China Daheng Group, Inc. Beijing Image Vision Technology Branch

POLARIS Frame Grabber

User Manual

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DAHENG IMAGING 大恒图像

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Preface

We really appreciate your choosing of the products of DAHENG IMAGING.

POLARIS Frame Grabber is the newest product of DAHENG IMAGING. CoaXPress Frame Grabber is based on CoaXPress 2.0 protocol, simultaneously backward compatible with CoaXPress 1.0 protocol. GEV Frame Grabber is based on GigE Vision V1.2 protocol. Frame Grabber is easy to install and use, and well suitable for industrial testing, medical treatment, scientific research, education and other fields.

This manual provides a detailed application introduction to the POLARIS Frame Grabber.

Contents

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1. Introduction

1.1. Series Introduction

The POLARIS Frame Grabber is a brand new product independently developed by DAHENG IMAGING, with optional CoaXPress interface and GEV interface.

Based on the PCIe Gen3 interface bus and CoaXPress 2.0 protocol, CoaXPress frame grabber can achieve high speed image acquisition and data transmission. It supports up to 4 channels of HD-BNC connection at the same time, acquiring images at a speed of 12.5Gbps per channel and transmitting them through PCIe Gen3 × 8 slot to host memory, with continuously stable bandwidth of 6700MB/s.

Based on the PCIe Gen3 interface bus and GigE Vision V1.2, GEV frame grabber can achieve high speed image acquisition and data transmission. It supports up to 4 channels connection at the same time, acquiring images at a speed of 10Gbps per channel and transmitting them through PCIe Gen3 × 8 slot to host memory, with continuously stable bandwidth of 40Gbps.

The POLARIS series is high performance, high reliability frame grabber, which is well suitable for industrial inspection, medical, scientific research, education, and security fields.

1.2. Naming Rules

The detailed information of the POLARIS Frame Grabber is provided in the following function/performance list. The frame grabber's model name is determined by its transmission interface, transmission rate, number of channels, transmission medium, PCIe protocol version, and the number of lanes.

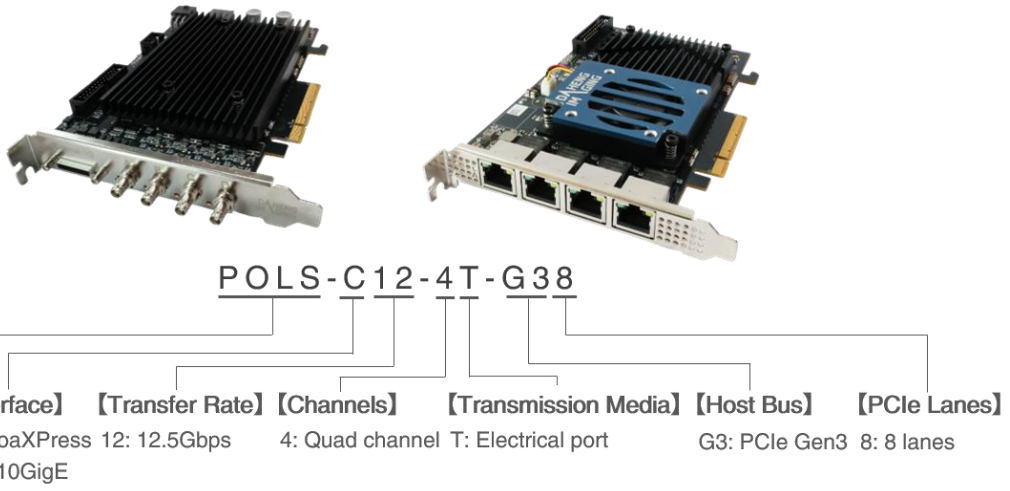

Figure 1-1 Naming rules

1.3. Protocol

The POLARIS CoaXPress frame grabber follows the CoaXPress 2.0 standard and can work with camera manufacturers that comply with the CoaXPress protocol, such as DAHENG IMAGING's CoaXPress camera, for image acquisition and basic preprocessing.

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The POLARIS GEV frame grabber follows the GigE Vision V1.2 standard and can work with DAHENG IMAGING's camera that comply with the GigE Vision protocol, such as GigE, 2.5GigE, 10GigE camera, for image acquisition and basic preprocessing.

1.4. Documents, CAD/Technical Drawing and Software Downloads

Product related document, CAD/Technical drawing, tools and software can be downloaded from the Downloads of DAHENG IMAGING website.

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2. Precautions

2.1. Safety Claim

Before installing and using DAHENG IMAGING products, please carefully read this manual and strictly comply with the usage requirements. And ensure to use the product in specified conditions, otherwise it may cause equipment malfunction. Our company will not bear any legal responsibility for any damage or injury caused by improper use of this product and disregard of safety instructions.

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

Symbol	Description
	Info: Provides additional information to emphasize or supplement important points of the main text
	Notice: Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance degradation, or unexpected results
	Warning: Indicates a potential risk that, if not avoided, could result in injury accidents, equipment damage, or business interruption
	Danger: Indicates a hazard with a high level of risk, which if not avoided, will result in death or serious injury

2.2. Safety Instruction

Usage	
 Warning	1) Do not install and operate the product in extreme environments with vibration, high temperature, humidity, dust, strong magnetic fields, explosive/corrosive smoke or gases, as it may damage the camera, cause a fire or electric shock. 2) If the frame grabber shows abnormal phenomena such as appearance damage, smoking, or noise, please immediately turn off the power and unplug it. 3) Unauthorized disassembly, repair, or modification of products is prohibited as it may damage the frame grabber or cause a risk of electric shock. 4) In the use of the device, you must be in strict compliance with the electrical safety regulations of the nation and region. 5) The power of external cameras should be strictly limited within the required values of the frame grabber, otherwise it may cause damage or abnormal operation of the camera.
 Notice	1) Check whether the device's package is in good condition, whether there is damage, deformation, etc. before unpacking. 2) After unpacking, please carefully inspect the quantity and appearance of the product and accessories for any abnormalities. 3) Please contact the metal object to release static electricity before the human body or other devices touch the frame grabber, in order to avoid damage to the frame grabber. 4) Please store and transport the product according to the specified storage and transportation conditions.

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Personal Safety	
 Warning	1) It is strictly prohibited to perform device wiring, dismantling, maintenance and other operations while powered on, otherwise there may be a risk of electric shock. 2) It is prohibited to touch the frame grabber directly during using, otherwise there may be a risk of burns.

2.3. Certification and Declaration

1. CE, RoHS

We declare that POLARIS frame grabber have passed the following EU certifications:

- 2014/30/EU—Electromagnetic Compatibility Restriction
- 2011/65/EU—Restriction of Hazardous Substances (RoHS) and its revised directive 2015/863/EU

2. FCC

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

- This device may not cause harmful interference
- This device must accept any interference received, including interference that may cause undesired operation

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

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3. Installation Guidelines

3.1. Hardware Installation

Before installing POLARIS Frame Grabber, Please follow operations below:

1) Turn off the PC power.

2) Release human static electricity.

3) Check the available PCIe slots

4) CoaXPress frame grabber: Check the PoCXP power interface on the PC end.

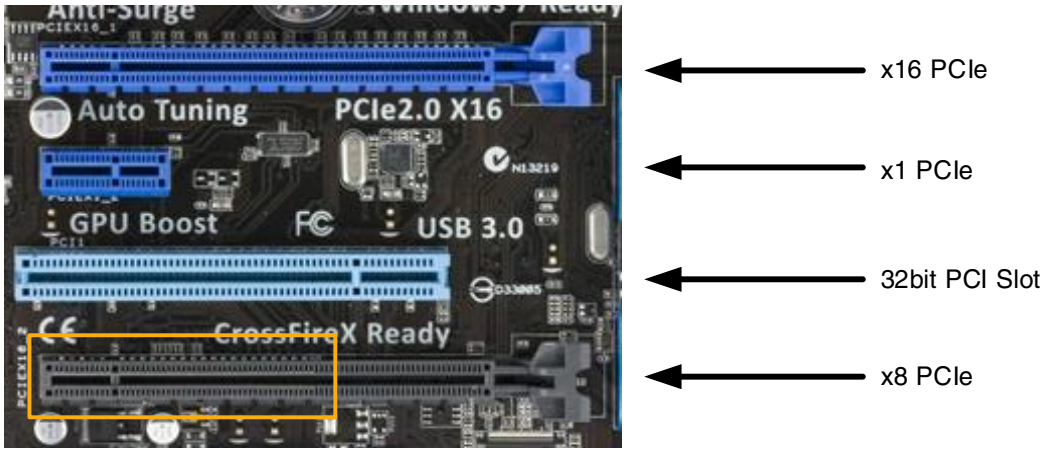

Figure 3-1 PCIe slot distribution (based on the actual PC motherboard)

For compatibility reasons, PCIe ×8 slots are made into the form of PCIe ×16 slots, but there only has half of the effective pins actually. Users can judgement it by observing the length of the welding spot (the specific distribution of PCIe slots depends on the actual PC motherboard used).

Figure 3-2 6 pin PoCXP power supply

Frame grabber installation steps:

1) Install the frame grabber into the PCIe ×16 slot of the PC motherboard,

2) For CXP frame grabber: if you need to power the external camera by PoCXP, you need to connect the 6pin terminal of both the PC and the frame grabber end (GEV frame grabber does not support PoE and does not require 6pin terminal on PC side), see Figure 3-3.

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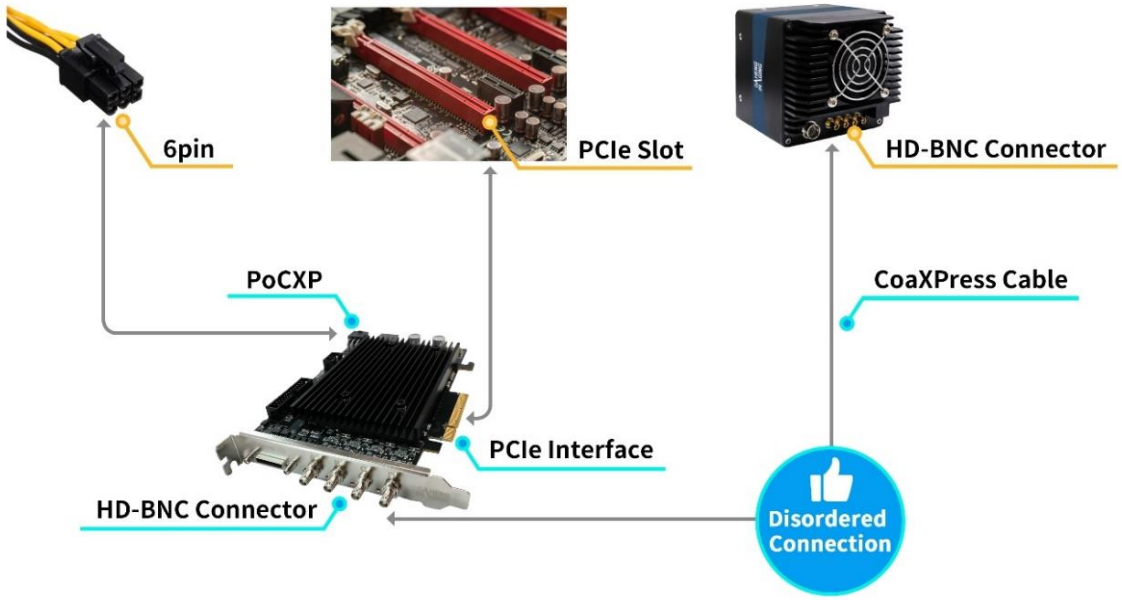

Figure 3-3 Schematic diagram of hardware connection for frame grabber

3) Camera connection: Taking CXP frame grabber as example, the way of connecting the external camera and the frame grabber is shown as Figure 3-3, users can choose single, dual or quad channel according to the actual usage.

Please install the corresponding software package after installing the frame grabber.

3.2. Host Preparation

3.2.1. Software package

The Software package of Galaxy SDK is used to control the POLARIS series frame grabber to provide stable, real-time image transmission, and provides a free SDK and abundant development sample source code. The package is composed of the following modules:

1) Driver Package (Driver): This package provides the POLARIS frame grabber driver program.

2) Interface Library (API): This package provides the POLARIS frame grabber and the camera control interface library and the image processing interface library, users can operate the frame grabber and the camera through GalaxyView.exe, also supports the user for secondary development.

3) Demonstration Program (GalaxyView.exe): This demonstration program is used to display the POLARIS frame grabber control, image acquisition and image processing functions, the user can control the camera and frame grabber directly by the demonstration program, and the user can develop their own control program based on the camera interface library.

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4) Sample: These samples demonstrate the functions of frame grabber and camera, users can easily use these samples to control frame grabbers and cameras, and then refer to the samples to develop their own control programs.

5) Programmer's Manual: This manual is the users programming guide that instructs the users how to configure the programming environment and how to achieve the acquisition and controlling of the frame grabber and camera through the interface library.

You can download the latest software package from the website: www.daheng-imaging.com/en/Downloads.

3.2.2. User Software Interface

After installing the Galaxy SDK, the user can use the demonstration program and the samples to control the frame grabber and camera, also the user can control them by the program which is written by the users. The software package provides three kinds of program interface, users can select the suitable one to use according to their own requirements:

1) API Interface

In order to simplify the users' programming complexity, the package provides the general C programming interface GxIAPI.dll and image processing algorithm interface DxImageProc.dll for the user to control the frame grabber or camera, and provides the samples and software development manual which are based on these interfaces. The API interface supports C/C++/C#/Python, etc.

2) GenTL Interface

This interface is developed according to the standard of general transport layer in Gen<i>Cam standard, DAHENG IMAGING follows the Gen<i>Cam standard and provides the GenTL interface to users, by which users can develop their own control program.

In addition, users can use some third-party software that supports Gen<i>Cam standard to control the frame grabber or camera, such as HALCON.

- **Note**

GEN<i>CAM standard: GEN<i>CAM is administered by the European Machine Vision Association (EMVA). GenICam provides a generic programming interface for all kinds of cameras and devices. It provides a standard application programming interface (API), no matter what interface technology is being used. It mainly includes the following modules:

- GenAPI: an XML description file format defining how to capture the features of a device and how to access and control these features in a standard way
- GenTL: a generic Transport Layer Interface, between software drivers and libraries, that transports the image data from the camera to the application running on a PC
- SFNC: common naming convention for camera features, which promotes interoperability between products from different manufacturers

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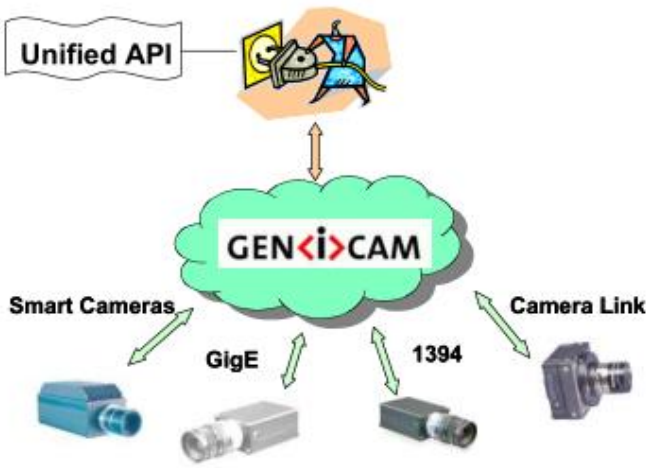

Figure 3-4 GEN<i>CAM standard schematic diagram

3.3. Frame Grabber Power

- POLS-C12-4T-G38 (CXP)

1) Power over PCIe

Insert frame grabber's PCIe interface into the PC's corresponding PCIe slot, and then the frame grabber will take power from the power rail from +12V and +3.3V to ensure that the frame grabber can work normally.

2) PoCXP

The PC motherboard or external power supply (DC12V) supplies power to the PoCXP link through the 6pin plug connector.

- POLS-DE-4T-G38 (GEV)

1) Power over PCIe

Insert frame grabber's PCIe interface into the PC's corresponding PCIe slot, and then the frame grabber will take power from the power rail from +12V and +3.3V to ensure that the frame grabber can work normally.

3.4. Frame Grabber Driver Installation

3.4.1. System Requirements

GalaxySDK can apply to all POLARIS series, the requirements for the operating system and version of the installation package are as follows:

Operating Systems	Applicable Version
Windows	Windows 7, Windows 10, Windows 11

Windows 64-bit system is recommended for POLARIS series, please contact our technical support for other systems

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3.4.2. Driver Installation

The steps of Galaxy SDK installation under windows are as follows:

1) Download the corresponding version of the installation package from www.daheng-imaging.com/en/Downloads. Please contact our technical support if not available.

2) Run the installer.

3) Follow the instructions of the installation wizard to complete the installation process. During the installation process, you can choose the camera interface you need (USB2.0, USB3 Vision, GigE Vision, CoaXPress, GEV etc.).

During the installation process, you must always pay attention to the anti-virus software to intercept the driver. If intercepted, it may cause the driver installation to fail.

3.5. Open the Camera and Start Acquisition

After completing the device power supply, connect the camera to the host frame grabber and other operations. Open GalaxyView.exe to start acquisition, the steps are as follows:

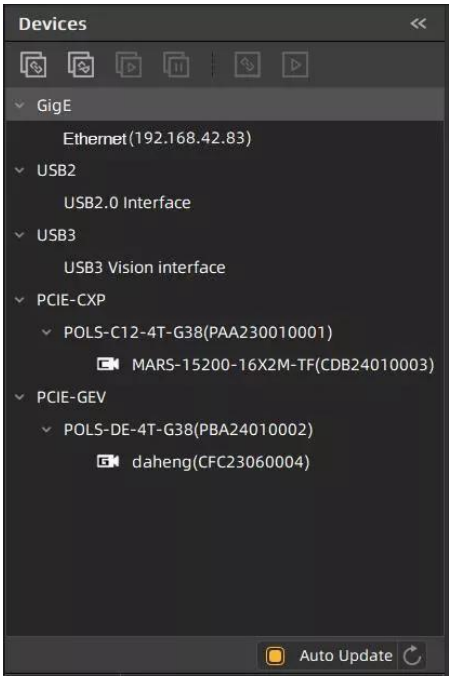
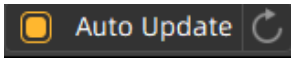


Figure 3-5 GalaxyView

1) Click the 

icon to refresh device list.

2) After enumerating, double click the enumerated device.

3) Click the  icon on the top of the Devices to start acquisition for the current device.

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4. General Specifications

4.1. POLS-C12-4T-G38 (CXP)

Specifications	POLS-C12-4T-G38
Memory	
Memory	4GB DDR4 SDRAM
Host Interface	
Bus	PCIe Gen3 × 8
Bus Performance	6700 MB/s
Camera Interface	
CXP Protocol	CoaXPress 1.0/2.0
Cable Connectors	HD-BNC 75Ω
Supported Cameras	4
Channel Indicator Light	4 dual color LEDs, each channel equipped with 1 indicator light
PoC Power Output	13W @ 24VDC × 4
Maximum Aggregate Bandwidth	12.5 Gbps × 4
Download Speed	1.25/2.5/3.125/6/10/12.5Gbps（CXP-1/2/3/5/6/10/12）
Upload Speed	Low-speed 20.83 Mbps (CXP-1 ~ CXP-6) Low-speed 41.6 Mbps (CXP-10, CXP-12)
Maximum Flow Packet Size	16KB
Pixel Format	Mono8/10/12/14/16 Bayer**8/10/12/14/16 (**=GR, RG, GB, BG, similarly hereinafter) RGB8
Data Transmission Method	Taps: 1X-1Y, 1X-2YE
Structure Specifications	
Cooling Method	Heatsink
Mounting	PCIe Gen3 × 8 or above
Dimensions	181mm × 21.63mm × 126.34mm
Temperature	Operating: 0°C ~ 50°C, Storage: -20°C ~70°C
Humidity	Operating: 95% (Non condensing), Storage: 95% (Non condensing)

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I/O	
Onboard I/O	4 opto-isolated inputs , 2 TTL inputs/outputs , 2 differential inputs, 2 opto-isolated outputs
Extend I/O	4 opto-isolated inputs , 2 TTL inputs/outputs , 2 differential inputs, 2 opto-isolated outputs
Connector	Onboard I/O: DH60-27P, The matching plug model: DH40-27S Extend I/O: 26pin double row 0.050" pin space with cover, model: 430225026S11B0
Electrical Characteristics	
Typical Power Consumption	19W (Excluding power consumption of PoCXP, camera, onboard I/O power supply, and extended I/O power supply)
PoCXP	DC12V, 6pin power plug
Other Specifications	
SDK	GalaxyView 2.0 or above
Operating System	Win7/10/11 (64 bit is recommended)
Conformity	CE, RoHS, FCC

Figure 4-1 POLS-C12-4T-G38 frame grabber specifications

4.2. POLS-DE-4T-G38 (GEV)

Specifications	POLS-DE-4T-G38
Memory	
Memory	4GB DDR4 SDRAM
Host Interface	
Bus	PCIe Gen3 × 8
Bus Performance	6700 MB/s (Ethernet transmission bandwidth: 4400MB/s)
Camera Interface	
GigE Vision	GigE Vision V1.2
Cable Connectors	RJ45
Supported Cameras	4
Channel Indicator Light	4 pairs of LEDs: one green light and one yellow light for each port
Maximum Aggregate Bandwidth	10 Gbps × 4
Download Speed	100M/1G/2.5G/5G/10G
Upload Speed	100M/1G/2.5G/5G/10G
Maximum Flow Packet Size	8192
Pixel Format	Mono8/10/12/14/16 Bayer**8/10/12/14/16 (**=GR, RG, GB, BG, similarly hereinafter) RGB8

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Structure Specifications	
Cooling Method	Heatsink, fan
Mounting	PCIe Gen3 × 8 or above
Dimensions	181mm × 22.4mm × 126.4mm
Temperature	Operating: 0°C ~ 50°C, Storage: -20°C ~70°C
Humidity	Operating: 95% (Non condensing), Storage: 95% (Non condensing)
I/O	
Onboard I/O	2 differential inputs, 4 opto-isolated outputs, 4 TTL inputs/outputs
Connector	Onboard I/O model: 430225026S11B0 The matching plug model: C23A25263820100 The onboard I/O can be led out by the appropriate accessories according to the user's requirements
Electrical Characteristics	
Typical Power Consumption	28W
Other Specifications	
SDK	GalaxyView 2.1 or above
Operating System	Win7/10/11 (64 bit is recommended)
Conformity	CE, RoHS, FCC

