter Polling Application Instruction

Please follow the procedures below to use the parameter polling function.

Procedure

Step 1 Set the **SequencerFPGAConfigurationMode** under the **SequencerFPGAControl** to **On**, as shown in the figure below.

Figure 8-6 Set SequencerFPGAControl



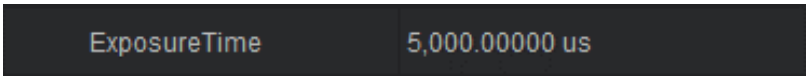
Step 2 Set the total groups of parameter polling in the **SequencerFPGAConfigurationCounters**. The maximum number of groups is up to 8.

Step 3 Select the certain group in the **SequencerFPGASetSelector** to configure its parameters.

Step 4 Configure the **SequencerFPGATriggerSource** to automatically execute the next set of parameters to perform image acquisition upon completion of the current parameter group execution. The default value of **SequencerFPGATriggerSource** is **FrameSignal**, that is, the parameter polling condition is frame signal. The trigger source signals can be customized by users according to the actual demands, for example, it will switch to the next group of image acquisition parameters to acquire images after receiving the user-defined trigger source signal.

Step 5 User can configure the parameters based on user's needs according to the actual supporting functions of camera. Take the exposure time setting as an example, user needs to enter the exposure time value in the **ExposureTime** under the **AcquisitionContorl**. After completing the settings of each group of parameters, click **Command** in the **SequencerFPGASetSave**, and save the user-defined parameters into the selected group.

Figure 8-7 Modify the exposure time



When setting the parameters needs to be set, you shall back to the original position of parameters to set their values.

Step 6 (Recommend) After clicking the **Command** in the **SequencerFPGASetLoad**, it will load the setting values of parameters saved in the current group, which means the setting values will be displayed on the corresponding parameters. This function can facilitate users to check the setting values of parameters of the group.

Step 7 If you need to modify the values of parameters again, please repeat the Step 5. Repeat the Step 3 ~ Step 6 to set other parameter groups.

Step 8 After completing the settings, set the **SequencerFPGAConfigurationMode** to **Off**, and set the **SequencerFPGAMode** to **On**. The parameter polling function will be enabled.

Step 9 After enabling the parameter polling, every time you click the start acquiring image, the parameter polling will restart from the ZERO group.

8.2.4 Cautions

Please note the following cautions when using the parameter polling.

- The parameter polling does not support the ultra-low exposure function; therefore, when you set the exposure value to the ultra-low exposure, the **SequencerFPGAMode** cannot be enabled.
- You should complete the settings of **PixelFormat** and **ReverseY** before enabling the parameter polling function. When running the polling function, the pixel format and mirroring function cannot be changed.

9 Event Monitor, Counter and Timer

9.1 Event Monitor

The event monitoring function can record and output the information and status of cameras when it meets some specific requirements. User can select the event type for checking and timestamp for reporting in the parameters under the **EventControl**. The event types are shown in the figure and table below.

Figure 9-1 Set EventSelector

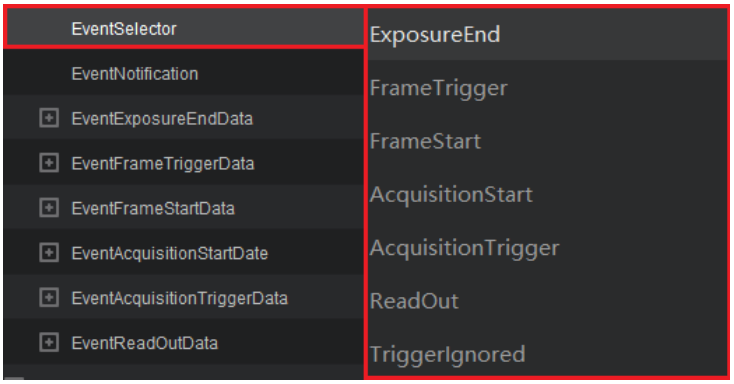


Table 9-1 Event type description

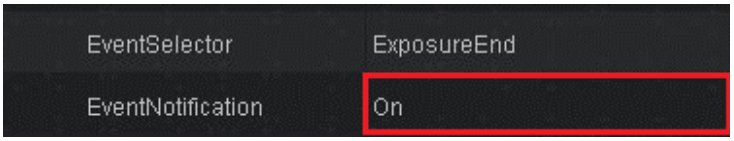
Type	Description
ExposureEnd	The exposure of one frame ends.
FrameTrigger	The camera receives the trigger signals when it is in the framestart mode.
FrameStart	Sensor starts outputting one frame data.
AcquisitionStart	Camera receives the command of starting acquisition.
AcquisitionTrigger	The camera receives the trigger signals when it is in the AcquisitionStart mode.
ReadOut	The one frame data output of sensor ends.
TriggerIgnored	The trigger signals are lost.

The detailed procedures of using EventControl are as follows.

Procedure

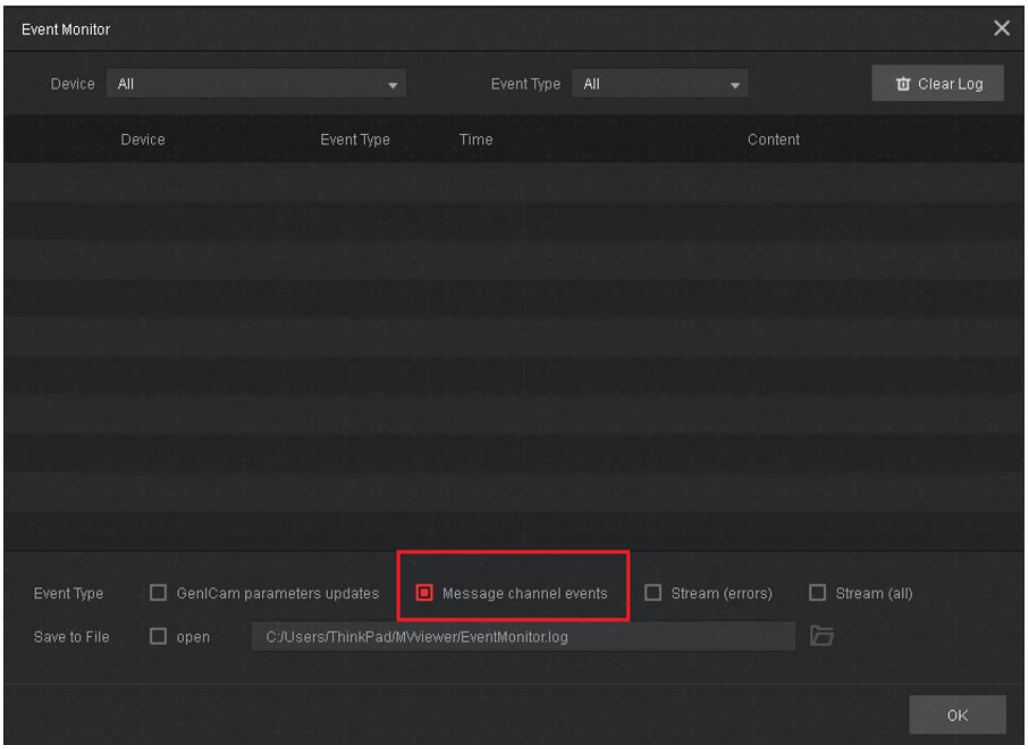
Step 1 Select the event type which needs to be recorded and outputted in the **EventSelector** under the **EventControl**. Take the event type of **ExposureEnd** as an example, set the **EventNotification** to **On** to enable it.

