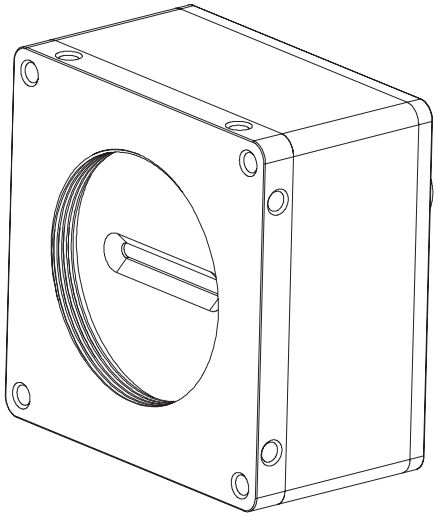
微图视觉
Vision Datum

Mars GigE Line Scan Cameras User Manual



V2.4.2, Feb. 2024

PREFACE

Purpose of This Manual

This Manual is a basic description of Mars Line Scan Cameras, which mainly includes the product description, quick installation guide and Simple introduction of SDK(iCentral).

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Hangzhou Vision Datum Technology Co., Ltd.
Tel: 86-571-86888309
Add.: No.8, Xiyuan 9th Road West Lake District, Hangzhou 310030 China

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Throughout this manual, trademarked names might be used. We state herein that we are using the names to the benefit of the trademark owner, with no intention of infringement.

Disclaimer

The information and specifications described in this manual are subject to change without notice.

Latest Manual Version

For the latest version of this manual, see the Download Center on our web site at:www.visiondatum.com

Technical Support

For technical support, e-mail: support@visiondatum.com.

Warranty

To ensure that your warranty remains in force, adhere to the following guidelines:

Do not remove the camera's serial number label
If the label is removed and the serial number can't be read from the camera's registers, the warranty is void.

Do not open the camera housing
Do not open the housing. Touching internal components may damage them.

Prevent ingress or insertion of foreign substances into the camera housing
Prevent liquid, flammable, or metallic substances from entering the camera housing. If operated with any foreign substances inside, the camera may fail or cause a fire.

Avoid electromagnetic fields
Do not operate the camera in the vicinity of strong electromagnetic fields. Avoid electrostatic charging.

Clean with care
Avoid cleaning the sensor if possible.

Handle this camera with care.

Do not abuse the camera. Avoid striking, shaking, etc. The camera could be damaged by improper handling.

Read the manual
Read the manual carefully before using the camera.

CHAPTER 1 Product Description

Product Introduction

Mars series line scan industrial cameras have high-performance sensitive sensors and transmit image data via GigE interface/ CameraLink interface. It is compatible to any application development tools which follow the GigE Vision, CameraLink protocol and GenICam standard. And it could work stably in a variety of harsh envi-ronment. It's distinguished itself by high reliability and high cost-performance.

Product Features

- Adopts GigE interface and max. transmission distance of 100 meters without relay
- Provides 256MB on-board buffer for image data retransmission under burst mode;
- Supports API trigger, external trigger, free run mode and etc.;
- Supports various output formats for image data;
- Conforms to GigE Vision protocol and GenICam standard;
- Support DC12V~24V wide-range power supply.

Status Indicators

Status	Description
Red Flashes quickly	The device is starting.
Red Solid on	The device is abnormal, such as no bit stream, firmware upgrade failure.
Red Flashes slowly	The network is disconnected
Blue Low light	The address has been allocated, but the application API is not connected to the device.
Blue High light	The application API is connected to the device and the device is in free-run mode, but there is no image transmission.
Blue Flashes quickly	The application API is connected to the device, the device is in free-run mode, and there is image transmission.
Blue Flashes slowly	The device is in trigger mode.
Flashes alternately	The firmware is being upgrading.

Mechanical Dimensions

The dimensions is in millimeters

- CMOSIS Sensor Cameras with 62 * 62 * 35.8mm housing are as shown in Figure 1-1.
- Gpixel Sensor Cameras with 62 * 62 * 44mm housing are as shown in Figure 1-2.
- Gpixel Sensor Cameras with 29 * 44 * 57.5mm housing are as shown in Figure 1-3.
- 8K GigE Cameras with 80 * 80 * 48mm housing are as shown in Figure 1-4.

Figure 1-1: CMOSIS Sensor Cameras with 62 * 62 * 35.8mm housing.

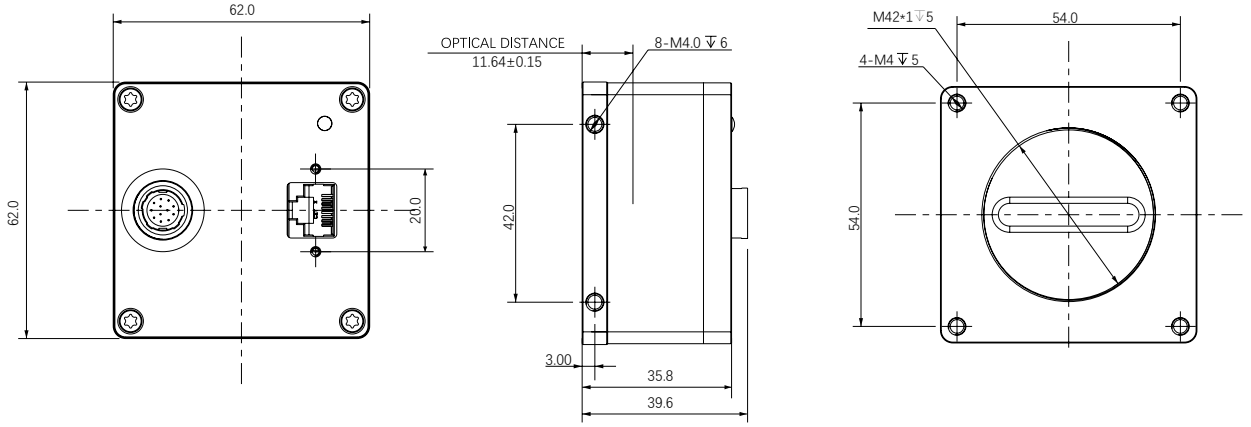


Figure 1-2: Gpixel Sensor Cameras with 62 * 62 * 44mm housing.

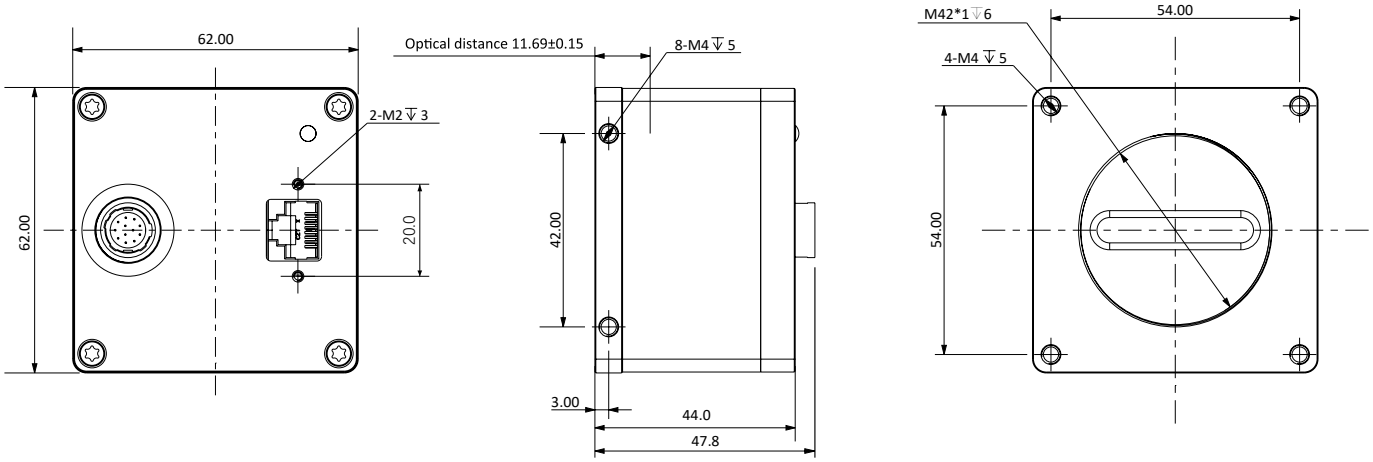
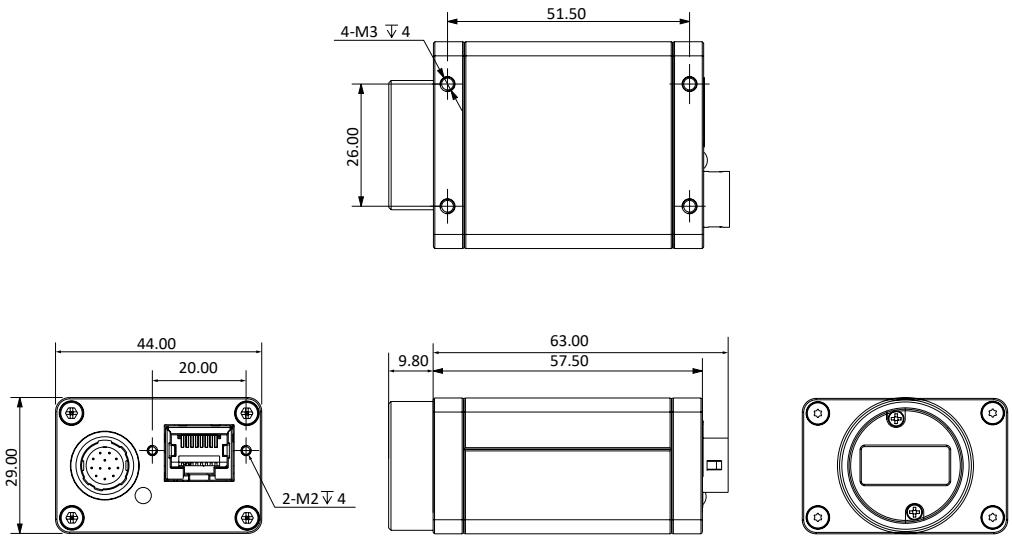
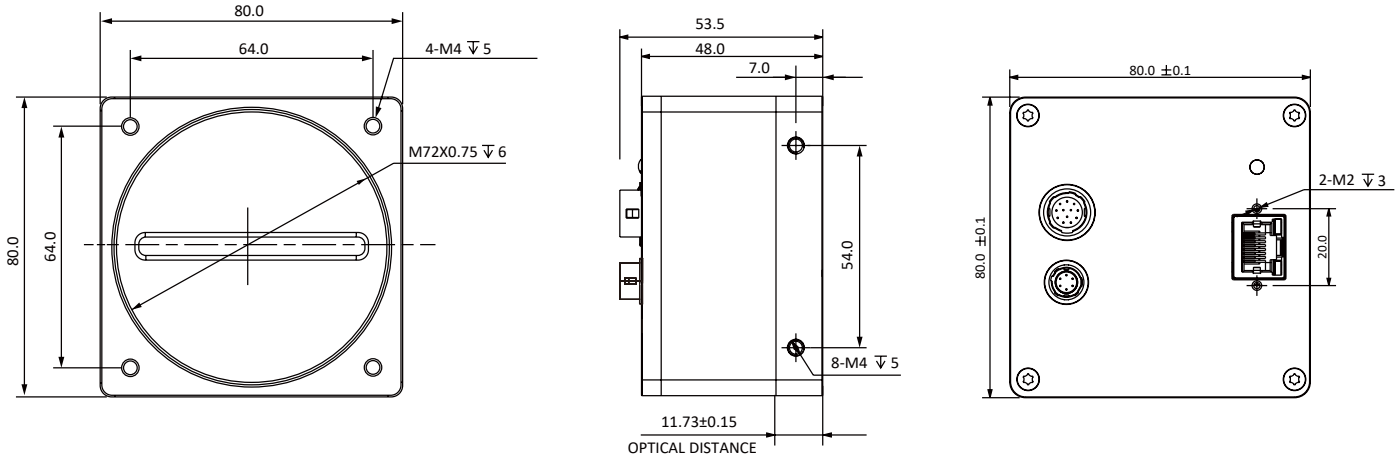


Figure 1-3: Gpixel Sensor Cameras with 29 * 44 * 57.5mm housing.



Mechanical Dimensions

Figure 1-4: 8K GigE Cameras with 80 * 80 * 48mm housing.



CHAPTER 2 Installation and Setup

Software Installation

System Requirements

The Mars Camera Software Suite for Windows requires that one of the following operating systems is installed on your computer:

- Windows 7 (32 bit/ 64 bit)
- Windows 10 (32 bit/ 64 bit)
- Linux (32 bit/ 64 bit): a. glibc 2.12 version and above b. Linux kernel version nubber from 2.6.32 (inclusive) to 5.11.0 (inclusive)
- ARM 64 bit: NVIDIA TX1/2、
  a. glibc 2.23 version and above
  b. If it is Nvida developing board, support L4T version below【32.1】& kernel version below 【4.9.140-tegra】

Brief Introduction of Mars Camera Software Suite

The options available with the Mars Camera Software Suite let you change parameters and control the camera by using a stand-alone GUI (known as iCentral) or by accessing the camera from within your software application using the API.

The Mars Camera Software Suite is designed for use with all Mars cameras with both the GigE and USB 3.0. The ICentral offers reliable, real-time image data transport into the memory of your computer at a very low CPU load.

The Mars Camera Software Suite includes several tools that you can use to change the parameters on your camera, including ICentral and API for different programming languages (C#/C++/.NET).

Installation Steps:

1. Download the iCentral from the Vision Datum website:

http://www.visiondatum.com/en/service/005001.html

2. Launch the downloaded installer.

3. Follow the instructions on the screen. The installer will guide you through the installation process.

During installation, you can choose whether to install the software for use with a GigE camera or a USB 3.0 camera.

Path to development manual (default) C:\Program Files\iCentral\iCentral\Documentations

Path to driver file (default) C:\Program Files\iCentral\iCentral\Drivers

Path to samples C:\Program Files\iCentral\iCentral\Development\Samples

Hardware Installation

Installing a GigE Lian Scan Camera

The installation procedures assume that you will be making a peer-to-peer connection between your camera and a computer.

Make sure that the following items are available before starting the installation:

- A Mars GigE Line Scan camera.
- A power supply.
- As applicable, a C-mount, M42-mount or F-mount lens for the camera.
- A computer with a GigE network adapter installed. The computer must be equipped with an appropriate
- A standard Ethernet patch cable(CAT 6 or better).

You should perform the software installation procedure first and the hardware installation procedure second.

Steps:

1. Mount a C-mount lens, M42-mount or F-Mount lens with adapter, as applicable onto your camera.

   Please make sure that you are using the right adapter for lens with different mount.

2. Connect the camera to the computer and power.

   If you are using PoE： Connect one end of the network cable to the computer's Gigabit Ethernet port or switch, and the other end to the camera's Ethernet port.

   If you are using 8K Cameras with Hirose cable:

   a. Plug one end of an Ethernet cable into the network adapter in your computer and the other end of the cable into the GigE connector of the camera.

   b. Plug the 6-pin connector of the cable from your power supply into the 6-pin connector of the camera.

   c. Switch on the power supply

   If you are using CMOSIS and Gpixel Sensor Cameras with Hirose cable:

   a. Plug one end of an Ethernet cable into the network adapter in your computer and the other end of the cable into the GigE connector of the camera.

   b. Plug the 12-pin connector of the cable from your power supply into the 12-pin connector of the camera.

   c. Switch on the power supply

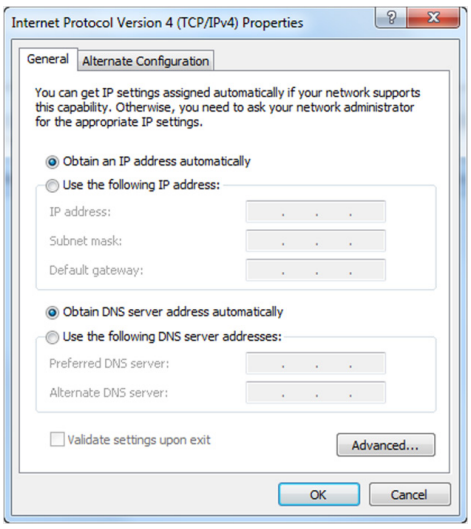
i	If you are using PoE, you need to check whether the purchased camera supports PoE power supply.

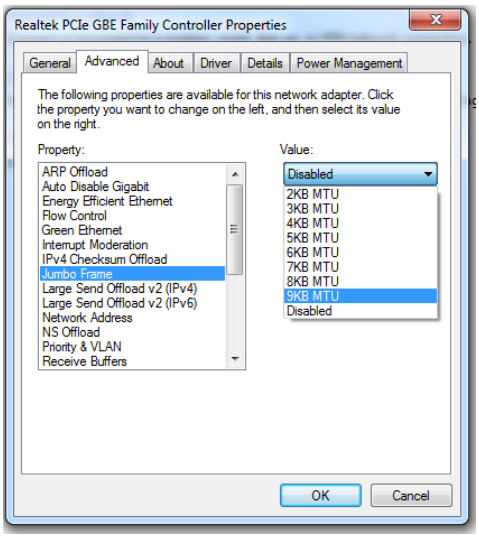
Network Settings

Before using the camera, you need to configure IP is in the same network segment with the computer. You can modify it in"Local Connection" to ensure network communication is normal.

Local Network Configuration :

- Click "Control Panel"> "Network and Internet"> "Network and Sharing Center"> "Change Adapter Configuration. "Then select corresponding network card to configure it automatically obtain IP address or manually assign it as same network segment address with the camera. Shown as below:
- Open "Advanced" in the properties, set "Jumbo Frame" as its maximum value:9014bytes, both of transmit buffer and receive buffer set as 2048bytes, the Interrupt Throttle Rate set as extremum value. These maximum values mentioned above depend on the specific network card. Shown as below:





CHAPTER 3 IO Electrical Specifications

CMOSIS 8K Ethernet Port IO Electrical Specifications

Parameter	Description
Data output port	Fast Ethernet (100 Mbit/s) or Gigabit Ethernet (1000 Mbit/s).
Sync mode	Hardware triggered, software triggered, or free run.
Exposure control	Hardware triggered or triggered by camera APIs.
Power supply specification	6–24 VDC, < 1% texture ripple, powered by the Hirose 6-pin connector[1] of the camera. The cable must be at least 26 AWG.
I/O lines	● 2 RS422 inputs, which can be configured as single-end input. ● 2 RS422 outputs, which can be configured as single-end output. ● 1 RS422 input/output, which can be configured as single-end input/output. ● 1 GPIO port, which can be configured as input or output.
Weight	About 230 g.
Lens Mount	M72 Mount.
EMS standard	● ESD (GBT17626.2/IEC61000-4-2): 6 KV for contacting with a metal surface. ● Surge (IEC61000-4-5): 2 KV in common mode/1 KV in differential mode through the Ethernet port (10/700μs). ● Power port: 2 KV in common mode (1.2/50 μs).
EMC standard	Class A。

[1]: The power supply must meet SELV and LPS specifications.