Figure 4-2 POLS-DE-4T-G38 frame grabber specifications

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5. Dimensions

5.1. CXP Frame Grabber

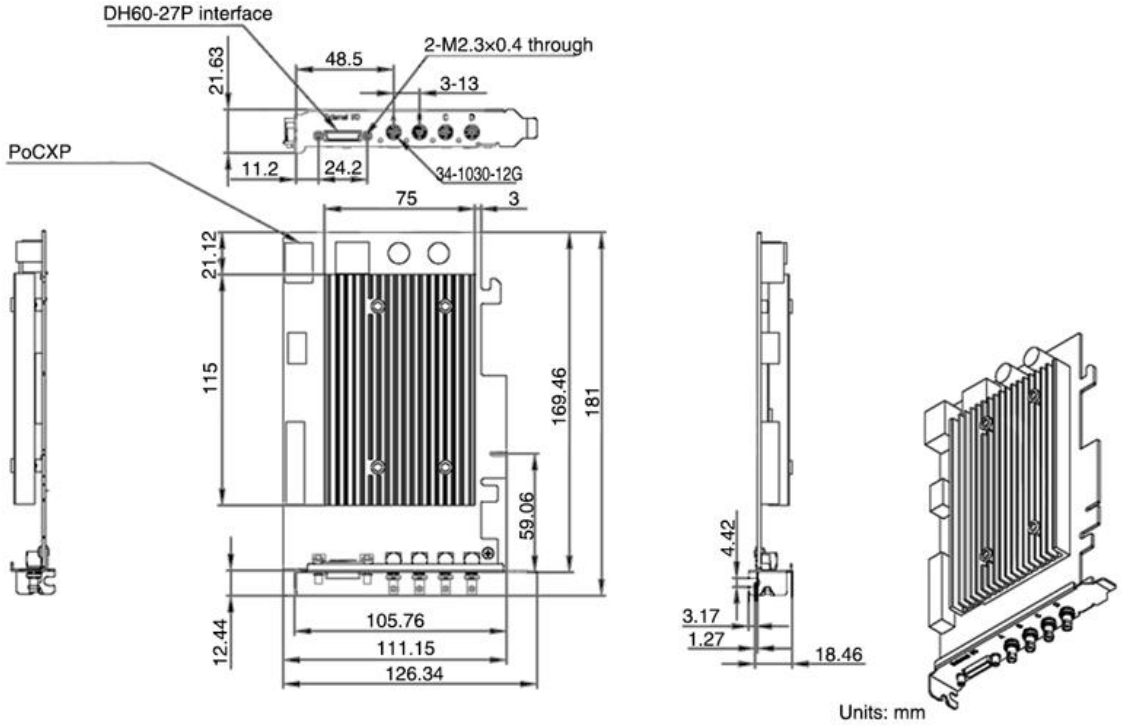

Figure 5-1 CXP frame grabber dimension

5.2. GEV Frame Grabber

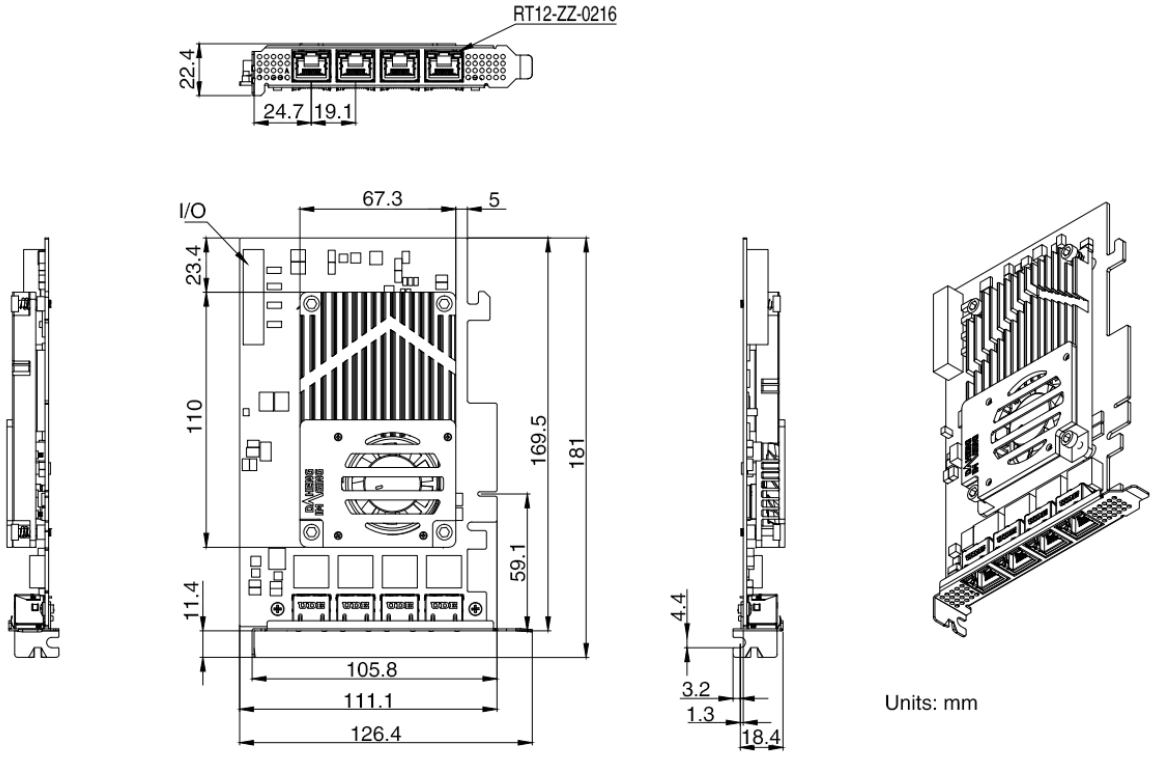

Figure 5-2 GEV frame grabber dimension

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6. Electrical Interface

6.1. POLARIS Frame Grabber's Interface/LED Distribution

6.1.1. CXP Frame Grabber

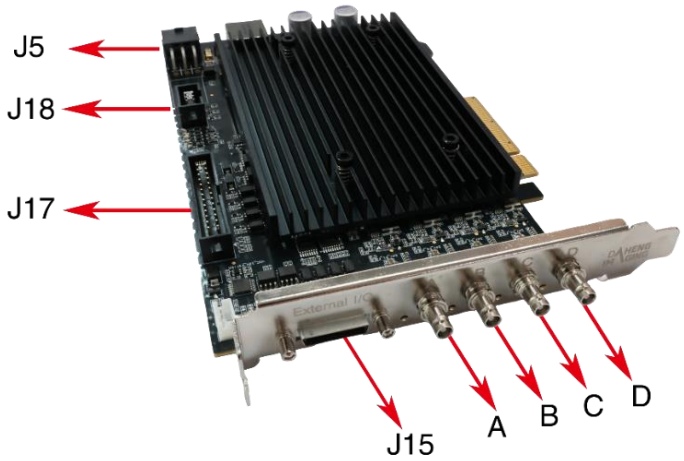

Figure 6-1 CoaXPress frame grabber connectors distribution

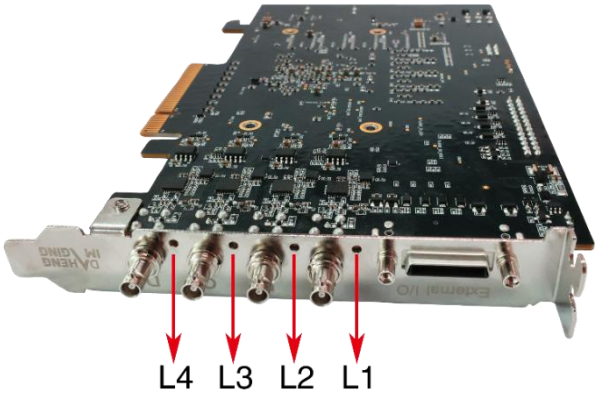

Figure 6-2 CoaXPress frame grabber LED distribution

Connector/LED descriptions:

Symbol	Description
J5	PoCXP (power over CXP connector)
J15	Onboard I/O connector (DH60-27P)
J17	Extend I/O connector (430225026S11B0)
J18	C2C connector
A, B, C, D	CXP interface
L1, L2, L3, L4	CXP indicator LEDs

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6.1.2. GEV Frame Grabber

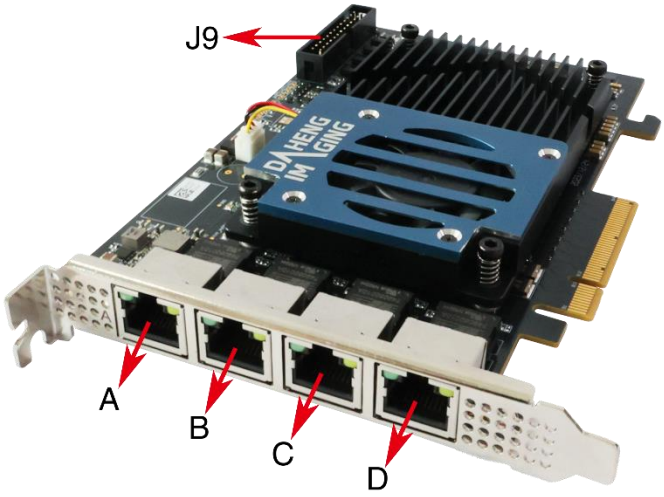

Figure 6-3 GEV frame grabber connectors distribution

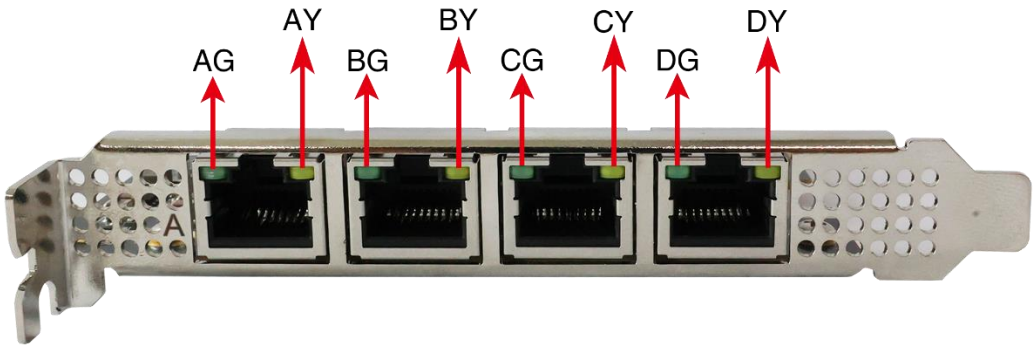

Figure 6-4 GEV frame grabber LED distribution

Connector/LED descriptions:

Symbol	Description
J9	Onboard I/O connector (430225026S11B0)
A, B, C, D	10GigE interface
AG, AY BG, BY CG, CY DG, DY	Indicator LEDs

6.2. LED Indicator Status

6.2.1. CXP Frame Grabber

There are four dual color LED indicator lights on the blocking side of the frame grabber, which are used to indicate the various working states of the frame grabber, as shown in Table 6-1. LED indicator lights can display three colors, namely red, orange, and green.

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LED Status	Frame Grabber Status
4 LEDs turn off simultaneously	No power supply or into factory settings
4 LEDs simultaneously keep the orange light constantly on	System boot phase
4 LEDs simultaneously flashing red at a frequency of 12.5Hz	Internal fault of the frame grabber
Single LED flashing green and orange alternately at a frequency of 12.5Hz	The PoCXP corresponding to Line has been turned on and no camera detected
Single LED flashing orange at a frequency of 12.5Hz	The PoCXP corresponding to Line has been turned off and no camera detected
Single LED flashing red and green alternately at a frequency of 0.5Hz	The corresponding Line cannot parse the camera protocol
Single LED keeps the red light constantly on	PoCXP of the corresponding Line overcurrent
Single LED keeps the green light constantly on	The corresponding Line has already opened the camera, but there is no valid data transfer
Single LED flashing green at a frequency of 12.5Hz	Corresponding Line is receiving or sending valid data
Single LED 500ms red light pulse	The Line corresponding to the frame grabber received incorrect data, such as 8B/10B decoding error, CRC error, data packet format error, etc
Single LED flashing green and orange alternately at a frequency of 0.5Hz	Corresponding Line is sending a connection test package

Table 6-1 CXP frame grabber status display

6.2.2. GEV Frame Grabber

There are eight LED indicator lights on the baffle side of the frame grabber, which are indicate the operating states of the Ethernet, as shown in Table 6-2. One green light and one yellow light for each port.

LED Status	Frame Grabber Status
Solid yellow and green	Corresponding Ethernet port link completed
Flashing green	Corresponding Ethernet port has data transmission

Table 6-2 GEV frame grabber status display

6.3. PCIe Interface

PCIe is a standard Gen3 ×8 interface, its pin definitions comply with PCIe standards, as shown in Figure 6-5.

The interaction between the frame grabber and the PC is completed through the PCIe interface, the signal rate of PCIe 3.0 ×8 is 8Gbps.

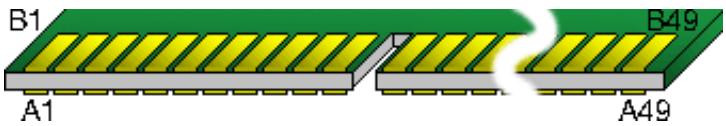

Figure 6-5 PCIe pin definition

6.4. CXP Interface

The CXP interface adopts the CXP 2.0 standard and at a speed of 12.5 Gbps.

The CXP interface connector uses Micro-BNC (HD-BNC) 75Ω, 90 degree plug, the model is 34-1030-12G.

There are 4 channels on the frame grabber, which is used to transmit image data captured by the camera, and provide power to external PoCXP supported cameras.

Each copper shaft of CXP can provide a maximum power of 17W within the range of 24VDC ± 2V, exceeding which may cause damage or abnormal operation of the external CXP camera.

CXP cable interface as shown in Figure 6-6:

Figure 6-6 CXP cable type

6.5. GEV Interface

The GEV interface adopts the IEEE 802.3an standard and at a speed of 10 Gbps.

The GEV interface connector uses standard RJ45 jack, and it is recommended to use CAT-6A cables or above, and the length of the cable is within 30m.

There are 4 channels 10GigE port on the frame grabber, which is used to transmit image data acquired by the camera, and does not support PoE (Power over Ethernet).

Figure 6-7 CAT6A cable type

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6.6. PoCXP Power Supply

The PoCXP interface is used for PoCXP link power supply. When it is necessary to power an externally connected CXP camera through the frame grabber's CXP interface, the PoCXP power interface of the frame grabber needs to be connected to the 6-pin terminal of the PC motherboard or an external power supply (DC12V). The connector definition is shown in Table 6-3.

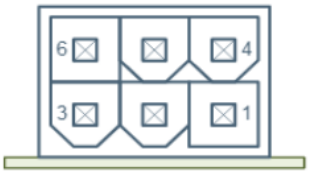
Diagram	Pin	Definition	Description
	1	+12VIN	Auxiliary +12V input
	2	+12VIN	Auxiliary +12V input
	3	+12VIN	Auxiliary +12V input
	4	GND	Ground
	5	GND	Ground
	6	GND	Ground

Table 6-3 PoCXP power supply connector definition

The polarity of the power supply should not be reversed, otherwise it may burn out the frame grabber.

6.7. I/O Interface

6.7.1. CXP Frame Grabber

6.7.1.1. Extended I/O Interface

The connector uses 26 pin dual row, 0.050" pin space with cover. The specific model is: 430225026S11B0.

Figure 6-8 Connector

Extended I/O module include 4 optocoupler isolated inputs, 2 TTL inputs/outputs, 2 pairs of differential inputs, and 2 optocoupler isolated outputs. The signal definition of connector pins are shown in Table 6-4.

Diagram					
					
Pin	Definition	Description	Pin	Definition	Description
1	GND	PWR GND & GPIO GND	14	Line13-	Opto-isolated input -
2	GND	PWR GND & GPIO GND	15	Line16+	Opto-isolated input +
3	Line18+	Differential input +	16	Line16-	Opto-isolated input -
4	Line18-	Differential input -	17	Line17+	Opto-isolated input +
5	Line19+	Differential input +	18	Line17-	Opto-isolated input -

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6	Line19-	Differential input -	19	Line14	TTL input/output
7	Line10+	Opto-isolated input +	20	GND	PWR GND & GPIO GND
8	Line10-	Opto-isolated input -	21	Line15	TTL input/output
9	Line11+	Opto-isolated input +	22	GND	PWR GND & GPIO GND
10	Line11-	Opto-isolated input -	23	NC	NC
11	Line12+	Opto-isolated input +	24	GND	PWR GND & GPIO GND
12	Line12-	Opto-isolated input -	25	+12V	+12V @ 500mA power output
13	Line13+	Opto-isolated input +	26	GND	PWR GND & GPIO GND

Table 6-4 Extended I/O connector definition

1) The polarity of the power supply should not be reversed, otherwise it may burn out the frame grabber or other externally connected devices.
2) The polarity of GPIO cannot be reversed, otherwise it may burn out the frame grabber or other connected devices.

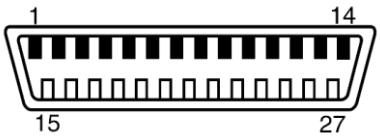
6.7.1.2. Onboard I/O Interface

The onboard I/O interface uses DH60-27P connector and DH40-27S plug.

Figure 6-9 Receptacle

Figure 6-10 Plug

Onboard I/O module include 4 optocoupler isolated inputs, 2 TTL inputs/outputs, 2 pairs of differential outputs, and 2 optocoupler isolated outputs. The signal definition of connector pins are shown in Table 6-5.

Diagram							
							
Pin	Definition	Core Colour	Description	Pin	Definition	Core Colour	Description
1	GND	Black	PWR GND & GPIO GND	15	Line4	White & Blue	TTL input/output
2	Line5	Green	TTL input/output	16	Line6-	White & Black	Opto-isolated output -
3	Line6+	Blue	Opto-isolated output +	17	GND	White & Orange	PWR GND & GPIO GND
4	Line7-	Yellow	Opto-isolated output -	18	Line7-	White & Brown	Opto-isolated output +
5	GND	Grey	PWR GND & GPIO GND	19	Line0+	White & Purple	Opto-isolated input +
6	Line0-	White	Opto-isolated input -	20	Line1+	Black & Red	Opto-isolated input +

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7	Line1-	Brown	Opto-isolated input -	21	Line2+	Black & Orange	Opto-isolated input +
8	Line2-	Purple	Opto-isolated input -	22	Line3+	Black & Yellow	Opto-isolated input +
9	Line3-	Orange	Opto-isolated input -	23	GND	Black & Green	PWR GND & GPIO GND
10	GND	Pink	PWR GND & GPIO GND	24	GND	Black & Grey	PWR GND & GPIO GND
11	Line9-	Light Green	Differential input -	25	Line9+	Black & Pink	Differential input +
12	Line8-	White & Red	Differential input -	26	Line8+	Pink & Red	Differential input +
13	+12V	White & Green	+12V power output	27	+12V	Pink & Blue	+12V power output
14	+12V	Red	+12V power output				

Table 6-5 Onboard I/O connector definition

1) The polarity of the power supply should not be reversed, otherwise it may burn out the frame grabber or other externally connected devices.
2) The polarity of GPIO cannot be reversed, otherwise it may burn out the frame grabber or other connected devices.
3) The rated current of the DH60-27P connector pins is 0.5A, but POLARIS provides a total current of 500mA.

6.7.1.3. Line0 (Opto-isolated Input) Circuit

Opto-isolated input circuit is shown as follow:

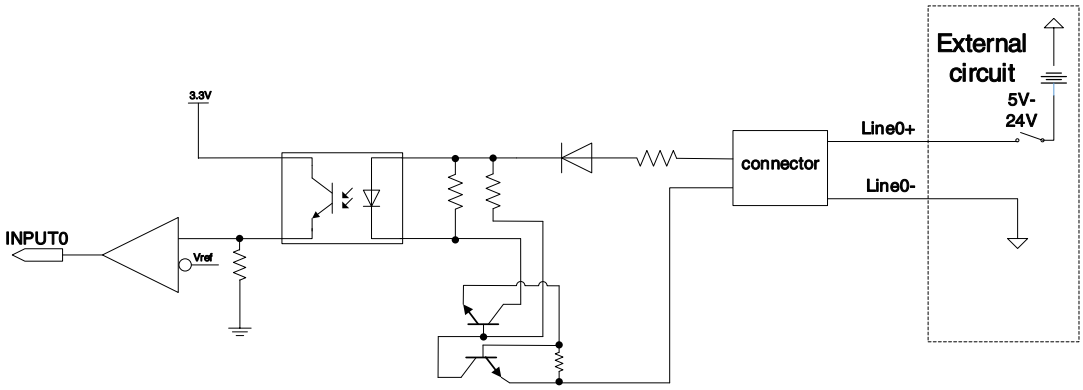

Figure 6-11 Opto-isolated input circuit

- Logic 0 input voltage: <1.3V (Line0+ voltage)
- Logic 1 input voltage: >2.0V (Line0+ voltage)
- Maximum input current: 5mA
- The status is unstable when input voltage is between 1.3V and 2.0V, which should be avoided

The connection method of the opto-isolated input circuit and the NPN and PNP photoelectric sensor is shown as follow:

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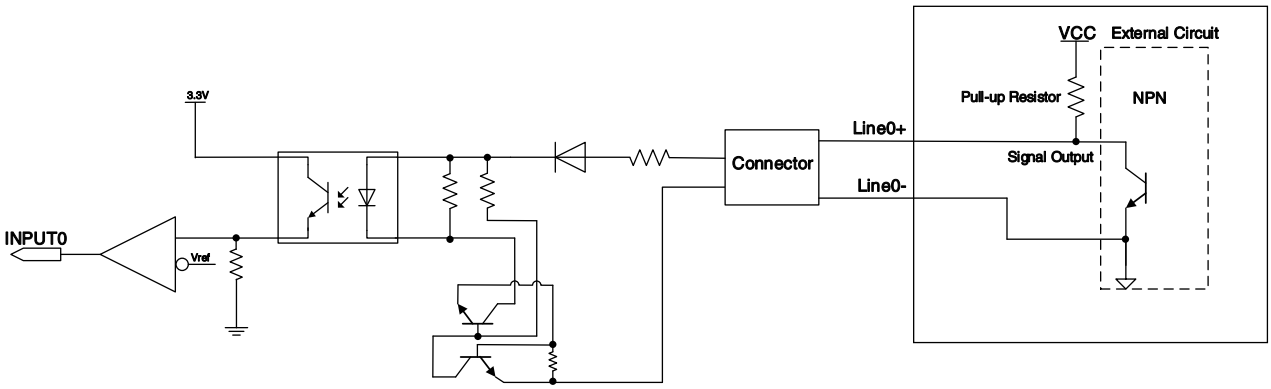