Figure 9-2 Event type and enabling



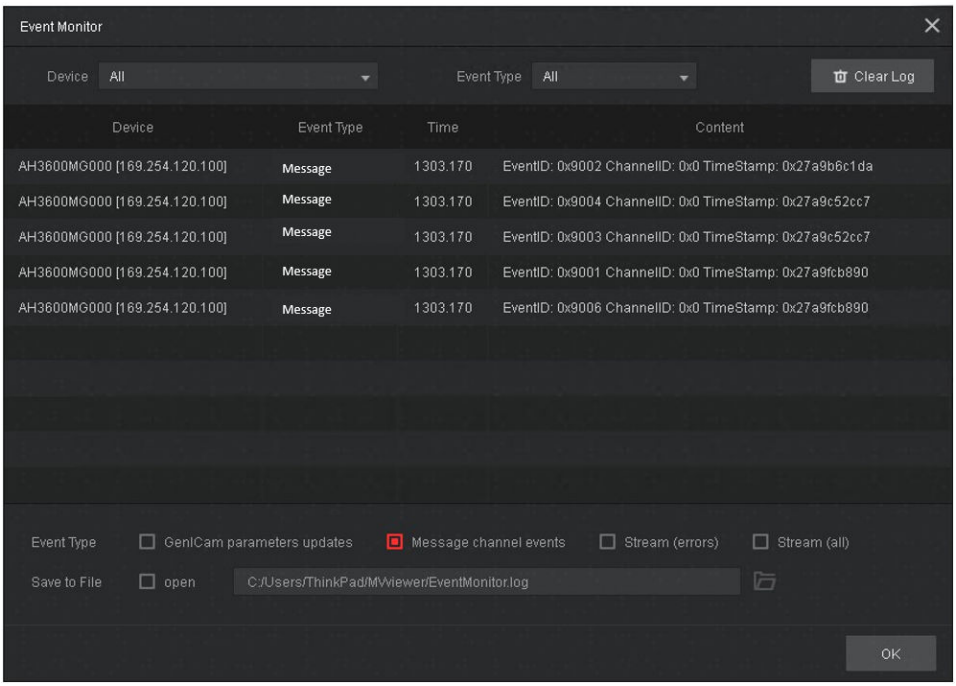
Step 2 Click "Event" in the menu bar of MV Viewer, and click **Message channel events**. As shown in the figure below.

Figure 9-3 Click message channel events



Step 3 If the behavior of camera meets the specific condition of the selected event type, the dialog box will display the event notification and timestamp. Some notifications only appear when the camera is acquiring images, as shown in the figure below.

Figure 9-4 Event notifications



- Whether camera supports the event monitoring function depends on the device model and firmware version. The actual condition shall prevail.
- The supported event types across the different cameras or different firmware versions may vary. The actual condition shall prevail.

9.2 Counter and Timer

9.2.1 Counter

The options of **CounterSelector** are described in the table below.

Figure 9-5 Set CounterSelector

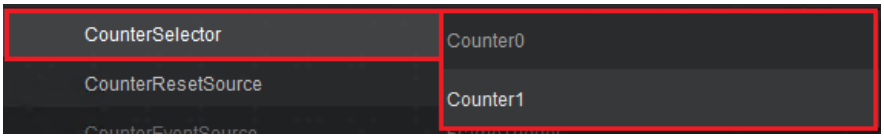
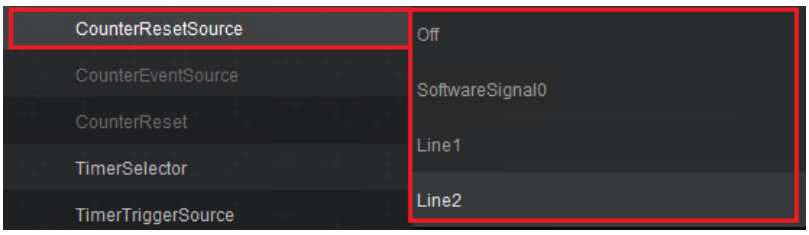


Table 9-2 CounterSelector description

Option	Description
Counter0	The statistics of the number of external triggers.
Counter1	The statistics of the number of output frames of camera.

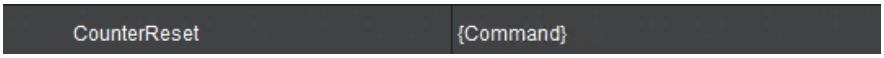
There are three ways to reset the counter, as shown in the figure below.

Figure 9-6 Set CounterResetSource



When you set the **CounterResetSource** to the **SoftwareSingl0**, you need to click the **Command** in the right side of **CounterReset**, as shown in the figure below.

Figure 9-7 Execute CounterReset

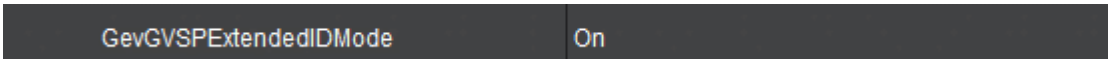


If you need the counter to display on the client, please follow the procedures below.

Procedure

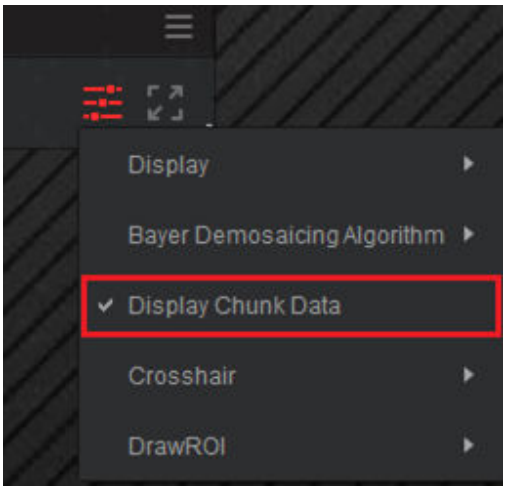
Step 1 Set the **GevGVSPExtendedIDMode** under the **TransportLayerControl** to **On**, as shown in the figure below.

Figure 9-8 Set GevGVSPExtendedIDMode



Step 2 Click **Settings** on the lower right corner of MV Viewer, and select the **DisplayChunkData**, as shown in the figure below.

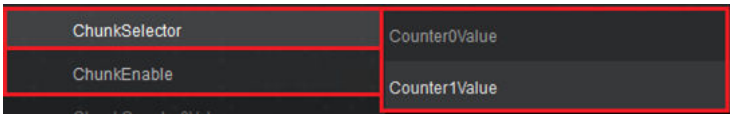
Figure 9-9 Select DisplayChunkData



Step 3 Set the **ChunkModeActive** under the **ChunkDataControl** to **True**

Step 4 Set the **ChunkSelector** to **Counter0Value** or **Counter1Value**, and set the **ChunkEnable** to **True**, as shown in the figure below.

Figure 9-10 Set ChunkSelector



Step 5 When you start streaming or acquiring images, the upper left of MV Viewer and **ChunkCounter0Value** and **ChunkCounter1Value** under the **ChunkDataControl** will display the actual value of counter.

Figure 9-11 Counter value on MV Viewer

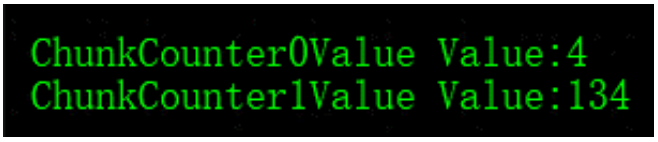
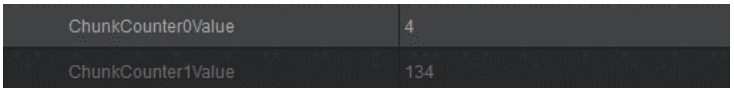


Figure 9-12 Counter value in parameters



9.2.2 Timer

The camera currently supports only one timer **Timer0** , and the trigger source of the timer can only be the **ExposureStart**. User can select the activation condition of the trigger source in the **TimerTriggerActivation**, including rising edge, falling edge and any edge.

Figure 9-13 Set TimerTriggerActivation

User can configure the values of the pulse signals generated by each activation condition in the **TimerDelay** and **TimerDuration**, as shown in the figures below.