VT-Hirose6-7 Color	Pin	Signal	Function
Red	1	Power	6–24 VDC Camera Power
Green	2		
White	3	-	-
Blue	4	-	-
Brown	5	GND	DC Camera Power Ground
Black	6		

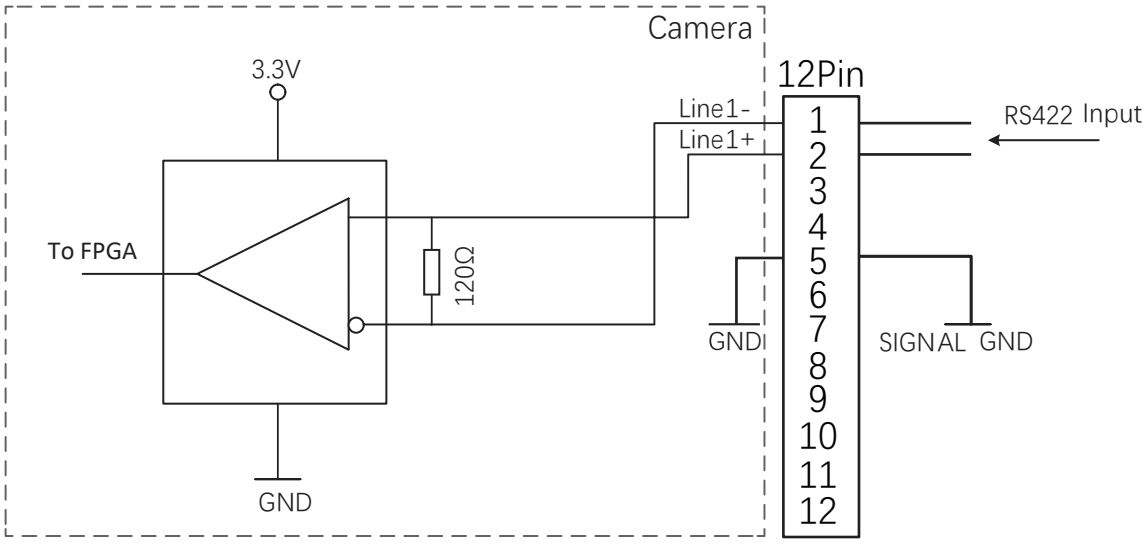
CMOSIS 8K Ethernet Port IO Electrical Specifications

Pin	Signal	Function	Remarks	Suggestion
Black	1	line1_in-	RS422 input-	Connects the encoder (line trigger)
Red	2	line1_in+	RS422 input+/single-end input	Connects the encoder (line trigger)
Brown	3	line3_inout-	RS422 input/output-	-
Orange	4	line3_inout+	RS422 input and output+/single-ended input and output	-
Yellow	5	Signal Ground	Signal ground (SGND)	Encoder power ground (0 V)
Green	6	Line5_out-	RS422 output–	/
Blue	7	Line5_out+	RS422 output+/single-ended output	/
Purple	8	Line2_in-	RS422 input-	Connects the encoder (line trigger)
Gray	9	Line2_in+	RS422 input+/single-ended input	Connects the encoder (line trigger)
White	10	Line4_GPIO	Single-ended input/output	Connects the photoelectric switch (frame trigger)
Pink	11	Line6_out-	RS422 output-	/
Light green	12	Line6_out+	RS422 output+/single-ended output	/

● A signal pin not in use must be hanged. Do not connect it to the power supply or GND to avoid camera damage.
● The wire color of this user manual is the color of Vision Datum. If you use other manufacturers' cable color definitions may be different, random connection may cause the camera to burn out, please connect according to the I/O port type and pin definition or contact our technical staff for advise.

RS422 input

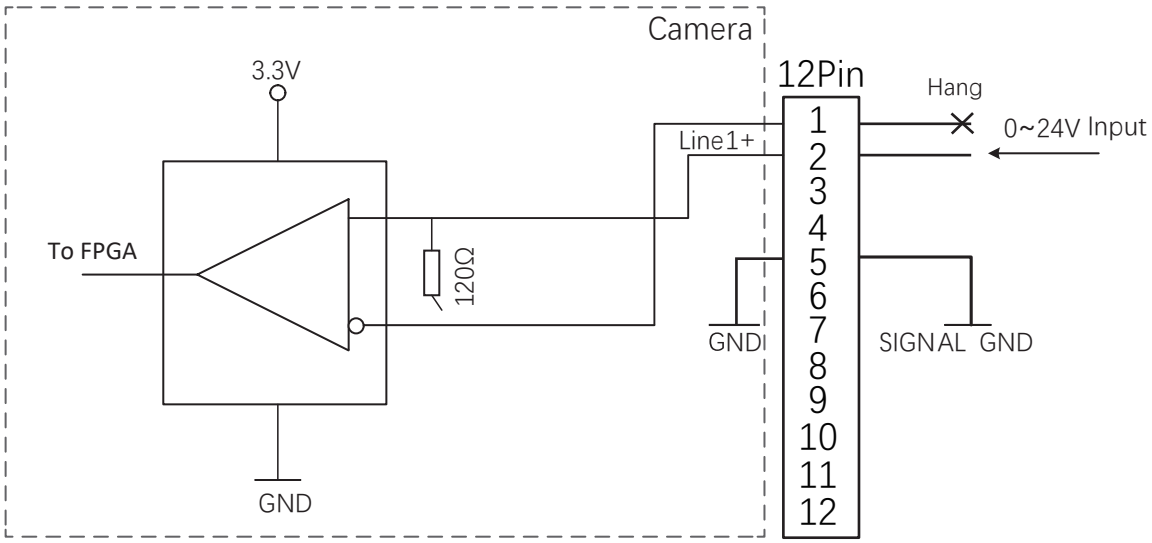
Input voltage		Description
Vcm	-25.0 V ~ +25V	Input common-mode voltage range.
VID	+200mV	Input differential voltage (A-B). It represents logic 1 when the value is exceeded.
	-200mV ~ +200mV	The input status reverses and the logic status inside the voltage range is unsure.
	-200mV	Input differential voltage (A-B). It represents logic 0 when the value is not exceeded.



CMOSIS 8K Ethernet Port IO Electrical Specifications

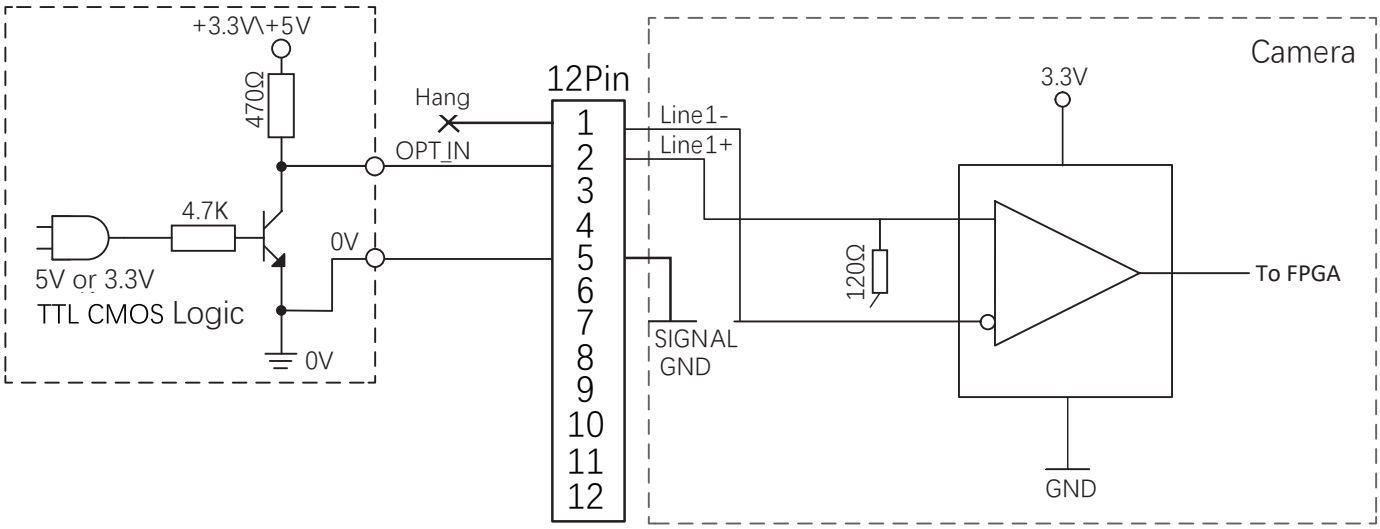
Single-end input

Input voltage		Description
-	-60.0 ~ +60.0 V	Max. voltage input, which must be not exceeded. Otherwise, the device might be damaged.
	0–24.0 V	
3.3 V TTL input	1.5 V	Safe operating voltage input range
5 V TTL input	2.5 V	Determining level for high and low conversion
12V	6 V	
24V		



Connection for typical application of single-end input (1) :

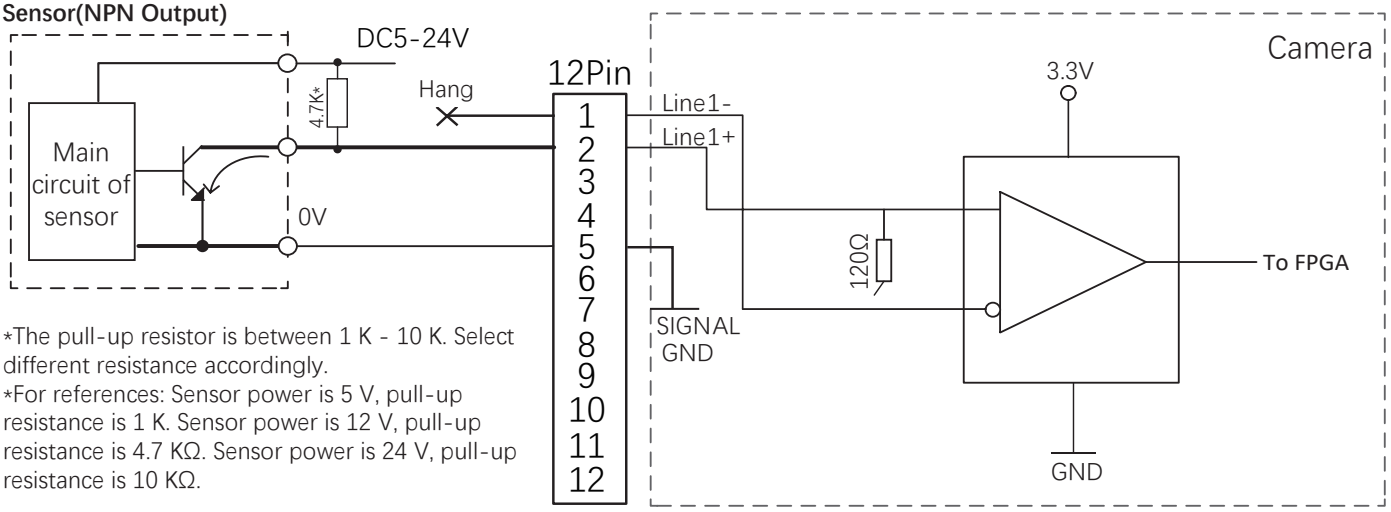
Connect TTL/CMOS Logic



CMOSIS 8K Ethernet Port IO Electrical Specifications

Connection for typical application of single-end input (2)

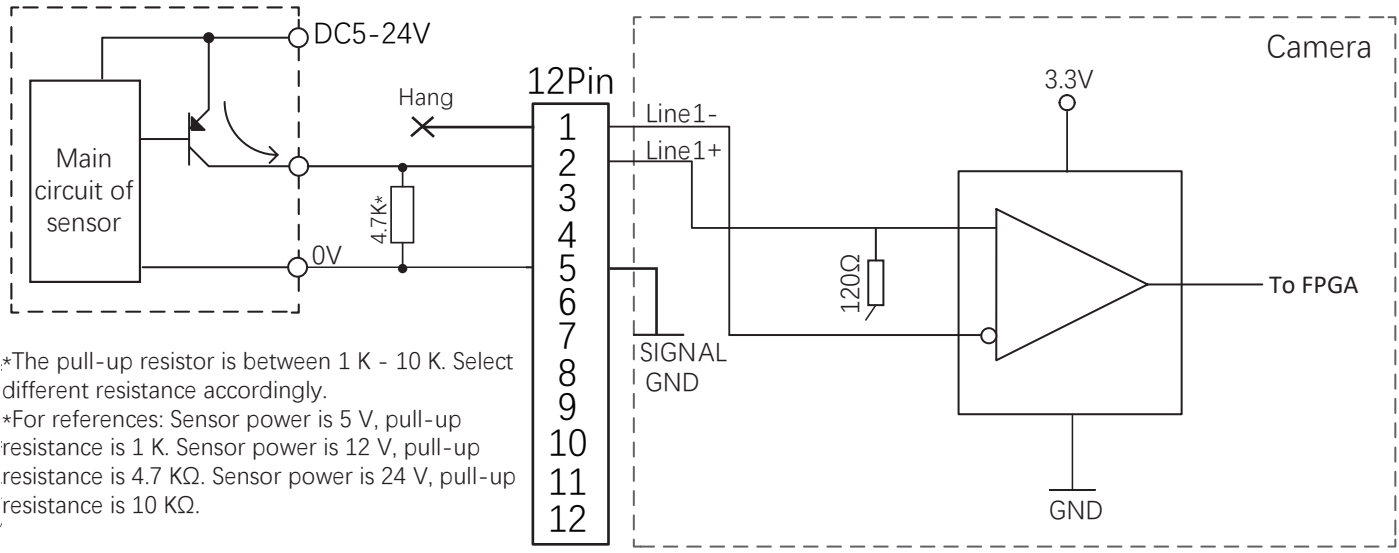
Sensor(NPN Output)



*The pull-up resistor is between 1 K - 10 K. Select different resistance accordingly.
*For references: Sensor power is 5 V, pull-up resistance is 1 K. Sensor power is 12 V, pull-up resistance is 4.7 KΩ. Sensor power is 24 V, pull-up resistance is 10 KΩ.

Connection for typical application of single-end input (3)

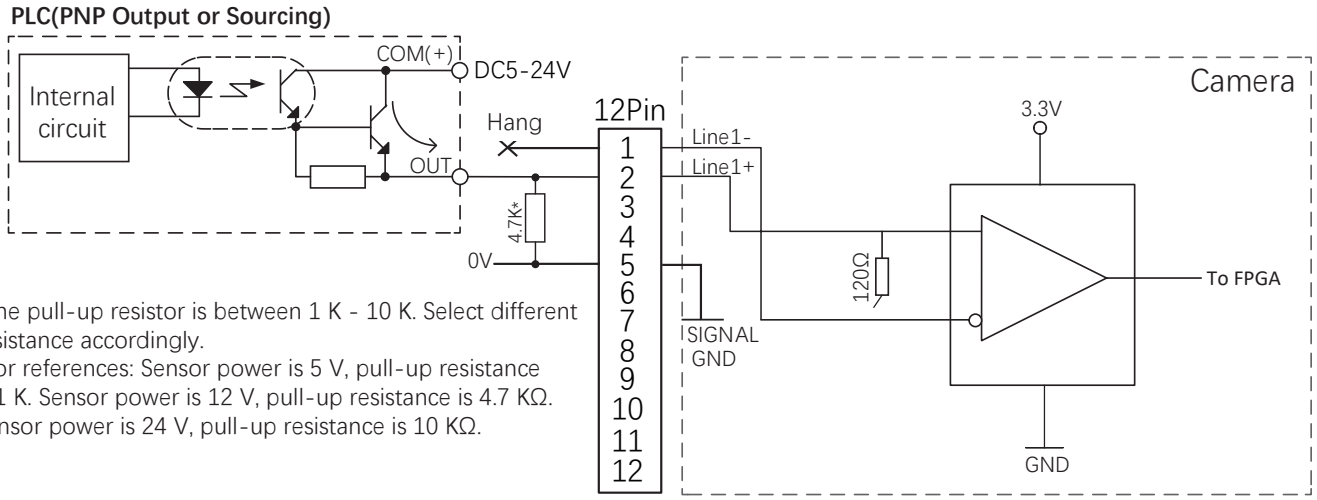
Sensor(PNP Output)



*The pull-up resistor is between 1 K - 10 K. Select different resistance accordingly.
*For references: Sensor power is 5 V, pull-up resistance is 1 K. Sensor power is 12 V, pull-up resistance is 4.7 KΩ. Sensor power is 24 V, pull-up resistance is 10 KΩ.

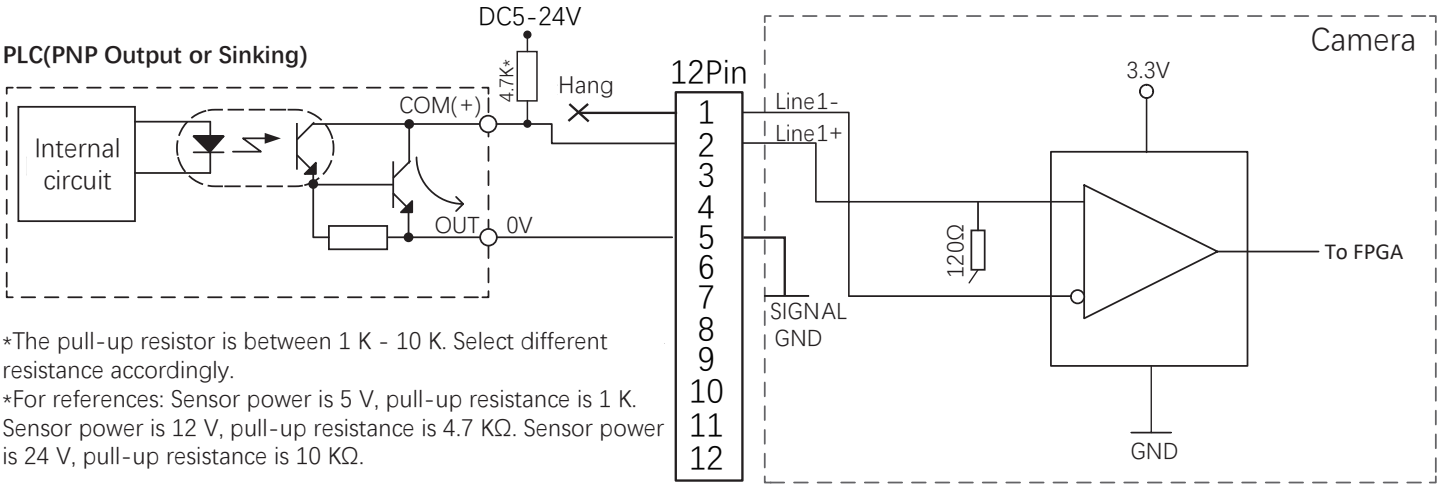
CMOSIS 8K Ethernet Port IO Electrical Specifications

Connection for typical application of single-end input (4) :



*The pull-up resistor is between 1 K - 10 K. Select different resistance accordingly.
*For references: Sensor power is 5 V, pull-up resistance is 1 K. Sensor power is 12 V, pull-up resistance is 4.7 KΩ. Sensor power is 24 V, pull-up resistance is 10 KΩ.

Connection for typical application of single-end input (5) :

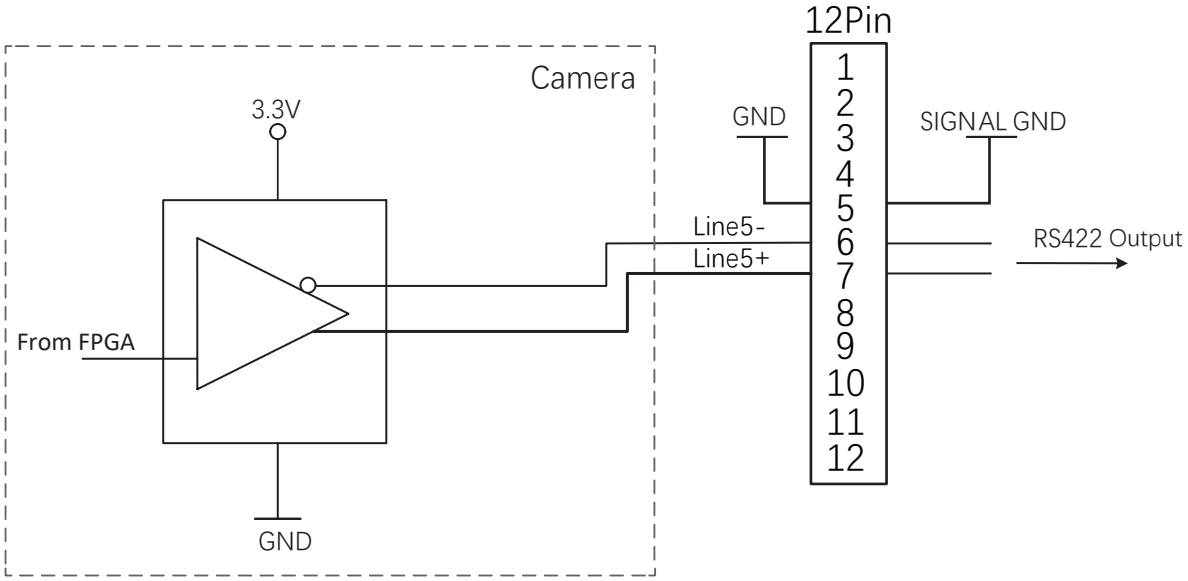


*The pull-up resistor is between 1 K - 10 K. Select different resistance accordingly.
*For references: Sensor power is 5 V, pull-up resistance is 1 K. Sensor power is 12 V, pull-up resistance is 4.7 KΩ. Sensor power is 24 V, pull-up resistance is 10 KΩ.

CMOSIS 8K Ethernet Port IO Electrical Specifications

RS422 output:

Output voltage		Description
Voc	+3.0 V	Max. common-mode output voltage.
VOD	+200mV	Output differential voltage (Y-Z). It represents logic 1 when the value is exceeded.
	-200mV ~ +200mV	The output status reverses, and the logic status inside the voltage range is unsure.
	-200mV	Output differential voltage (Y-Z). It represents logic 0 when the value is not exceeded.