Figure 6-12 NPN photoelectric sensor connected to opto-isolated input circuit

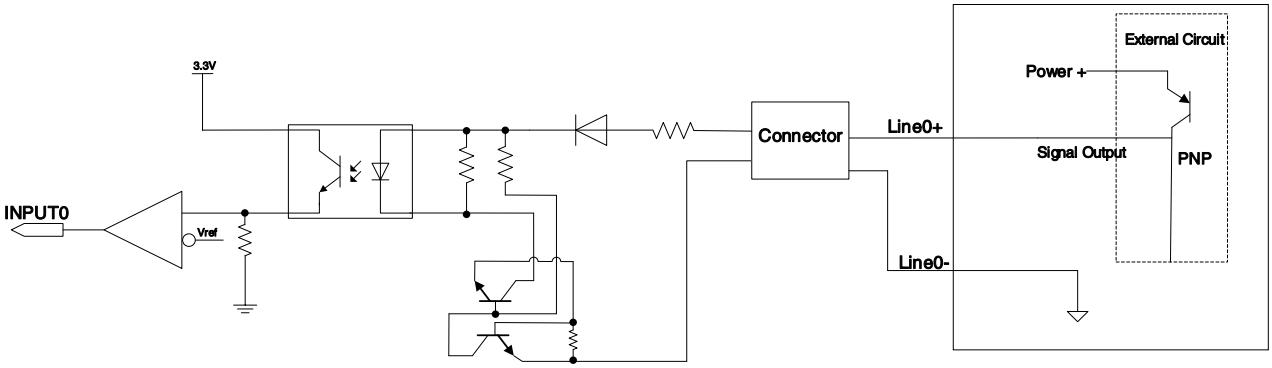

Figure 6-13 PNP photoelectric sensor connected to opto-isolated input circuit

- Rising edge delay: <6μs (0°C~45°C), parameter description as shown in Figure 6-14
- Falling edge delay: <6μs (0°C~45°C), parameter description as shown in Figure 6-14
- Different environment temperature and input voltage have influence on delay time of opto-isolated input circuit. Delay time in typical application environment (temperature is 25°C) is shown in Table 6-6

Parameter	Test condition	Value (μs)		
Rising edge delay	VIN=5V	5	~	6
Falling edge delay	VIN=5V	3	~	4

Table 6-6 Delay time of opto-isolated input circuit in typical application environment

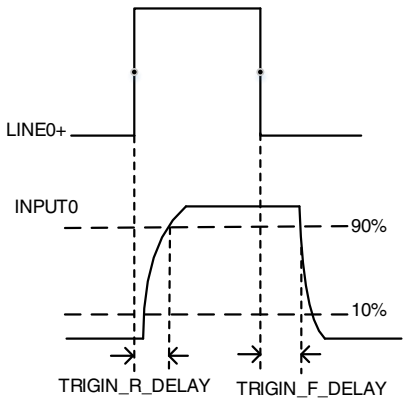

Figure 6-14 Parameter of opto-isolated input circuit

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- Rising time delay (TRIGIN_R_DELAY): The time from LINE0+ rising to half of the amplitude to INPUT0 rising to 90%
- Falling time delay (TRIGIN_F_DELAY): The time from LINE0+ dropping to half of the amplitude to INPUT0 dropping to 10%

6.7.1.4. Line6 (Opto-isolated Output) Circuit

Opto-isolated output circuit is shown as Figure 6-15:

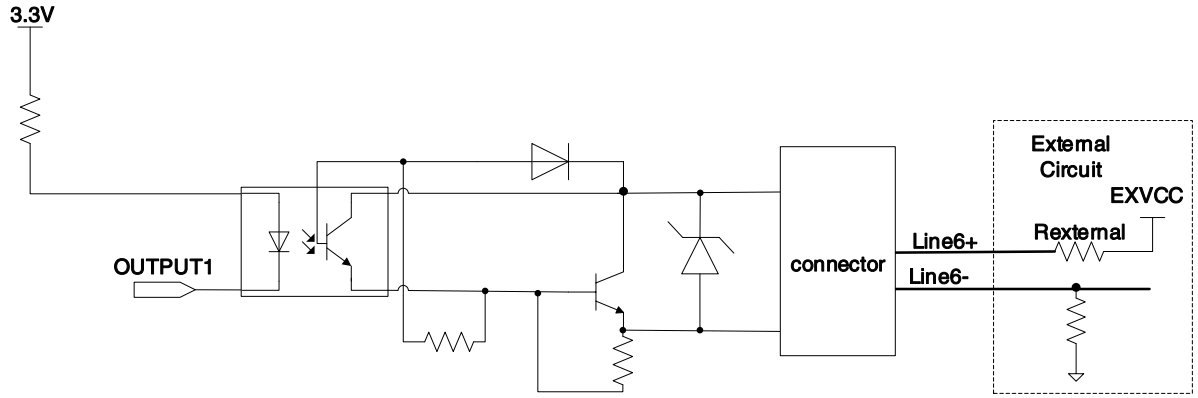

Figure 6-15 Opto-isolated output circuit

- Range of external voltage (EXVCC) is 3.3~30V
- Maximum output current of Line6 is 100mA
- When the external input voltage is equal to 3.3V, external of Line6+ does not require a series resistor. When the external input voltage is higher than 5.0V, Line 6+ needs to be connected with an external series limiting resistor to avoid damage. Recommended resistance value as shown in Table 6-7.

External Voltage (EXVCC)	External Resistance Rexternal (Ω)	Transistor voltage drop (turn on, unit V)	Output current (mA)
3.3	0	0.547	11
5	560	0.549	20
12	560	0.549	14
30	560	0.555	39

Table 6-7 Recommended resistance values for Line6+ series current limiting resistors

- Rising time delay = td+tf: <4μs (0°C~45°C) (parameter description is shown in Figure 6-16)
- Falling time delay = ts+tr: <4μs (0°C~45°C) (parameter description is shown in Figure 6-16)
- Delay time in typical application conditions (environment temperature is 25°C) are shown in Table 6-8

Parameter	Test Condition	Value (μs)
Storage time (ts)	External power is 3.3V	~0.937
Delay time (td)		~1.5
Rising time (tr)		~1.5

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Falling time (tf)		~1.6
Rising time delay = td+tf		~3.0
Falling time delay = ts+tr		~2.537

Table 6-8 Delay time of opto-isolated output circuit in typical application environment

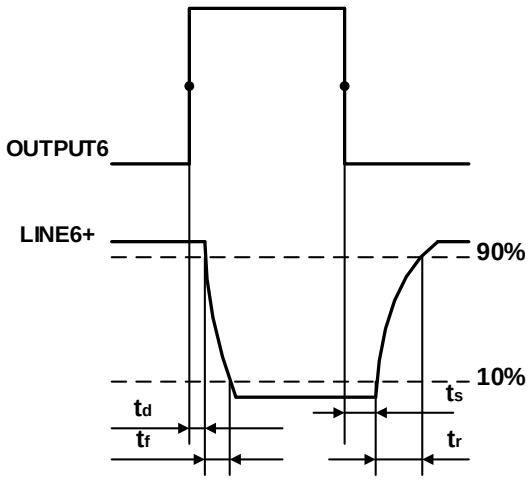

Figure 6-16 Parameter of opto-isolated output circuit

- Delay time (td): the response time from OUTPUT6 rises to 50% of amplitude to LINE6+ decreases to 90% of amplitude
- Falling time (tf): the response time for LINE6+ to decrease from 90% of the amplitude to 10%
- Storage time (ts): the response time from OUTPUT6 decreases to 50% of amplitude to LINE6+ rises to 10% of amplitude
- Rising time (tr): the response time for LINE6+ to rise from 10% of the amplitude to 90%

6.7.1.5. Line8 (Encoder Differential Input) Circuit

Encoder differential input circuit is shown as Figure 6-17:

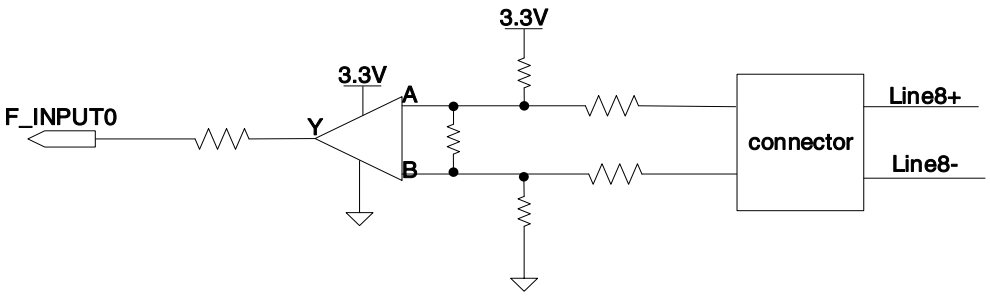

Figure 6-17 Encoder differential input circuit

- Input common mode voltage: -7.0V ~ +7.0V
- Input high level of differential voltage (VIDH): > 0.2V
- Input low level of differential voltage (VIDL): < -0.2V

- Maximum output current: ≤ 5mA
- Input pulse frequency: ≤ 5MHz
- The input common mode voltage is unstable state between -0.2V ~ 0.2V, please avoid inputting voltage values within this range

6.7.1.6. Line4 (TTL Input/Output) Circuit

TTL input/output circuit is shown in Figure 6-18:

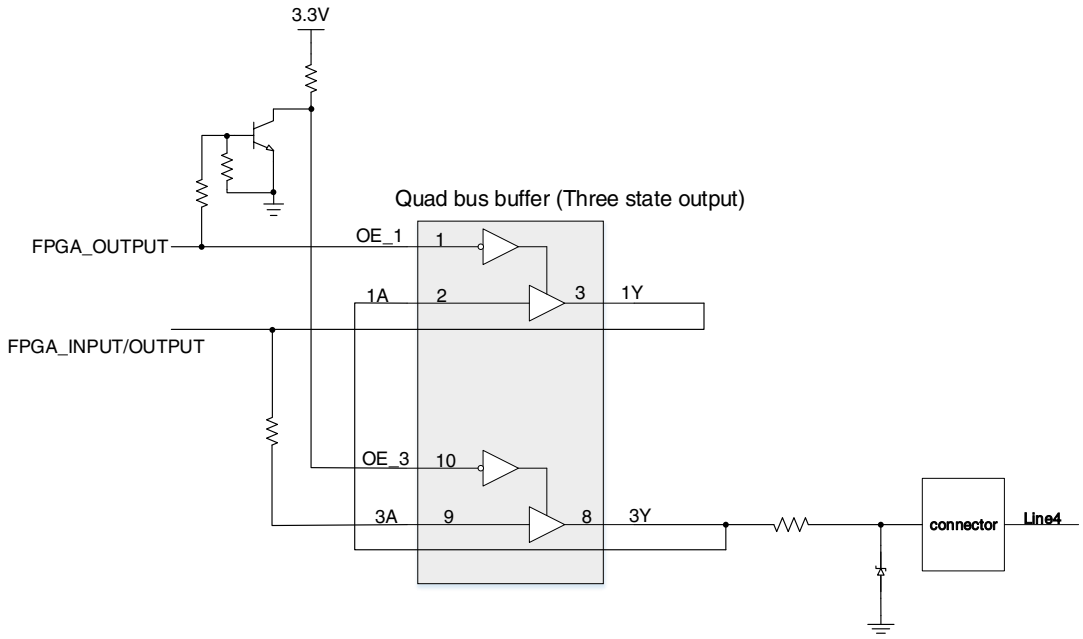

Figure 6-18 TTL input/output circuit

When configuring Line4 as an input pin, the FPGA_OUTPUT signal needs to be configured as low level, and the equivalent circuit inside the frame grabber is shown in Figure 6-19:

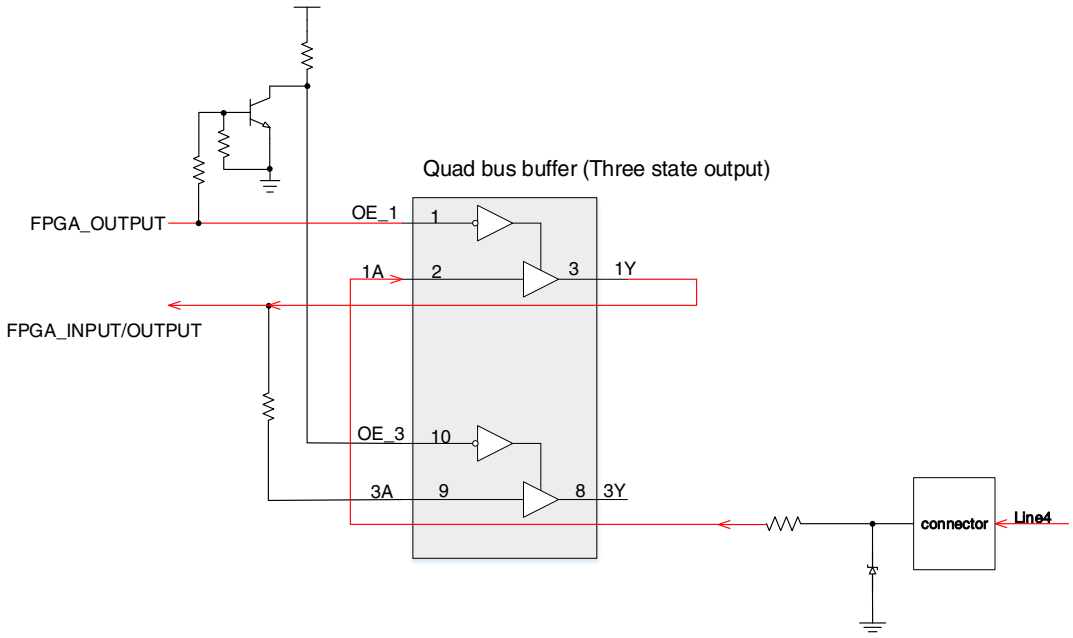

Figure 6-19 TTL input circuit

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- Input voltage: ≤ 5V
- Minimum pulse width: 100ns
- Input high level: > 2.0V
- Input low level: < 0.8V
- Input pulse frequency: ≤ 5MHz
- Rising time delay = td+tf: <4μs (0°C~45°C) (parameter description is shown in Figure 6-20)
- Falling time delay = ts+tr: <4μs (0°C~45°C) (parameter description is shown in Figure 6-20)
- Delay time in typical application conditions (environment temperature is 25°C) are shown in Table 6-9

Parameter	Test Condition	Value (μs)
Storage time (ts)	External power is 3.3V	~0.937
Delay time (td)		~1.5
Rising time (tr)		~1.5
Falling time (tf)		~1.6
Rising time delay = td+tf		~3.0
Falling time delay = ts+tr		~2.537

Table 6-9 Delay time of TTL output circuit in typical application environment

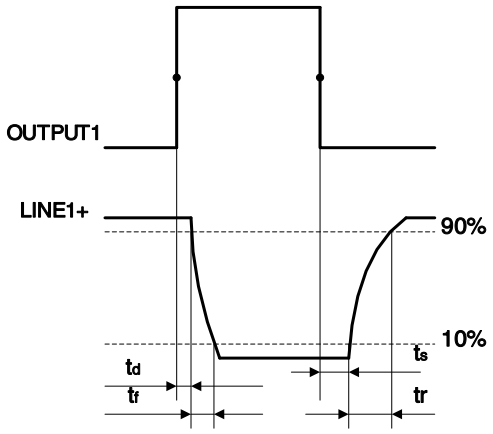

Figure 6-20 Parameter of TTL output circuit

- Delay time (td): the response time from OUTPUT4 rises to 50% of amplitude to LINE4+ decreases to 90% of amplitude
- Falling time (tf): the response time for LINE4+ to decrease from 90% of the amplitude to 10%
- Storage time (ts): the response time from OUTPUT4 decreases to 50% of amplitude to LINE4+ rises to 10% of amplitude
- Rising time (tr): the response time for LINE4+ to rise from 10% of the amplitude to 90%

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When configuring Line4 as output pin, the FPGA_OUTPUT signal needs to be configured as high level, the equivalent circuit inside the frame grabber is shown in Figure 6-21:

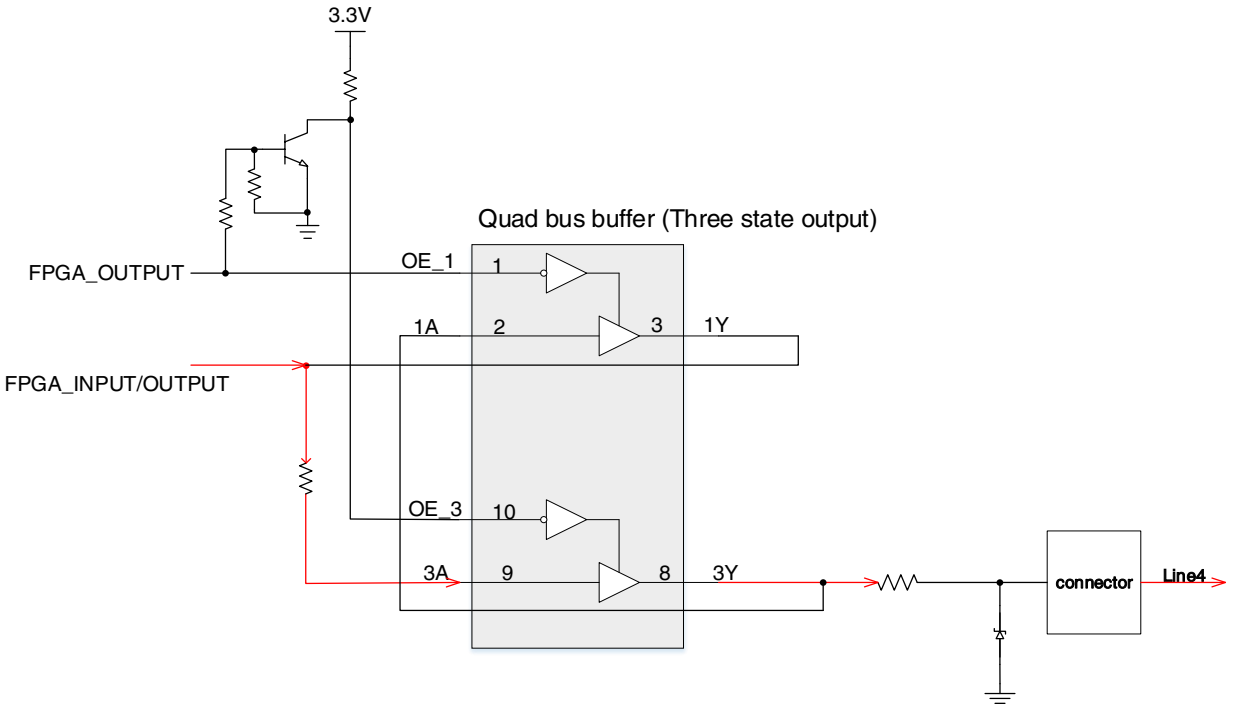

Figure 6-21 TTL output circuit

- High level voltage output

Typ	Min	Description
3.0V	2.6V	@-8mA, 300Ω Line terminal grounding
2.7V	2.2V	@-16mA, 300Ω Line terminal grounding
2.2V	1.75V	@-32mA, 300Ω Line terminal grounding

- Low level voltage output

Typ	Min	Description
0.34V	0.36V	@8mA
0.48V	0.55V	@16mA
0.78V	0.81V	@32mA
1.34V	1.36V	@64mA

- Output current range: -32mA ~ 64mA
- Output minimum pulse width: 100ns
- Output pulse frequency: ≤ 5MHz

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6.7.2. GEV Frame Grabber

6.7.2.1. Onboard I/O port

The connector uses 26 pin dual row, 0.050" pin space with cover. The specific model is: 430225026S11B0.

Figure 6-22 Connector

Onboard I/O module include 2 differential inputs, 4 opto-isolated outputs and 4 TTL inputs/outputs. The signal definition of connector pins are shown in Table 6-10.

Diagram					
					
Pin	Definition	Description	Pin	Definition	Description
1	GND	PWR GND & GPIO GND	14	Line5-	Opto-isolated output -
2	GND	PWR GND & GPIO GND	15	Line6	TTL input/output
3	Line0+	Differential input +	16	Line7	TTL input/output
4	Line0-	Differential input -	17	Line8	TTL input/output
5	Line1+	Differential input +	18	Line9	TTL input/output
6	Line1-	Differential input -	19	NC	NC
7	Line2+	Opto-isolated output +	20	GND	PWR GND & GPIO GND
8	Line2-	Opto-isolated output -	21	NC	NC
9	Line3+	Opto-isolated output +	22	GND	PWR GND & GPIO GND
10	Line3-	Opto-isolated output -	23	NC	NC
11	Line4+	Opto-isolated output +	24	GND	PWR GND & GPIO GND
12	Line4-	Opto-isolated output -	25	+12V	+12V @ 500mA power output
13	Line5+	Opto-isolated output +	26	GND	PWR GND & GPIO GND

Table 6-10 Onboard I/O connector definition

1) The polarity of power cannot be reversed, otherwise, frame grabber or other peripherals could burn out.
2) The polarity of GPIO pins cannot be reversed, otherwise, frame grabber or other peripherals could burn out.

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6.7.2.2. Line0/1 (Differential Input) Circuit

Differential input circuit is shown as follow:

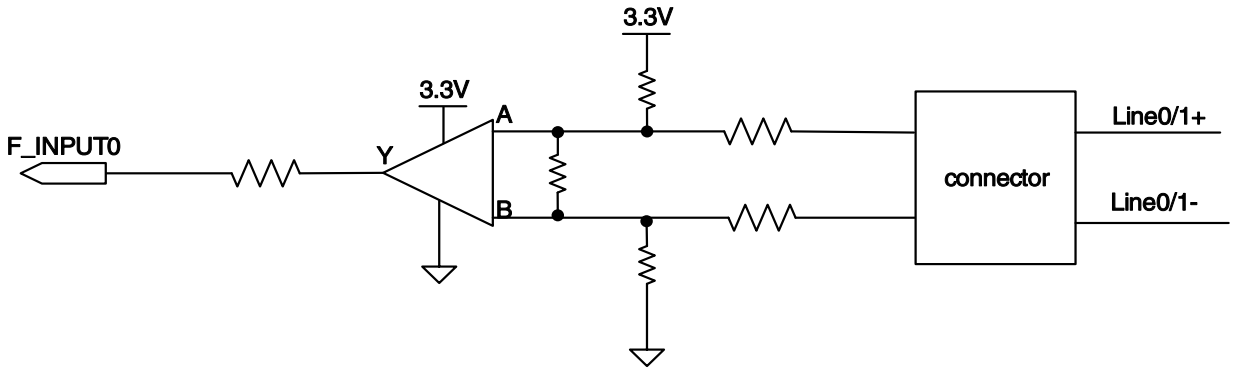

Figure 6-23 Differential input circuit

- Input common mode voltage: -7.0V ~ +7.0V
- Input high level of differential voltage (VIDH): > 0.2V
- Input low level of differential voltage (VIDL): < -0.2V
- Maximum output current: ≤ 5mA
- Input pulse frequency: ≤ 5MHz
- The input differential common mode voltage is unstable state between -0.2V ~ 0.2V, please avoid inputting voltage values within this range

6.7.2.3. Line2/3/4/5 (Opto-isolated Output) Circuit

Opto-isolated output circuit is shown as follow:

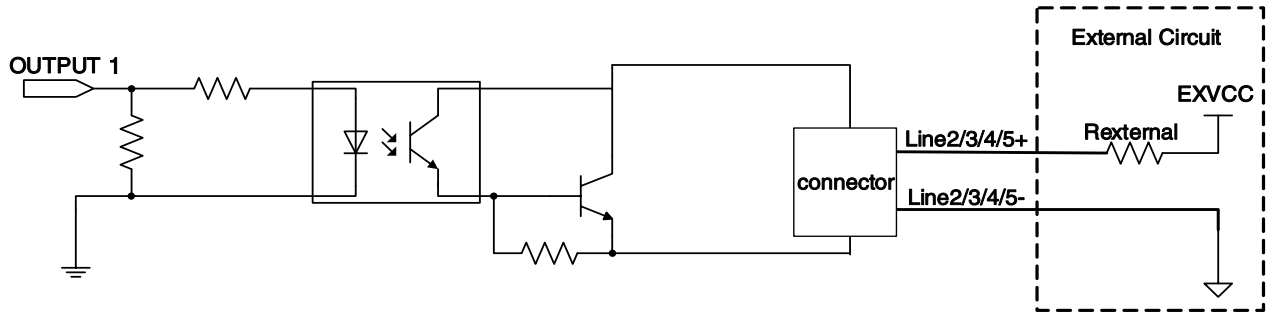

Figure 6-24 Opto-isolated output circuit

- Range of external voltage (EXVCC) is 5~24V
- Maximum output current of Line2/3/4/5 is 25mA
- Transistor voltage drop and output current in typical application conditions (environment temperature is 25°C) are shown in Table 6-11.