Figure 9-14 Diagram of pulse signals in rising edge

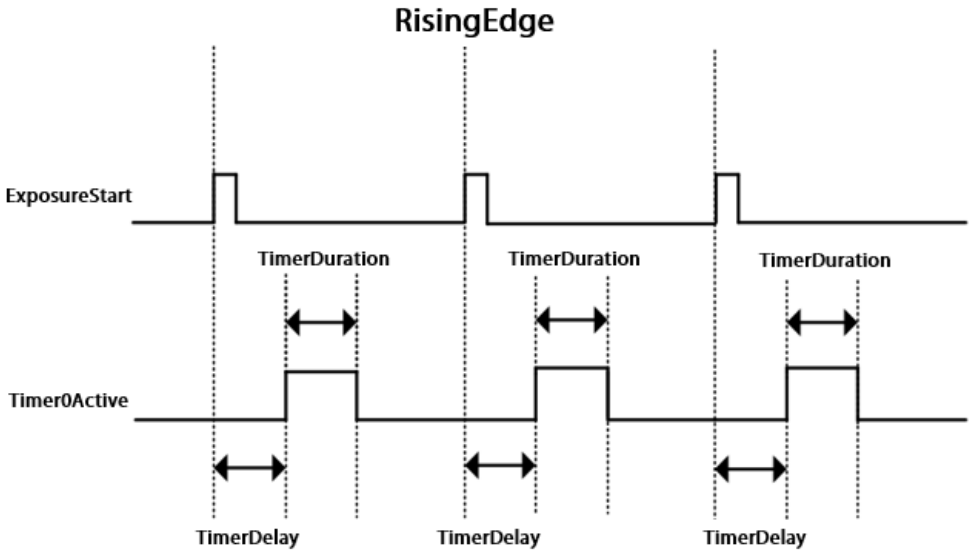


Figure 9-15 Diagram of pulse signals in falling edge

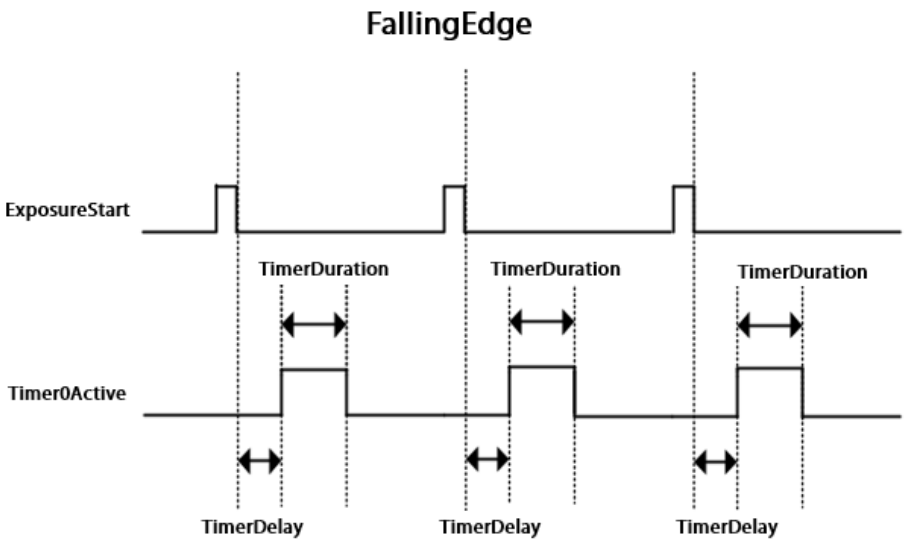
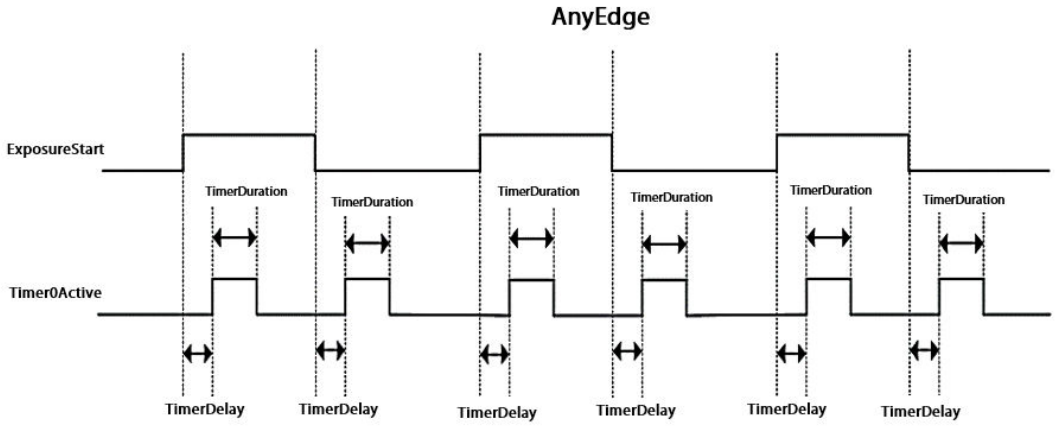


Figure 9-16 Diagram of pulse signals in any edge



9.2.3 Counter as External Trigger Source

When the **TriggerSource** is set to **Counter0**, the external trigger signals are combined into one signal, so that a high-frequency trigger signals is combined into an external trigger signal having a frequency suitable for the camera.

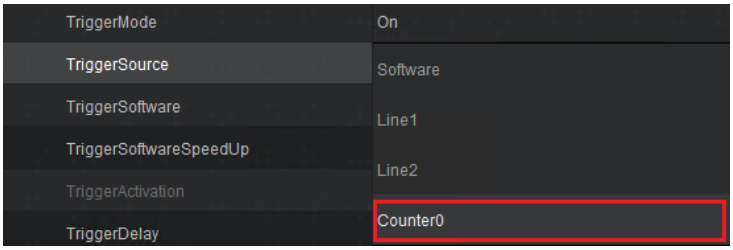
Procedure

Step 1 Set the **TriggerSelector** under the **AcquisitionControl** to the **AcquisitionStart** or **FrameStart**.

Step 2 Set the **TriggerMode** to the **On**.

Step 3 Set the **TriggerSource** to the **Counter0**.

Figure 9-17 Set external trigger source



The option **Counter0** is available only in some device models. The actual condition shall prevail.

After selecting the **Counter0** as the external trigger source, the property of **CounterControl** will appear behind the **CounterAndTimerControl**, as shown in the figure below. The parameters are described in the table below.

Figure 9-18 Set CounterControl

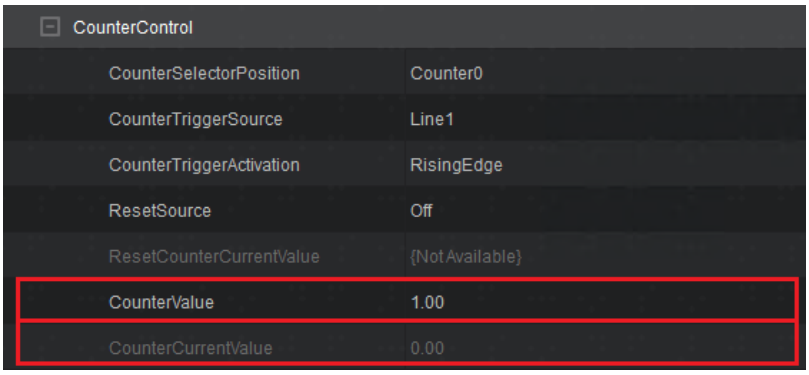
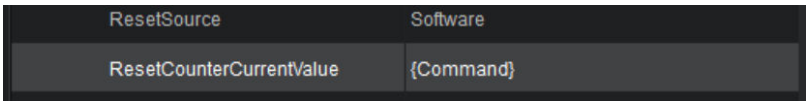


Table 9-3 Parameter description

Parameter	Description
CounterTriggerSource	For selecting the external trigger source, including line1 and line2.
CounterTriggerActivation	For selecting the activation condition of trigger signal, including rising edge and falling edge.
CounterValue	For configuring how many external triggers pulse signals need to be combined into one signal to output.
CounterCurrentValue	For recording the serial number of the input pulse signal which is to be combined. The serial number is starting from the zero.

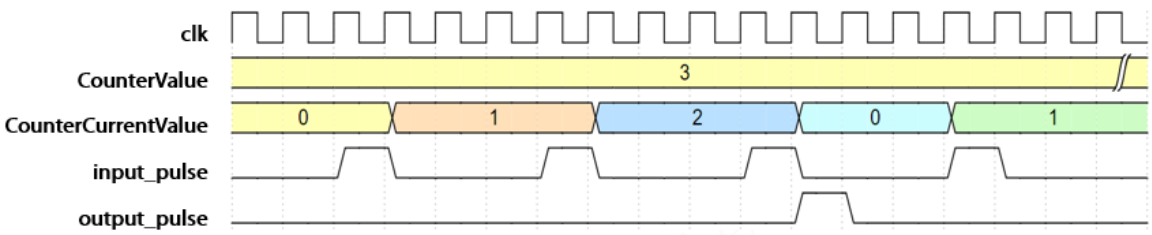
To reset the **CounterCurrentValue** , you need to set the **ResetSource** to the **Software**, and click **Command** in the **ResetCounterCurrentValue**.

Figure 9-19 Reset CounterCurrentValue



Configure the parameters to start/reset/shutdown Counter0, and it will merge input pulse signals into one signal to the sensor to perform exposure trigger according to the value which user set in the **CounterValue**.