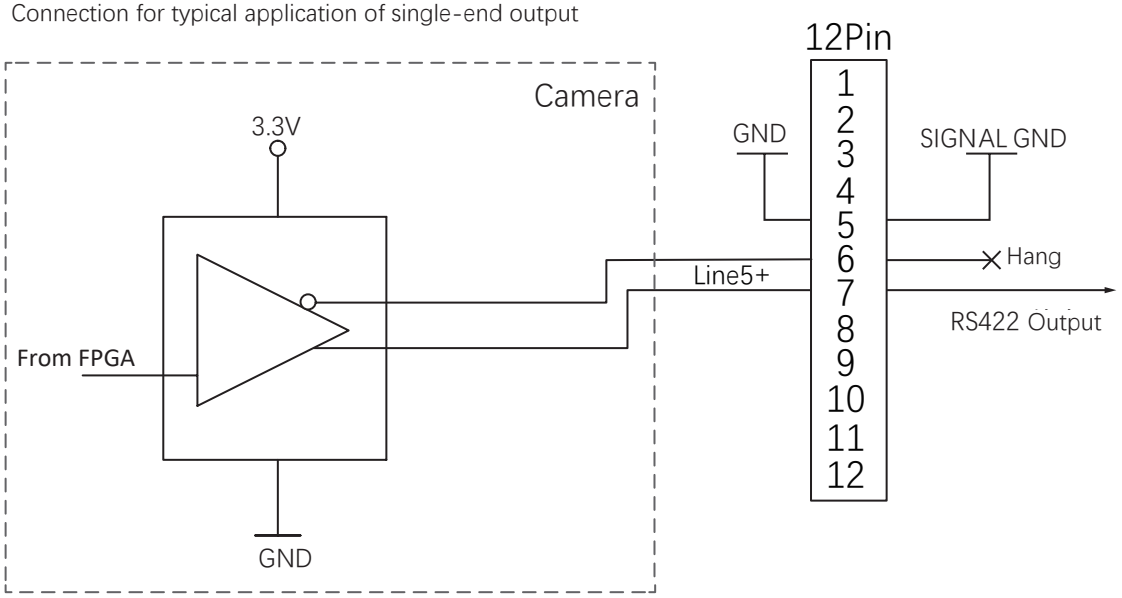
CMOSIS 8K Ethernet Port IO Electrical Specifications

Single-end output:

Voltage	Description
0~+3.3 V	3.3 V TTL level
0~0.8 VDC	Logic 0
>2.0 VDC	Logic 1

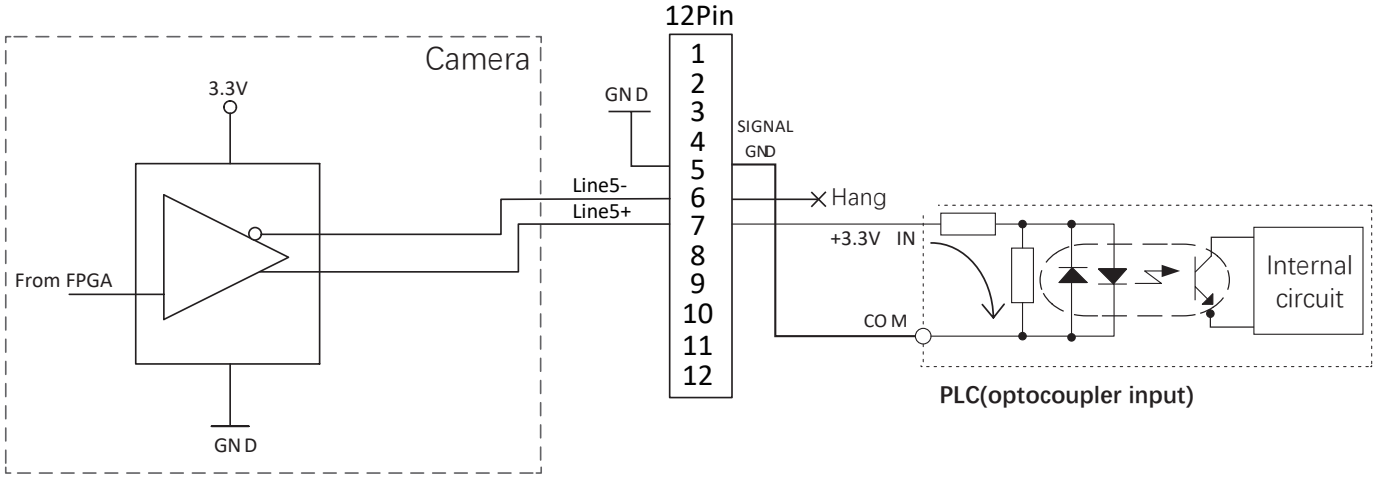
Only 3.3 V can be output even when an external pull-up adapter provides a voltage higher than 3.3 V. If an output voltage exceeding 3.3 V is required, a GPIO port is necessary.

Connection for typical application of single-end output



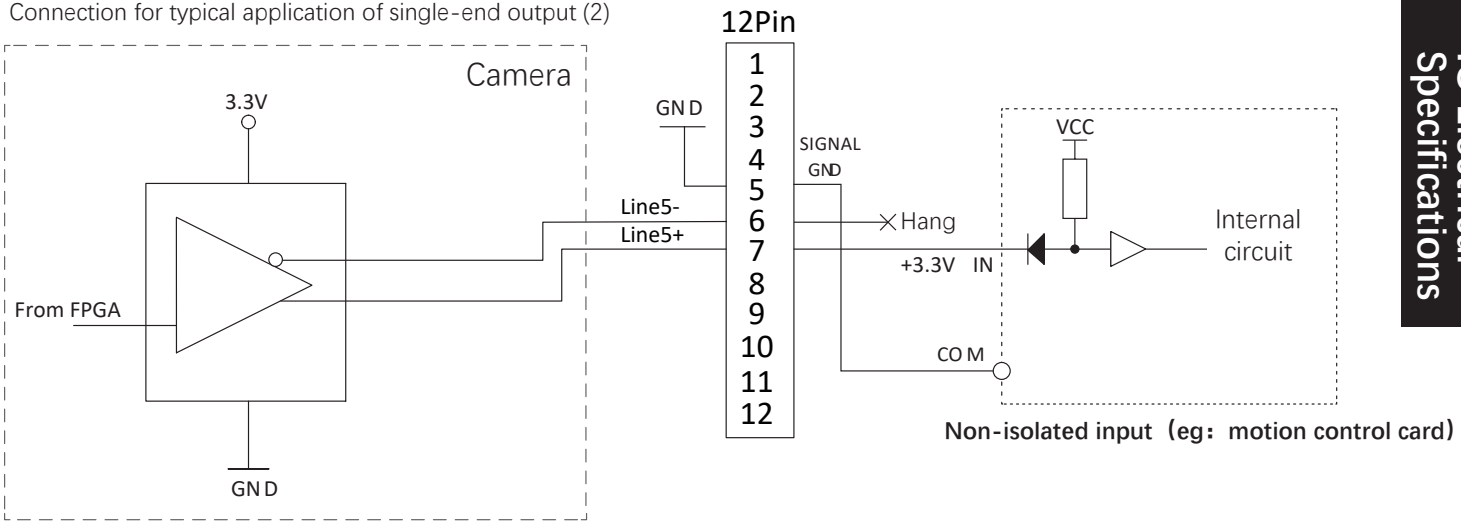
The following typical applications support 3.3 V input on the input side. When higher supply voltage is required on the input side, a GPIO port must be used.

Connection for typical application of single-end output (1)

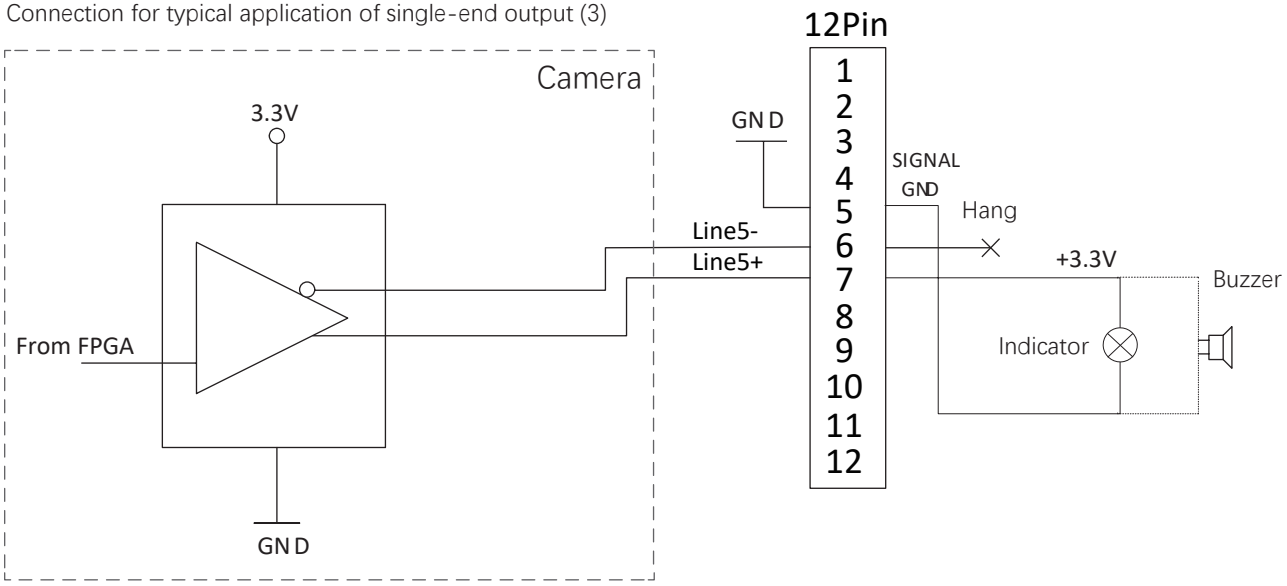


CMOSIS 8K Ethernet Port IO Electrical Specifications

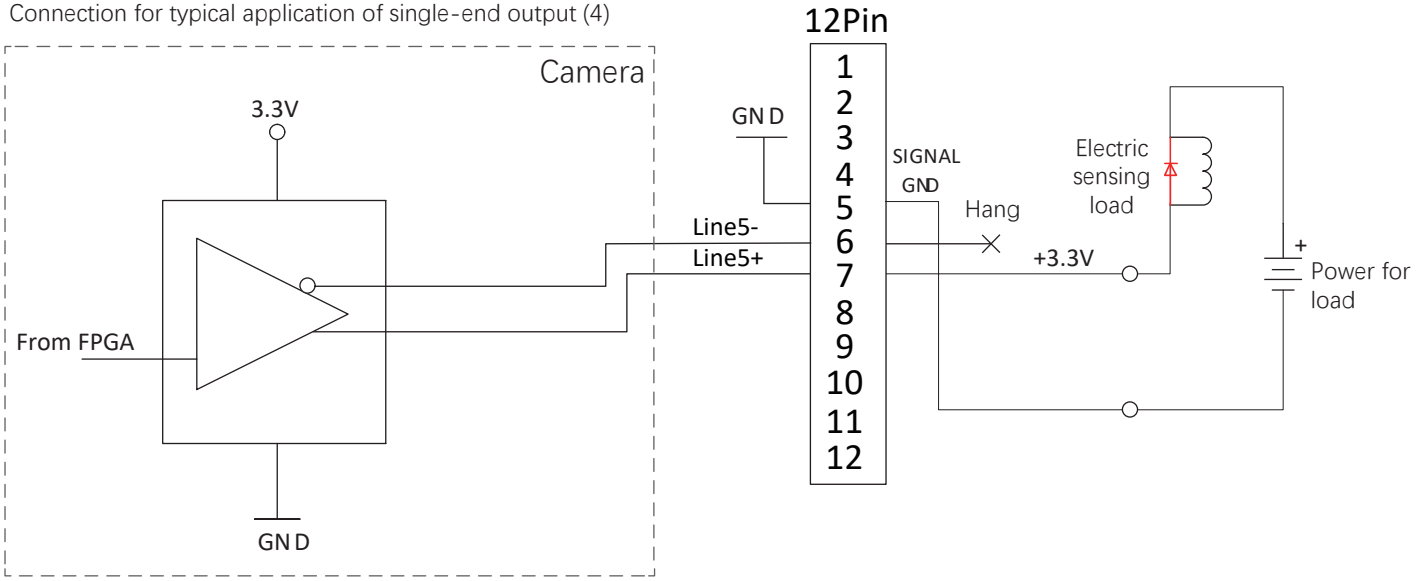
Connection for typical application of single-end output (2)



Connection for typical application of single-end output (3)



Connection for typical application of single-end output (4)



If the output of the camera is connected to an inductive load such as an intermediate relay, the model with a built-in fly-wheel diode must be used (or an external fly-wheel diode, such as 1N4007); otherwise, this may lead to the damage of the output port due to instantaneous overvoltage.

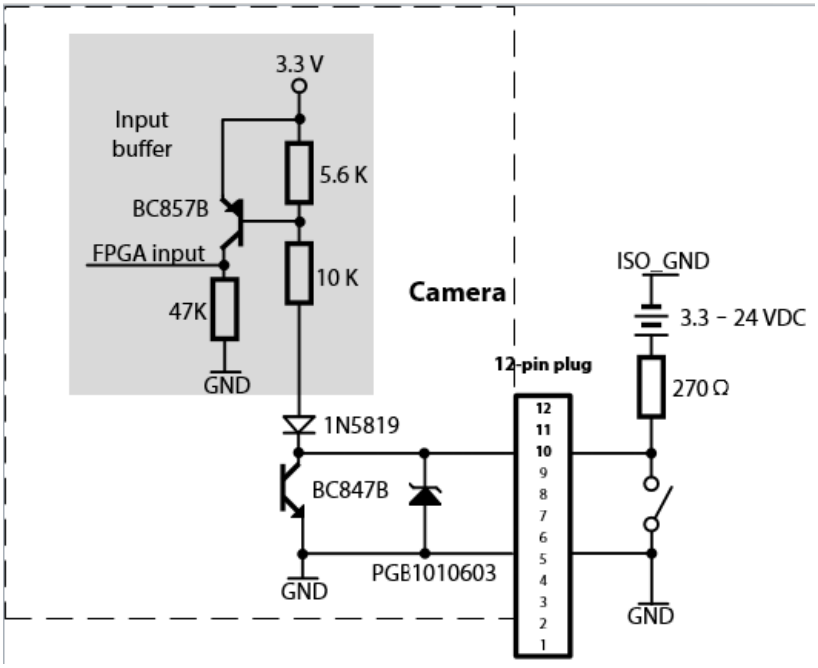
CMOSIS 8K Ethernet Port IO Electrical Specifications

GPIO input

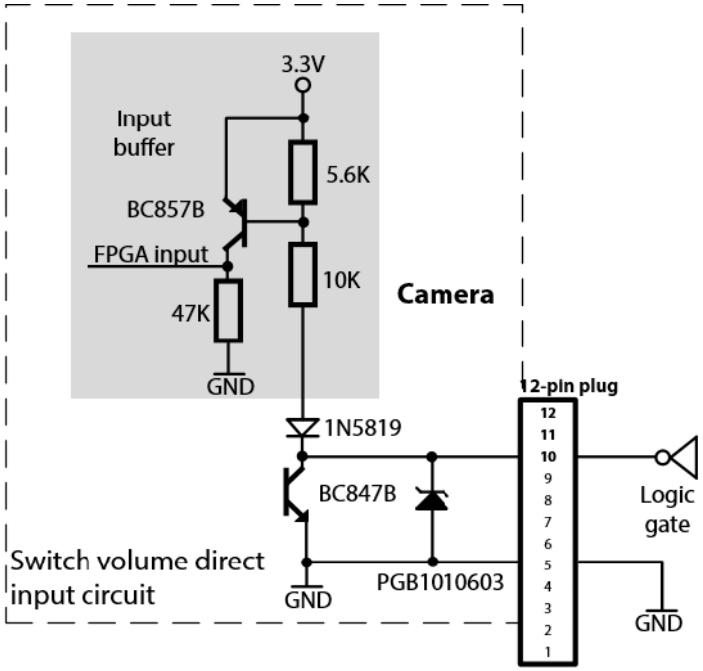
Voltage	Description
+30.0VDC	Max. voltage. Input voltage cannot exceed the value. Otherwise, the device might be damaged.
+0~+5.0VDC	Safe range of operating voltage input (min. 3.3 VDC when an external pull-up adapter exists).
+0~+0.8VDC	Logic 0
>+0.8~+2.0VDC	The input status reverses, and the logic status inside the voltage range is unsure.
>2.0VDC	Logic 1

The external circuit must be able to input up to 2 mA sink current with voltage less than 0.8 VDC. The sink current must not be greater than 100 μA at high level input.

Connection for GPIO input



5 V TTL logic level input



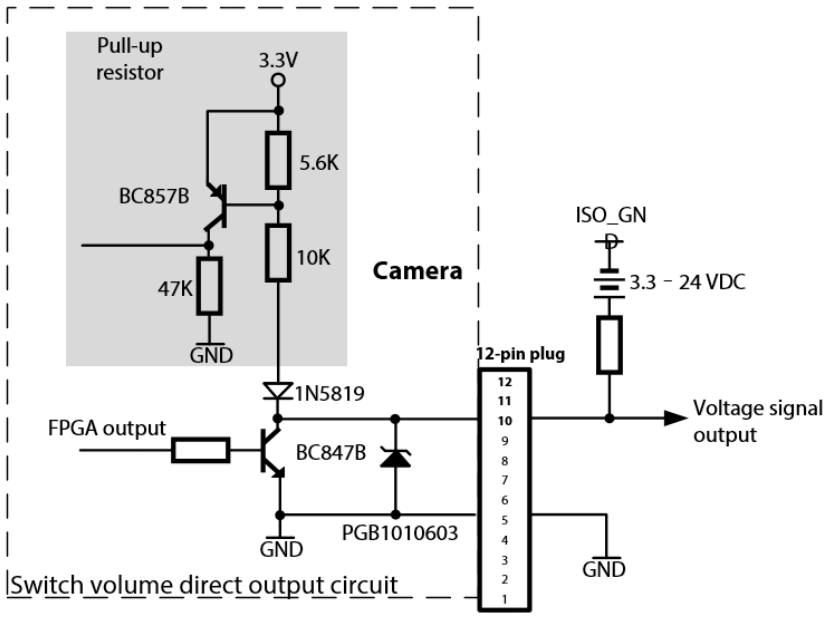
CMOSIS 8K Ethernet Port IO Electrical Specifications

GPIO output:

Voltage	Description
+30.0VDC	Max. voltage. Output voltage cannot exceed the value. Otherwise, the device might be damaged.
+3.3~+24VDC	The security working voltage range when output.
< 3.3 VDC	Possible error on I/O output.

Up to 50 mA sink current when the IO port is used as output.

Connection for GPIO output :



CMOSIS 4K Ethernet Port IO Electrical Specifications

Parameter	Descriptions
Data output port	Fast Ethernet (100 Mbit/s) or Gigabit Ethernet (1000 Mbit/s)
Sync mode	Hardware triggered, software triggered, or free run
Exposure control	Hardware triggered or triggered by camera APIs
Power supply specification	9–24 VDC, < 1% texture ripple, powered by the Hirose 12-pin connector [1] of the camera. The cable must be at least 26 AWG.
I/O lines	● 2 differential inputs ● 1 differential output ● 2 high-speed opto-isolated single-end inputs ● 1 GPIO port, which can be configured as input or output
Weight	About 230 g
Lens Mount	M42 Mount。
EMS standard	● ESD (GBT17626.2/IEC61000-4-2): 6 KV for contacting with a metal surface ● Surge (IEC61000-4-5): 2 KV in common mode/1 KV in differential mode through the Ethernet port (10/700 μs) ● Power port: 500 V in common mode (1.2/50 μs)
EMC standard	Class A。

[1]: The power supply must meet SELV and LPS specifications. Be aware of the difference from the 6-pin and 12-pin camera variants.