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Test Condition	Transistor voltage drop (turn on, unit V)	Output current (mA)
EXVCC: 5V, Rexternal: 1kΩ	0.90	4.16
EXVCC: 12V, Rexternal: 1kΩ	0.97	11.11
EXVCC: 24V, Rexternal: 1kΩ	1.04	23.08

Table 6-11 Transistor voltage drop and output current of Line2/3/4/5 in typical conditions

- Rising time delay = td + tf: <50μs (0°C~45°C) (parameter description is shown in Figure 6-25)
- Falling time delay = ts + tr: <50μs (0°C~45°C) (parameter description is shown in Figure 6-25)
- Delay time in typical application conditions (environment temperature is 25°C) are shown in Table 6-12

Parameter	Test Condition	Value (μs)		
Storage time (ts)	EXVCC: 15V Rexternal: 1kΩ	6.16	~	13.26
Delay time (td)		1.90	~	3.16
Rising time (tr)		2.77	~	10.60
Falling time (tf)		7.60	~	11.12
Rising time delay = tf + td		4.70	~	13.76
Falling time delay = tr + ts		14.41	~	24.38

Table 6-12 Time parameters of opto-isolated output circuit in typical application environment

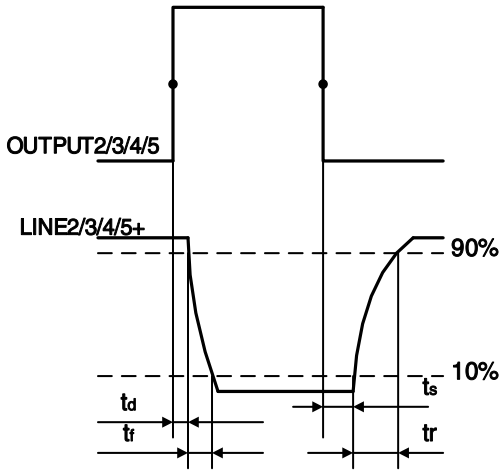

Figure 6-25 Parameter of opto-isolated output circuit

- Delay time (td): the response time from OUTPUT2/3/4/5 rises to 50% of amplitude to LINE2/3/4/5+ decreases to 90% of amplitude
- Falling time (tf): the response time for LINE2/3/4/5+ to decrease from 90% of the amplitude to 10%
- Storage time (ts): the response time from OUTPUT2/3/4/5 decreases to 50% of amplitude to LINE2/3/4/5+ rises to 10% of amplitude
- Rising time (tr): the response time for LINE2/3/4/5+ to rise from 10% of the amplitude to 90%

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6.7.2.4. Line6/7/8/9 (Bi-directional TTL) Circuit

Bi-directional TTL circuit is shown as follow:

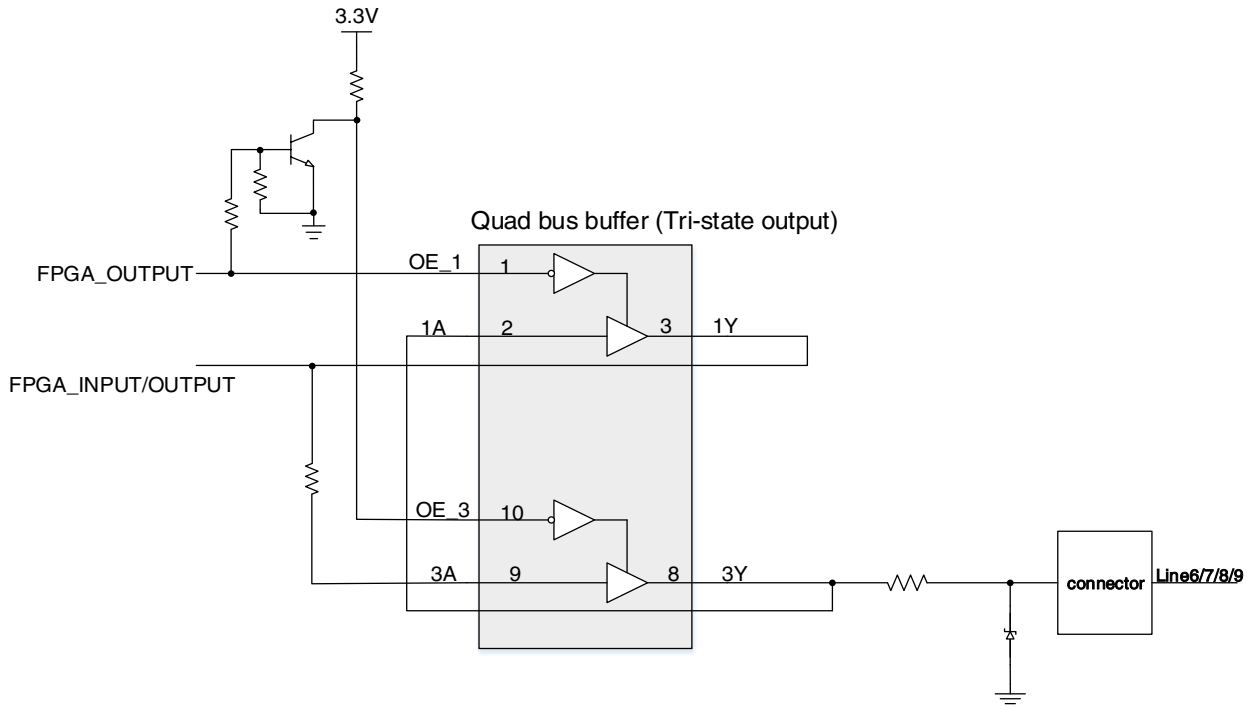

Figure 6-26 Bi-directional TTL circuit

When configuring Line6/7/8/9 as input, the FPGA_OUTPUT signal needs to be configured as low level, and the equivalent circuit inside the frame grabber is shown in Figure 6-27:

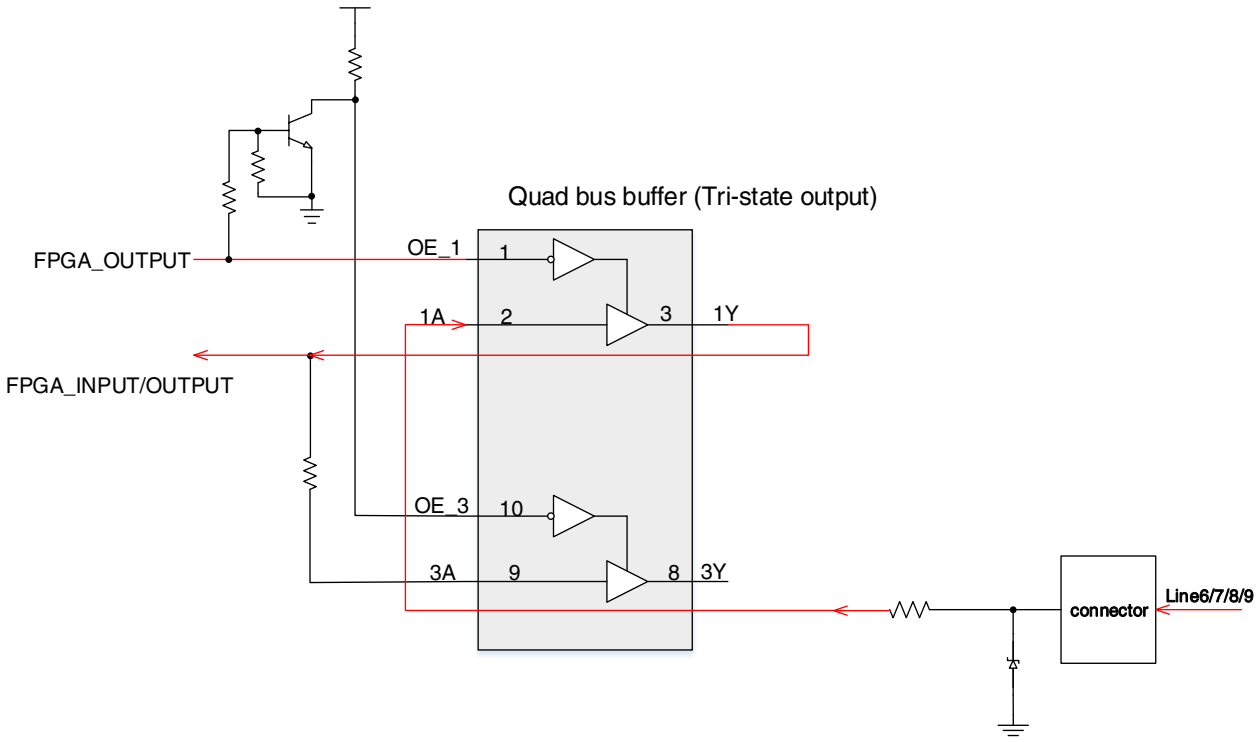

Figure 6-27 TTL input circuit

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- Input voltage: ≤ 5V
- Minimum pulse width: 100ns
- Input high level: > 2.0V
- Input low level: < 0.8V
- Input pulse frequency: ≤ 5MHz
- Rising time delay = td+tf: <4μs (0°C~45°C) (parameter description is shown in Figure 6-28)
- Falling time delay = ts+tr: <4μs (0°C~45°C) (parameter description is shown in Figure 6-28)
- Delay time in typical application conditions (environment temperature is 25°C) are shown in Table 6-13

Parameter	Test Condition	Value (μs)
Storage time (ts)	External power is 3.3V	~0.937
Delay time (td)		~1.5
Rising time (tr)		~1.5
Falling time (tf)		~1.6
Rising time delay = td+tf		~3.0
Falling time delay = ts+tr		~2.537

Table 6-13 Delay time of TTL output circuit in typical application environment

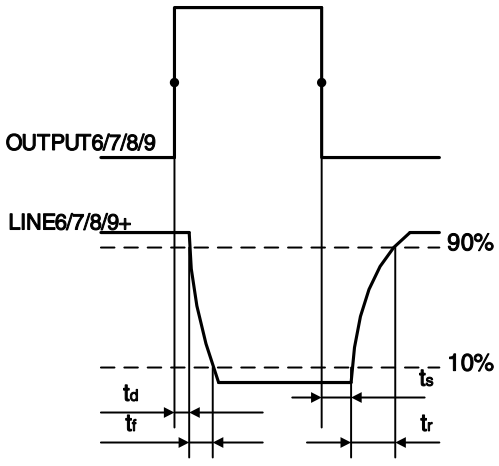

Figure 6-28 Parameter of TTL output circuit

- Delay time (td): the response time from OUTPUT6/7/8/9 rises to 50% of amplitude to LINE6/7/8/9+ decreases to 90% of amplitude
- Falling time (tf): the response time for LINE6/7/8/9+ to decrease from 90% of the amplitude to 10%
- Storage time (ts): the response time from OUTPUT6/7/8/9 decreases to 50% of amplitude to LINE6/7/8/9+ rises to 10% of amplitude
- Rising time (tr): the response time for LINE6/7/8/9+ to rise from 10% of the amplitude to 90%

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When configuring Line6/7/8/9 as output pin, the FPGA_OUTPUT signal needs to be configured as high level, the equivalent circuit inside the frame grabber is shown in Figure 6-29:

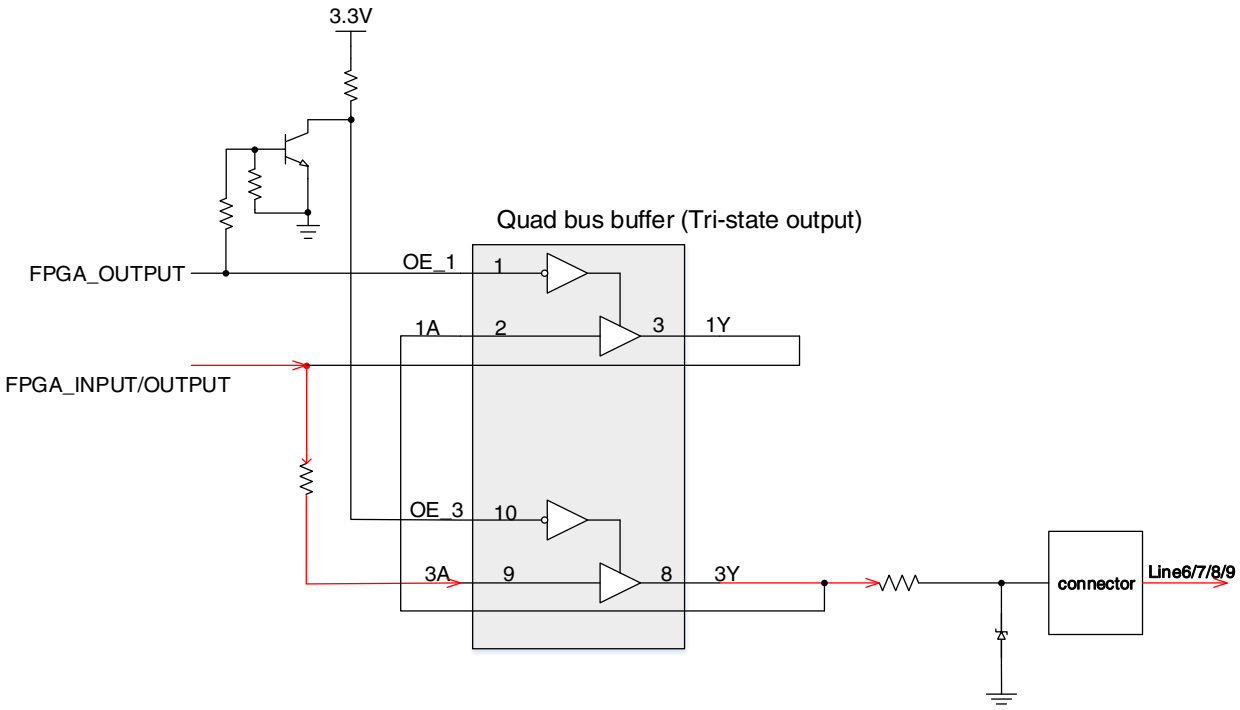

Figure 6-29 TTL output circuit

- High level output voltage

Typ	Min	Description
3.0V	2.6V	@-8mA, 300Ω Line terminal grounding
2.7V	2.2V	@-16mA, 300Ω Line terminal grounding
2.2V	1.75V	@-32mA, 300Ω Line terminal grounding

- Low level output voltage

Typ	Min	Description
0.34V	0.36V	@8mA
0.48V	0.55V	@16mA
0.78V	0.81V	@32mA
1.34V	1.36V	@64mA

- Output current range: -32mA ~ 64mA
- Output minimum pulse width: 100ns
- Output pulse frequency: ≤ 5MHz

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7. Features

7.1. I/O Control

7.1.1. I/O Type

7.1.1.1. CXP Frame Grabber

The frame grabber provides 20 I/O pins for accessing onboard I/O control signals. The I/O numbers and their types are shown in the table below:

No.	Position	Level Standard	Direction	No.	Position	Level Standard	Direction
Line0	Onboard I/O	OptoCoupler	Input	Line10	Extended I/O	OptoCoupler	Input
Line1	Onboard I/O	OptoCoupler	Input	Line11	Extended I/O	OptoCoupler	Input
Line2	Onboard I/O	OptoCoupler	Input	Line12	Extended I/O	OptoCoupler	Input
Line3	Onboard I/O	OptoCoupler	Input	Line13	Extended I/O	OptoCoupler	Input
Line4	Onboard I/O	TTL	Input(Default) /Output	Line14	Extended I/O	TTL	Input(Default) /Output
Line5	Onboard I/O	TTL	Input(Default) /Output	Line15	Extended I/O	TTL	Input(Default) /Output
Line6	Onboard I/O	OptoCoupler	Output	Line16	Extended I/O	OptoCoupler	Output
Line7	Onboard I/O	OptoCoupler	Output	Line17	Extended I/O	OptoCoupler	Output
Line8	Onboard I/O	Difference	Input	Line18	Extended I/O	Difference	Input
Line9	Onboard I/O	Difference	Input	Line19	Extended I/O	Difference	Input

The CXP frame grabber has four bi-directional I/O: Line4, Line5, Line14, and Line15, which can be configured to be input or output by LineMode.

7.1.1.2. GEV Frame Grabber

The frame grabber provides 10 I/O pins for accessing I/O control signals. The I/O numbers and their types are shown in the table below:

No.	Position	Level Standard	Direction	No.	Position	Level Standard	Direction
Line0	Onboard I/O	Difference	Input	Line5	Onboard I/O	OptoCoupler	Output
Line1	Onboard I/O	Difference	Input	Line6	Onboard I/O	TTL	Input(Default) /Output
Line2	Onboard I/O	OptoCoupler	Output	Line7	Onboard I/O	TTL	Input(Default) /Output
Line3	Onboard I/O	OptoCoupler	Output	Line8	Onboard I/O	TTL	Input(Default) /Output
Line4	Onboard I/O	OptoCoupler	Output	Line9	Onboard I/O	TTL	Input(Default) /Output

The GEV frame grabber has four bi-directional I/O: Line6, Line7, Line8, and Line9, which can be configured to be input or output by LineMode.

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- For unidirectional I/O, "LineMode" is a read-only item that displays the current direction of the I/O
- After configuring bi-directional I/O to input, it can be used and configured according to normal input I/O
- After configuring bidirectional I/O to output, it can be used and configured according to normal output I/O

7.1.2. Configure Input Lines

1) LineSelector

The CXP frame grabber provides up to 16 input signals and the GEV frame grabber provides up to 6 input signals. Please refer to the table above for details.

Configure I/O through "LineSelector", and the default selection is Line0 when the frame grabber is powered on.

2) LineFilterDelay

In order to suppress external interference signals, the frame grabber has a filtering function for the rising and falling edges of the input signal. Users can set through "LineFilterDelay" function, and the range is [0, 10000]μs, precision of 20ns.

Example 1: Setting the rising edge filter width to 1ms, then the pulse width less than 1ms (positive or negative pulses) will be filtered out, as shown in Figure 7-1.

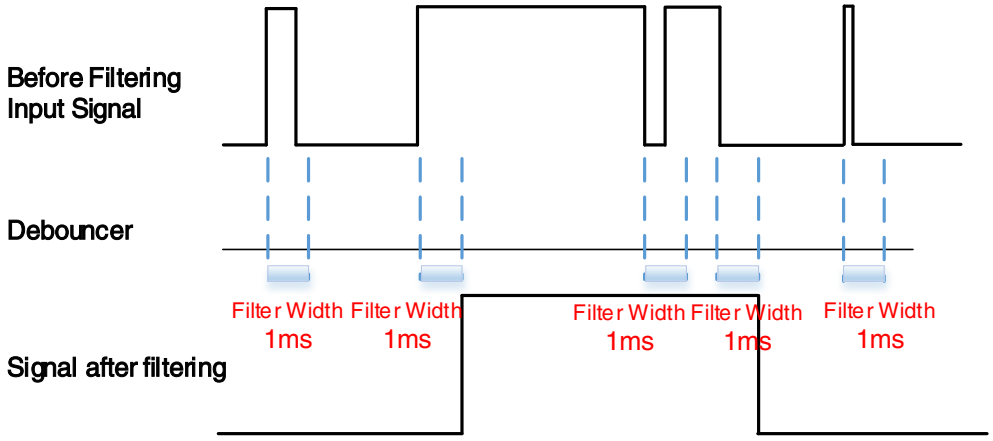

Figure 7-1 Filter diagram of input signal

7.1.3. Configure Output Lines

The CXP frame grabber provides up to 8 output signals, including 4 unidirectional opto-isolated output I/O and 4 bi-directional I/O. The GEV frame grabber provides up to 8 output signals, including 4 unidirectional opto-isolated output I/O and 4 bi-directional I/O. Users can configure the I/O specifically through LineSelector.

The CXP frame grabber's output sources of each output signal are configurable, including: UserOutput0~UserOutput19, Line0~Line19, Timer0~Timer3, and UserOutput_TL0~UserOutput_TL3.

The GEV frame grabber's output sources of each output signal are configurable, including: UserOutput0~UserOutput9, Line0~Line9, Timer0~Timer3, and UserOutput_TL0~UserOutput_TL3.

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The frame grabber's default output source for power on is Timer0.

The high or low level of the output signal is the same as the corresponding state of the selected signal source.

- **UserOutput**

In this mode, users can set frame grabber's output level by themselves.

For example: selecting Line4 as output, output source as UserOutput4, and controlling the UserOutputValue by users. Set LineSelector to Line4, set LineMode to Output, set LineSource to UserOutput4, and set UserOutputSelector to UserOutput4. Users can control the output level of Line4 by changing the UserOutputValue to True/False.

When selecting UserOutput as the I/O output source, it is necessary to select UserOutput_x with the same serial number as the current I/O to the output source.

- **Line0 ~ Line19 (CXP) / Line0 ~ Line9 (GEV)**

The frame grabber supports to output the output I/O directly from the input I/O's input level state.

Example: Output the input signal of Line0 from Line 7. Set LineSelector as Line7 and LineSource as Line0.

- **Timer0 ~ Timer3**

The frame grabber supports to output the waveform generated by Timer through I/O.

Example: Output the waveform generated by Timer2 through Line7. Set LineSelector as Line7 and LineSource as Timer2.

- **UserOutput_TL0 ~ UserOutput_TL3**

Users can set frame grabber's output level freely in this mode.

For example: selecting Line4 as output and set UserOutputSelector as UserOutput_TL0, the output value is controlled by the user. Set LineSelector as Line4, LineMode as Output, LineSource as UserOutput_TL0, UserOutputSelector as UserOutput_TL0. Users can control the output level of Line4 by changing the UserOutputValue to True/False.

7.1.4. LineFormat

Users can query the current level format of the selected I/O through LineFormat.

7.1.5. LineStatus

7.1.5.1. CXP Frame Grabber

1) Read the logic status of single Line

The frame grabber can obtain the signal status of individual Lines. When powered on, Line0~Line7 and Line10~Line17's default Line state is False, while Line8~Line9, Line18~Line19's default Line state is True.

2) Read the logic status of all Lines

The frame grabber can obtain the signal status of all Lines, the signal state level can reflect the I/O level.

The frame grabber's all Line level status are shown in the following table, the default power on value is 0xC0300.