Figure 9-20 Diagram of external trigger signals merging



10 Device Control and Other Functions

10.1 Device Control

User can check device information, protocol version, customized ID, device temperature, device reset,etc. in the **DeviceControl** . The descriptions of parameters under the **DeviceControl** are shown in the table below.

Table 10-1 DeviceControl description

Parameter	Description	Read / Write
DeviceType	The type information of device.	Read Only
DeviceScanType	The scan mode of device's sensor.	Read Only
DeviceVendorName	The name of the manufacturer.	Read Only
DeviceModelName	The model information of the device.	Read Only
DeviceManufacturerInfo	The manufacturer information.	Read Only
DeviceVersion	The version of the device.	Read Only
DeviceFirmwareVersion	The firmware version of the device.	Read Only
DeviceSerialNumber	The serial number of the device.	Read Only
DeviceUserID	The device ID can be customized and it is empty by default.	Read and Write
DeviceTLType	The protocol type in the version number of GEV.	Read Only
DeviceTLVersionMajor	The major version information in the GEV version.	Read Only
DeviceTLVersionMinor	The minor version information in the GEV version.	Read Only
DeviceMaxThroughput	Maximum operating flow rate of device (Kbps).	Read Only
DeviceCharacterSet	The string set of devices.	Read Only
DeviceReset	Click this button to perform the soft reboot and parameter reset.	Read and Write
DeviceTemperatureSelector	For selecting the temperature sensor of device to read the temperature information of sensor or motherboard.	Read and Write

Parameter	Description	Read / Write
DeviceTemperature	To display the temperature of the selected components in **DeviceTemperatureSelector**.	Read Only
FanSelector	For selecting fan.	Read and Write
FanMode	To enable the fan.	Read and Write
FanSpeed	The speed setting of fan.	Read and Write
FanRpm	To display the speed detection value of fan.	Read Only
SensorTargetTemperature	The target temperature of TEC refrigeration.	Read and Write
DeviceRegistersIsBigEndian	The byte order of device registers.	Read Only
DeviceDevelopData	The command port for developing and debugging.	Read and Write
DeviceTLVersionSelector	The version information of GEV.	Read Only

10.2 Transport Layer Control

The **TransportLayerControl** property includes some parameters of network modes and performance information which can be configured. The parameters may vary depending on the camera models.

Table 10-2 Parameter description

Parameter	Description	Read / Write
PayloadSize	The total size of payload (B) including end-of-line, end-of-frame, or other stamp data.	Read Only
GevActiveLinkCount	The number of valid links.	Read Only
GevInterfaceSelector	To select the physical network interface.	Read and Write
GevLinkSpeed	The transmission speed of the network interface.	Read Only
GevMACAddress	The MAC address of the network interface.	Read Only
GevSupportedOptionSelector	To check whether the GEV is valid by selecting it.	Read and Write
GevSupportedOption	To display the status of selected option in the **GevSupportedOptionSelector**.	Read Only

Parameter	Description	Read / Write
GevCurrentIPConfigurationLLA	To display whether the IP address of camera is obtained through the dynamic link address. It is enabled by default.	Read Only
GevCurrentIPConfigurationDHCP	After enabling, the IP address is loaded obtained by DHCP. It is disabled by default.	Read and Write
GevCurrentIPConfigurationPersistentIP	After enabling, the static IP address will be loaded. It is enabled by default.	Read and Write
GevCurrentIPAddress	The IP address of the network interface.	Read Only
GevCurrentSubnetMask	The subnet mask of the network.	Read Only
GevCurrentDefaultGateway	The gateway IP address of the network interface.	Read Only
GevIPConfigurationStatus	The set mode of IP address.	Read Only
DeviceManifestPrimaryURL	The primary URL of device manifest.	Read Only
DeviceManifestSecondaryURL	The secondary URL of device manifest.	Read Only
GevNumberOfInterfaces	The number of physical network interface which device supports.	Read Only
GevPersistentIPAddress	To configure the static IP address of the network interface.	Read and Write
GevPersistentSubnetMask	To configure static subnet mask of network interface.	Read and Write
GevPersistentDefaultGateway	To configure the static gateway of the network interface.	Read and Write
GevMessageChannelCount	The number of event channels which device supports	Read Only
GevStreamChannelCount	The number of stream channels.	Read Only
GevHeartbeatTimeout	To set the timeout value of heartbeat packet. Within the set timeout value, if no heartbeat response is received from the camera SDK, the camera occupation status will be cleared. This function is for checking whether the camera is working normally.	Read and Write
GevTimestampTickFrequency	To display the number of times timestamp marks in one second (Hz).	Read Only
GevTimestampControlLatch	After enabling, it will lock the counter of timestamp into the **GevTimestampValue**.	Read and Write
GevTimestampControlReset	After enabling, it will restore the counter of timestamp.	Read and Write

Parameter	Description	Read / Write
GevTimestampValue	To display the latched value of timestamp.	Read Only
GevGVCPExtendedStatusCodesSelector	To set the GigE version to control extended status codes.	Read and Write
GevGVCPExtendedStatusCodes	To enable the extended status codes production. It is disabled by default.	Read and Write
GevGVCPPendingAck	To enable the answer command generation. It is enabled by default.	Read and Write
GevGVCPHeartbeatDisable	To enable the heartbeat. It is disabled by default.	Read and Write
GevGVCPPendingTimeout	To display the delay time before the camera returns the response command.	Read Only
GevPrimaryApplicationSwitchoverKey	To control the secret key which is used to verify the switch request of the main application.	Read Only
GevGVSPExtendedIDMode	To enable the ID mode. It is disabled by default.	Read and Write
GevCCP	To set the access permission.	Read and Write
GevPrimaryApplicationSocket	The port number which is used to connect the port of host computer.	Read Only
GevPrimaryApplicationIPAddress	To set the IP address for connecting the host computer.	Read Only
GevMCPHostPort	To set the device port for sending messages. Entering “0” will disable the message channel.	Read and Write
GevMCDA	To control the target IP address of the message channel.	Read and Write
GevMCTT	To set the transmission timeout value in milliseconds.	Read and Write
GevMCRC	To set the number of retransmissions allowed when the message channel transmits the timeout information.	Read and Write
GevMCSP	To display the source port of message channel.	Read Only
GevStreamChannelSelector	To select the device stream channel.	Read and Write
GevSCPInterfaceIndex	To select the network link index.	Read and Write
GevSCPHostPort	To set the host computer port of stream channel. Entering “0” will disable the stream channel.	Read and Write
GevSCPSFireTestPacket	Every time this function is enabled, a test packet is sent.	Read and Write

Parameter	Description	Read / Write
GevSCPSDoNotFragment	After enabling, the status will be displayed in the unfragmented bit of IP header of each stream data packet to prevent fragmentation of packet in stream channel.	Read and Write
GevSCPSPacketSize	To set the maximum packet size during transmitting the data of camera.	Read and Write
GevSCPDSwitch	To enable the transmission delay among data packets. It is disabled by default. When this function is disabled, the value of **GevSCPD** shall prevail; when this function is enabled, the value of **SCPDSwitchValue** shall prevail.	Read and Write
SCPDSwitchValue	To set the value of SCPD. The jumbo frame is recommended.	Read and Write
AdaptiveStreaming	If your network is not good enough, this function will adjust the SCPD value automatically without affecting the frame rate. This function is enabled by default.	Read and Write
RealSCPD	If **AdaptiveStreaming** is enabled, this parameter will display the current SCPD value.	Read Only
GevSCPD	To set the transmission delay value of each data packet.	Read and Write
GevSCDA	To set the target IP address for receiving the stream data.	Read and Write
GevSCSP	To display the source port of stream channel.	Read Only
FrameTriggerCount	To return the number of trigger signals which camera receives. The trigger signals include the external trigger signal and software trigger signal.	Read Only
FrameTriggerLostCount	To return the number of trigger signals which camera losses. The trigger signals include the external trigger signal and software trigger signal.	Read Only
SensorTriggerCount	To count the signals for acquiring images which sensor receives. It can count the image acquiring signals which operated in three modes including free run, external trigger, and software trigger.	Read Only
SensorFrameCount	To count output frame rate of sensor. It can count frame rate of sensor which operates in three modes including free run, external trigger, and software trigger.	Read Only
FrameTriggerCountReset	To reset the counter of parameters, such as FrameTriggerCount, FrameTriggerLostCount, SensorTriggerCount, SensorFrameCount.	Read and Write