Pin	Signal	Function	Remarks	Suggestion
Black	1	Power GND	Camera power supply (signal ground)	Camera power supply ground (0 V)
Red	2	Camera Power	Camera power	Camera power VCC
Brown	3	IN Line5+	Input Line5+	Connects the encoder (line trigger)
Orange	4	IN Line5-	Input Line5-	
Yellow	5	OPT GND	Optocoupler isolated ground	-
Green	6	OPT IN Line1	Optocoupler input 1	Connects the photoelectric switch (frame trigger)
Blue	7	OPT IN Line2	Optocoupler input 2	
Purple	8	GPIO Line4	Bidirectional GPIO Line4	-
Gray	9	OUT Line6+	Output Line6+	Reserved
White	10	OUT Line6-	Output Line6-	
Pink	11	IN Line3+	Input Line3+	Connects the encoder (line trigger)
Light green	12	IN Line3-	Input Line3-	

An output signal pin not in use must be hanged. Connect an unused input pin to GND (recommended) or leave it hanging, instead of connecting it to the power supply to avoid camera damage.

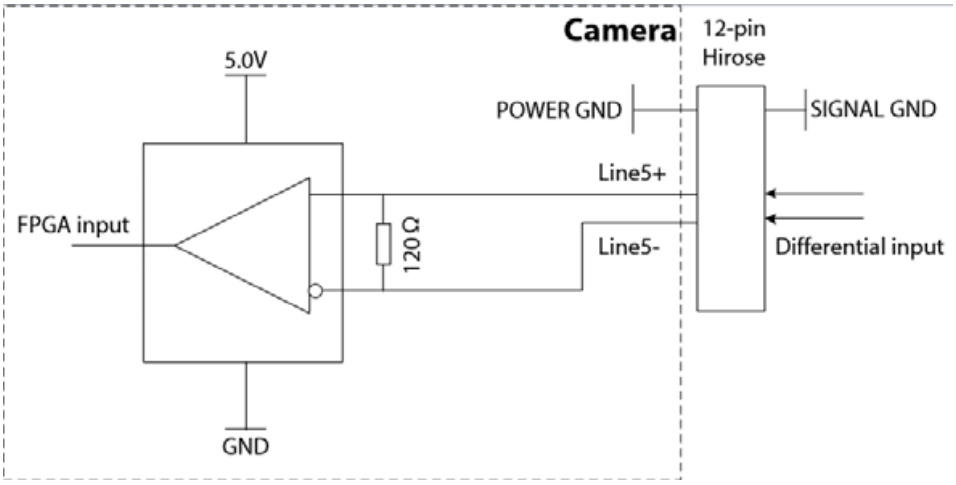
CMOSIS 4K Ethernet Port IO Electrical Specifications

Differential input

Input voltage		Description
Vcm	±13 V	Input common-mode voltage range
VID	+200mV	Input differential voltage (A-B). It represents logic 1 when the voltage exceeds the value.
	-200mV ~ +200mV	The input status reverses, and the logic status inside the voltage range is unsure.
	-200mV	Input differential voltage (A-B). It represents logic 0 when the voltage is lower than this value.

There are 2 differential inputs, Line5 and Line3, which can be configured as differential encoder phase A or B on the software respectively.
To ensure good quality of the common-mode signal, connect the input to the signal ground when using. At the same time, for the trigger signal with high common mode voltage input, we recommend you connect the trigger signal to the high-speed opto-isolated input.

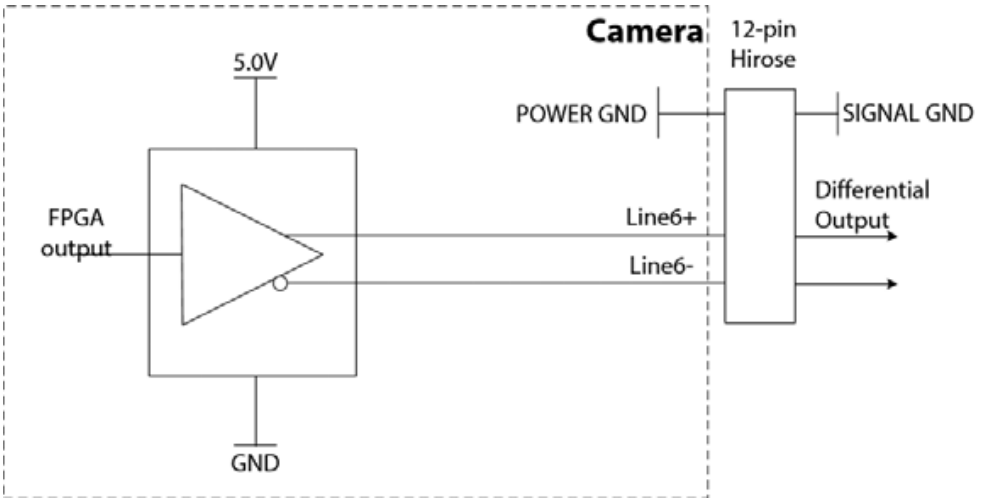
Connection of differential input:



Differential output

Output voltage		Description
Voc	+3.3 V	Max. common-mode output voltage
VOD	+200mV	Differential output voltage (A-B). It represents logic 1 when the value is exceeded
	-200mV ~ +200mV	The output status reverses, and the logic status inside the voltage range is unsure.
	-200mV	Differential output voltage (A-B). It represents logic 0 when the value is not exceeded.

Connection of differential output



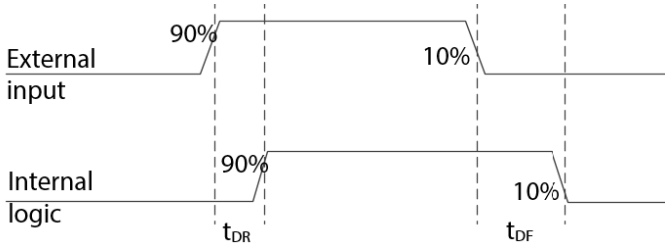
CMOSIS 4K Ethernet Port IO Electrical Specifications

High-speed opto-isolated input

Input voltage	Description
+26.0 VDC	Max. voltage input, which must be not exceeded. Otherwise, the device might be damaged.
0–24 VDC	Safe operating voltage input range
0–1.4 VDC	Logic 0
>1.4–2.2 VDC	The input status reverses, and the logic status inside the voltage range is unsure.
>+2.2 VDC	Logic 1

- The max. sink current for the opto-isolated input is 20 mA.
- The values above are typical values measured at an ambient temperature of 25 ° C, and there are differences between cameras.

Relationship between the input signal amplitude and trigger delay：

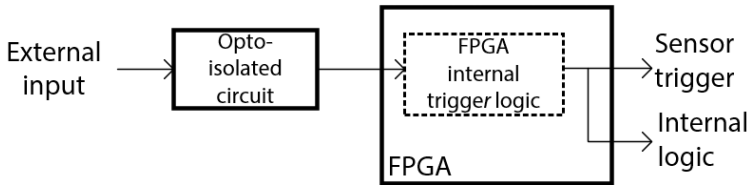


Relationship between the input signal amplitude and trigger delay:

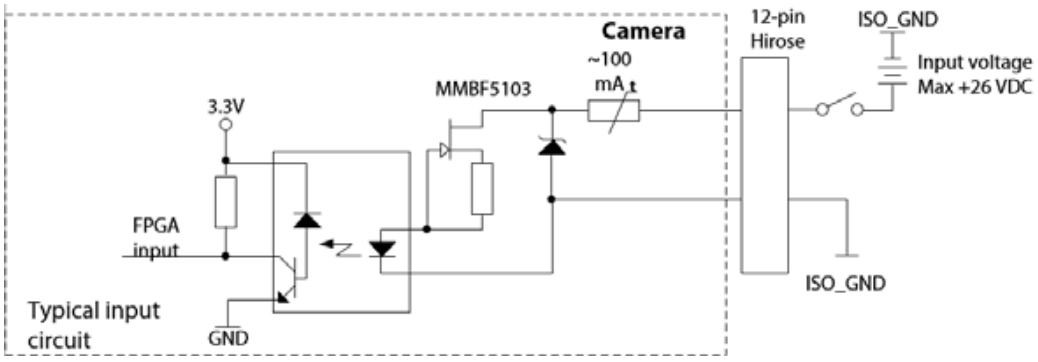
Input signal amplitude (Vp-p)	Rising edge trigger delay tDR (ns)	Falling edge trigger delay tDF（ns）
5.00	0.036	0.19

- The trigger delay refers to the delay from the external opto-isolated input to FPGA pin input, without taking into account the internal logic delay of FPGA.
- The values above are measured when the environment temperature is 25° C.

Trigger delay：

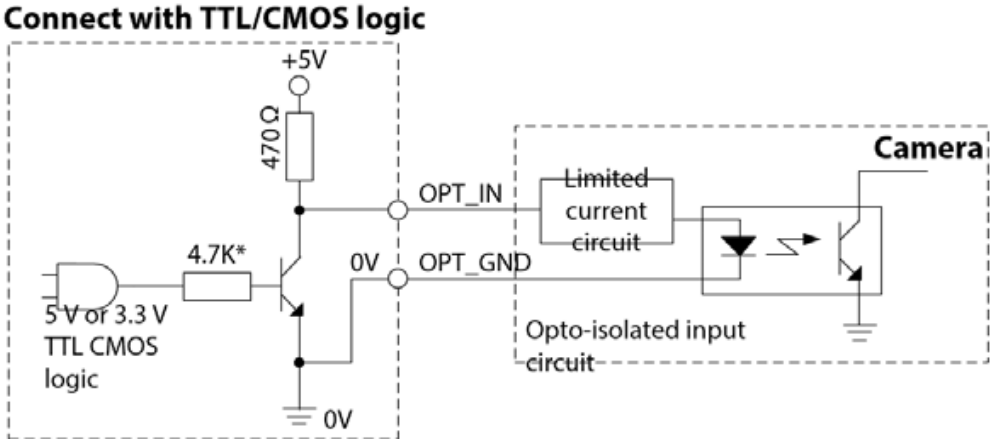


Connection of high-speed opto-isolated input:

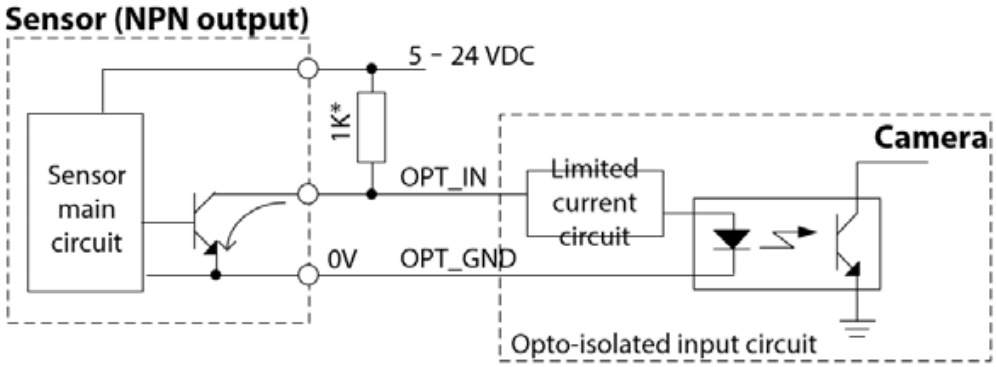


CMOSIS 4K Ethernet Port IO Electrical Specifications

Typical application of opto-isolated input (1) :

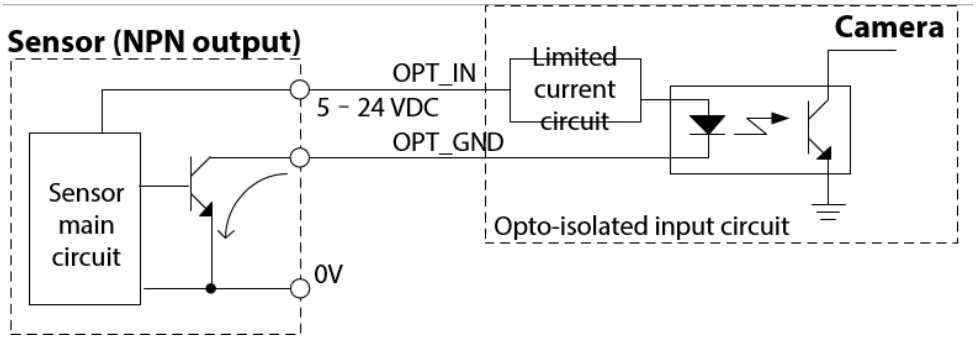


Typical application of opto-isolated input (2) :

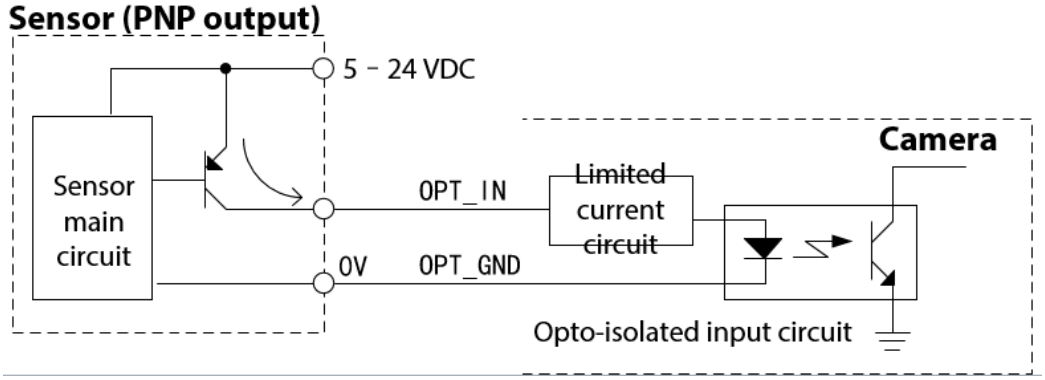


For this connection, a pull-up resistor needs to be installed from the sensor output to the power. Select a proper resistance value to ensure that the high and low levels meet the input requirements of the camera opto-isolated port

Typical application of opto-isolated input (3) :



Typical application of opto-isolated input (4) :



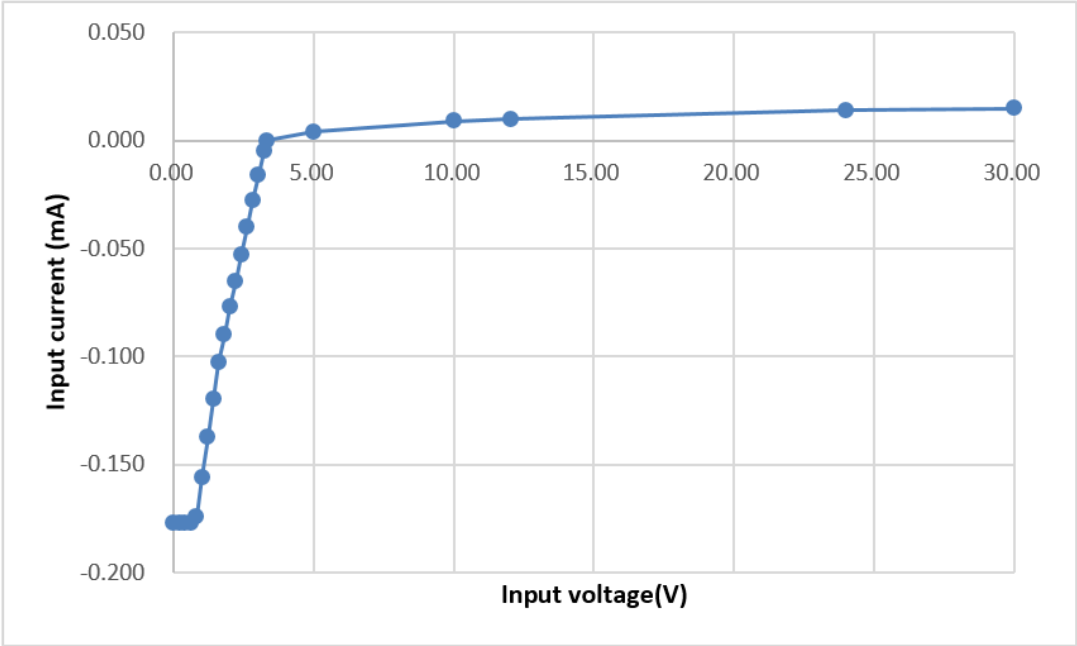
CMOSIS 4K Ethernet Port IO Electrical Specifications

GPIO input

Voltage	Description
+26.0 VDC	Max. voltage input, which must be not exceeded. Otherwise, the device might be damaged.
0–24.0 VDC	Safe operating voltage input range (min. 3.3 VDC when an external pull-up adapter exists)
0–0.8 VDC	Logic 0
>0.8–2.0 VDC	The input status reverses, and the logic status inside the voltage range is unsure.
>2.0 VDC	Logic 1

When GPIO is used as an input port, the sink current from an external circuit must not be lower than 2 mA at low input level. In this case, the voltage must not be greater than 0.8 VDC. The sink current must not be greater than 100 µA at high input level.

Relationship between sink current and input voltage of GPIO_IN :



- The max. input sink current of GPIO is 15 µA.
- The values above are measured when the environment temperature is 25° C.

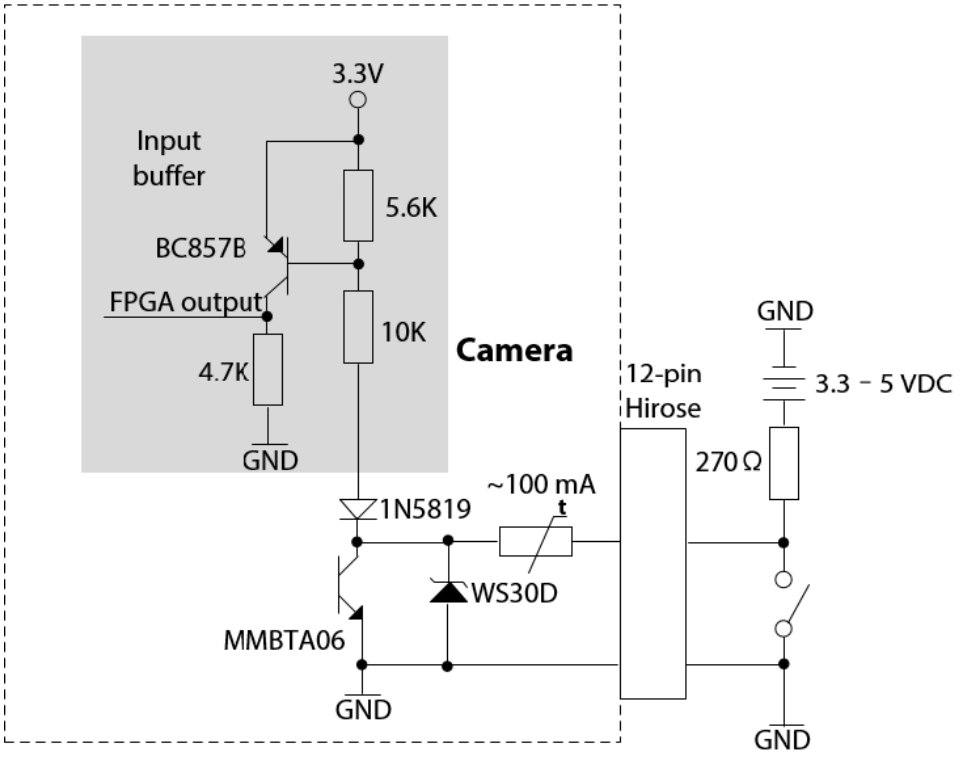
Relationship between the input signal amplitude and trigger delay:

Input signal amplitude (Vp-p)	Rising edge trigger delay tDR (ns)	Falling edge trigger delay tDF (ns)
3.00	6.783	0.339
5.00	6.563	0.200
9.00	6.164	0.106
10.00	6.416	0.960

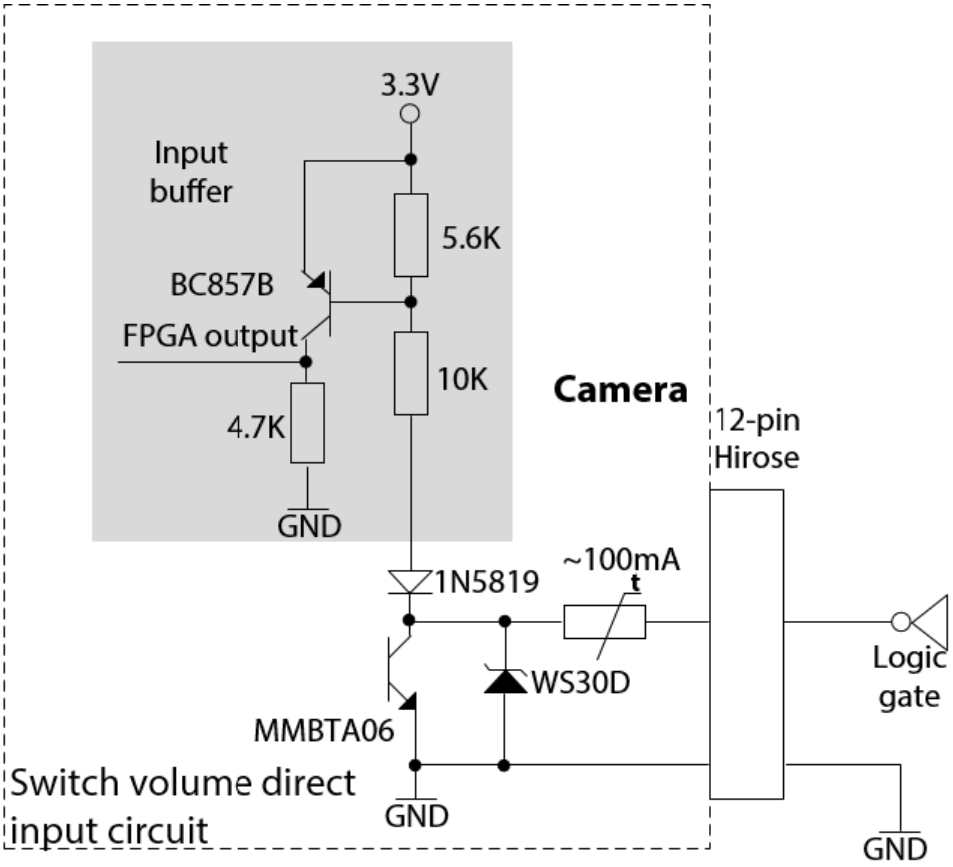
- The trigger delay refers to the delay from the external opto-isolated input to FPGA pin input, without taking into account the internal logic delay of FPGA.
- The GPIO input port supports the shortest input positive pulse of 20 µs (typical value) and the shortest input negative pulse of 2 µs (typical value).