Reserve	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
x	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0

7.1.5.2. GEV Frame Grabber

1) Read the logic status of single Line

The GEV frame grabber can get the line's signal status. When the device is powered on, the default status of Line0 and Line1 is True, and the default status of Line2~Line9 is False.

2) Read the logic status of all Lines

All the lines level status bit of the GEV frame grabber are shown as follows, and the default value is 0xC0003.

Reserve	9	8	7	6	5	4	3	2	1	0
x	0	0	0	0	0	0	0	0	1	1

The I/O Line status of the output mode is False.

7.1.6. Set UserOutputValueALL

The CXP frame grabber and GEV frame grabber provides two types of UserRegSelector (The CXP frame grabber: UserOutput0~19 and UserOutputTL0~3, The GEV frame grabber: UserOutput0~9 and UserOutputTL0~3). Users can specify the register to be configured through UserOutputSelector and change the register value by setting UserOutputValue to true or false.

The frame grabber features of modifying user-defined output registers in groups by selecting UserOutput or UserOutputTL through UserRegSelector. After that, set user-defined output register values through UserOutputValueALL.

Example1 (CXP frame grabber): Set UserOutput0, UserOutput3 and UserOutput12 to True, and other UserOutput registers to false. Set UserRegSelector to UserOutput and set the value of UserOutputValueALL to 0×1009.

Example2 (GEV frame grabber): Set UserOutput2, UserOutput3 and UserOutput8 to True, and other UserOutput registers to false. Set UserRegSelector to UserOutput and set the value of UserOutputValueALL to 0×10C.

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7.2. Basic Property Settings

7.2.1. ImageFormatControl

Users can query the frame grabber's original image information, as shown in follows:

Image Info	Meaning
Width	The width of the camera output image
Height	The height of the camera output image
PixelSize	Pixel bit depth of the output image
PixelFormat	Bayer format of the output image, when the camera outputs non Bayer images, then display NULL

7.2.2. OutPixelFormat

7.2.2.1. CXP Frame Grabber

The frame grabber will process the captured images, and users can query the frame grabber output images through OutPixelFormat. The OutPixelFormat is affected by the functions of "UnpackingMode", "ReverseY", "BayerConversion", and "RedBlueSwap". The mapping relationship between OutPixelFormat and input pixel format is shown in the table below:

Input Pixel Format	UnpackingMode	ReverseY	BayerConversion	RedBlueSwap	OutPixelFormat
Mono8	---	---	---	---	Mono8
Mono10/12/14/16	LSB	---	---	---	Mono10/12/14/16
Mono10/12/14/16	MSB	---	---	---	Mono16
Bayer**8	---	false	Disable	Disable	Bayer**8
Bayer**8	---	true	Disable	Disable	Bayer**8 (See section 7.2.6)
Bayer**10/12/14/16	LSB	false	Disable	Disable	Bayer**10/12/14/16
Bayer**10/12/14/16	LSB	true	Disable	Disable	Bayer**10/12/14/16 (See section 7.2.6)
Bayer**10/12/14/16	MSB	false	Disable	Disable	Bayer**16
Bayer**10/12/14/16	MSB	true	Disable	Disable	Bayer**16 (See section 7.2.6)
Bayer**8/10/12/14/16	---	---	Enable	Disable	RGB8
Bayer**8/10/12/14/16	---	---	Enable	Enable	BGR8
RGB8	--	--	--	Disable	RGB8
RGB8	--	--	--	Enable	BGR8

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RGB10/12/14/16	LSB	--	--	Disable	RGB10/12/14/16
RGB10/12/14/16	LSB	--	--	Enable	BGR 10/12/14/16
RGB10/12/14/16	MSB	--	--	Disable	RGB16
RGB10/12/14/16	MSB	--	--	Enable	BGR16

7.2.2.2. GEV Frame Grabber

The frame grabber will process the acquired images, and users can query the frame grabber output images through OutPixelFormat. The OutPixelFormat is affected by the functions of "ReverseY", "BayerConversion", and "RedBlueSwap". The mapping relationship between OutPixelFormat and input pixel format is shown in the table below:

Input Pixel Format	ReverseY	BayerConversion	RedBlueSwap	OutPixelFormat
Mono8	---	---	---	Mono8
Mono10/12/16	---	---	---	Mono10/12/16
Bayer**8	False	Disable	Disable	Bayer**8
Bayer**8	True	Disable	Disable	Bayer**8 (See section 7.2.6)
Bayer**10/12/16	False	Disable	Disable	Bayer**10/12/16
Bayer**10/12/16	True	Disable	Disable	Bayer**10/12/16 (See section 7.2.6)
Bayer**8/10/12/16	---	Enable	Disable	RGB8
Bayer**8/10/12/16	---	Enable	Enable	BGR8
RGB8	--	--	Disable	RGB8
RGB8	--	--	Enable	BGR8

7.2.3. CXP Frame Grabber UnpackingMode

The CXP protocol requires image data to be transmitted in "Packet" format to improve bandwidth utilization. For 10/12/14 bit images, the frame grabber will perform Unpacket operation after receiving images, aligning the received image data in pixels to the 16 bit boundary.

- Unpacket operation will cause additional PCIe bandwidth consumption, the relationships between PCIe bandwidth and input bandwidth are shown as follows:

Input Bit Width	Input Bandwidth	PCIe Bandwidth
10bit	N	1.6×N
12bit	N	1.33×N
14bit	N	1.14×N

The output of 8 bit image data is still 8 bit, and the output of 16 bit image data is still 16 bit.

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- There are two modes of Unpacket operation: LSB and MSB

LSB		MSB	
Input Bit Width	Output Format	Input Bit Width	Output Format
10bit	0000 00<pp pppp pppp>	10bit	<pppp pppp pp>00 0000
12bit	0000 <pppp pppp pppp>	12bit	<pppp pppp pppp> 0000
14bit	00<pp pppp pppp pppp>	14bit	<pppp pppp pppp pp> 00

1) LSB mode does not change the value of pixels.

2) MSB mode does not change the value of pixels. After completing the transformation, 10 bit is equivalent to multiplying the original pixel value by 64, 12 bit is equivalent to multiplying the original pixel value by 16, and 14 bit is equivalent to multiplying the original pixel value by 4.

3) The MSB mode will change the pixel format, and after completing the transformation, all 10/12/14 bit images will change to 16 bit images.

7.2.4. PayloadSize

Users can query the size of the host content space required for the output image of the current frame grabber through PayloadSize, expressed in bytes.

7.2.5. TimeStamp

7.2.5.1. CXP Frame Grabber

The frame grabber provides TimeStamp function. Mark the receiving time for each frame of the image sent by the CXP camera. The TimeStamp is the internal stable clock counter of the frame grabber, with a unit of 1ns and an accuracy of 3ns. After resetting the frame grabber, the TimeStamp counter is reset to zero.

7.2.5.2. GEV Frame Grabber

The frame grabber provides TimeStamp function which is achieved by forwarding timestamps sent by the GEV camera.

7.2.6. ReverseY

The frame grabber supports vertical mirror function.

Set Reverse Y as True to enable vertical mirror function, then, the frame grabber will output the reversed image:

Figure 7-2 Original image

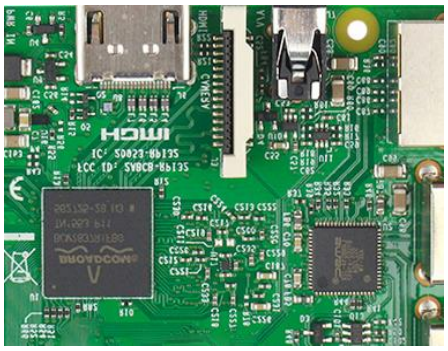

Figure 7-3 Reverse Y enabled

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- Pixel Format Alignment

When using the reverse function of the frame grabbers, the alignment of the Bayer format will change. The mapping relationship is shown in the table below:

Input Pixel Format	Output Pixel Format
BayerRG8/10/12/14/16	BayerGB8/10/12/14/16
BayerGR8/10/12/14/16	BayerBG8/10/12/14/16
BayerGB8/10/12/14/16	BayerRG8/10/12/14/16
BayerBG8/10/12/14/16	BayerGR8/10/12/14/16
MONO8/10/12/14/16	MONO8/10/12/14/16
RGB8	RGB8
BGR8	BGR8

7.2.7. Packet Size

The GEV frame grabber supports two packet sizes for data image transmission

GEV Frame Grabber	Description
GVSPPacketSize	The GigE Vision camera packet size, which can be set to 4100 / 8164

7.3. ImageFormatControl

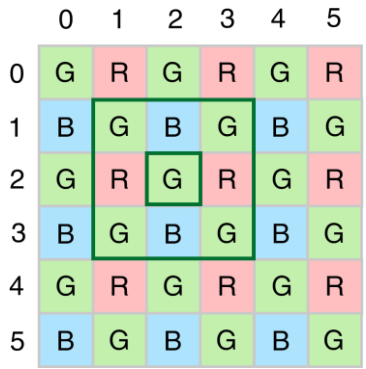
7.3.1. BayerConversion

The frame grabber supports converting the acquired Bayer format images to RGB format. Users can turn this feature on or off through BayerConversion. The frame grabber provides two Bayer conversion methods: Average and Median, which users can choose through the BayerMethod.

- 3×3 Average

The interpolation method and calculation method are as follows:

1) Centered around G



To interpolate the R, G and B values of point G marked above, take 3×3 regions from that center point (G), interpolation method as follows:

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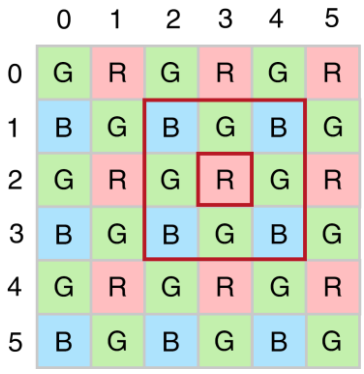
$$G_{rgb}=G_{2,2}$$

$$R_{rgb}=(R_{2,1}+R_{2,3})/2$$

$$B_{rgb}=(B_{1,2}+B_{3,2})/2$$

2) Centered around R



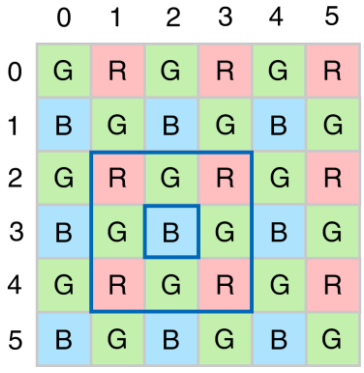
To interpolate the R, G and B values of point R marked above, take 3×3 regions from that center point (R), interpolation method as follows:

$$R_{rgb}=R_{2,3}$$

$$G_{rgb}=(G_{1,3}+G_{2,2}+G_{2,4}+G_{3,3})/4$$

$$B_{rgb}=(B_{1,2}+B_{1,4}+B_{3,2}+B_{3,4})/4$$

3) Centered around B



To interpolate the R, G and B values of point B marked above, take 3×3 regions from that center point (B), interpolation method as follows:

$$B_{rgb}=B_{3,2}$$

$$G_{rgb}=(G_{2,2}+G_{3,1}+G_{3,3}+G_{4,2})/4$$

$$R_{rgb}=(R_{2,1}+R_{2,3}+R_{4,1}+R_{4,3})/4$$

- 3×3 Median

Explain the definition of the median operator:

Wherein, n is an integer greater than or equal to 0, sort the x_n sequence (unlimited order).

When n is an odd number, take the sorted value of $\frac{n-1}{2}$ as the output.

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When n is even, take the average of sorted numbers $\frac{n}{2}$ and $(\frac{n}{2}+1)$ as the output.

The interpolation method and calculation method are as follows:

$$f(x)= median(x_0,x_1,x_2,\ldots,x_n)$$

1) Centered around G

	0	1	2	3	4	5
0	G	R	G	R	G	R
1	B	G	B	G	B	G
2	G	R	G	R	G	R
3	B	G	B	G	B	G
4	G	R	G	R	G	R
5	B	G	B	G	B	G

To interpolate the R, G and B values of point G marked above, take 3×3 regions from that center point (G), interpolation method as follows:

$$G_{rgb}=G_{2,2}$$

$$R_{rgb}=median(R_{2,1},R_{2,3})$$

$$B_{rgb}=median(B_{1,2},B_{3,2})$$

For center point G, the interpolated R/B has only two values, so according to the definition of the median, the result is the same as the mean method, that is:

$$R_{rgb}=(R_{2,1}+R_{2,3})/2$$

$$B_{rgb}=(B_{1,2}+B_{3,2})/2$$

2) Centered around R

	0	1	2	3	4	5
0	G	R	G	R	G	R
1	B	G	B	G	B	G
2	G	R	G	R	G	R
3	B	G	B	G	B	G
4	G	R	G	R	G	R
5	B	G	B	G	B	G

To interpolate the R, G and B values of point R marked above, take 3×3 regions from that center point (R), interpolation method as follows:

$$R_{rgb}=R_{2,3}$$

$$G_{rgb}=median(G_{1,3},G_{2,2},G_{2,4},G_{3,3})$$

$$B_{rgb}=median(B_{1,2},B_{1,4},B_{3,2},B_{3,4})$$

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3) Centered around B

	0	1	2	3	4	5
0	G	R	G	R	G	R
1	B	G	B	G	B	G
2	G	R	G	R	G	R
3	B	G	B	G	B	G
4	G	R	G	R	G	R
5	B	G	B	G	B	G

To interpolate the R, G and B values of point B marked above, take 3×3 regions from that center point (B), interpolation method as follows:

$$B_{rgb}=B_{3,2}$$

$$G_{rgb}=median(G_{2,2},G_{3,1},G_{3,3},G_{4,2})$$

$$R_{rgb}=median(R_{2,1},R_{2,3},R_{4,1},R_{4,3})$$

7.3.2. RedBlueSwap

When the frame grabber's output format is RGB or BGR, users can switch the positions of the red and blue components in pixels for Enable through RedBlueSwap. This feature only affects pixel format and has no effect on pixel bit width.

The transformation relationship between input pixel and output pixel formats under different configurations is detailed in the section 7.2.2.OutPixelFormat.

7.4. Image Transmission

7.4.1. Camera CXP Trigger Function

1) CXPTrigger packet sending

The frame grabber supports sending trigger packets specified by the CoaXPress protocol to the camera through CXP communication cables. Users can turn On/Off CXPTrigger packet sending through CameraTrigger. The frame grabber supports sending two types of trigger packets specified in the protocol: LinkTrigger0/LinkTrigger1, which can be specified through CameraTriggerAction. Users can trigger the frame grabber to send CXPTrigger by inputting trigger signals. The supported trigger sources include: Line0~Line19, Timer0~Timer3, UserOutput0~UserOutput19, and UserOutput_TL0~UserOutput_TL3.

Example 1: When the onboard I/O signal Line0 receives the rising edge, it will trigger the camera by sending CXPTrigger. See setting process as follows:

- Set CameraTriggerAction as RisingEdge
- Set CameraTriggerSource as Line0
- Set CameraTrigger as Enable

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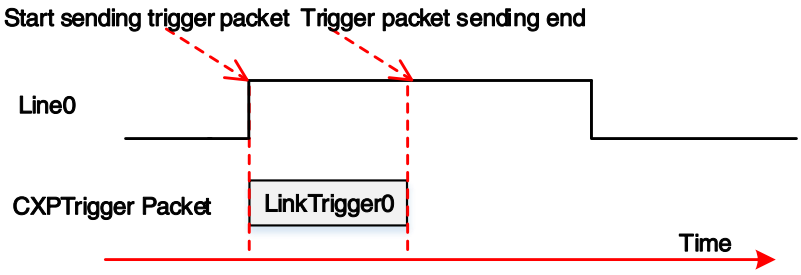


Figure 7-4 Timing diagram of CXPTrigger package output by frame grabber

Example 2: Trigger the camera on any edge of UserOutput8 by sending CXPTrigger. See setting process as follows:

- Set CameraTriggerAction as AnyEdge
- Set CameraTriggerSource as UserOutput8
- Set CameraTrigger as Enable

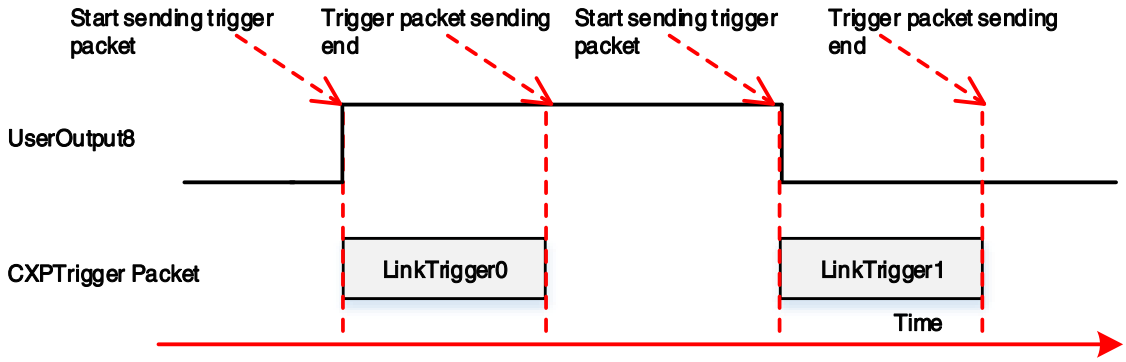


Figure 7-5 Timing diagram of CXPTrigger package output by frame grabber

2) CameraTriggerMissCnt

When a valid trigger signal is received again during the CXPTrigger packet sending process, the frame grabber will directly discard the trigger signal. Users can query the number of the discarded trigger signals through CameraTriggerMissCnt and reset the CameraTriggerMissCnt by CameraTriggerMissCntReset function.

When the CameraTriggerAction is FallingEdge mode, the timing diagram of the lost trigger signals statistics is shown below:

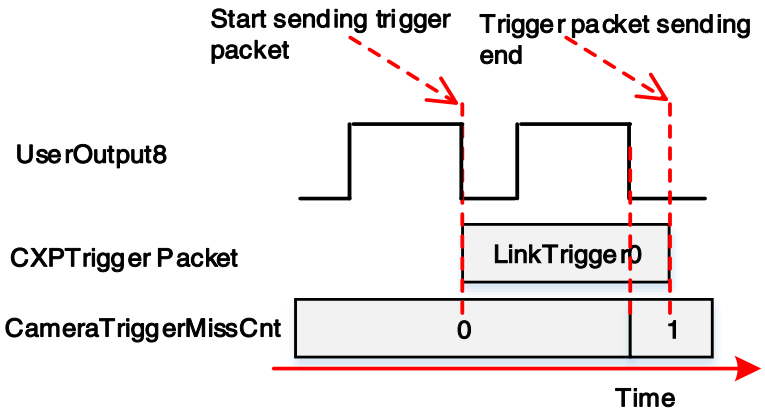


Figure 7-6 Timing diagram of trigger signal loss statistics in FallingEdge mode

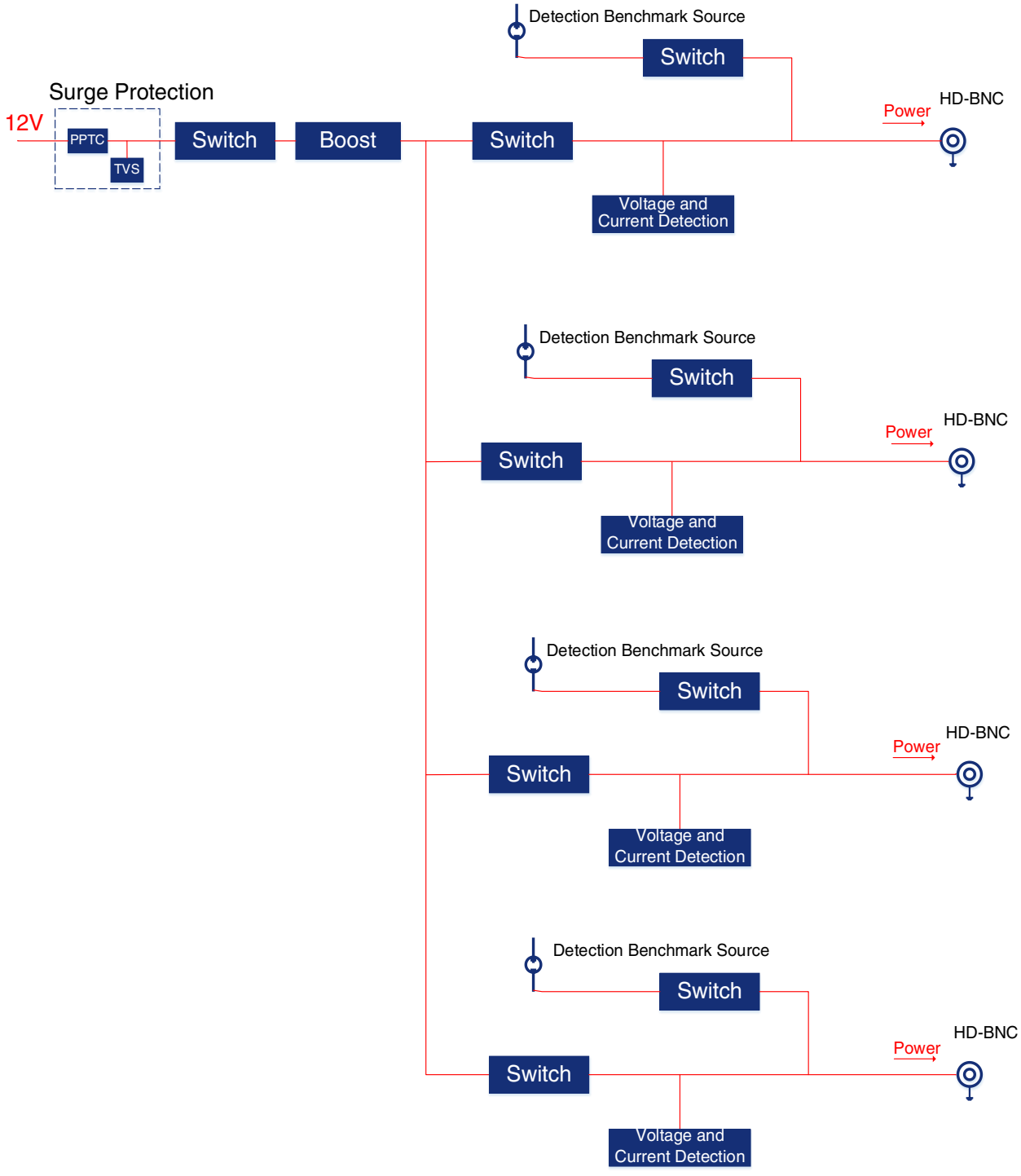
3) CameraTriggerACKMissCnt

The frame grabber can count the number of times of the unreceived response packets after sending the CXPTtrigger packet, which can be queried through CameraTriggerACKMissCnt. Users can reset the CameraTriggerACKMissCnt by CameraTriggerACKMissCntReset function.

7.5. CoaXPress Power Supply

Each CoaXPress host connector can provide power to the camera through the CoaXPress cable.