10.3 User Set

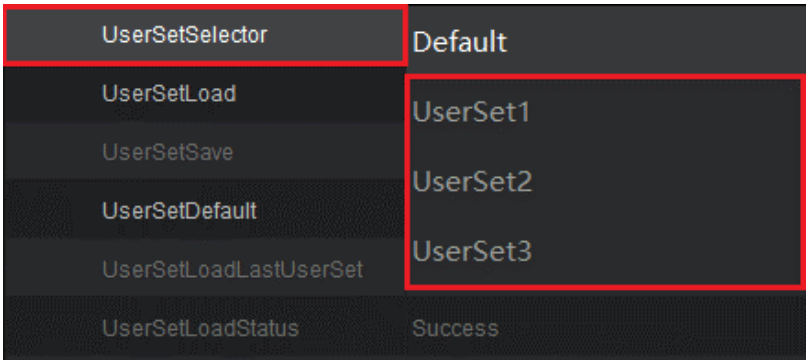
User can save and load user-defined parameters, and configure the default parameters in the **UserSetControl** . The camera has four set of parameters, one set of default parameters and three set of user-definable parameters. If you want the camera to still use the parameters which you defined after restarting the camera, you can save the configurations into the parameter set named **UserSet** and set it as the default one.

10.3.1 Save User-Defined Parameters

Procedure

Step 1 After the parameters are set, select the user-defined configuration set (except the Default) in the **UserSetSelector**, as shown in the figure below.

Figure 10-1 Set UserSetSelector



Step 2 Click **UserSetLoad**, as shown in the figure below.

Figure 10-2 UserSetSave

10.3.2 Load User-Defined Parameters

Procedure

Step 1 Select the user-defined configuration set to be loaded in **UserSetSelector**.

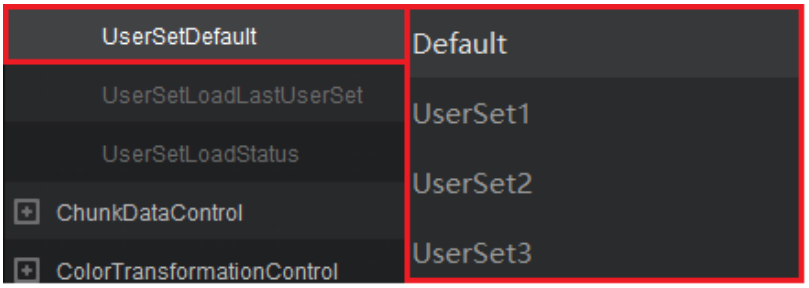
Step 2 Click **User Set Load**, as shown in the figure below.

Figure 10-3 UserSetLoad

10.3.3 User Set Default

User can select the configuration group as the default one in the **UserSetDefault**. After restarting the device, it will automatically load the configuration group which you selected.

Figure 10-4 Options in UserSetDefault



- The **UserSetLoadLastUserSet** displays the name of loaded configuration group.
- The **UserSetLoadStatus** displays whether the configuration group is loaded successfully.

10.4 Chunk Data Control

The **ChunkDataControl** is for embedding the information behind the image data. This function can only be valid when the parameter of **GevGVSPExtendedIDMode** under the **TransportLayerControl** is configured as **On**.

The property and parameter may vary depending on the device model.

Table 10-3 ChunkDataControl description

Parameter	Description	Read / Write
ChunkModeActive	After enabling, the chunk data will be embedded behind the image data. It is disabled by default.	Read and Write
ChunkSelecto	To select the channel of Chunk control.	Read and Write
ChunkEnable	To enable the Chunk channel. It is disabled by default.	Read and Write
ChunkCounter0Value	Counter0	Read Only
ChunkCounter1Value	Counter1	Read Only

10.5 File Open and File Save

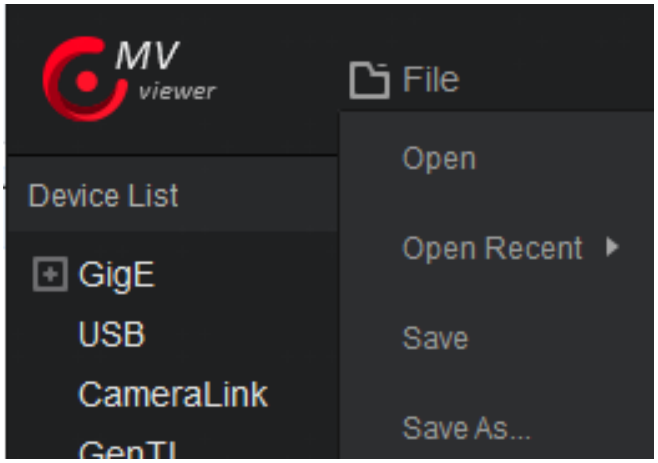
This section introduces how to open or save the configuration file.

- The suffix of the saved file is ".mvcfg".
- Before opening or saving the configuration file, please click **Stop Streaming**.

- Load User-defined Configuration File
  - Click **File** > **Open**, the file selection window will pop up. Select and load the configuration file to complete the configuration loading.
  - Click **File** > **Open Recent**, it will display the recent loaded configurations. User can select and load the configurations as needed.
- Save User-defined Configuration File

- ◇ Click **File** > **Save**. If it is the first time to save the configuration file, the client will suggest you to name the file.
- ◇ Click **File** > **Save As**. User can save and rename the current loaded configurations as another file.

Figure 10-5 File Open and File Save



10.6 Multi-Cast

The multi-cast function can permit multiple host computers to access the same device. After enabling this function, the device can be connected with the permissions of control and data receiving and be connected by multiple devices with the permission of data receiving. The device has two kinds of multi-cast modes.

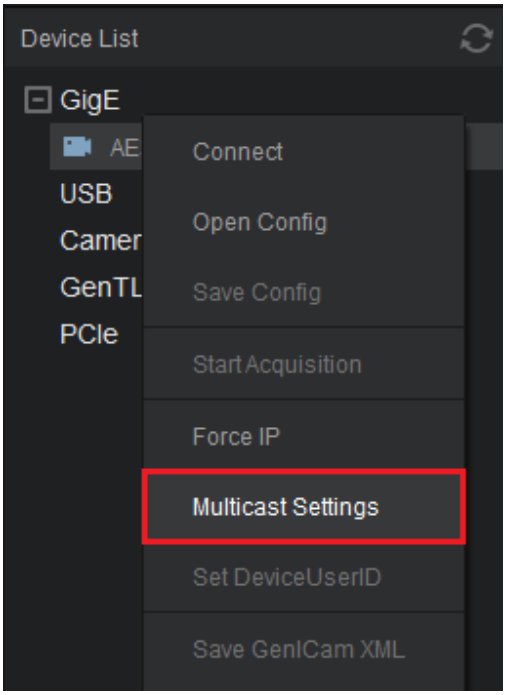
- Controller and Data Receiver: It can control the device to streaming, and read and modify the parameters of device
- Data Receiver: It can control the device to streaming and read the parameters of device, but it cannot modify the parameters of device.

The detailed procedures of enabling the multi-cast function are as follows.

Procedure

Step 1 Select the device in the device list, right click the device and select the **Multicast Settings**, as shown in the figure below.

Figure 10-6 Enable the multi-cast function



Step 2 If the device is in the available mode, user can select the **Controller and Data Receiver** or **Data Receiver** to enable the multi-cast function in the **Multicast Setting interface**, as shown in the figure below. If the device is in the connection mode, user can only enable multi-cast function with the mode of **Controller and Data Receiver**, as shown in the figure below.