CMOSIS 4K Ethernet Port IO Electrical Specifications

Connection for GPIO input:



5 V TTL logic level input:



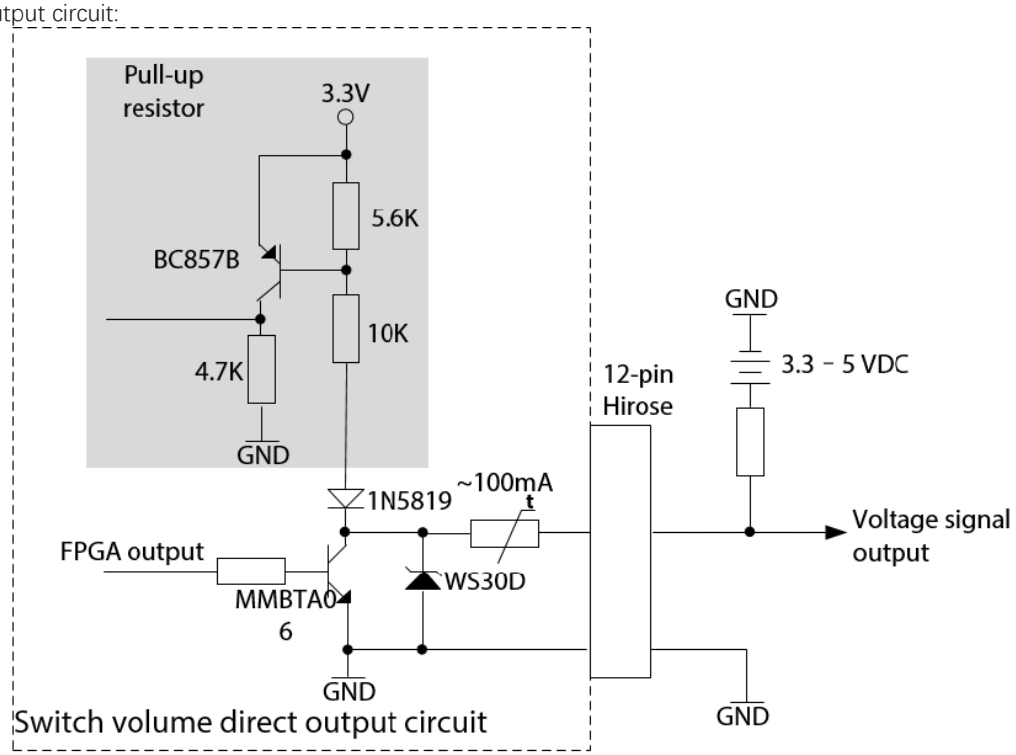
CMOSIS 4K Ethernet Port IO Electrical Specifications

GPIO output

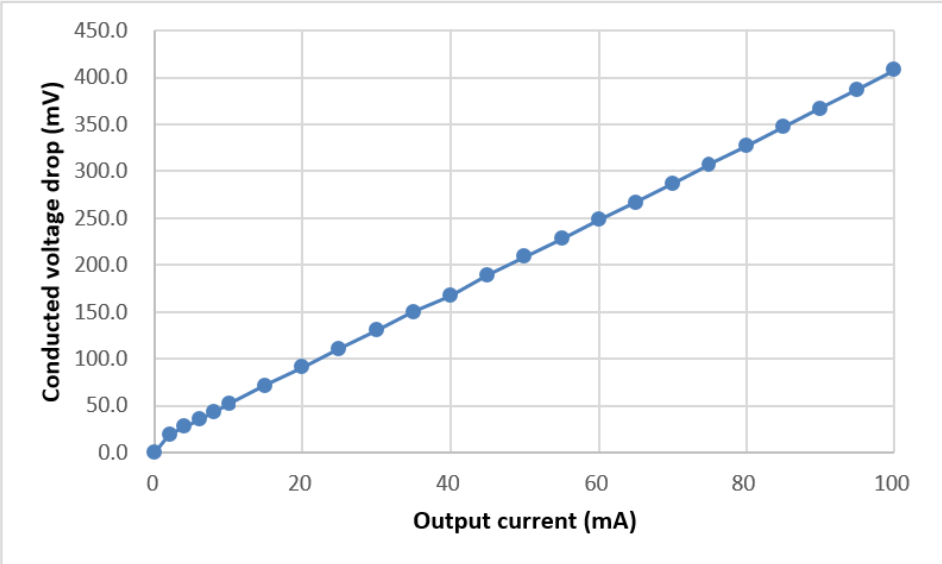
Voltage	Description
+30.0 VDC	Max. voltage. Output voltage cannot exceed the value. Otherwise, the device might be damaged.
3.3–24 VDC	Safe operating voltage output range
< 3.3 VDC	I/O output might be incorrect

Up to 100 mA sink current when the IO port is used as output.

On/off direct output circuit:



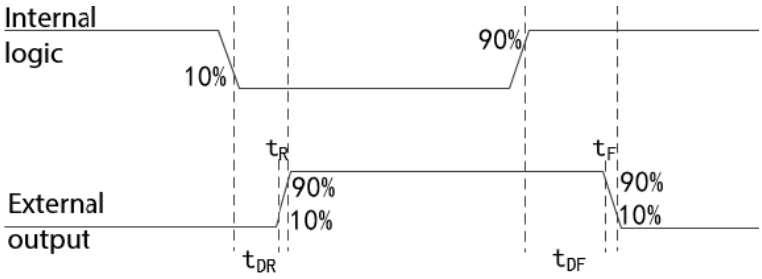
Relationship between the GPIO output voltage drop (voltage drop between GPIO and GND) and output current (current flowing into GPIO pin) :



- The max. voltage drop at GPIO output port is about 0.41 V (measured at the max. output current of 100 mA).
- The values above are typical values measured at an ambient temperature of 25 ° C, and there are differences between cameras.

CMOSIS 4K Ethernet Port IO Electrical Specifications

Delay time：



The following table describes the rising and falling time, and delay time of rising and falling edge when using a 470 Ω pull-up resistor.

External power supply voltage (V)	Rising time tR（ns）	Falling time tF（ns）	Rising edge trigger delay tDR（ns）	Falling edge trigger delay tDF（ns）
-	-		5.43	0.35
5	0.16	0.02	1.80	39
12	0.22	0.04	2.37	71

- The output delay refers to the delay from the FPGA pin output to GPIO pin, without taking into account the internal logic delay of FPGA.
- When no external pull-up resistor exists, the shortest output positive pulse is 11 μs and the shortest output negative pulse is 1 μs.

GPixel 4K Ethernet Port IO Electrical Specifications

Parameter	Description
Data output port	Fast Ethernet (100 Mbit/s) or Gigabit Ethernet (1000 Mbit/s)
Sync mode	Hardware triggered, software triggered, or free run
Exposure control	Hardware triggered or triggered by camera APIs
Power supply specification	9–24 VDC, < 1% texture ripple, powered by the Hirose 12-pin connector of the camera. The cable must be at least 26 AWG.
I/O lines	● 3 differential inputs (among them, Line1/2 can be configured as differential or single-end input, and Line3 can only be configured as differential input). ● 1 differential output (Line3 can be configured as differential input or output). ● 1 high-speed opto-isolated single-end input (Line5, isolated input). ● 1 GPIO (Line4 can be configured as input or output)
Weight	About 230 g
Lens Mount	M42 Mount。
EMS standard	● ESD (GBT17626.2/IEC61000-4-2): 6 KV for contacting with a metal surface ● Surge (IEC61000-4-5): 2 KV in common mode/1 KV in differential mode through the Ethernet port (10/700 μs) ● Power port: 500 V in common mode (1.2/50 μs)
EMC standard	Class A。

Pin	Signal	Function	Remarks	Suggestion
Black	1	Power GND	Camera power ground	Camera power supply ground (0 V)
Red	2	Camera Power	Camera power	Camera power VCC
Brown	3	IN Line1+	Input Line1+	Connects the encoder (line trigger)
Orange	4	IN Line1-	Input Line1-	
Yellow	5	Signal GND	Signal ground (SGND)	Signal ground
Green	6	IN Line2+	Input Line2+	Connects the encoder (line trigger)
Blue	7	IN Line2-	Input Line2-	
Purple	8	IN Line4	Bidirectional GPIO Line4	-
Gray	9	IN/OUT Line3+	Input/output Line3+	
White	10	IN/OUT Line3-	Input/output Line3-	
Pink	11	OPT_IN Line5	Optocoupler input Line5	Connects the photoelectric switch (frame trigger)
Light green	12	OPT GND	Optocoupler isolated ground	-

An output signal pin not in use must be hanged. Connect an unused input pin to Signal ground (recommended) or leave it hanging, instead of connecting it to the power supply to avoid camera damage.

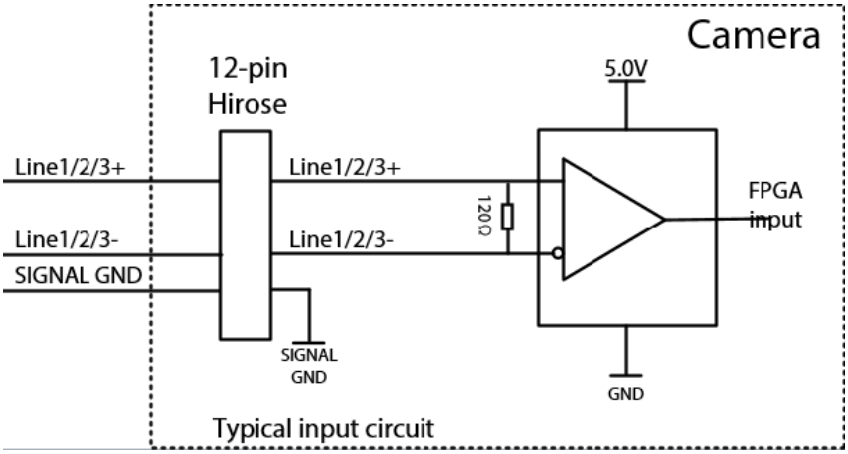
GPixel 4K Ethernet Port IO Electrical Specifications

Differential input

Input voltage		Description
Vcm	±25.0 V	Input common-mode voltage range
VID	+200mV	Input differential voltage (A-B). It represents logic 1 when the value is exceeded.
	-200mV ~ +200mV	The input status reverses, and the logic status inside the voltage range is unsure.
	-200mV	Input differential voltage (A-B). It represents logic 0 when the value is not exceeded.

- There are 2 differential inputs, i.e. Line1/Line2/Line3, which can be configured as differential encoder phase A or B by software, respectively, among which Line1/Line2 can only be configured as trigger input, while Line3 can not only be configured as input but also output.
- When Line1/Line2/Line3 is configured as input, the terminal resistor is disabled by default. Instead, it is enabled when the RS422 mode is selected. To ensure good quality of the common-mode signal, connect the input to the signal ground when using.

Connection of differential input：



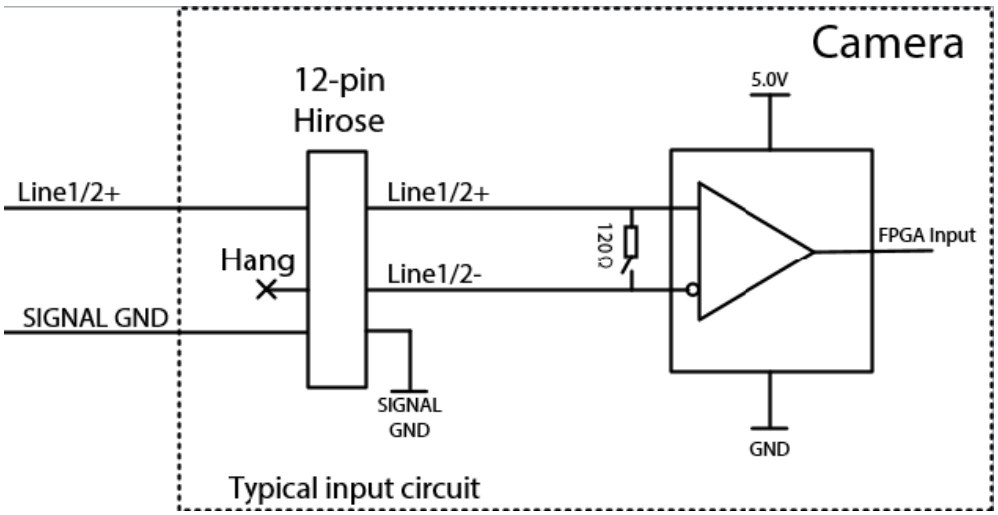
Single-end input:

+ input voltage	- reference voltage	Description
0–24.0 V	-	Safe operating voltage input range
< 2.23 V	0 V	Do not meet the min. level for trigger logic
3.3 V TTL input	1.5 V	Determining level for high and low conversion
5 V TTL input	2.5 V	
12 V	5 V	
24 V	8.4 V	
25 V	-	Max. voltage input, which must be not exceeded. Otherwise, the device might be damaged.

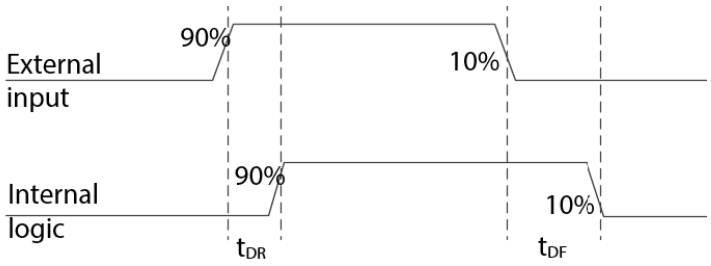
For GPixel 4K line scan cameras, only Line1/Line2 can be configured as single-end input, and Line3 can only be configured as differential input or output. For single-end input, the trigger level must not be lower than 2.32 V and the shortest trigger pulse must not be lower than 50 ns. Otherwise, the trigger might fail.

GPixel 4K Ethernet Port IO Electrical Specifications

Typical input circuit：



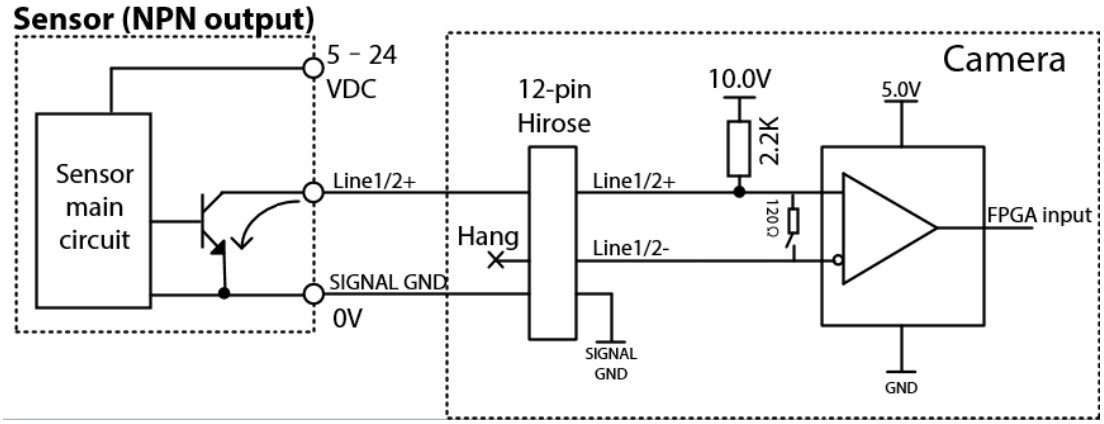
Output delay time:



Output delay time:

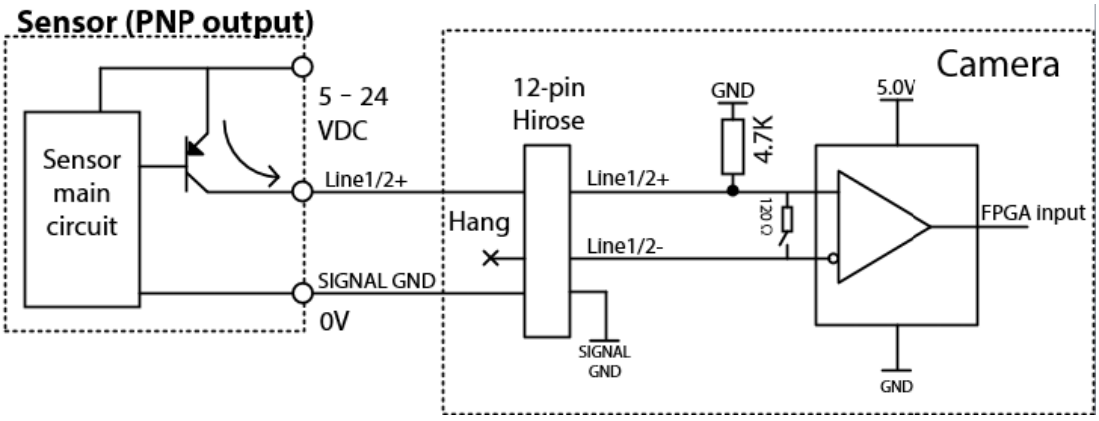
External power supply voltage (V)	Rising time tR（ns）	Falling time tF（ns）	Rising edge trigger delay tDR（ns）	Falling edge trigger tDF（ns）
3.3	< 3.4	< 4	< 15	< 34.5
5				< 31
12			< 13	< 41.2

Connection of typical application when differential mode is configured as single-end input (1):

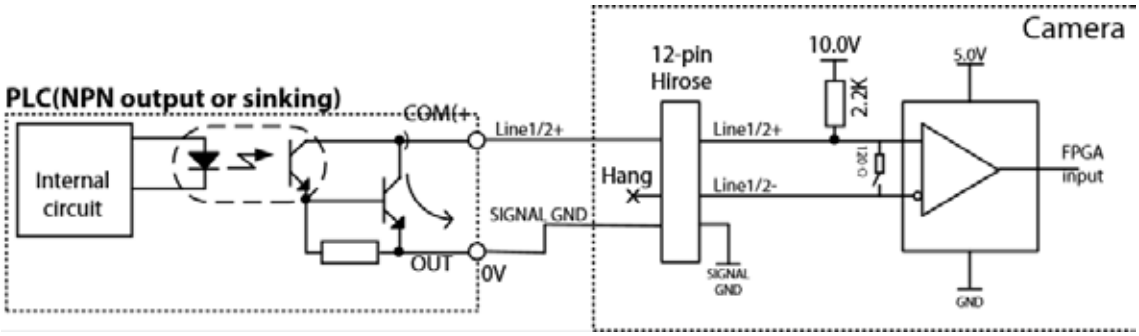


GPixel 4K Ethernet Port IO Electrical Specifications

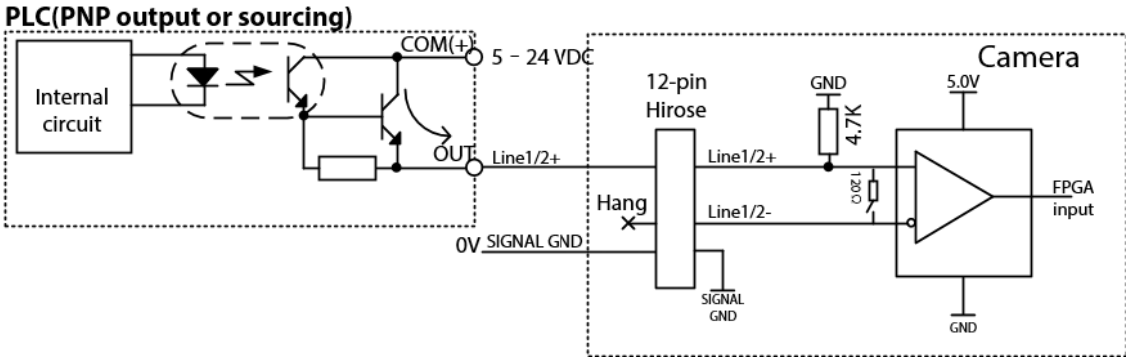
Connection of typical application when differential mode is configured as single-end input (2) :