7.5.1. Power Supply Unit



Power supply unit is responsible for safe power supply, meeting the requirements of the CoaXPress host for the CoaXPress standard, which means:

1) Can provide 24VDC power supply with a maximum power of 17W for each connector of the device.

2) Equipped with overcurrent protection device.

3) Support automatic CoaXPress PoCXP detection method.

In addition, the power supply unit also provides the following functions for the application:

1) Turn off or interrupt automatic power supply.

2) Reset overcurrent protection device when tripping.

3) Measure the PoCXP output current and PoCXP output voltage on each connector.

4) Control the range of PoCXP sensing resistance.

7.5.2. CxpPocxpAuto

When executing the CxpPocxpAuto command, the frame grabber will initiate the PoCXP device detection process. While the frame grabber is powered on and in boot, CxpPocxpAuto is enabled by default, and the application does not need to enable PoCXP power supply by issuing the CxpPocxpAuto command.

The frame grabber will be powered on when PoCXP device detection process is successfully completed.

If the PoCXP device detection process fails, the frame grabber will be powered off by disconnecting the electronic fuse switch and attempting to execute the PoCXP process again. Possible causes of malfunction include:

1) The external power supply cannot provide 12V power (CxpPocxpPowerInputStatus = NotOK).

2) No camera connected.

3) The connected camera does not comply with PoCXP.

Once powered on, the frame grabber will remain powered status until any of the following situations occur:

1) The application disabled powersupply by executing the CxpPocxpTurnOff command.

2) The external power supply has been disconnected (CxpPocxpPowerInputStatus = NotOK).

3) CoaXPress cable disconnected (detected cable current <8mA and duration reached 0.5s).

4) Overcurrent occurs (instantaneous detection current >800mA).

7.5.3. Manual PoCXP Control

Users can control the frame grabber to disconnect the PoCXP power supply through CxpPocxpTurnOff. In this state, the frame grabber does not perform the PoCXP detection process.

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- Users can view the frame grabber's PoCXP configuration status through CxpPocxpConfigurationStatus:

Option	Description
Auto	Automatically execute PoCXP, connect CXP supported cameras and supply power
Off	Turn off PoCXP, no power supply
Compound	Compound state (read only), when some Lines are configured as Auto while others are configured as Off, LineSelector's value is All, and CxpPocxpConfigurationStatus is Compound

- Users can view the power supply status of the cable through CxpPocxpStatus:

Option	Description
On	PoCXP is supplying power with a voltage of approximately 24
Off	PoCXP is currently not powered
Tripped	The Line has experienced overcurrent, so TripReset must be executed before resupplying power
Compound	Compound state, only CxpPocxpHostConnectionSelector is set to All, and each Line status is different, Compound will be displayed

- PoCXP detection mode control, users can modify the voltage detection range of PoCXP by configuring the PoCXP detection mode:

Option	Description
Extended	The PoCXP device detection configuration of the frame grabber is an extended range of resistance values. Allow cameras that do not fully meet the range specifications of the PoCXP sensing resistor to be detected as valid PoCXP cameras and powered on
Standard	The PoCXP device detection configuration of the frame grabber is within a limited range of resistance values, which is 4.7kΩ +/- 10%

7.5.4. Overcurrent Protection

Overcurrent protection is achieved through detection circuits, which can provide two types of protection:

1) Overload protection solves the problem of excessive load.

2) Short circuit protection solves unexpected short circuit situations.

If overload or overcurrent occurs, the frame grabber will immediately disconnect the electronic fuse to cut off the power supply. Users can check the cable power supply status (Tripped) through CxpPocxpStatus. Overcurrent cables can only be restored for PoCXP detection process through CxpPocxpTripReset. When CxpPocxpStatus is in Tripped status, executing CxpPocxpAuto or CxpPocxpTurnOff will not change CxpPocxpStatus.

CxpPocxpTripReset is used to restore the PoCXP detection process for cables that have experienced overcurrent. After executing CxpPocxpTripReset, the frame grabber executes the PoCXP detection process based on the value of CxpPocxpConfigurationStatus. If users execute CxpPocxpTurnOff before executing CxpPocxpTripReset, and the value of CxpPocxpConfigurationStatus is Off, then the frame grabber will

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disconnect the PoCXP power supply and do not execute the PoCXP detection process. If users execute CxpPocxpAuto before executing CxpPocxpTripReset, and the value of CxpPocxpConfigurationStatus is Auto, then the frame grabber does not perform the PoCXP detection process, and the frame grabber will restore the PoCXP detection process and PoCXP power supply until users execute CxpPocxpTripReset successfully.

7.5.5. Output Current and Voltage Measurement Values

CxpPoCxpCurrent and CxpPoCxpVoltage respectively represent the current and voltage transmitted by the CoaXPress physical connection indicated by CxpPoCxpHostConnectionSelector.

When set CxpPoCxpHostConnectionSelector to All, the total output power transmitted by PoCXP is:

$$\text{CxpPoCxpCurrent} \times \text{CxpPoCxpVoltage}$$

Among them, CxpPoCxpCurrent displays the sum of the currents transmitted by PoCXP, and CxpPoCxpVoltage displays the maximum voltage transmitted by PoCXP.

7.5.6. PoCXP Status Feedback

PoCXP status feedback includes: CxpPocxpConfigurationStatus (PoCXP configuration status), CxpPocxpStatus (PoCXP working status), CxpPocxpPowerInputStatus (12V power supply status), all above are read only.

- CxpPocxpConfigurationStatus

Display the CoaXPress physical connection's current configuration status (Auto, Off or Compound) indicated by CxpPocxpHostConnectionSelector. If CxpPocxpHostConnectionSelector select single physical connection, then CxpPocxpConfigurationStatus display Auto (PoCXP automatically detects power on) or Off (PoCXP function disabled). If CxpPocxpHostConnectionSelector's value is All, then CxpPocxpConfigurationStatus display Auto (All physical connections are configured as Auto), Off (All physical connections are configured as Off), or Compound (The configuration status of each physical connection varies, with both Auto and Off).

- CxpPocxpStatus

Display the CoaXPress physical connection's current working status (On, Off, Tripped or Compound) indicated by CxpPocxpHostConnectionSelector. If CxpPocxpHostConnectionSelector select single physical connection, then CxpPocxpStatus display On (PoCXP is supplying power), Off (PoCXP stops power supply), or Tripped (PoCXP has experienced overcurrent or overload). If CxpPocxpHostConnectionSelector select All, then CxpPocxpConfigurationStatus display On (All physical connections are supplying power), Off (All physical connections are stop power supply), Tripped (All physical connections have experienced overcurrent or overload), or Compound (The configuration status of each physical connection varies, including Auto, Off, and Compound).

- CxpPocxpPowerInputStatus

Display OK (Connected to 12V power supply) or NotOK (12V power supply not connected).

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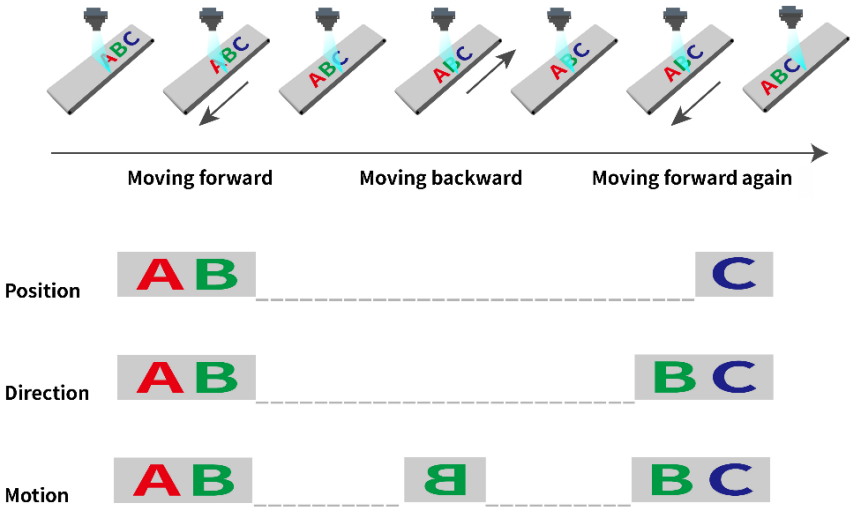
7.6. EncoderControl

Encoders are used to trigger cameras for acquisition at specific positions or movements. POLS-C12-4T-G38 frame grabber can be connected to an AB type incremental encoder. After decoding, the frame grabber can generate pulses at fixed positions, intervals, or specific directions of motion to trigger the internal timer of the frame grabber. Trigger camera exposure and acquisition through waveform output from internal timer to achieve different acquisition effects.

See as follow picture, which showcased the acquisition effects under three different configurations:



The line scan camera is fixed directly above the conveyor belt, which can move forward or backward. The encoder signal of the conveyor belt is connected to the frame grabber, and the decoding module of the frame grabber outputs pulses to trigger the timer of the frame grabber to work. The timer outputs pulses through the frame grabber I/O, which are used as external trigger signals to control camera exposure.

- Scenario 1: Only the forward moving parts are scanned and imaged, and the repeated areas caused by the temporary reverse of the conveyor belt are not subject to repeat acquisition and imaging

Scenario description: Under normal circumstances, the conveyor belt moves forward and completes the scanning imaging of A and B. At this time, it moves in the opposite direction and reaches the starting point of B due to the interference of the conveyor belt. After interference is eliminated, the conveyor belt resumes forward movement. During this process, only once imaging scan of the area on the conveyor belt can be achieved (no repeat scanning) by configuring the frame grabber as follows.

Configuration method:

No.	Node Name	Attribute Value	Description
1	EncoderSelector	Encoder0	Choose any one
2	EncoderDirection	Forward	It needs to be determined according to the wiring method to meet the Incremental effect of the framer grabber's EncoderValue when the conveyor belt is moving forward
3	EncoderValueSource	StepBackwardWhilePositive	

4	EncoderOutputMode	StepForwardWhilePositive	
5	EncoderMultiplier	1	
6	EncoderPositionTrigger	2147483600	
8	EncoderResetSource	PositionTrigger	Prevent encoder counter overflow and reset counter near maximum value
9	EncoderSourceA	-----	Connect I/O according to the actual situation
10	EncoderSourceB	-----	Connect I/O according to the actual situation
11	EncoderValue	0	Ensure initial state by writing any numerical value to zero
12	TimerSelector	Timer0	Choose according to actual use
13	TimerDelay	1000	Output low level time according to actual settings
14	TimerDuration	1000	Output high level time according to actual settings
15	TimerTriggerSource	RotaryEncoder0	Need to select the same as step1
16	TimerTriggerDivider	1	Divide the trigger signal frequency based on actual settings
17	TimerState	Enable	Turn on timer
18	Line Selector	-----	Select onboard I/O based on the actual trigger Line connection method
19	LineSource	Timer0	Ensure that the Timer configuration is the same as step12

Encoder counter and motion direction, as well as whether to trigger acquisition relationship table shown as follow:

No.	Counter Value	Motion Direction	Acquisition or Not
1	0	Forward	No
2	1	Forward	Yes
3	2	Forward	Yes
4	…	Forward	Yes
5	500	Forward	Yes
6	-1	Backward	No
7	-2	Backward	No
8	-3	Backward	No
9	-2	Forward	No
10	-1	Forward	No
11	0	Forward	No
12	1	Forward	Yes
13	2	Forward	Yes

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- Scenario2: Forward motion for scanning and imaging

Scenario description: Under normal circumstances, the conveyor belt moves forward and completes the scanning and imaging of A and B. At this time, the conveyor belt moves in the opposite direction due to interference and reaches the starting point of B. After interference is eliminated, the conveyor belt resumes forward movement. During this process, any area passing through the camera during forward movement needs to be scanned and imaged. The frame grabber can be configured as follows.

Configuration method:

No.	Node Name	Attribute Value	Description
1	EncoderSelector	Encoder0	Choose any one
2	EncoderDirection	Forward	It needs to be determined according to the wiring method to meet the Incremental effect of the framer grabber's EncoderValue when the conveyor belt is moving forward
3	EncoderOutputMode	StepForward	
4	EncoderSourceA	-----	Connect I/O according to the actual situation
5	EncoderSourceB	-----	Connect I/O according to the actual situation
6	TimerSelector	Timer0	Choose according to actual use
7	TimerDelay	1000	Output low level time according to actual settings
8	TimerDuration	1000	Output high level time according to actual settings
9	TimerTriggerSource	RotaryEncoder0	Need to select the same as step1
10	TimerTriggerDivider	1	Divide the trigger signal frequency based on actual settings
11	TimerState	Enable	Turn on timer
12	Line Selector	-----	Select onboard I/O based on the actual trigger Line connection method
13	LineSource	Timer0	Ensure that the Timer configuration is the same as step6

Encoder counter and motion direction, as well as whether to trigger acquisition relationship table shown as follow:

No.	Counter Value	Motion Direction	Acquisition or Not
1	0	Forward	Yes
2	1	Forward	Yes
3	2	Forward	Yes
4	…	Forward	Yes
5	500	Forward	Yes
6	-1	Backward	No
7	-2	Backward	No
8	-3	Backward	No
9	-2	Forward	Yes
10	-1	Forward	Yes

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11	0	Forward	Yes
12	1	Forward	Yes
13	2	Forward	Yes

- Scenario3: Scanning and imaging occurs when moving in any direction

Scenario description: Under normal circumstances, the conveyor belt moves forward and completes the scanning imaging of A and B. At this time, due to interference with the conveyor belt, it moves in the opposite direction and reaches the starting point of B. After interference is eliminated, the conveyor belt resumes forward movement. During this process, the passing camera through the area during any direction of movement needs to be scanned and imaged. The frame grabber can be configured as follows.

Configuration method:

No.	Node Name	Attribute Value	Description
1	EncoderSelector	Encoder0	Choose any one
2	EncoderDirection	Forward	It needs to be determined according to the wiring method to meet the Incremental effect of the framer grabber's EncoderValue when the conveyor belt is moving forward
3	EncoderOutputMode	StepAny	
4	EncoderSourceA	-----	Connect I/O according to the actual situation
5	EncoderSourceB	-----	Connect I/O according to the actual situation
6	TimerSelector	Timer0	Choose according to actual use
7	TimerDelay	1000	Output low level time according to actual settings
8	TimerDuration	1000	Output high level time according to actual settings
9	TimerTriggerSource	RotaryEncoder0	Need to select the same as step1
10	TimerTriggerDivider	1	Divide the trigger signal frequency based on actual settings
11	TimerState	Enable	Turn on timer
12	Line Selector	-----	Select onboard I/O based on the actual trigger Line connection method
13	LineSource	Timer0	Ensure that the Timer configuration is the same as step6

Encoder counter and motion direction, as well as whether to trigger acquisition relationship table shown as follow:

No.	Counter Value	Motion Direction	Acquisition or Not
1	0	Forward	Yes
2	1	Forward	Yes
3	2	Forward	Yes
4	…	Forward	Yes
5	500	Forward	Yes

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6	-1	Backward	Yes
7	-2	Backward	Yes
8	-3	Backward	Yes
9	-2	Forward	Yes
10	-1	Forward	Yes
11	0	Forward	Yes
12	1	Forward	Yes
13	2	Forward	Yes

7.6.1. EncoderSelector

The CXP frame grabber provides two independent AB type incremental encoder decoding modules. The decoding module selection is completed through the EncoderSelector function. After completing the selection, the relevant properties of the currently selected decoding module can be obtained, and the properties can be modified. The default selection for powering on the frame grabber is Encoder0.

The GEV frame grabber provides only one independent AB type incremental encoder decoding modules. The default selection is Encoder0 when the frame grabber is powered on.

7.6.2. EncoderSourceA and EncoderSourceB

When using the encoder decoding function, the EncoderSourceA/B should first be connected to the I/O port of the frame grabber. Then specify the encoder connected I/O port through the EncoderSourceA and EncoderSourceB. The decoding module identifies the signal phase of the corresponding I/O port to complete the decoding operation, and converts it into a 32 bit signed counter.

1) Only differential mode input I/O can be selected as the EncoderSourceA/B.

2) It will cause the A/B phase unable to be correctly parsed and the encoder decoding function unable to be completed, when the EncoderSourceA and EncoderSourceB's selected I/O are same, so it is better to avoid this operation.

7.6.3. EncoderDirection

The decoding module can recognize the motion direction of the encoder, and when the encoder moves forward, the counter auto-increment, while the encoder moves in reverse, the counter auto-decrement.

Users can specify the decoding direction of the encoder by setting the EncoderDirection with option "Forward" and "Backward".

When the phase of EncoderSourceA is ahead of EncoderSourceB under Forward mode, the counter auto-increment, while when the EncoderSourceA lags behind EncoderSourceB, the counter auto-decrement. As shown in the following figure:

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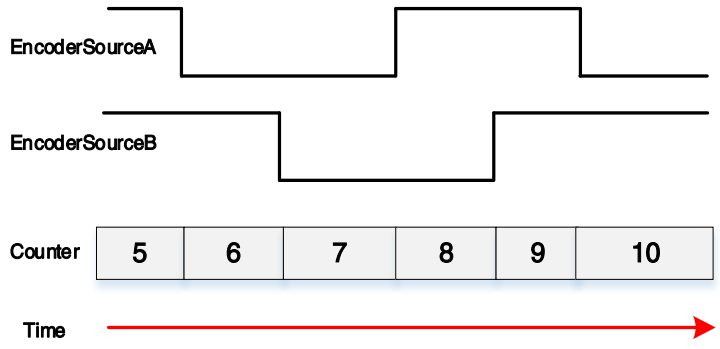

Figure 7-7 The encoder moves forward when in Forward mode

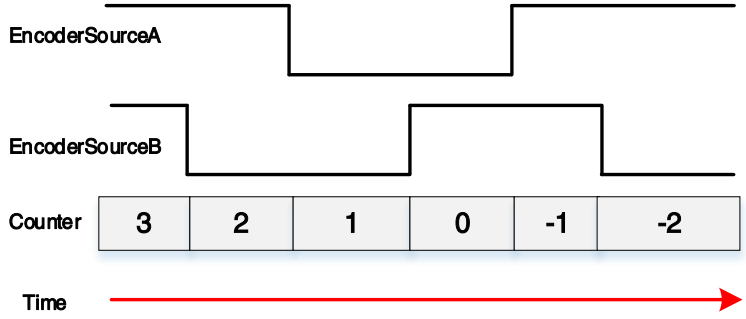

Figure 7-8 The encoder moves in reverse when in Forward mode

When the phase of EncoderSourceA lags behind EncoderSourceB under Backward mode, the counter auto-increment, and when EncoderSourceA leads before EncoderSourceB, the counter auto-decrement. As shown in the following figure:

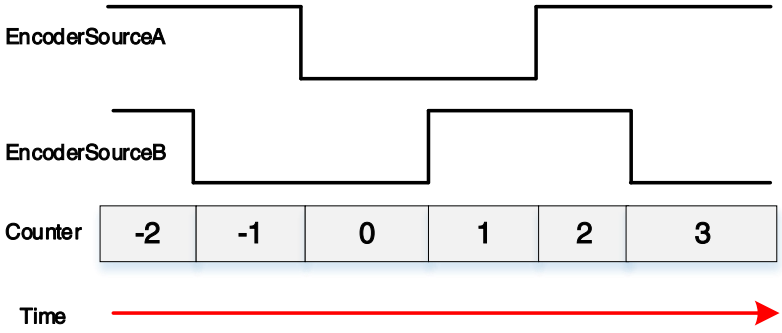

Figure 7-9 The encoder moves forward when in Backward mode

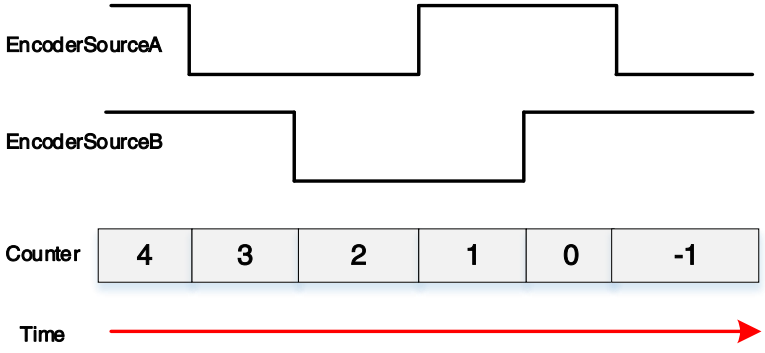

Figure 7-10 The encoder moves in reverse when in Backward mode

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7.6.4. EncoderValueSource

The counter generated by the frame grabber parsing encoder signal supports forcing the counter to be set to "-1" when the rising edge of the selected signal arrives. Users can configure EncoderValueSource in the application to achieve the above operations.

EncoderValueSource options and it's corresponding trigger timing are shown as following:

CXP Frame Grabber Options	GEV Frame Grabber Options	Trigger Timing
NULL	NULL	No effect on the counter
Line0 ~ Line19	Line0 ~ Line9	1) Select the input mode of I/O, and the filtered rising edge signal will set the counter to -1 2) Choosing the output mode of I/O will not affect the counter
COUNT_OVERFLOW	COUNT_OVERFLOW	When the counter's auto-increment exceeds 0x7FFF_FFFF, set the counter to 0xFFFF_FFFF(-1)
POSITION_TRIGGER	POSITION_TRIGGER	When the encoder moves to the position specified by EncoderPositionTrigger, set the counter to -1
STEP_BACKWARD_WHILE_POSITIVE	STEP_BACKWARD_WHILE_POSITIVE	When the counter is greater than 0 and the encoder moves in reverse and the counter needs to auto-decrement, forcibly set the counter to -1

1) If the I/O selected by EncoderValueSource is the same as the EncoderSourceA and EncoderSourceB, then the counter will not function properly, please avoid this situation
2) Select the signal's rising edge trigger by default without additional settings
3) When selecting an I/O signal from Line0 ~ Line19, and the I/O is output mode, the frame grabber cannot acquire the rising edge and has no effect on the counter
4) When selecting an I/O signal from Line0 ~ Line19, and the I/O is input mode, the frame grabber defaults to acquire the rising edge of the filtered input signal, without additional settings and cannot be changed

7.6.5. EncoderFrameEndPosition

- EncoderFrameEndPosition

The frame grabber supports locking the encoder's operating position when receiving images. In the application, if the user wants to use this feature, they need to configure EncoderFrameEndRead as one of Stream0~Stream3. When the selected stream is received and the complete valid frame information is parsed, the frame grabber will lock the current counter value to the EncoderFrameEndPosition.

- EncoderFrameEndPositionReset

Users can execute EncoderFrameEndPositionReset function to clear the EncoderFrameEndPosition.

The saved value of EncoderFrameEndPosition is the actual encoder position when frame grabber receives image, not the encoder position at the time of camera exposure.

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7.6.6. EncoderMultiplier

The frame grabber supports to multiply the encoder's increment or decrement. Users can achieve this function by setting EncoderMultiplier.

EncoderMultiplier function is achieved by adjusting the counter step interval, and do not perform multiply operation for EncoderSourceA and EncoderSourceB.