Figure 10-7 Multicast settings interface in the available mode

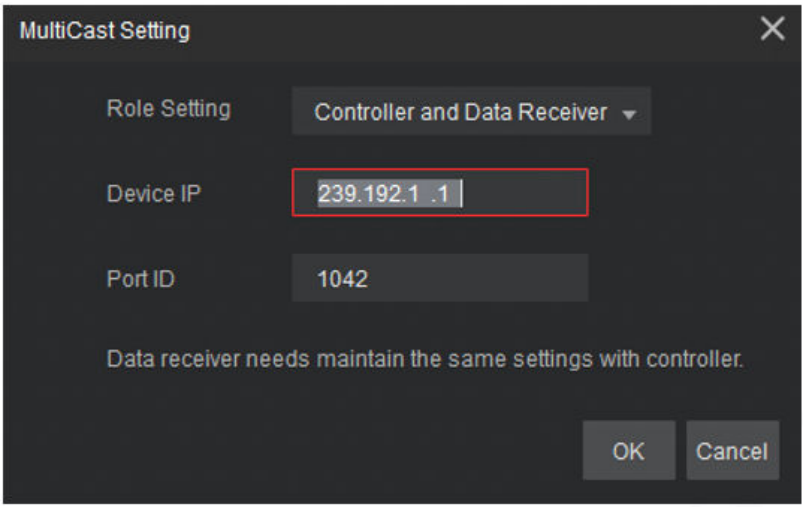
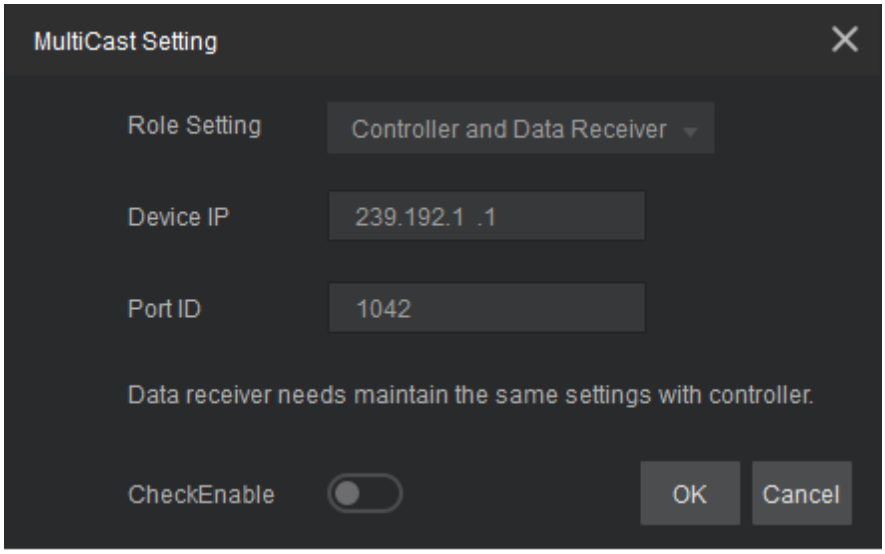
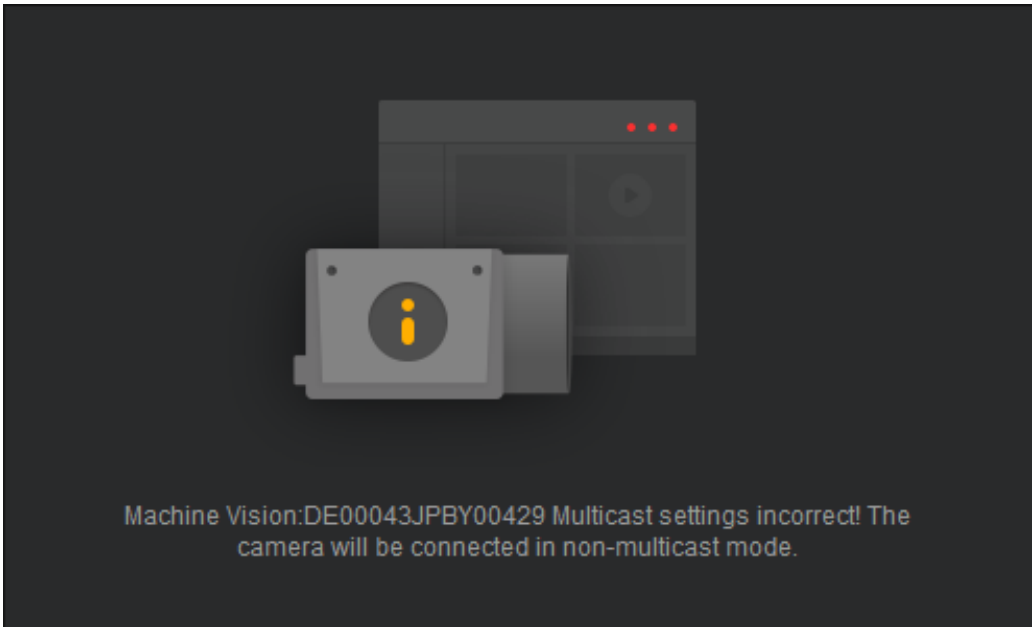


Figure 10-8 Multicast settings interface in the connection mode



Step 3 The IP address of multi-cast function can only be the D-type Ip address. If the set IP address is invalid, the client will prompt saying "Multicast settings incorrect! The camera will be connected in non-multicast mode", as shown in the figure below.

Figure 10-9 Invalid IP address prompt



Step 4 The value range of port number of multi-cast function is 0~65535. Please make sure the entered port number is not occupied.

Step 5 Click **OK** to enable the multi-cast function.

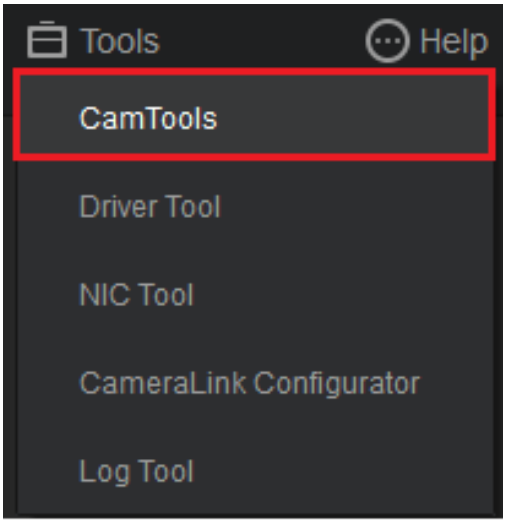
10.7 Firmware Upgrade

The detailed procedures are as follows.

Procedure

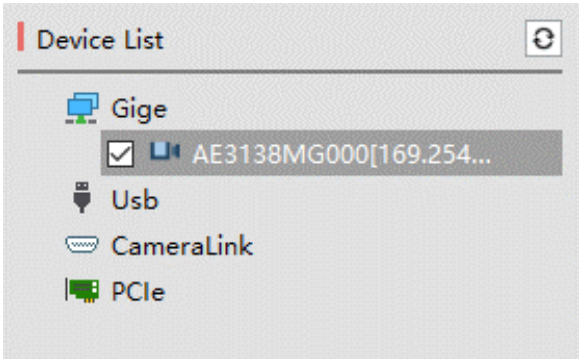
Step 1 Click **Tools** > **CamTools**, the client software for firmware upgrading will start.

Figure 10-10 Open CamTools



Step 2 Select the device in the device list, as shown in the figure below.

Figure 10-11 Select the device

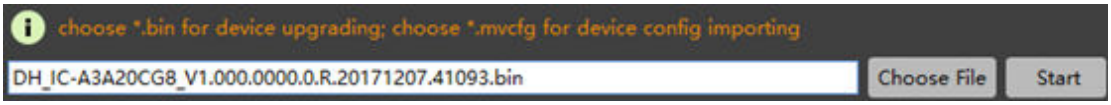


Step 3 Select the zip file of firmware and click **Decompress** to obtain the firmware bin file. If you already have the bin file, this step can be skipped.

Figure 10-12 Select the firmware file

Step 4 Select the corresponding firmware file, and click **Start**. After the firmware upgrading is completed, the camera will restart automatically.

Figure 10-13 Start firmware upgrading



11 FAQ and Technical Support

11.1 FAQ (Frequently Asked Question)

The solutions below can help you solve the most problems which you may encounter when using the industrial cameras. If these solutions cannot solve your problem, or you have other problems, please contact our technical specialist.

11.1.1 MV Viewer Cannot Search the Camera

Possible Reasons

- Abnormal network cable connection.
- Camera is not started normally.

Solution

- Check whether the power indicator light of camera is normal. If the power indicator light shows a “slow flashing red” state, it proves that the network is disconnected. You need to further check whether the network card indicator light is on. If it doesn't, you need to try to replug or replace the network cable.
- If the power supply of camera is abnormal, or the camera is not started normally, the client also cannot find the camera. Therefore, you need to check the power supply or restart the camera.

11.1.2 MV Viewer Failed to Connect Cameras

Possible Reasons

- Camera may be occupied by other software.
- Camera and client software are not on the same network segment.

Solution

- Disconnect the connection between the camera and the software, and then try to use MV Viewer to connect the camera.
- Configure the IP address of camera manually to make it on the same network segment as the client software.