Connection of typical application when differential mode is configured as single-end input (3) :



Connection of typical application when differential mode is configured as single-end input (4) :



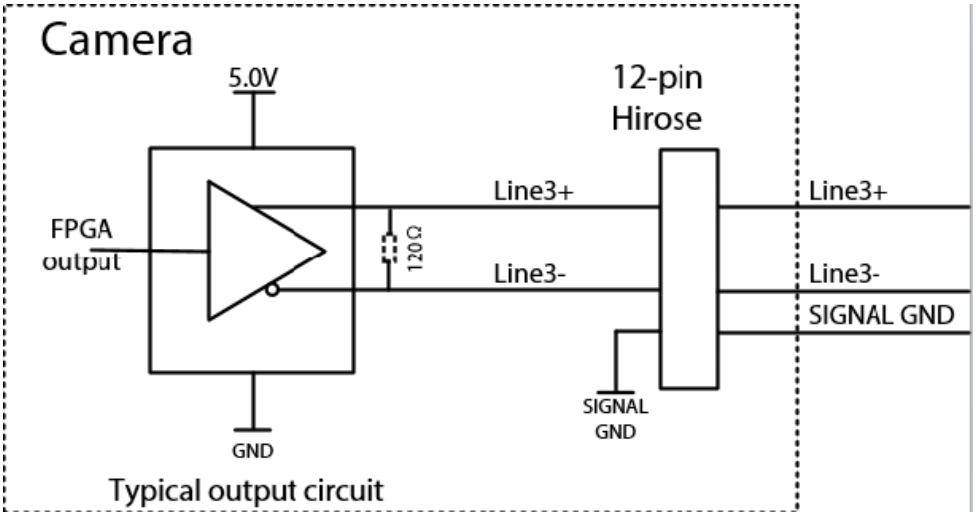
GPixel 4K Ethernet Port IO Electrical Specifications

Differential output

Output voltage		Description
Voc	+3.3 V	Max. output voltage
VOD	+200mV	Differential output voltage (A-B). It represents logic 1 when the value is exceeded.
	-200mV ~ +200mV	The output status reverses, and the logic status inside the voltage range is unsure.
	-200mV	Differential output voltage (A-B). It represents logic 0 when the value is not exceeded

For GPixel 4K line scan cameras, the differential output contains only Line3.

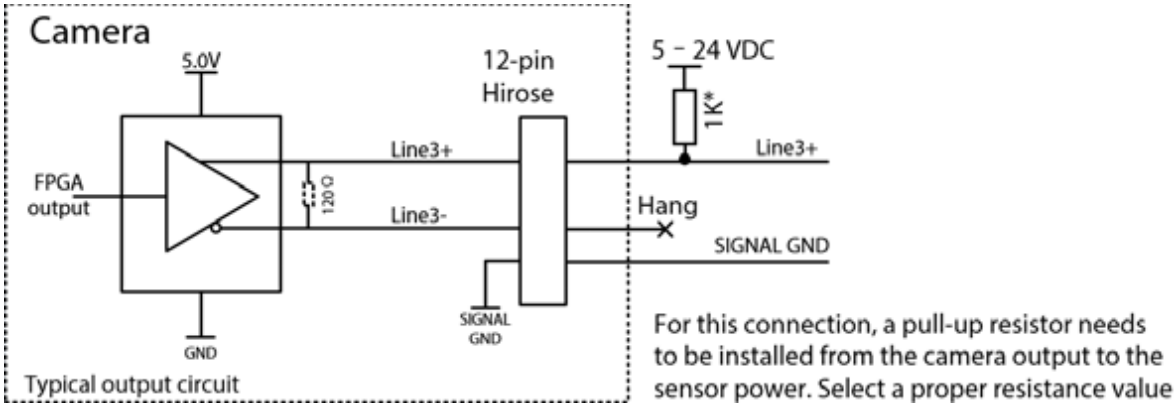
Connection of differential output:



Out delay when empty:

Rising time tR (ns)	Falling time tF (ns)	Rising edge trigger delay tDR (ns)	Falling edge trigger delay tDF (ns)
< 4.5	< 5.4	< 27.5	< 26.4

Special use of a differential output as a single-end output：

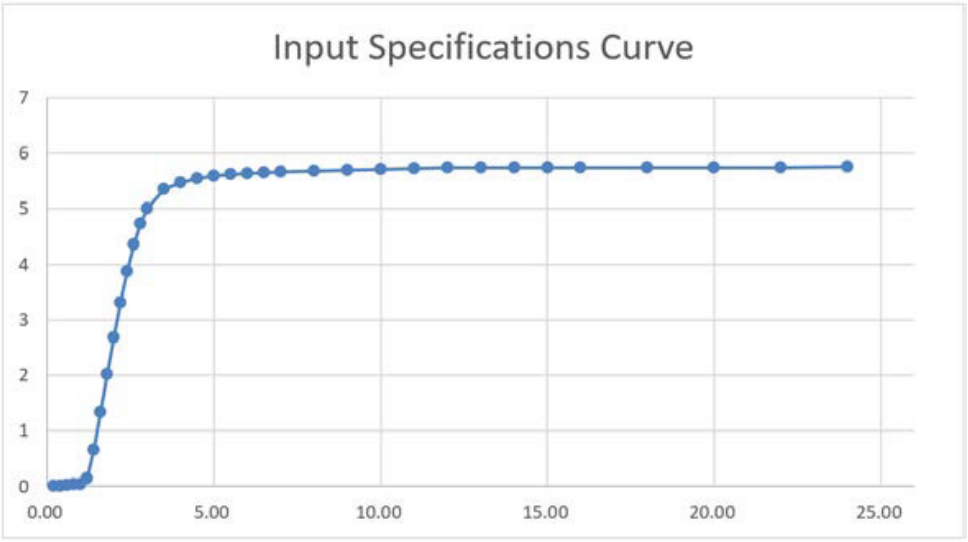


GPixel 4K Ethernet Port IO Electrical Specifications

Opto-isolated Input

Input voltage	Description
+26.0 VDC	Max. voltage input, which must be not exceeded. Otherwise, the device might be damaged.
0–24 VDC	Safe operating voltage input range
0–1.4 VDC	Logic 0
>1.4–2.2 VDC	The input status reverses, and the logic status inside the voltage range is unsure.
>+2.2 VDC	Logic 1

Relationship between sink current and input voltage of OPT_IN:



- The max. sink current for the opto-isolator input is 6 mA.
- The values above are typical values measured at an ambient temperature of 25 ° C, and there are differences between cameras.

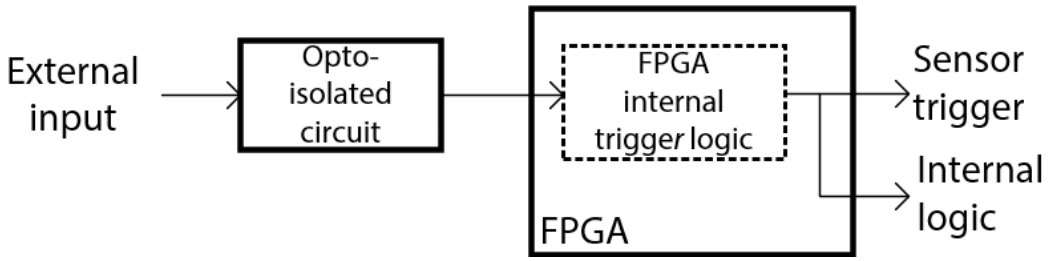
Relationship between the input signal amplitude and trigger delay:

Input signal amplitude (Vp-p)	Rising edge trigger delay tDR (ns)	Falling edge trigger delay tDF（ns）
3.00	28	90
5.00	14	94
9.00	4	94
10.00	4	98

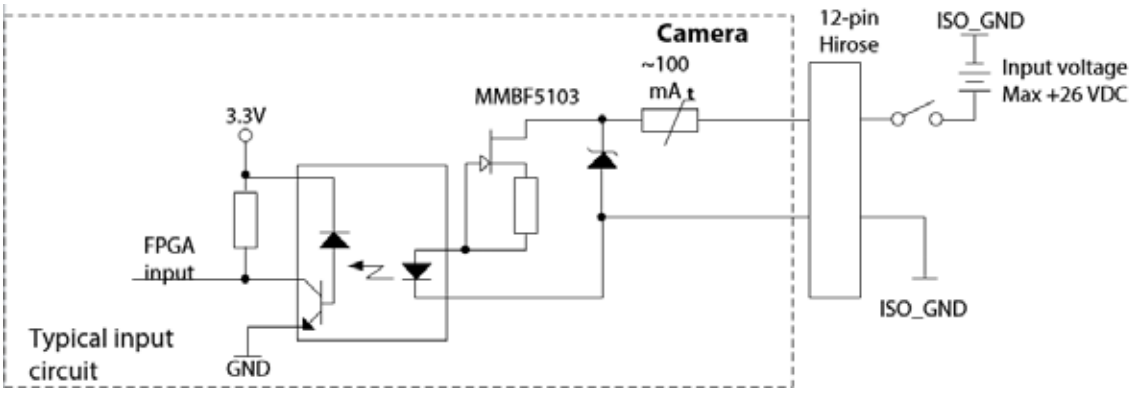
- The trigger delay refers to the delay from the external opto-isolated input to FPGA pin input, without taking into account the internal logic delay of FPGA.
- The values above are measured when the environment temperature is 25° C.

GPixel 4K Ethernet Port IO Electrical Specifications

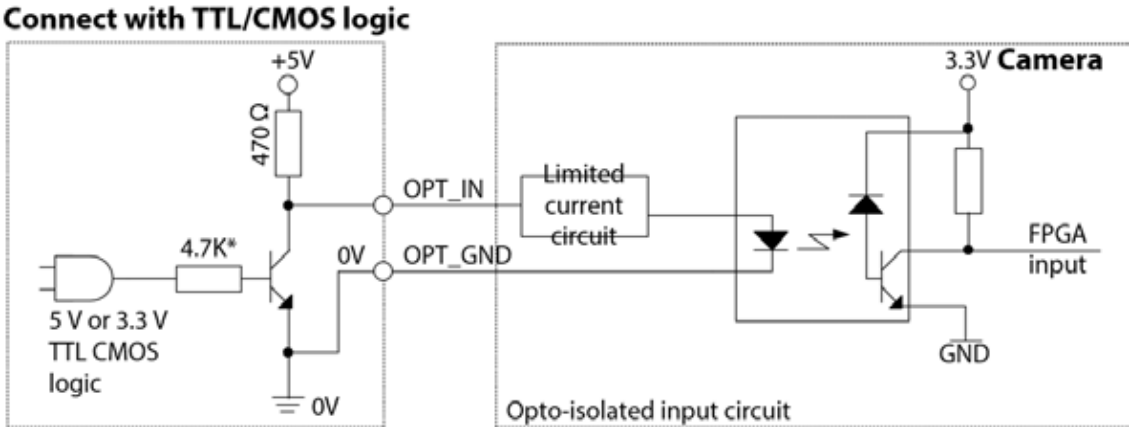
Opto-isolated trigger delay：



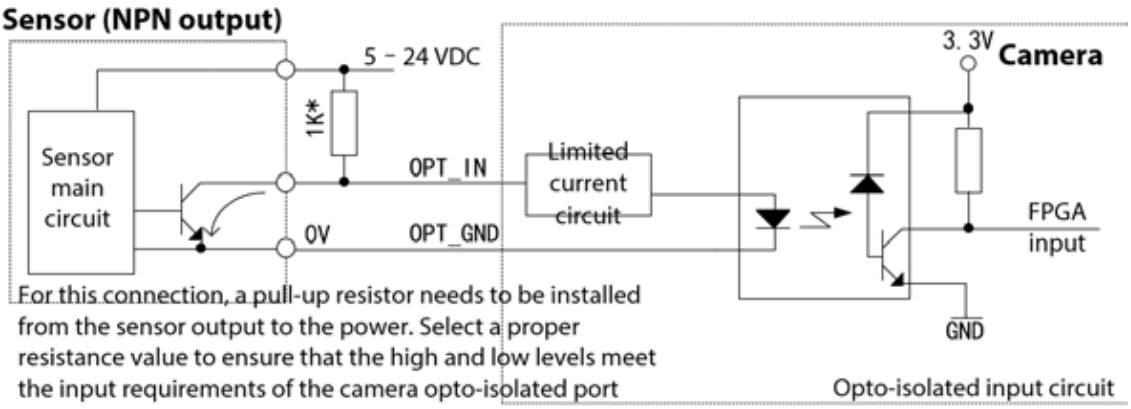
Typical input circuit：



Typical application of opto-isolated input (1)：

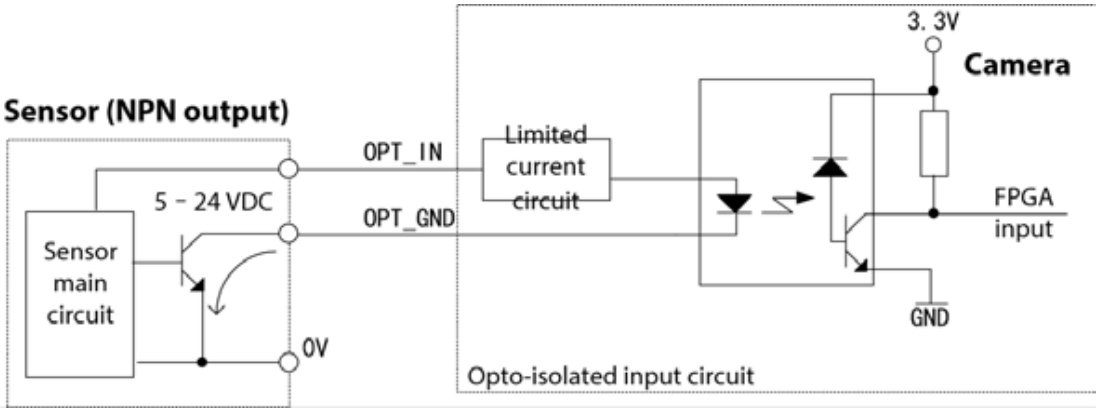


Typical application of opto-isolated input (2)：

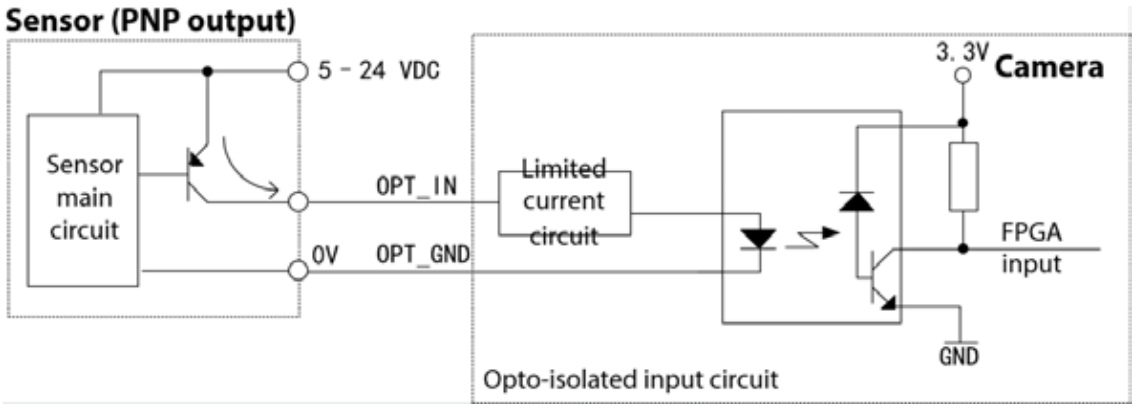


GPixel 4K Ethernet Port IO Electrical Specifications

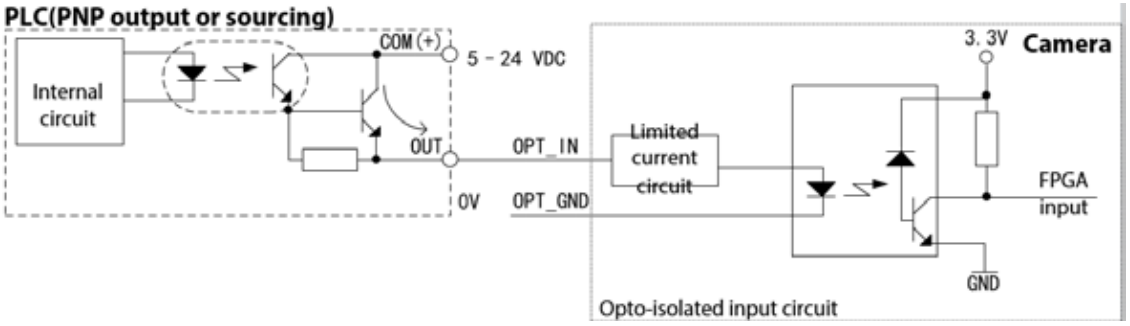
Typical application of opto-isolated input (3)：



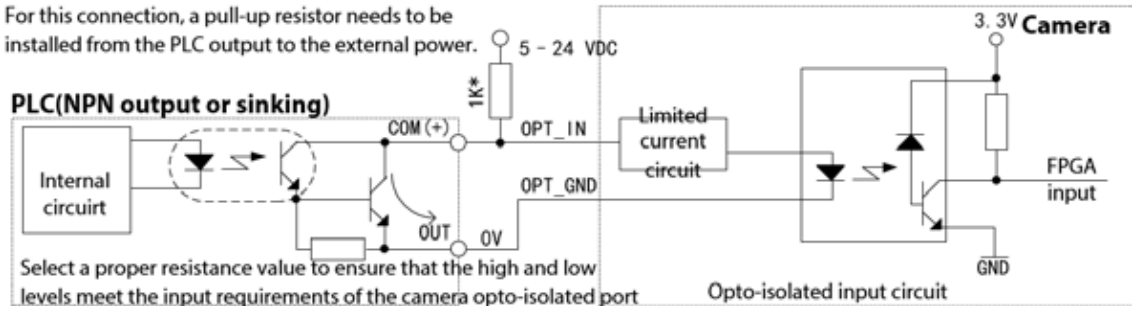
Typical application of opto-isolated input (4)：



Typical application of opto-isolated input (5)：



Typical application of opto-isolated input (6)：



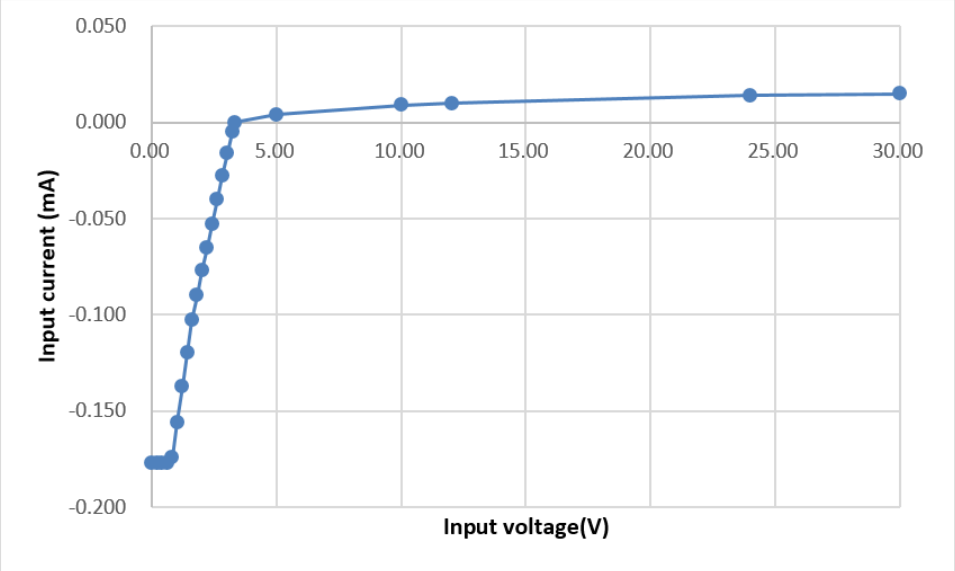
GPixel 4K Ethernet Port IO Electrical Specifications

GPIO input

Voltage	Description
+26.0 VDC	Max. voltage input, which must be not exceeded. Otherwise, the device might be damaged.
0–24 VDC	Safe operating voltage input range (min. 3.3 VDC when an external pull-up adapter exists)
0–0.8 VDC	Logic 0
>0.8–2.0 VDC	The input status reverses, and the logic status inside the voltage range is unsure.
>2.0 VDC	Logic 1

When GPIO is used as an input port, the sink current from an external circuit must not be lower than 2 mA at low input level. In this case, the voltage must not be greater than 0.8 VDC. The sink current must not be greater than 100 µA at high input level.