For example: Set EncoderDirection to Forward, EncoderMultiplier to 5, then the increment or decrement of the encoder each time is 5. The relationship between the encoder input waveform and the counter variation is shown in the following figure:

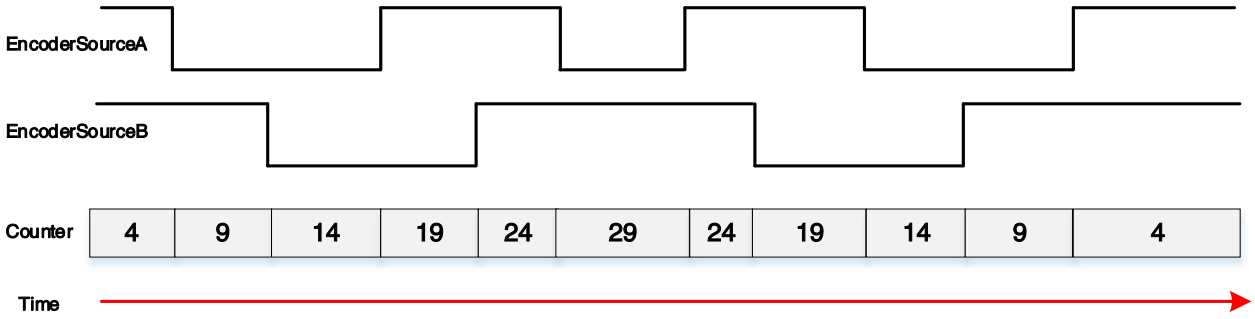

Figure 7-11 The relationship between the encoder input waveform and the counter variation

7.6.7. EncoderOutputMode

After the encoder decoding module completes decoding process, it can output trigger pulses in different situations. This trigger pulse can be used to trigger Timer output. Users can determine the output trigger pulse situation by configuring the EncoderOutputMode.

There are POSITION_TRIGGER, POSITION_TRIGGER_MULTIPLE, STEP_ANY, STEP_FORWARD, STEP_ANY_WHILE_POSITIVE, STEP_FORWARD_WHILE_POSITIVE options of EncoderOutputMode.

- **Encoder runs to a fixed position and outputs trigger pulses**

1. Configuration method

Set the EncoderPositionTrigger to target position value, and set EncoderOutputMode to POSITION_TRIGGER mode. When the encoder is in motion and the value of the counter after motion is equal to the EncoderPositionTrigger's set value, the decoding module can output a pulse signal.

2. Usage instruction

For example: Set EncoderPositionTrigger to 5, EncoderOutputMode to POSITION_TRIGGER, EncoderDirection to Forward, then the time of the output pulse is generated as follows:

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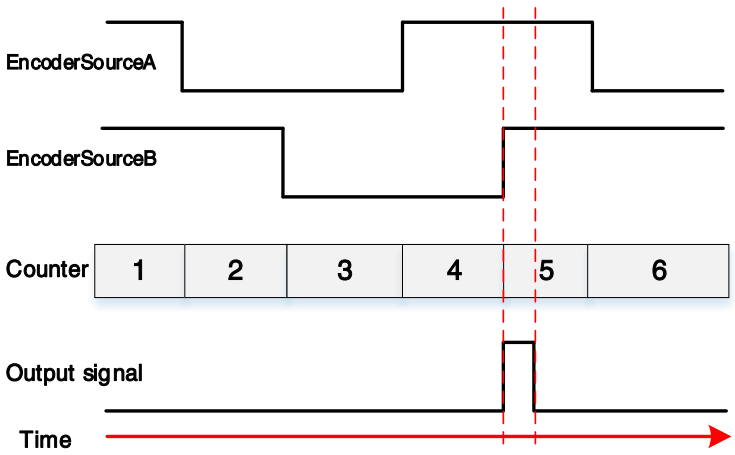

Figure 7-12 Schematic diagram of output pulse timing

1) The encoder can generate a pulse signal when moving to a same value of position as the EncoderPositionTrigger.
2) When the encoder keep staying in a position without moving, it will not generate repeated pulse signals.
3) The generated pulse signal can only be used for Timer triggering and cannot be output through the frame grabber I/O.

- **The encoder moves to a position that is an integer multiple of the set value and outputs trigger pulse**

1. Configure method

Set the EncoderPositionStartTrigger as the target value and configure the EncoderOutputMode to POSITION_TRIGGER_MULTIPLE mode. When the encoder moves and the counter value after movement is an integer multiple of the EncoderPositionStartTrigger's value, the decoding module can output a pulse signal. The lag between the output pulse time and the corresponding position time is 0.144μs.

2. Usage instruction

For example: Set EncoderPositionStartTrigger to 3, EncoderOutputMode to POSITION_TRIGGER_MULTIPLE, and EncoderDirection to Forward, then the time of the output pulse is generated as follows:

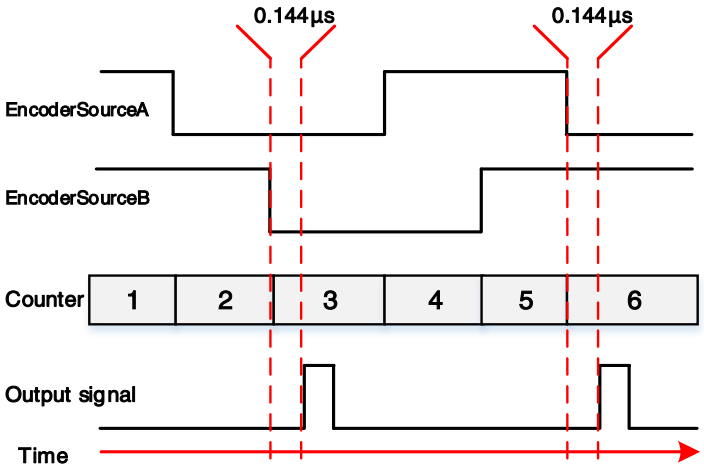

Figure 7-13 Schematic diagram of output pulse timing

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1) The encoder can generate a pulse signal from any direction to a position that with an integer multiple of the EncoderPositionStartTrigger's setting value.
2) After the encoder reaches the position that meets the conditions, the decoding module lags 0.144μs to generate a trigger pulse
3) When the encoder keep staying in a position without moving, it will not generate repeated pulse signals.
4) The encoder can generate a pulse signal when it moves to a position that with an integer multiple of the EncoderPositionStartTrigger's setting value. The encoder position (that is counter value) can be positive or negative.
5) When the encoder moves to the "0" position, no pulse signal generated.

- **Encoder outputs trigger pulses in any direction of motion**

1. Configure method

Configured the EncoderOutputMode to STEP_ANY mode, and when the encoder generates any direction of motion, it will output a trigger pulse.

2. Usage instruction

Example: When set the EncoderOutputMode to STEP_ANY and the EncoderDirection to Forward, then the time of the output pulse is generated as follows:

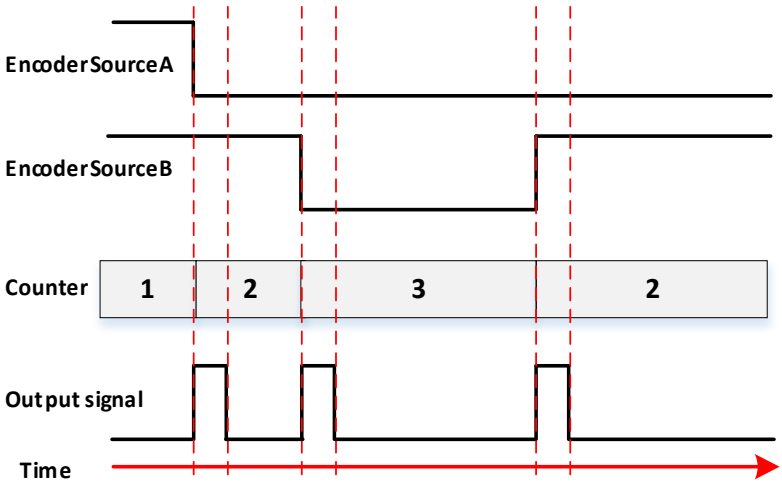

Figure 7-14 Schematic diagram of output pulse timing

1) The encoder can generate a pulse signal in any direction of motion.
2) When the encoder keep staying in a position without moving, it will not generate repeated pulse signals.

- **Trigger pulse for motion output in any direction when the encoder position is positive**

1. Configure method

Configure EncoderOutputMode to STEP_ANY_WHILE_POSITIVE. When the counter of the decoding module (equivalent to the encoder position) is greater than 0, the encoder will output a trigger pulse when it moves in any direction.

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2. Usage instruction

Example: Set the EncoderOutputMode to STEP_ANY and the EncoderDirection to Forward, then the time of the output pulse is generated as follows:

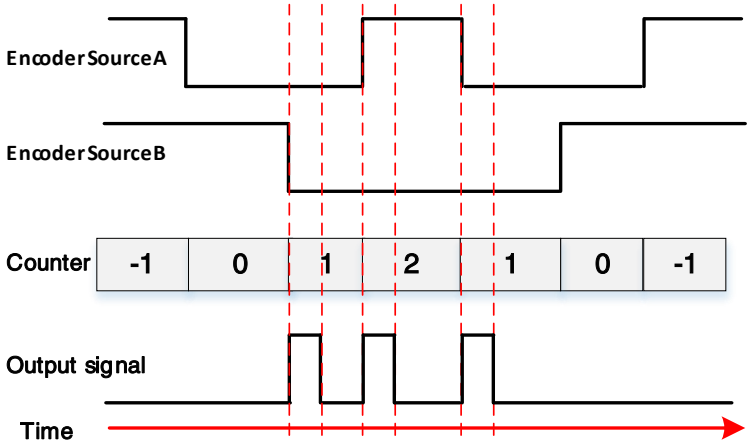

Figure 7-15 Schematic diagram of output pulse timing

1) When the encoder position is greater than 0, any direction of motion can generate a pulse signal.
2) When the encoder keep staying in a position without moving, it will not generate repeated pulse signals.

7.6.8. EncoderValue

The decoding module uses high resolution mode to analyse the encoder and convert the current encoder position into a signed 32 bit integer counter.

By reading the EncoderValue, the current encoder position can be obtained. Writing any value to the EncoderValue will clear the counter's value.

7.6.9. EncoderPositionTrigger

Used to specify a fixed position where the decoding module generates a trigger signal when the encoder moves to that position.

1) The decoding module will inevitably generate trigger pulses at the specified position, which is not affected by the EncoderOutputMode setting.
2) When selecting POSITION_TRIGGER in EncoderOutputMode, only the trigger pulse generated at the specified position can be used to trigger the timer. Please refer to EncoderOutputMode section for usage details. Otherwise, the trigger pulse generated by the decoding module at the specified position can only serve as the trigger source for the EncoderValueSource and EncoderResetSource functions.

7.6.10. EncoderPositionStartTrigger

This register is used to set the rotary decoder's counter value upon which to start generating triggers. When the encoder moves to an integer multiple of the starting position, it can generate output pulses to trigger the timer operation. This register needs to be used in conjunction with the EncoderOutputMode. For specific settings, please refer to EncoderOutputMode section, "The encoder moves to a position that is an integer multiple of the set value and outputs trigger pulse" part.

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7.6.11. EncoderResetSource

The counter generated by the frame grabber analysis encoder signal supports forcibly clearing the counter to zero when the rising edge of the selected signal arrives. Users can configure the EncoderResetSource function to achieve the above operations.

The operation of EncoderResetSource and its corresponding trigger timing are shown in the table below:

CXP Frame Grabber Operations	GEV Frame Grabber Operations	Trigger Timing
NULL	NULL	No effect on the counter
Line0~Line19	Line0~Line9	1) Select the input mode of I/O, and the filtered rising edge signal will set he counter to 0 2) Choosing the output mode of I/O will not affect the counter
POSITION_TRIGGER	POSITION_TRIGGER	When the encoder moves to the position specified by EncoderPositionTrigger, set the counter to 0

1) If the I/O selected for "EncoderResetSource" is the same as the input source I/O of EncoderSourceA/B, the counter cannot operate normally, and this operation should be avoided

2) Trigger the selected signal's rising edge by default, without additional settings

3) Selecting an I/O signal from Line0 to Line19, when the output mode I/O is selected, the frame grabber cannot acquire the rising edge and has no effect on the counter

4) Selecting an I/O signal from Line0 to Line19, when the input mode I/O is selected, the frame grabber will acquire the rising edge of the filtered input signal by default, without additional settings and cannot be changed

7.7. Timer

The frame grabber can support 4 Timers, which can be started by specified events or signals. The Timer output can control the external devices synchronously through the I/O port, or synchronous trigger control for other internal functions of the frame grabber.

7.7.1. Timer Output Format

After receiving a valid trigger signal, the timer will complete one output. A complete timer output consists of four parts: two low levels for a specified time and two high levels for a specified time. The output format is shown in the following figure:

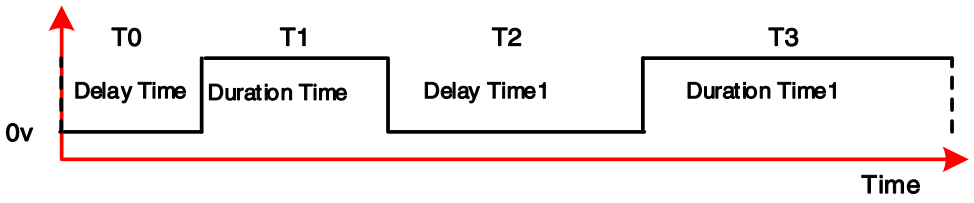


Figure 7-16 Timer output format

T0: Delay time, set through TimerDelay, with precision of 1μs.

T1: Duration time, set through TimerDuration, with precision of 1μs.

T2: Delay time1, set through TimerDelay2, with precision of 1μs.

T3: Duration time1, set through TimerDuration2, with precision of 1μs.

1) The frame grabber supports a total of 4 Timers. When setting up, you should first select the Timer to be configured through TimerSelector, with a range of Timer0 ~ Timer3.
2) The values of T0~T3 can be modified at any time, and after modification, Timer will immediately output the waveform according to the latest parameters. The complete output of the waveform defined by the previous set of parameters is not guaranteed.

7.7.2. TimerClockSource

Timer supports using different signals as clock sources to drive the Timer to output waveforms. Select from TimerClockSource. At present, the frame grabber only supports Timer to output waveforms using the system clock as the clock source.

7.7.3. TimerClockFrequency

After selecting different clock sources for the Timer, you can view the frequency of the currently selected clock source through TimerClockFrequency. The unit of query result is Hz.

7.7.4. TimerOutputInverter

The Timer output supports inversion function. By default, if the Timer delays for a specified time, the Timer outputs a low level, and the Timer outputs a high level while in a specified duration, stay low level during periods of no output. Users can set TimerOutputInverter to make the Timer output a high level for a specified delay time, output a low level for a specified duration time, and maintain a high level during no output. As shown in the following figure:

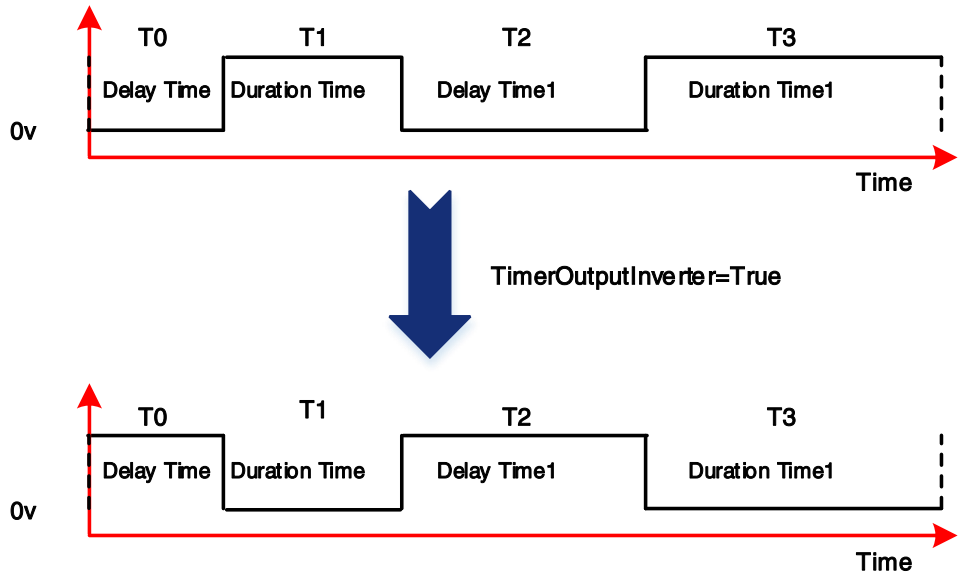
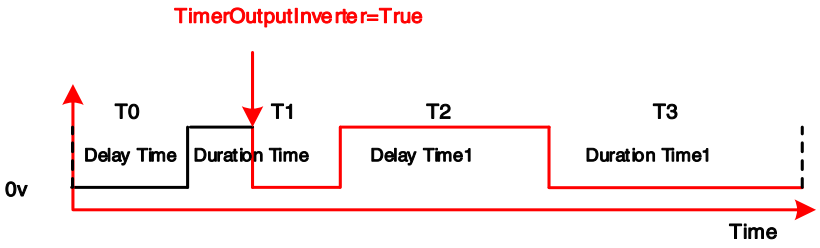


Figure 7-17 TimerOutputInverter

1) The frame grabber supports a total of 4 Timers. When setting up, you should first select the Timer to be configured through TimerSelector, with a range of Timer0 ~ Timer3.
2) During the timer output disabled period, the timer output remains at a low level and is not controlled by the timer output invert.
3) Allow modifying the TimerOutputInverter's value during Timer operation, which will take effect immediately after modification. The output timing is as follows:



7.7.5. TimerState

The timer output is controlled by TimerState. Only when the TimerState is set to Enable, the timer can output when it receives a valid trigger signal, otherwise the timer output will remain at a low level.

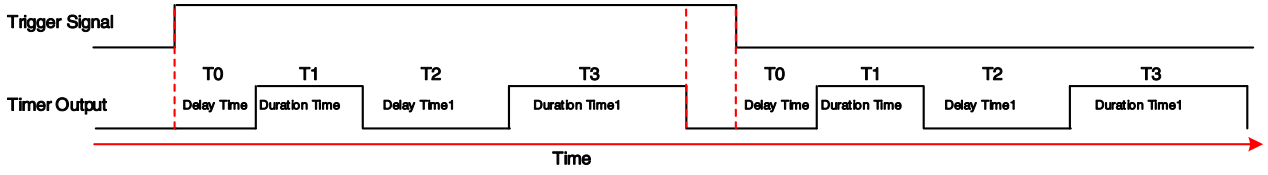
1) The frame grabber supports a total of 4 Timers. When setting up, you should first select the Timer to be configured through TimerSelector, with a range of Timer0 ~ Timer3.
2) After setting the TimerState to Disable, the Timer will immediately interrupt the current output and keep the output at a low level.

7.7.6. TimerTriggerActivation

The Timer needs to specify the effective polarity of the selected trigger source through TimerTriggerActivation. When receiving a valid signal from the trigger source, Timer begins to output waveform.

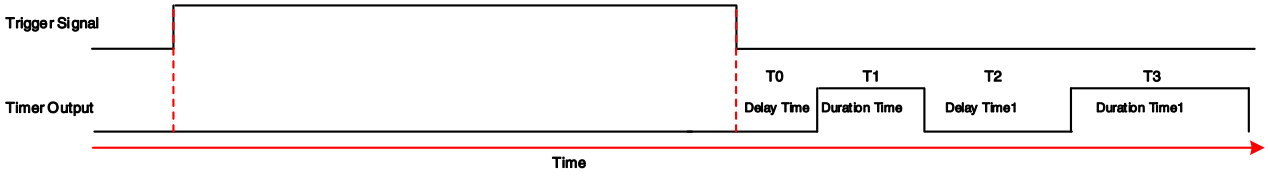
- **Both rising and falling edges serve as effective triggering signals**

Set the TimerTriggerActivation to AnyEdge mode, and when the rising or falling edge of the trigger signal arrives, the Timer generates an output. The timing is shown in the following figure:



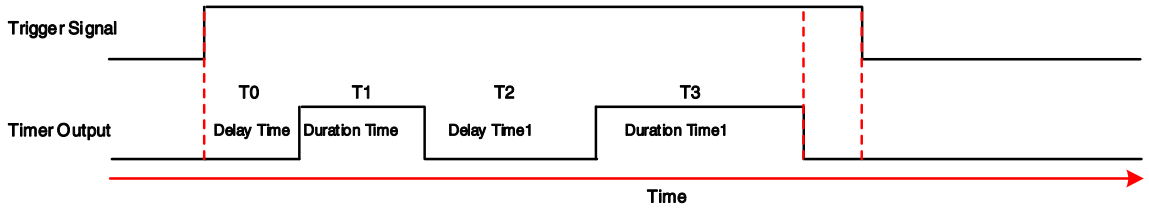
- **Only falling edge serve as effective triggering signals**

Set the TimerTriggerActivation to FallingEdge mode, and when the falling edge of the trigger signal arrives, the Timer generates an output. The timing is shown in the following figure:



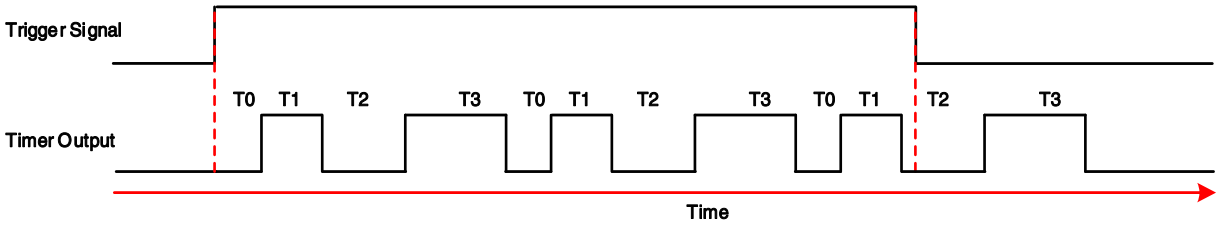
- **Only rising edge serve as effective triggering signals**

Set the TimerTriggerActivation to RisingEdge mode, and when the rising edge of the trigger signal arrives, the Timer generates an output. The timing is shown in the following figure:



- **High level serve as effective triggering signals**

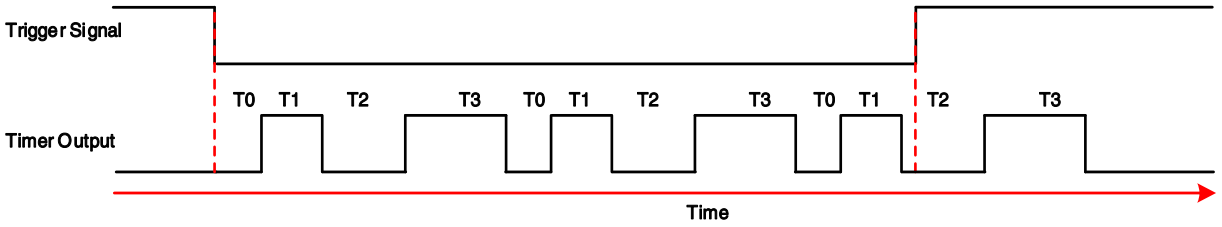
Set the TimerTriggerActivation to LevelHigh mode, and when the trigger signal is high level, the Timer generates an output. The timing is shown in the following figure:



1) During the high level period of the trigger source, the Timer continuously outputs without any interval.
2) When the trigger source turns to a low level. If the output of the Timer is not completed, the Timer will ensure the integrity of the output. After T0~T3 are all output, they will remain at a low level and wait for the next effective trigger signal's arriving.