11.1.3 Image is Black When Acquiring Images

Possible Reasons

- Aperture of lens is closed.
- Lens is blocked by objects
- Image acquisition is in the trigger mode.

Solution

- Adjust the aperture of lens.
- Move the objects which block the lens.
- Disable the trigger mode and enable the free run mode to acquire images.

11.1.4 Hardware Trigger Cannot be Performed

Possible Reasons

- Trigger source is incorrectly selected or the trigger function is disabled.
- Cable connection for hardware trigger is incorrect.
- External trigger signal is not provided correctly.

Solution

- Select the correct hardware trigger source and enable the trigger function.
- Connect the cable correctly on the corresponding trigger source and external trigger device according to the electrical specifications.
- Provide the correct trigger signal by using external trigger device.

11.1.5 Image Orientation is Incorrect

Possible Reasons

- The installation direction of camera is incorrect.
- The mirroring functions is enabled.

Solution

- Readjust the installation direction of camera.
- Use the mirroring functions to mirror the image in X-axis or Y-axis to adjust the image orientation.

11.1.6 Network Bandwidth is Only 100 Mbps

Possible Reasons

- CAT 5e or CAT 6 cable is not adopted.
- Network cable is damaged.

Solution

- Use the CAT 5e or CAT 6 network cable which meet GigE transmission standard.
- Replace the network cable.

11.1.7 Camera Lost Connection During Running

Possible Reasons

- The power supply is unstable or does not meet the rated requirements.
- Insufficient bandwidth caused by connecting too many cameras via switch.

Solution

- Provide stable input voltage and current according to the technical specifications of camera.
- Connecting too many cameras with client software cannot guarantee that each camera has sufficient transmission rate; therefore, we recommend you use the independent GigE frame grabber.

11.2 Technical Support

If the FAQ cannot solve your problems, you can obtain further support and assistance through the following methods:

- Official Website:www.irayple.com
- Technical Support Hotline: 400-681-8858

Appendix 1 Device Parameter Index

Appendix 1.1 DeviceControl

The **DeviceControl** includes the information of the device, protocol version, customized device ID, device temperature, device reset, etc. The parameters will vary with the device models.

Appendix Table 1-1DeviceControl description

Property	Parameter	Chapter
DeviceControl	DeviceType	10.1 Device Control
	DeviceScanType	
	DeviceVendorName	
	DeviceModelName	
	DeviceManufacturerInfo	
	DeviceVersion	
	DeviceFirmwareVersion	
	DeviceSerialNumber	
	DeviceUserID	
	DeviceTLType	
	DeviceTLVersionMajor	
	DeviceTLVersionMinor	
	DeviceMaxThroughput	
	DeviceCharacterSet	
	DeviceReset	
	DeviceTemperatureSelector	
	DeviceTemperature	
	FanSelector	
	FanMode	
	FanSpeed	
	FanRpm	
	SensorTargetTemperature	
	DeviceRegistersIsBigEndian	
	DeviceDevelopData	
	DeviceTLVersionSelector	

Appendix 1.2 ImageFormatControl

The **ImageFormatControl** has the device resolution information, and many function, such as binning, mirroring, image testing, etc.

Appendix Table 1-2DeviceControl description

Property	Parameter	Chapter
ImageFormatControl	Binning	7.4 Binnging
	BinningMode	
	PixelScalingEnable	7.5 Scaling
	PixelScalingWidth	
	PixelScalingHeight	
	SensorWidth	7.3 Resolution and ROI
	SensorHeight	
	WidthMax	
	HeightMax	
	Width	
	Height	
	OffsetX	
	OffsetY	
	ReverseX	7.6 Mirroring
	ReverseY	
	PixelFormat	7.1 Pixel Bit and 7.2 Pixel Format
	PixelSize	
	PixelColorFilter	
	PixelDynamicRangeMin	
	PixelDynamicRangeMax	
	Test Image	7.7 Test image

Appendix 1.3 AcquisitionControl

User can configure the acquisition mode, trigger mode, exposure mode, etc. in the **AcquisitionControl**.

Appendix Table 1-3AcquisitionControl description

Property	Parameter	Chapter
AcquisitionControl	ShutterMode	5.1 Shutters
	AcquisitionMode	6.1 Acquisition Mode
	AcquisitionStart	

Property	Parameter	Chapter
	AcquisitionStop	
	AcquisitionFrameCount	
	AcquisitionFrameRate	
	AcquisitionFrameRateEnable	
	AcquisitionStatusSelector	
	AcquisitionStatus	
	BurstMode	6.4 Burst Mode
	OverlapMode	5.2 Exposure Mode
	TriggerSelector	6.2 Acquisition Start and Frame Start
	TriggerMode	
	TriggerSource	
	TriggerSoftware	
	TriggerSoftwareSpeedUp	
	TriggerActivation	
	TriggerMixMode	
	TriggerDelay	
	TriggerCacheEnable	
	LightTriggerDelay	
	ExposureMode	6.6 Exposure
	ExposureTargerBrightness	
	ExposureAuto	
	ExposureTime	
	ResultingExposureTime	
	ResultingFrameRateAbs	6.7 Theoretical Frame Rate
	AVGNum	6.8 Multi-frame Average
	AVGEnable	
	Compress	6.9 Lossless Compression
	CompressionBandwidthMode	

Appendix 1.4 AutoFunctionControl

User can perform exposure auto adjustment, gain auto adjustment and target brightness setting in the full frame of image or target area in the **AutoFunctionControl**.

Appendix Table 1-4AutoFunctionControl description

Property	Parameter		Chapter
AutoFunctionControl	AutoTargetBrightness		8.1 Auto Function Control
	AutoFunctionProfile		
	AutoGainLowerLimit		
	AutoGainUpperLimit		
	AutoExposureTimeLowerLimit		
	AutoExposureTimeUpperLimit		
	AutoFunctionROIControl	AutoFunctionROIUsageIntensity	
		AutoFunctionROICount	
		AutoFunctionROISelector	
		AutoFunctionROIOffsetX	
		AutoFunctionROIOffsetY	
		AutoFunctionROIWidth	
		AutoFunctionROIHeight	

Appendix 1.5 DigitalIOControl

User can configure the mode of input or output of external I/O in the **DigitalIOControl**.

Appendix Table 1-5TransportLayerControl description

Property	Parameter	Chapter
DigitalIOControl	LineSelector	6.5 Input and Output Control
	LineMode	
	LineInverter	
	LineStatus	
	LineStatusAll	
	LineSource	
	ExposureActiveMode	
	ExposureActiveValue	
	StrobeStart	
	StrobeLineDuration	
	StrobeLineDelay	
	LineFormat	
	LineDebouncerTimeAbs	
	UserOutputSelector	
	UserOutputValue	

Property	Parameter	Chapter
	UserOutputValueAll	

Appendix 1.6 EventControl

User can record and check the event information of camera in the **EventControl**.

Appendix Table 1-6EventControl description

Property	Parameter		Chapter
EventControl	EventSelector		9.1 Event Monitor
	EventNotification		
	EventExposureEndData	EventExposureEnd	
		EventExposureEndTimestamp	
	EventFrameTriggerData	EventFrameTrigger	
		EventFrameTriggerTimestamp	
	EventFrameStartData	EventFrameStart	
		EventFrameStartTimestamp	
	EventAcquisitionStart Data	EventAcquisitionStart	
		EventAcquisitionStartTimestamp	
	EventAcquisitionTriggerData	EventAcquisitionTrigger	
		EventAcquisitionTriggerTimestamp	
	EventReadOutData	EventReadOut	
		EventReadOutTimestamp	

Appendix 1.7 LUTControl

User can perform the desired grayscale mapping relationship flexibly in the **LUTControl**.

Appendix Table 1-7LUTControl description

Property	Parameter	Chapter
LUTControl	LUTSelector	7.21 LUT
	LUTEnable	
	LUTIndex	
	LUTValue	
	LUTValueAll	

Appendix 1.8 AnalogControl

User can configure the parameters of gain, black level, white balance, etc. in the **AnalogControl**.