Relationship between sink current and input voltage of GPIO_IN：



- The max. input sink current of GPIO is 15 µA.
- The values mentioned above are measured when the environment temperature is 25° C.

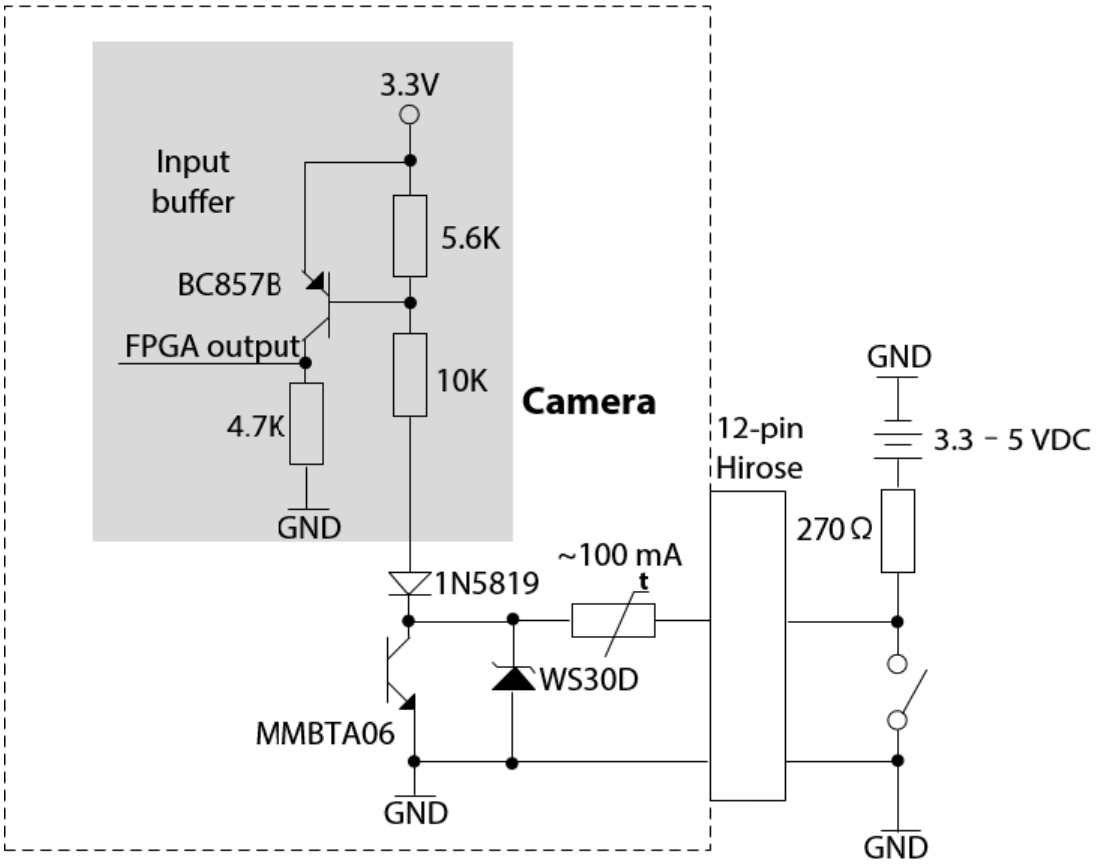
Relationship between the input signal amplitude and trigger delay:

Input signal amplitude (Vp-p)	Rising edge trigger delay tDR (ns)	Falling edge trigger delay tDF（ns)
3.00	6.783	0.339
5.00	6.563	0.200
9.00	6.164	0.106
10.00	6.416	0.960

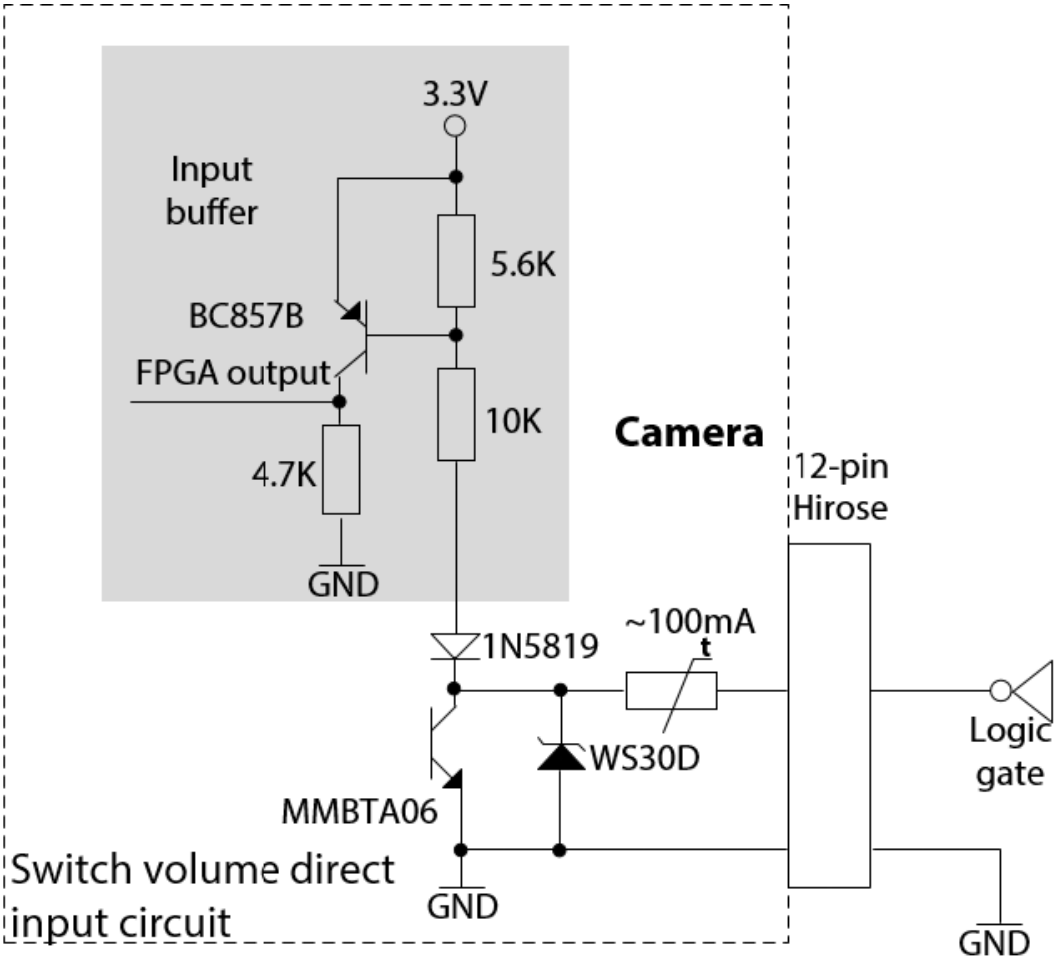
- The trigger delay refers to the delay from the external opto-isolated input to FPGA pin input, without taking into account the internal logic delay of FPGA.
- The GPIO input port supports the shortest input positive pulse of 20 µs (typical value) and the shortest input negative pulse of 2 µs (typical value).

GPixel 4K Ethernet Port IO Electrical Specifications

GPIO input:



5 V TTL logic level input:



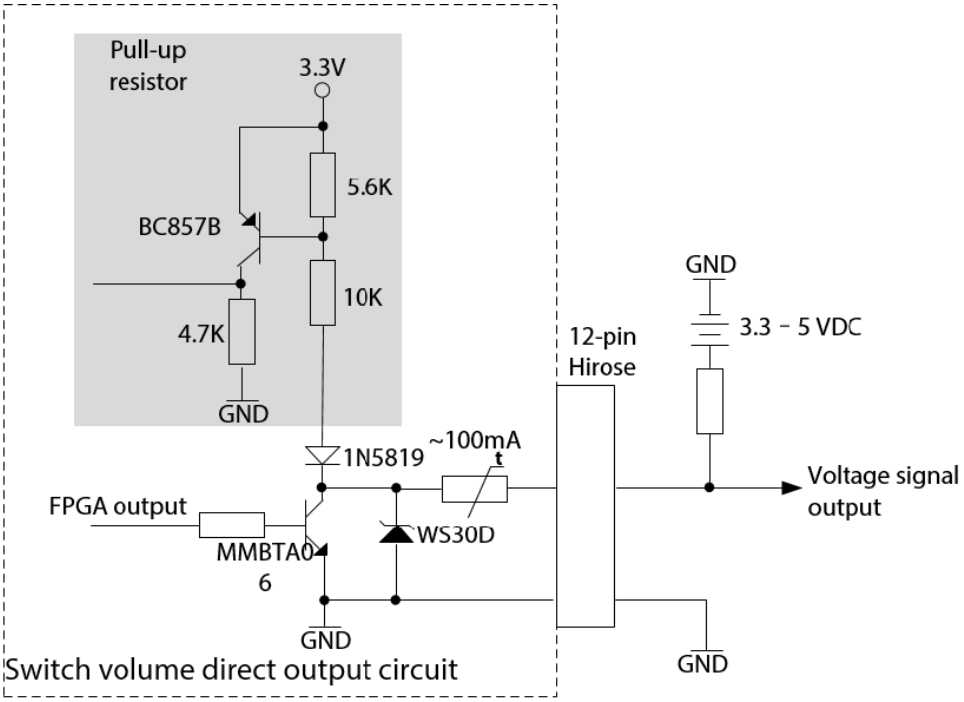
GPixel 4K Ethernet Port IO Electrical Specifications

GPIO output

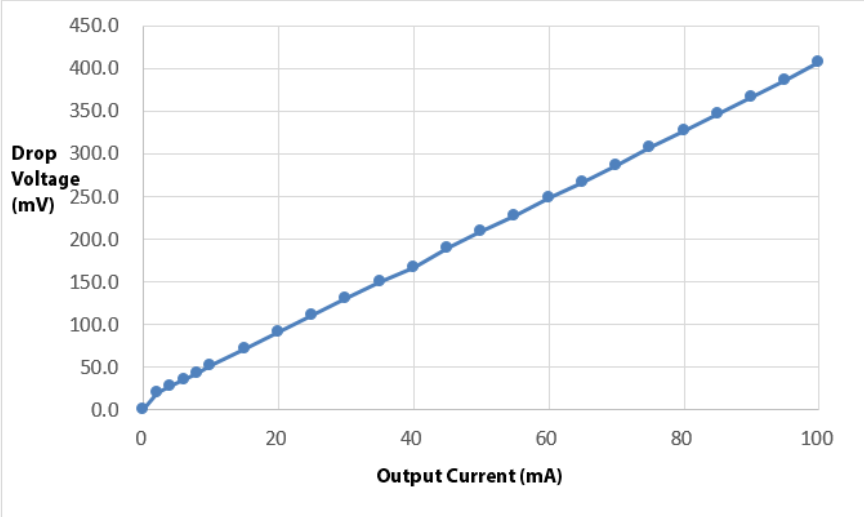
Voltage	Description
+30.0 VDC	Max. voltage. Output voltage cannot exceed the value. Otherwise, the device might be damaged.
3.3–24 VDC	Safe operating voltage output range
< 3.3 VDC	I/O output may be incorrect

Up to 100mA sink current when the IO port is used as output.

On/off direct output circuit:



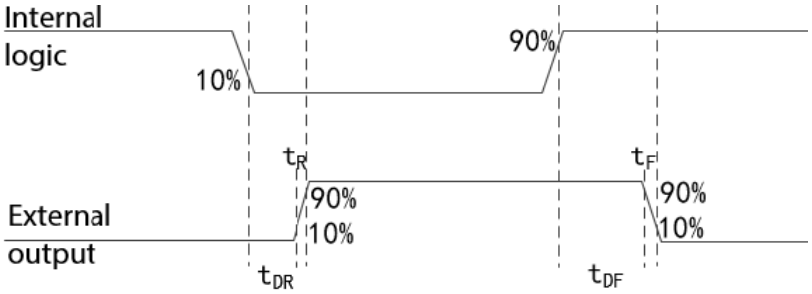
Relationship between the GPIO output voltage drop (voltage drop between GPIO and GND) and output current (current flowing into GPIO pin) :



- The max. voltage drop at GPIO output port is about 0.41 V (measured at the max. output current of 100 mA).
- The values above are typical values measured at an ambient temperature of 25 ° C, and there are differences between cameras.

GPixel 4K Ethernet Port IO Electrical Specifications

Logic delay :



Output delay when using 470 Ω pull-up resistor:

External power supply voltage (V)	Rising time tR（ns）	Falling time tF（ns）	Rising edge trigger delay tDR（ns）	Falling edge trigger delay tDF（ns）
-	-		5.43	0.35
5	0.16	0.02	1.80	39
12	0.22	0.04	2.37	71

- The output delay refers to the delay from the FPGA pin output to GPIO pin, without taking into account the internal logic delay of FPGA.
- When no external pull-up resistor exists, the shortest output positive pulse is 11 μs and the shortest output negative pulse is 1 μs.

Notes for IO Electrical Specifications

During the use of the camera, improper electrical operations can easily lead to damage to the camera. An unused output signal pin must be hanged. Connect an input pin not in use to GND (recommended) or leave it hanging, instead of connecting it to the power supply to avoid camera damage. For max. safe voltage of input signal, see the IO electrical introduction in the previous section. The safe voltage and instantaneous voltage must not exceed 24 V.
You might not be familiar with the operating principle encoders. Therefore, the following chapter describes knowledge of encoders and methods to avoid EMI and ESD.

Avoiding EMI and ESD

In an industrial environment, some devices might generate EMI (electromagnetic interference). Cameras are susceptible to ESD (electrostatic discharge). Significant EMI and ESD lead to issues such as false trigger and sudden stop of stream acquiring. EMI and ESD also reduce the imaging quality of cameras and the reliability of data transmission between cameras and computers.

In order to avoid issues caused by EMI and ESD, we recommend you take the following measures:

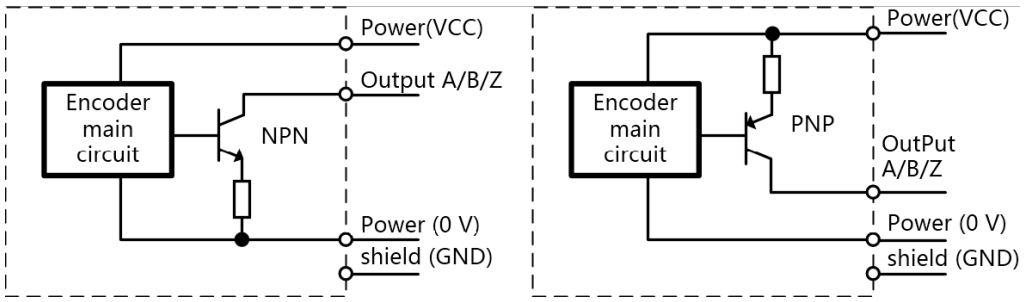
- Use a high-quality cable with the shielding function, which shields cameras from EMI and ESD.
- Use a cable with an appropriate length. If the cable is excessively long, bend it back and forth instead of making it a coil.
- Make the power cord of the camera in parallel with the data cable.
- Do not make camera cables in parallel with cables with heavy current or cables connected to high-power switch devices (such as stepper motor drive and solenoid valve). Do not make camera cables close to the preceding devices.
- Connect all grounding (GND) wires to a single point. For example, you can use a distribution board to connect the grounding wires of the whole system to a single point. This prevents a ground loop from occupying a large area, which is the main cause of EMI.
- Use a line filter for the main power supply of the camera, or use a separate power supply.
- Install the camera and cables far away from devices generating spark, such as brush motors and relays. If necessary, you can use a metal shield.
- You can take the following measures to reduce the risk of ESD::
  - Use conductive material for the mounting surface.
  - Ensure appropriate humidity in the environment. Dry air easily leads to ESD.

FAQs on Rotary Encoders

What is the difference among voltage output, collector signal output, and differential output encoders?

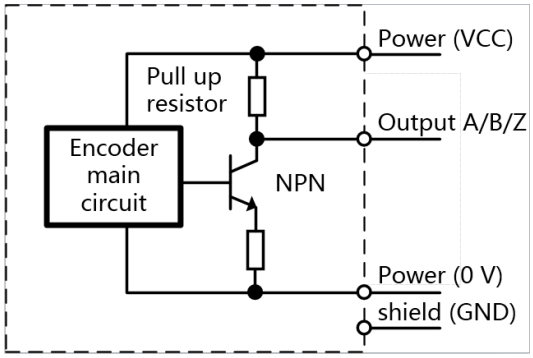
- The collector signal output uses the transistor emitter of the output circuit as the common end, and the collector is suspended in the output circuit. Generally, the collector signal output is divided into NPN open collector output and PNP open collector output.

Collector signal output :



- Voltage output is based on an open-collector output circuit. A pull-up resistor is connected between the power supply and the collector, so that stable voltage can be provided between the collector and the power supply.

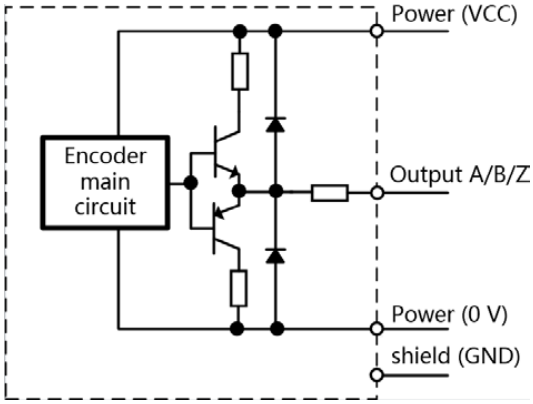
Voltage output circuit :



FAQs on Rotary Encoders

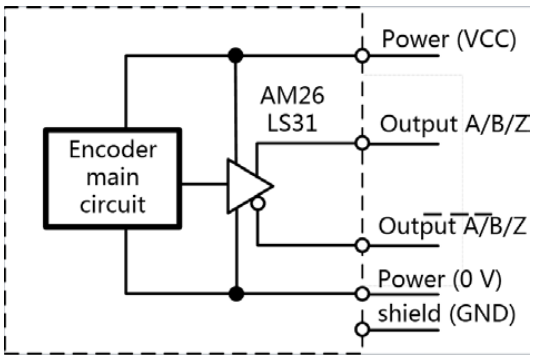
■ Output circuit with NPN and PNP transistors for complementary output. According to the strength of the output signal, the 2 output transistors switch alternately. This allows longer transmission distance than the open-collector output circuit.

Complementary output circuit :



■ Differential output is a data transmission method by using dedicated IC output and based on RS422-A specifications. The signal outputs as a differential 2 signal, so it has strong anti-interference ability, suitable for long-distance and high-speed transmission. The camera uses a dedicated IC (called RS422 transceiver) to receive the signal sent by the encoder.

Differential output:



What is the difference between an incremental encoder and an absolute encoder?

After power failure, incremental encoders do not record the angle that it has rotated before the power failure. Absolute encoders can save the previously rotated angle after power-off, and record up to 360° . Vision Datum line scan cameras only support incremental encoders.

What causes missing pulses of rotary encoders?

Possible causes:

- The encoder rotated too fast, exceeded the response frequency of the encoder or subsequent device.
- The wire is extended too long and the signal is attenuated.
- There is hardware failure of encoders.
- There is jitter or interference on site, such as jitter of mechanical transmission devices and electrical cable interference.
- The encoder and the motor shaft are not fixed tightly, and there is eccentric angle.