- **Low level serve as effective triggering signals**

Set the TimerTriggerActivation to LevelLow mode, and when the trigger signal is low level, the Timer generates continuous output. The timing is shown in the following figure:



1) During the low level period of the trigger source, the Timer continuously outputs without any interval.
2) When the trigger source turns to a high level. If the output of the Timer is not completed, the Timer will ensure the integrity of the output. After T0~T3 are all output, they will remain at a low level and wait for the next effective trigger signal's arriving.

7.7.7. TimerTriggerDivider

The Timer can perform frequency division on the edge of the trigger signal, using the divided signal to trigger the Timer output and reduce the triggering frequency. Internal signal division is achieved through Counter. Support 1~255 frequency division of trigger signals.

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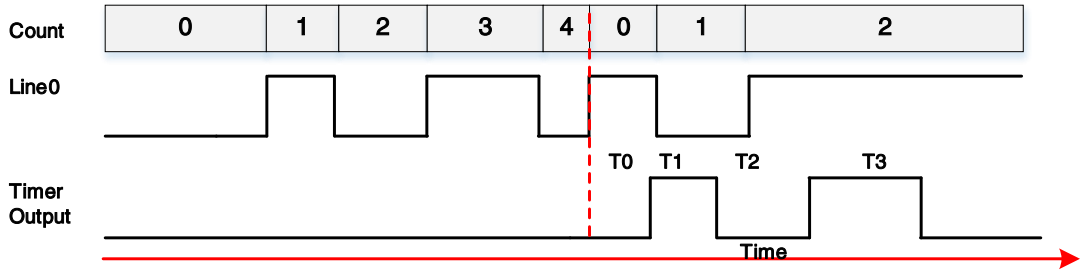
1. Configuration Method

Choose the appropriate trigger source from TimerTriggerSource, set the TimerTriggerActivation to one of the three options of AnyEdge, FallingEdge, or RisingEdge, and then set the TimerTriggerDivider's value as your need.

2. Usage Instruction

Eg: Expect Line0 to generate a Timer output after receiving 5 edges.

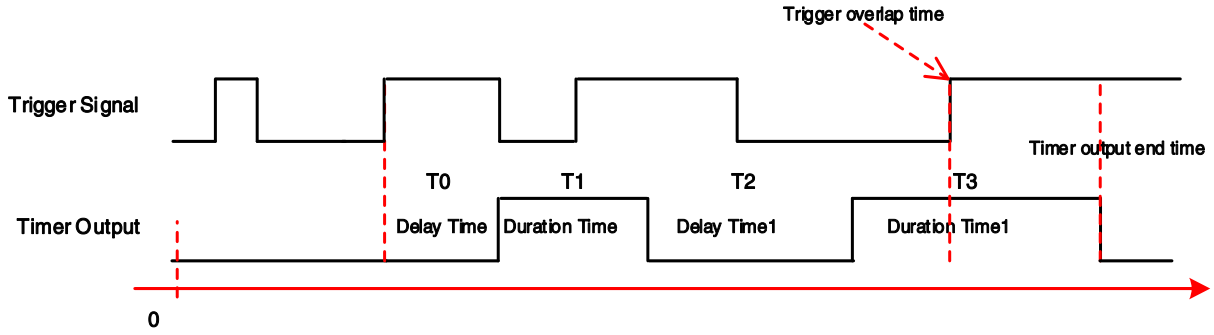
Set TimerTriggerSource to Line0, TimerTriggerActivation to AnyEdge, and TimerTriggerDivider to 5, and then refer to 7.7.1.Timer Output Format for Timer output waveform's configuration. Set TimerState to Enable, the timer can output as expected after completing this configuration, and the specific timing is shown in the following figure:



1) The TimerTriggerDivider is only effective for AnyEdge, FallingEdge, and RisingEdge modes, and has no effect on LevelHigh and LevelLow modes.
2) After setting the TimerState to Disable, the division counter will reset to zero. When the Timer output is turned on again, it needs to be counted again.

7.7.8. TimerTriggerOverlap

When Timer is operating in trigger mode (TimerTriggerSource's value is not "Continuous"), and the output is between T0 and T3, receiving a valid trigger signal again indicates that trigger overlap has occurred. The following figure shows the timing of triggering overlap in the case of TimerTriggerActivation set to RisingEdge and TimerTriggerDivider set to 2:



1) Triggering overlap only occurs in AnyEdge, FallingEdge, and RisingEdge modes, and there is no triggering overlap in LevelHigh and LevelLow modes.
2) Trigger overlap requires analyzing the trigger signal after frequency division.

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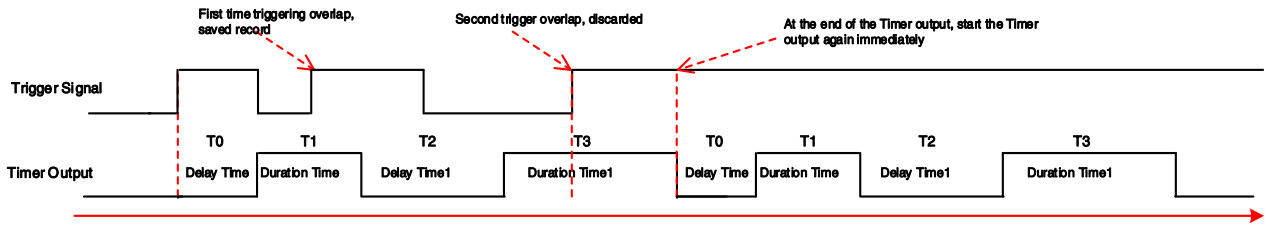
- **Off**

In this mode, all overlapping trigger signals are discarded and have no impact on the Timer output.

- **Latch**

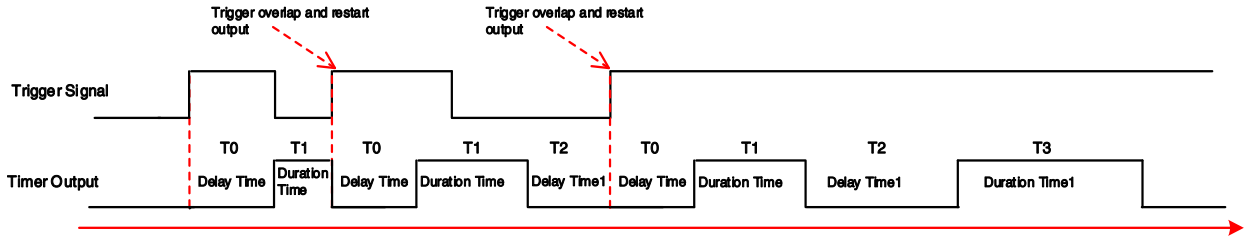
The first overlapped trigger signal in this mode will be saved, and any subsequent overlapped signals generated by the Timer during the output process will be discarded. A new Timer output will immediately initiate at the end of the Timer output. Taking TimerTriggerActivation is RisingEdge and TimerTriggerDivider's value is 1 as an example, the schematic timing is shown in the following figure:



In Latch mode, only one overlapping trigger signal can be saved during each Timer's output process, and others will be discarded.

- **Reset**

In this mode, when trigger signal overlap occurs, the Timer will immediately end the current output and start the next Timer output. Taking TimerTriggerActivation is RisingEdge and TimerTriggerDivider's value is 1 as an example, the schematic timing is shown in the following figure:



All triggering signals are responded to, and no triggering signals are discarded.

7.7.9. TimerTriggerMissedCnt

The frame grabber can count the number of trigger signals that are discarded when triggering overlap as described in the TimerTriggerOverlap section.

Users can determine whether to initiate the statistics of discarded trigger signals by setting the TimerTriggerMissed. Set Enable to allow the statistics of discarded trigger signals. Users can obtain the statistical value by querying the TimerTriggerMissedCnt. Set the TimerTriggerMissed to Disable to prohibit the discard trigger signal statistic function, and the value of TimerTriggerMissedCnt remains unchanged.

Users can reset the value of TimerTriggerMissedCnt by TimerTriggerMissedCntReset function.

7.7.10. TimerTriggerSource

Timers can be triggered through various triggering sources, and users can specify the triggering source of the current Timer through TimerTriggerSource. Currently, it supports different Line options, Continuous, RotaryEncoder0, RotaryEncoder1, Software, Timer1~Timer3. Among them, different Line options indicates support triggering through I/O's input signals, Timer1~Timer3 indicates support triggering through Timer's output signals, Continuous indicates Timer continuous free output, RotaryEncoder0 and RotaryEncoder1 indicates support triggering through pulse signals output by the encoder decoding module.

The triggering polarity and characteristics supported by the triggering signal are shown in the table below:

CXP Frame Grabber Options	GEV Frame Grabber Options	Supported TimerTriggerActivation	Characteristics
Line0~Line19	Line0~Line9	AnyEdge FallingEdge RisingEdge LevelLow LevelHigh	Choosing the output mode of I/O is equivalent to continuously connecting the trigger signal to a low level
Continuous	Continuous	--	Timer is not controlled by trigger signals and continuously output
RotaryEncoder0 RotaryEncoder1	RotaryEncoder0	RisingEdge	The internal default is to acquire trigger signals based on the rising edge, without the need to set TimerTriggerActivation
Software	Software	RisingEdge	1) The internal default is to acquire trigger signals based on the rising edge, without the need to set TimerTriggerActivation 2) The software trigger signal is also controlled by TimerTriggerDivider
Timer1~Timer3	Timer1~Timer3	AnyEdge FallingEdge RisingEdge LevelLow LevelHigh	It is prohibit to select the timed output of the current configuration as the trigger source

7.8. Packet Resend

Packet resend function ensure the accuracy of image data transmission by detecting and resending unexpected data packets.

Resend can correct the image transmission exception caused by accidental network exceptions or slight jitter of physical connections. If the network environment is poor, resend cannot solve the image transmission exception (such as the computer configuration is poor, CPU performance is too low, or the network cable is not specified).

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7.9. FanEnable

A fan is installed on GEV frame grabber, and user can set the "FanEnable" to turn on/off the fan.

GEV Frame Grabber Options	Descriptions
FanEnable	Control the fan. Set the parameter to "true", turn on the fan. Set the parameter to "false", turn off the fan.
FanSpeed	The current fan speed after enable the fan

7.10. DeviceTemperatureSelector

Current temperature values can be displayed on the software.

CXP Frame Grabber Options	GEV Frame Grabber Options	Descriptions
MainBoard	Mainboard PHY	Mainboard: The current motherboard temperature. PHY: The temperature of the frame grabber's Ethernet port

7.11. Alert Log

GEV frame grabber can create alerts in the windows system logs.

Types	Descriptions
Network port link	When the network port is connected to a network device and the network port light is on, the system log will record the current network port linkup
Network port disconnect	When the network port is disconnected from the network device and the network port light goes off, the system log will record the current network port linkdown
Network port excess-temperature	When the PHY is excess-temperature, the system log will records that the temperature of the 4 ports is too high

When the network port is excess-temperature, the frame grabber will execute the temperature alert, and the data transmission of the network port will be disconnected.

7.12. PCIExpressInfomation

PCIExpressInfomation refers to "PCI Express® Base Specification Revision 3.0" in section 7.8.PCI Express Capability Structure, which is described in the following table:

Functions	Descriptions
PCIeMaxPayloadSizeSupported	The maximum effective packet size which can support TLP
PCIeMaxPayloadSize	The current TLP packet size
PCIeMaxReadRequestSize	The current maximum data size supported for a single memory read
PCIeMaxLinkSpeed	Maximum link speed for associated ports
PCIeCurrentLinkSpeed	Negotiate link speed for PCI high speed link

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PCIeMaximumLinkWidth	The maximum link width supported by the host
PCIeNegotiatedLinkWidth	The negotiated link width of the PCI high speed link
PCIeLinkSpeed2500MTpsSupported	Whether it supports a link speed of 2500MTps
PCIeLinkSpeed5000MTpsSupported	Whether it supports a link speed of 5000MTps
PCIeLinkSpeed8000MTpsSupported	Whether it supports a link speed of 8000MTps
PCIBus	Current device PCI bus index value
PCIDevice	Current device's PCI index value
PCIFunction	Current device PCI function index value

7.13. ErrorCounters

CoaXPressErrorCounters displays the information statistics of format errors found after parsing protocol packets received by the frame grabber from the camera. The functional description is shown in the table below:

Function	Description
CxpLineSelector	Switching the value to view the count of error messages for the corresponding physical connection
Cxp8b10bErrorCount	This value counts the number of 8B and 10B errors in the downlink data received by the frame grabber
CxpDuplicatedCharactersUnCorrectedErrorCount	This value counts the number of Word messages with 3 or more identical bytes that cannot be detected, as the protocol packet received by the frame grabber did not meet the requirements of the CXP protocol with 4 byte duplicates
CxpControlDataPacketlengthErrorCount	Count the number of control packets with incorrect packet length
CxpControlPacketCrcErrorCount	Count the number of control packets with crc errors
CxpEventPacketlengthErrorCount	Count the number of event packets with incorrect packet length
CxpEventPacketCrcErrorCount	Count the number of event packets with crc errors
CxpStreamDataPacketlengthErrorCount	Count the number of stream packets with incorrect packet length
CxpStreamDataPacketCrcErrorCount	Count the number of crc error streams
Cxp8b10bErrorCountReset	Cxp8b10bErrorCount zeroing
CxpDuplicatedCharactersUnCorrectedErrorCount Reset	CxpDuplicatedCharactersUnCorrectedErrorCount zeroing

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CxpControlDataPacketlengthErrorCountReset	CxpControlDataPacketlengthErrorCount zeroing
CxpControlPacketCrcErrorCountReset	CxpControlPacketCrcErrorCount zeroing
CxpEventPacketlengthErrorCountReset	CxpEventPacketlengthErrorCount zeroing
CxpEventPacketCrcErrorCountReset	CxpEventPacketCrcErrorCount zeroing
CxpStreamDataPacketlengthErrorCountReset	CxpStreamDataPacketlengthErrorCount zeroing
CxpStreamDataPacketCrcErrorCountReset	CxpStreamDataPacketCrcErrorCount zeroing

PcieGevErrorCounters displays the information statistics of format errors found after parsing protocol packets received by the frame grabber from the camera. The functional description is shown in the table below:

Function	Description
PortSelector	Switching the value to view the count of error messages for the corresponding physical connection
ControlPacketErrorCount	Count the number of received control packets with errors
EventPacketCount	Count the number of received event packets
SendEventPacketAckCount	Count the number of send event response packets
EventPacketErrorCount	Count the number of received event packets with errors
StreamPacketErrorCount	Count the number of received stream packets with errors
StreamPacketTotalCount	Count the number of received stream packets
SendResendCmd1Count	Count the number of first resend of image packets
SendResendCmd2Count	Count the number of second resend of image packets
PauseTimeCount	Count the camera pause time, unit: 3ns
ReceiveResendGVSPCount	Count the number of received resend packets
ReceiveResendUnvaildGVSPCount	Count the number of received resend unvalid packets
DeliverResendUnvaildCount	Count the number of delivered resend unvalid packets
BufOverflowCount	Count the number of overflowed buffer
ResendTimeoutCount	Count the number of resend timeout
FBWriteFIFOFullCount	Count the number of overflowed write FIFObuffer
EventPacketCountReset	EventPacketCrcErrorCount zeroing
ControlPacketErrorCountReset	ControlPacketErrorCount zeroing
EventPacketErrorCountReset	EventPacketErrorCount zeroing
SendEventPacketAckCountReset	SendEventPacketAckCount zeroing
StreamPacketErrorCountReset	StreamPacketErrorCount zeroing

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StreamPacketTotalCountReset	StreamPacketTotalCount zeroing
SendResendCmd1CountReset	SendResendCmd1CountReset zeroing
SendResendCmd2CountReset	SendResendCmd2CountReset zeroing
PauseTimeCountReset	PauseTimeCountReset zeroing
ReceiveResendGVSPCountReset	ReceiveResendGVSPCountReset zeroing
ReceiveResendUnvaildGVSPCountReset	ReceiveResendUnvaildGVSPCountReset zeroing
DeliverResendUnvaildCountReset	DeliverResendUnvaildCountReset zeroing
BufOverflowCountReset	BufOverflowCountReset zeroing
ResendTimeoutCountReset	ResendTimeoutCountReset zeroing
FBWriteFIFOFullCountReset	FBWriteFIFOFullCountReset zeroing

7.14. CoaXPress

Test whether the connection between the CXP frame grabber and the camera is stable, and whether the signal quality is normal. The relevant functions and descriptions are shown in the table below:

Functions	Descriptions
CXPLinkTestLine	Select the physical connection to control
CXPLinkTestMode	Connect the test switch, stop sending test packets when in Off mode, and start sending test packets corresponding to the physical connection when Model1 is selected
TestPackageSendCount	When CXPLinkTestMode selects Model1, the value starts counting the number of test packets sent
TestPackageReceiveCount	Count the number of frame grabber received test packets sent by the cameras
TestPackageReceiveErrCount	Count the number of Word errors received by the frame grabber in the test package sent by the camera
ClearTestPackageSendCount	TestPackageSendCount zeroing
ClearTestPackageReceiveCount	TestPackageReceiveCount zeroing
ClearTestPackageReceiveErrCount	TestPackageReceiveErrCount zeroing

7.15. Stream

Stream function displays the statistical information generated during the acquisition process, and the functional description is shown in the table below:

BufferHandlingControl	Description
CxpStreamPacketImageHeaderErrorCount	Count the error number of the image header information received by the frame grabber
CxpStreamDataLostTagErrorCount	Count the error number of stream packet loss

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CxpStreamRecImageFrameCount	Count the image frame number received by the frame grabber
CxpStreamRecImageLineCount	Count the number of image lines received by the frame grabber
CxpStreamPacketImageHeaderErrorCountReset	Clear CxpStreamPacketImageHeaderErrorCount
CxpStreamDataLostTagErrorCountReset	Clear CxpStreamDataLostTagErrorCount
CxpStreamRecImageFrameCountReset	Clear CxpStreamRecImageFrameCount
CxpStreamRecImageLineCountReset	Clear CxpStreamRecImageLineCount
StreamIsGrabbing	Status of the frame grabber, False indicates that the current device is in AcquisitionStop state. True indicates that the current device is in the AcquisitionStart state
StreamAnnouncedBufferCount	This value represents the number of Buffers when TL acquiring images, the value is 0 when the in AcquisitionStop status
StreamBufferHandlingMode	The current buffer processing mode used, which support three modes: OldestFirst (Default), OldestFirstOverwrite and NewestOnly
StreamAnnounceBufferMinimum	The minimum number of buffers required for acquisition
StreamBufferAlignment	This value represents the acquisition requirements for Buffer address and Buffer size, requiring Buffer address to be aligned with this value and Buffer size to be integer multiples of this value
StreamDeliveredFrameCount	The number of received images from the beginning of acquisition to the end of acquisition
StreamLostFrameCount	The number of frame lost from start to the end of acquisition
StreamIncompleteFrameCount	The number of incomplete frames from start to the end of acquisition
StreamContinuousBufferNum	This value represents the number of StreamAnnouncedBufferCount that use continuous physical memory
StreamNonContinuousBufferNum	This value represents the number of StreamAnnouncedBufferCount that use discontinuous physical memory

The difference between the three modes of StreamBufferHandlingMode:

1) OldestFirst

Default value. The image buffer follows the principle of FIFO (First in, First out). After all buffers are filled, new image data will be discarded until the user completes the buffer processing that has already filled the image data. A typical application is to ensure no frame loss for every frame of image acquired by the camera. This mode requires the transmission and processing speed of image data to be as fast as possible (at least less than the frame period) to meet no frame loss requirement.

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2) OldestFirstOverwrite

Also follow the principle of FIFO (First in, First out). The difference from OldestFirst mode is that when all buffers are filled, the SDK will actively discard the oldest timestamp image buffer for receiving new image data.

3) NewestOnly

In this mode, users always receives the latest image received by the SDK. Every time SDK receives new frame of image data, it actively discards the old timestamp image. Therefore, if user's image processing is not timely or the speed is slow, frame loss may occur. The main application of this mode is that when requires high real-time image acquisition and display, and does not require receiving every frame of image acquired by the camera. However, due to the limitations of the camera's acquisition frame rate and internal cache, as well as transmission speed and user usage scenarios, there may be a delay between the latest images received by the SDK and the latest images exposed by the camera.

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8. FAQ

No.	General Question	Answer
1	Buffer lack and frame loss	1) Hardware environment issue: It is necessary to confirm whether the PCIe slot connected to the frame grabber supports the speed of PCIe Gen3 × 8. Check whether the value of **PCIeLinkSpeed8000MTpsSupported** is " true ", and whether the **PCIeNegotiatedLinkWidth** is " ×8 ", If not, it indicates that the PCIe slot connected to the current frame grabber does not support Gen3 × 8. 2) The continuous output bandwidth of the frame grabber is 6700MB/s. If the Bayer2RGB function is enabled for the camera, the maximum bandwidth of the receiving camera is 2200MB/s. If the output bandwidth of the camera exceeds this bandwidth, frame loss may occur. 3) Acquiring and displaying images from multiple cameras simultaneously using software will cause excessive CPU load average, resulting in insufficient buffer and frame loss. This problem can be solved by turning off the image display and reducing the CPU pressure.
2	PC does not detect the frame grabber during the upgrade process.	1) Frame grabber to upgrade the internal firmware involves a similar PCIe hot-swap operation, so the PC may not be able to detect the frame grabber during upgrade process. The user needs to restart the computer and the upgrade software also pops up a message at the right time about restart the computer. 2) In principle, it is not allowed to have PC power down during the upgrade process of the frame grabber, but if the PC cannot detect the frame grabber after this situation occurs. It may be caused by incomplete firmware inside the frame grabber. The user needs to restart the computer to let the frame grabber restore to the original state to upgrade the operation again.
3	The GEV frame grabber connected to the camera through the network cable and find that the camera cannot be enumerated.	1) Check the length of the network cable, which should within 30m. 2) Check the network cable connection, use the RJ45 jack to connect the camera. Observe the network port indicator, the yellow and green LED solid at the same time when the connection is successful, otherwise, please confirm that the network cable and the camera is normal.

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9. Revision History

No.	Version	Changes	Date
1	V1.0.0	Initial release	2024-03-01
2	V1.0.1	Add GEV frame grabber	2024-05-06
3	V1.0.2	Update section 8 FAQ	2024-05-30
4	V1.0.3	Add section 7.2.7 Packet Size, section 7.8 Packet Resend, section 7.9 FanEnable and section 7.13 ErrorCounters	2024-07-10

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