Appendix Table 1-8AnalogControl description

Property	Parameter	Chapter
AnalogControl	GainSelector	7.8 Gain
	GainAuto	
	GainRaw	
	BlackLevelAuto	7.9 Black Level
	BlackLevelSelector	
	BlackLevel	
	LightSourcePreset	7.10 Light Source Preset
	BalanceWhiteAuto	7.11 White Balance
	BalanceRatioSelector	
	BalanceRatio	
	Gamma	7.12 Gamma Correction

Appendix 1.9 Transport Layer Control

The parameters under the property of **TransportLayerControl** are for the network mode configuration and performance configuration of the camera. The parameters may vary depending on the device model.

Appendix Table 1-9TransportLayerControl

Property	Parameter	Chapter
TransportLayerControl	PayloadSize	10.2 Transport Layer Control
	GevActiveLinkCount	
	GevInterfaceSelector	
	GevLinkSpeed	
	GevMACAddress	
	GevSupportedOptionSelector	
	GevSupportedOption	
	GevCurrentIPConfigurationLLA	
	GevCurrentIPConfigurationDHCP	
	GevCurrentIPConfigurationPersistentIP	
	GevCurrentIPAddress	

Property	Parameter	Chapter
	GevCurrentSubnetMask	
	GevCurrentDefaultGateway	
	GevIPConfigurationStatus	
	DeviceManifestPrimaryURL	
	DeviceManifestSecondaryURL	
	GevNumberOfInterfaces	
	GevPersistentIPAddress	
	GevPersistentSubnetMask	
	GevPersistentDefaultGateway	
	GevMessageChannelCount	
	GevStreamChannelCount	
	GevHeartbeatTimeout	
	GevTimestampTickFrequency	
	GevTimestampControlLatch	
	GevTimestampControlReset	
	GevTimestampValue	
	GevGVCPExtendedStatusCodesSelector	
	GevGVCPExtendedStatusCodes	
	GevGVCPPendingAck	
	GevGVCPHeartbeatDisable	
	GevGVCPPendingTimeout	
	GevPrimaryApplicationSwitchoverKey	
	GevGVSPExtendedIDMode	
	GevCCP	
	GevPrimaryApplicationSocket	
	GevPrimaryApplicationIPAddress	
	GevMCPHostPort	
	GevMCDA	
	GevMCTT	
	GevMCRC	
	GevMCSP	
	GevStreamChannelSelector	
	GevSCPInterfaceIndex	
	GevSCPHostPort	
	GevSCPSFireTestPacket	

Property	Parameter	Chapter
	GevSCPSDoNotFragment	
	GevSCPSPacketSize	
	GevSCPDSwitch	
	SCPDSwitchValue	
	AdaptiveStreaming	
	RealSCPD	
	GevSCPD	
	GevSCFTD	
	GevSCDA	
	GevSCSP	
	FrameTriggerCount	
	FrameTriggerLostCount	
	SensorTriggerCount	
	SensorFrameCount	
	FrameTriggerCountReset	

Appendix 1.10 User Set Control

User can save and load user-defined parameters, and configure the default parameters in the **UserSetControl**.

Appendix Table 1-10UserSetControl description

Property	Parameter	Chapter
UserSetControl	UserSetSelector	10.3 User Set Control
	UserSetload	
	UserSetSave	
	UserSetDefault	
	UserSetLoadLastUserSet	
	UserSetLoadStatus	

Appendix 1.11 ChunkDataControl

User can embed the information behind the image data in the **ChunkDataControl**.

Appendix Table 1-11ChunkDataControl description

Property	Parameter	Chapter
ChunkDataControl	ChunkModeActive	10.4 Chunk Data Control
	ChunkSelector	

Property	Parameter	Chapter
	ChunkEnable	
	ChunkCounter0Value	
	ChunkCounter1Value	

Appendix 1.12 ColorTransformationControl

User can perform image color corrections in the **ColorTransformationControl**.

Appendix Table 1-12ColorTransformationControl description

Property	Parameter	Chapter
ColorTransformationControl	ColorTransformationSelector	7.22 Color Conversion Control
	ColorTransformationEnable	
	ColorTransformationValueSelector	
	ColorTransformationValue	

Appendix 1.13 CounterAndTimerControl

User can enable the counter function to count the external trigger signals and control the exposure function according to the user-defined requirements in the **CounterAndTimerControl**.

Appendix Table 1-13CounterAndTimerControl description

Property	Parameter	Chapter
CounterAndTimerControl	CounterControl	9.2 Counter and Timer
	CounterSelector	
	CounterResetSource	
	CounterEventSource	
	CounterReset	
	TimerSelector	
	TimerTriggerSource	
	TimerTriggerActivation	
	TimerDelay	
	TimerDuration	

Appendix 1.14 ISPControl

User can adjust the image effect in the **ISPControl**.

Appendix Table 1-14ISPControl description

Property	Parameter	Chapter
ISPControl	SharpnessEnabled	7.13 Sharpness
	Sharpness	
	DenoisingEnabled	7.14 Noise Reduction
	Denoising	
	DenoisingYuvEnabled	
	DenoisingYuv	
	PseudocolorElimination	7.15 Pseudocolor Elimination
	Hue	7.16 Hue and Saturation
	Saturation	
	DigitalShift	7.8.3 Digital Gain
	Brightness	7.8.4 Brightness
	Contrast	7.17 Contrast
	ContrastMode	
	ContrastThreshold	
	FFCEnable	7.18 FFC
	ColorAdjustmentSelector	7.19 Six-Axis Adjustment
	ColorAdjustmentHue	
	ColorAdjustmentSaturation	
	ColorAdjustmentConfigurationReset	
	HDRControl	7.20 HDR

Appendix 1.15 SequencerFPGAControl

User can configure multiple groups of parameter polling to control the image acquisition according to the different peripheral light sources in the **SequencerFPGAControl**. The parameter polling function are supported in many functions, such as ROI, gain, binning, binning mode, offset, exposure time, black level, brightness, white balance, digital gain, frame rate control, 6-axis adjustment, etc.

Appendix Table 1-15SequencerFPGAControl description

Property	Parameter	Chapter
SequencerFPGAControl	SequencerFPGAMode	8.2 Parameter Polling
	SequencerFPGAConfigurationMode	
	SequencerFPGASetSave	
	SequencerFPGASetLoad	
	SequencerFPGAConfigurationCounters	

Property	Parameter	Chapter
	SequencerFPGASetSelector	
	SequencerFPGATriggerSource	

Appendix 2 Legal Information

Copyright

- Copyright © ZheJiang HuaRay Technology Co.,Ltd.
- This document cannot be copied, transferred, distributed, or saved in any form without the prior written permission of Zhejiang HuaRay Technology Co., LTD (hereinafter referred to as "HuaRay"). The products described in this document may contain the software that belongs to HuaRay or the third party. Without the prior written approval of the corresponding party, any person cannot (including but not limited to) copy, distribute, amend, abstract, reverse compile, decode, reverse engineer, rent, transfer, sublicense the software. Without the prior written approval of the corresponding party, any person cannot (including but not limited to) copy, distribute, amend, abstract, reverse compile, decode, reverse engineer, rent, transfer, sublicense the software.

Trademark

- iRAYPLE 华睿科技 iRAYPLE are the trademarks or registered trademarks of HuaRay Technology.
- All trademarks and registered trademarks mentioned herein are the properties of their respective owners.

Disclaimer

- To the maximum extent permitted by applicable laws, in no event shall we be liable for any special, incidental, indirect, or consequential damages or any damages whatsoever on, including without limitation, loss of profit, data, goodwill, files, or expected savings, arising out of or in any way connected with the relevant contents and described products in this document.
- All products described in this document are provided on an "as-is" basis. Unless required otherwise by applicable laws, this document is provided without a warranty of any kind, either express or implied, including but not limited to, merchantability, degree of satisfaction, fitness for a particular purpose, or non-infringement.

Compliance to Export Control

HuaRay abides by the applicable export control laws and regulations, and implements the requirements related to the export, reexport, and transfer of hardware and software technologies. You are supposed to fully understand and strictly comply with domestic and international laws and regulations on export control related to the products described in this document.

About This Manual

- The manual is for reference only. If there is inconsistency between the manual and the actual product, the actual product shall prevail.
- We are not liable for any loss caused by the operations that do not comply with the Manual.
- The company reserves the right to maintain any information in this document at any time, and the maintenance content will be added to the new version of this document, and the document will only be released on our official website without other notifications, and please refer to the contents of the latest released document.

- There still might be deviation in technical data, function and operation description, or errors in print. If there is any doubt or dispute, we reserve the right of final explanation.
- Upgrade the reader software or try other mainstream reader software if the manual (in PDF format) cannot be opened.