How do I judge the quality of a rotary encoder?

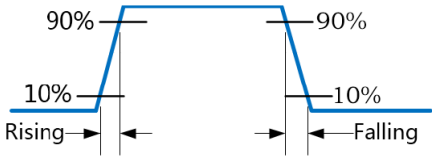
- Check whether the number of pulses is correct when connecting the camera.
- Connect the oscilloscope to view the waveform.
- Use a multimeter to test whether the output is normal.

■ When the encoder is NPN output: Test the positive pole of the power supply and the signal output cable. When the transistor is turned on (ON), the output voltage is close to the encoder supply voltage, and when the transistor is turned off (OFF), the output voltage is close to 0 V.

■ When the encoder is PNP output: Test the negative pole of the power supply and the signal output cable. When the transistor is turned on (ON), the output voltage is close to the encoder supply voltage, and when the transistor is turned off (OFF), the output voltage is close to 0 V.

FAQs on Rotary Encoders

What are rise time and fall time?



- Rise time: The time for the output pulse to rise from 10% to 90%.
- Fall time: The time for the output pulse to fall from 90% to 10%.

What are max. response frequency and max. allowed speed?

- The max. response frequency is the max. electrical response frequency of the encoder. The unit is Hz. If the encoder is used when max. response frequency is exceeded, its internal circuit will not be able to respond, resulting in pulse leakage of the encoder.
- The max. allowed speed refers to the highest speed that the shaft of the encoder can withstand during rotation. The unit is r/min. If the encoder is used when max. allowed speed is exceeded, the shaft of the encoder will be damaged.

How far can the signal output of the rotary encoder be transmitted?

It depends on the encoder output type.

- Open collector NPN/PNP output: 10 m.
- Voltage output: 2 m.
- Complementary output: 30 m.
- Differential output (or cable drive output): 100 m.

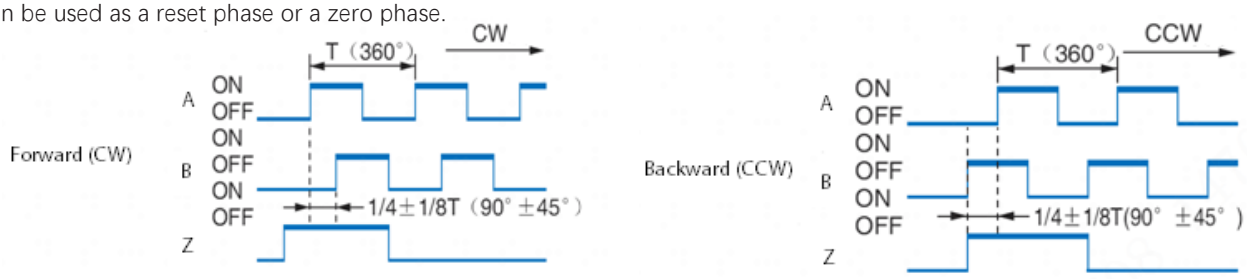
i	• We recommend you use a differential output (linear drive output) encoder for long-distance transmission. • If you want to extend the wire of the encoder, you must use a shielded twisted pair.

How do I avoid encoder interference?

- Use shielded cables for signal cables, and connect them reliably.
- The signal wires are routed separately from high-current power cables (such as motor wiring).
- Install the device separately from high-power or high-frequency device.

What do the phase A, phase B and phase Z output of the incremental encoder mean?

Each time the encoder rotates, phase A and phase B send out the same number of pulses, but there is a 90° phase difference between phase A and phase B (one rotation is 360°), and you can learn whether the encoder is rotating forward or reverse according to the phase difference. During forward rotation, phase A leads B phase 90° for phase output, and for reverse rotation, phase B leads phase A by 90° for phase output (as shown in the figure below). Each time the encoder rotates, phase Z only sends out a pulse at a fixed position, so it can be used as a reset phase or a zero phase.



What is encoder resolution?

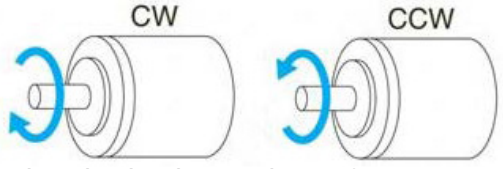
Resolution is also called the number of pulses. For an incremental encoder, resolution is the number of pulses output by the encoder after the shaft rotates one circle.

What is the output phase?

For incremental encoders, it refers to the number of output signals. It includes 1-phase type (phase A), 2-phase type (phase A, phase B), 3-phase type (phase A phase, phase B, and phase Z).

What are CW and CCW?

CW means clockwise rotation. For this rotation direction and an incremental encoder, phase A outputs before phase B. The opposite of the CW rotation direction is CCW (counter clockwise). In such rotation direction, phase B of an incremental encoder outputs before phase A.



How do I convert the signal output by NPN into the signal output by PNP?

Connect a pull-up resistor between the NPN output pin and the encoder power supply, output a low level when the transistor is turned on, and output a high level when the transistor is turned off. The pull-up resistor value depends on the camera's minimum turn-on voltage and the internal resistance of the input terminal, generally 4.7 K–10 K.

Precautions

NOTICE

Cleaning of the sensor and the housing

Sensor

Avoid cleaning the surface of the camera's sensor if possible. If you must clean it:

- Before starting, disconnect the camera from camera power and I/O power.
- Use a soft, lint-free cloth dampened with a small amount of high-quality window cleaner.
- Because electrostatic discharge can damage the sensor, you must use a cloth that won't generate static during cleaning (cotton is a good choice).
- Make sure the window cleaner has evaporated after cleaning, before reconnecting the camera to power.

Housing

To clean the surface of the camera housing:

- Do not use solvents or thinners; they can damage the surface.
- Use a soft, dry cloth that won't generate static during cleaning (cotton is a good choice).
- To remove tough stains, use a soft cloth dampened with a small amount of neutral detergent; then wipe dry.

NOTICE

Using a wrong pin assignment for the 6-pin/12-pin receptacle can severely damage the camera.

Make sure the cable and plug you connect to the 12-pin receptacle follows the correct pin assignment.

In particular, there is also a 6-pin receptacle in the line scan cameras. So, please keep in mind that do not use a pin assignment that would be correct for Mars area scan cameras. The 6-pin receptacles of Mars line scan cameras are electrically incompatible.

NOTICE

Avoid dust on the sensor.

The camera is shipped with a protective plastic seal on the camera front. To avoid collecting dust on the camera's sensor, make sure that you always put the protective plastic seal in place when there is no lens mounted on the camera. Also, make sure to always point the camera downward when there is no protective seal on the camera front or no lens mounted.

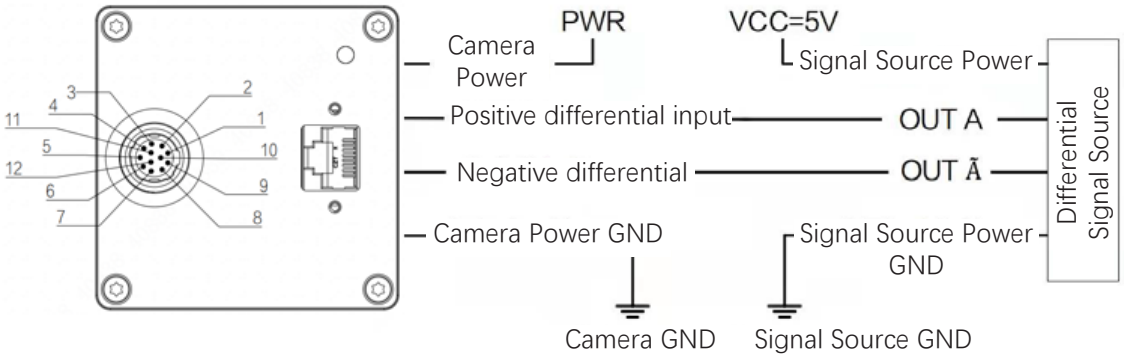
CHAPTER 4 Camera IO Trigger Solution

Frame Trigger

Typical scenario: Use a photoelectric switch to provide frame signals. This requires the object to move at a constant speed during the actual operation, and the direction does not change. Then, use the line scan camera to scan the object. Set a photoelectric switch in the passage, and the object moves at a constant speed after passing through the photoelectric switch. After the photoelectric switch senses the object, it provides the camera a frame signal to start scanning.

In actual use, you need to adjust the focal length, angle, exposure value and line frequency of the camera to make the final image meet the requirements.

Frame trigger :

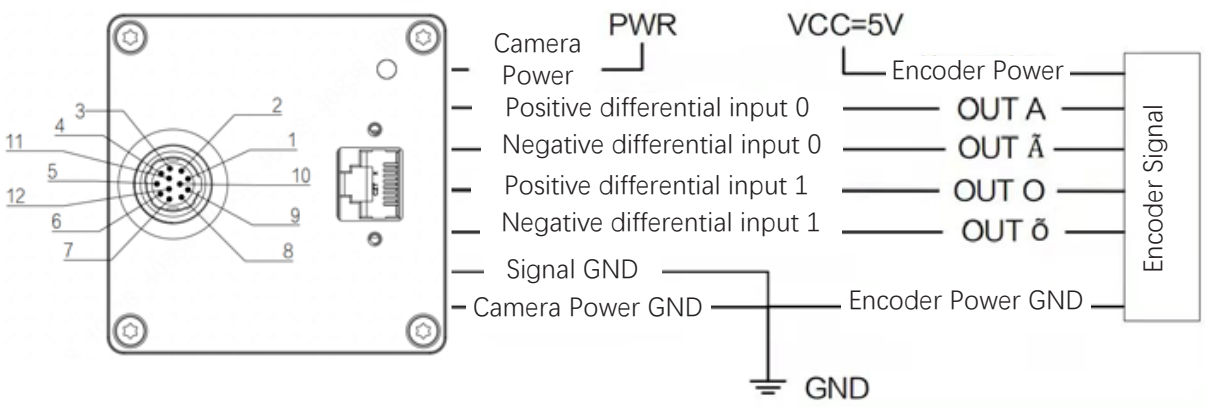


Line Trigger

Typical scenario: The object is transported by the roller, and its speed changes constantly due to processing or other operations. If you use a line scan camera to capture in freerun mode, it easily leads to excessive stretching or compression of the image, so it is necessary to use line trigger performed by the encoder signal to control the camera to capture images, so that the exposure and data acquisition logics of the camera conform to the motion law of the object. When there is no slippage between the belt and the roller, the frequency of the belt speed matches the frequency of the line signal given by the encoder, so that the line frequency and the movement speed of the object match. The final imaging effect meets the requirements.

When the line signal is not lost, and there are no other issues in the environment, such as roller slippage, but the image is still stretched or compressed, you can use division and multiplication to control the final imaging effect.

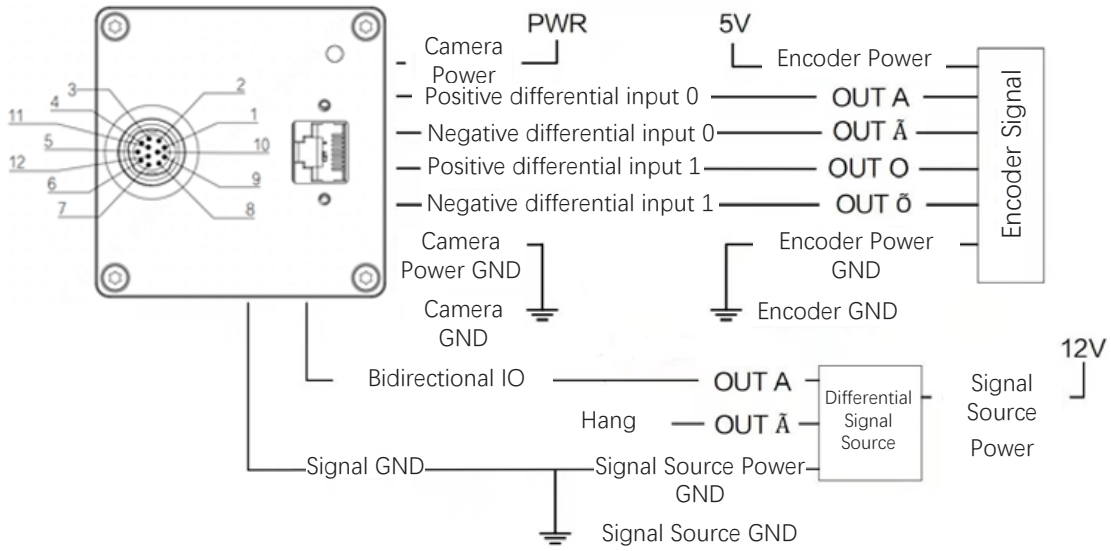
Line trigger :



Line Trigger and Frame Trigger

When there are multiple trigger signals, you can enable frame trigger and line trigger at the same time, so that the images fit the application environment and the law of object motion.

Line trigger and frame trigger :



In actual use, you can also use the IO output of the camera:

- ExposureActive: Outputs signal when exposure starts.
- LightTrigger: The light source controls the signal output.
- FrameActive: Frames output signals to control the light source.

i	Encoder signals can also control light sources.

Conclusion of the external ports of line scan cameras

CMOSIS 8K Ethernet port:

Pin	Signal	Function	Remarks	Suggestion
Black	1	line1_in-	RS422 input-	Connects the encoder (line trigger)
Red	2	line1_in+	RS422 input+/single-end input	Connects the encoder (line trigger)
Brown	3	line3_inout-	RS422 input/output-	-
Orange	4	line3_inout+	RS422 input and output+/single-ended input and output	-
Yellow	5	Signal Ground	Signal ground (SGND)	Encoder power ground (0 V)
Green	6	Line5_out-	RS422 output–	/
Blue	7	Line5_out+	RS422 output+/single-ended output	/
Purple	8	Line2_in-	RS422 input-	Connects the encoder (line trigger)
Gray	9	Line2_in+	RS422 input+/single-ended input	Connects the encoder (line trigger)
White	10	Line4_GPIO	Single-ended input/output	Connects the photoelectric switch (frame trigger)
Pink	11	Line6_out-	RS422 output-	/
Light green	12	Line6_out+	RS422 output+/single-ended output	/

Conclusion of the external ports of line scan cameras

CMOSIS 4K Ethernet port:

Pin	Signal	Function	Remarks	Suggestion
Black	1	Power GND	Camera power supply (signal ground)	Camera power supply ground (0 V)
Red	2	Camera Power	Camera power	Camera power VCC
Brown	3	IN Line5+	Input Line5+	Connects the encoder (line trigger)
Orange	4	IN Line5-	Input Line5-	
Yellow	5	OPT GND	Optocoupler isolated ground	-
Green	6	OPT IN Line1	Optocoupler input 1	Connects the photoelectric switch (frame trigger)
Blue	7	OPT IN Line2	Optocoupler input 2	
Purple	8	GPIO Line4	Bidirectional GPIO Line4	-
Gray	9	OUT Line6+	Output Line6+	Reserved
White	10	OUT Line6-	Output Line6-	
Pink	11	IN Line3+	Input Line3+	Connects the encoder (line trigger)
Light green	12	IN Line3-	Input Line3-	

GPixel 4K Ethernet port:

Pin	Signal	Function	Remarks	Suggestion
Black	1	Power GND	Camera power ground	Camera power supply ground (0 V)
Red	2	Camera Power	Camera power	Camera power VCC
Brown	3	IN Line1+	Input Line1+	Connects the encoder (line trigger)
Orange	4	IN Line1-	Input Line1-	
Yellow	5	Signal GND	Signal ground (SGND)	Signal ground
Green	6	IN Line2+	Input Line2+	Connects the encoder (line trigger)
Blue	7	IN Line2-	Input Line2-	
Purple	8	IN Line4	Bidirectional GPIO Line4	-
Gray	9	IN/OUT Line3+	Input/output Line3+	
White	10	IN/OUT Line3-	Input/output Line3-	
Pink	11	OPT_IN Line5	Optocoupler input Line5	Connects the photoelectric switch (frame trigger)
Light green	12	OPT GND	Optocoupler isolated ground	-

- Use RS-422 input to connect to the encoder, and provide line trigger signal.
- Use optocoupler input to connect photoelectric switch or PLC output to provide frame trigger signal. If there is no optocoupler input, use GPIO input instead.

CHAPTER 5 Function Parameters

- Industrial cameras support 3 user levels, including Beginner, Expert and Guru. Each corresponds to slightly different sets of parameters.
- Grayed out parameters cannot be changed under the current running mode.
- The software pages in this manual are for reference only, and might be different from actual product.
- The properties of different models of cameras are different, and the specific property parameters can be viewed in iCentral.

Device Control

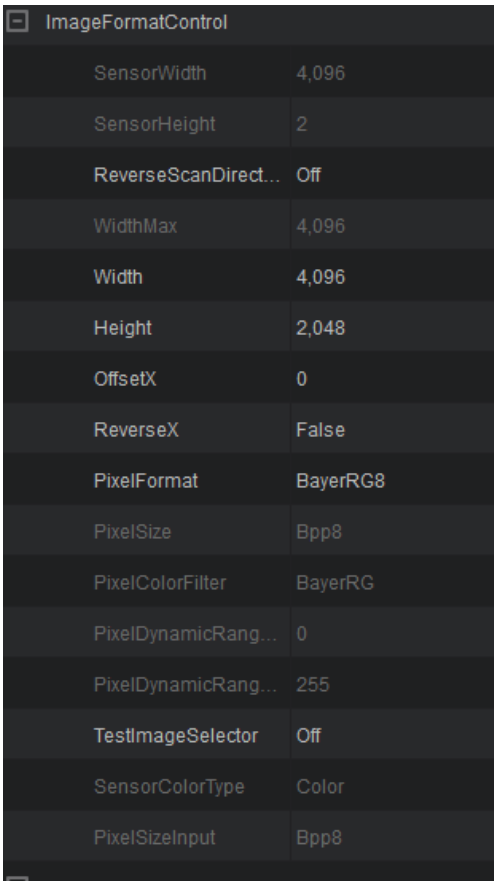
In DeviceControl, you can view the device information and change the device name.

Parameter	Description
DeviceType	The device type defined by GigE Vision.
DeviceScanType	The scanning type of the sensor, such as area scan and line scan.
DeviceVendorName	The vendor of the device.
DeviceModeName	The model of the device.
DeviceManufacturerInfo	The manufacturer of the device.
DeviceVersion	The software version of the device, including date and SVN number.
DeviceFirmwareVersion	The firmware version of the device, including date and SVN number. The number next to the semicolon indicates the hardware version.
DeviceSerialNumber	The serial number of the device.
DeviceUserID	The custom name of the device.
DeviceTLType	The protocol type used by the device in the transmission layer. Supports GigE Vision, CameraLink, CameraLinkHD, CoaXPress, and USB3 Vision. The preceding figure indicates that the device uses the GigE protocol. The software automatically recognizes the protocol of the device and the protocol cannot be modified.
DeviceTLVersionMajor	The main version of the transmission layer protocol that is compatible with the device.
DeviceTLVersionMinor	The sub version of the transmission layer protocol that is compatible with the device.
DeviceMaxThroughput	The max. transmission speed of the device.
DeviceCharacterSet	The character set used by the index register. The default character set is UTF-8.
DeviceReset	The restart button of the device. You can also an API to restart the device.
DeviceTemperatureSelector	Allows you view the temperature of the motherboard or sensor board. In general, only the temperature of the motherboard can be viewed.
DeviceTemperature	The temperature of the motherboard or sensor board.
DeviceRegisterIsBigEndian	Displays the big end or small end of the device register. The big end is supported by default.
DeviceTLVersionSelector	The compatible version of the transmission layer protocol. GigE cameras support switching between V2.0 and V1.0.
Device Uptime	The total running time of the device. The unit is s.
DeviceDevelop Data	The parameter is reserved for debugging.

ImageFormatControl

In ImageFormatControl, you can modify image properties such as image size, image pixel format, and test image mode.

i	Specific formats supported by industrial cameras might differ depending on the models.



Parameter	Description
SensorWidth	The original image width of the sensor, in pixels.
SensorHeight	The original image height of the sensor, in pixels.
ReverseScanDirection	If the moving direction of the object captured by the color line scan camera is not perpendicular to the direction of the camera label, the color camera will have a different color at the edge of a line, which can be corrected by inverting the difference. Figure 5-3 shows the correct direction.
WidthMax	The max. image width, in pixels.
Width	The actual width of output images, in pixels. Each camera has the max. width, min. width and step size, which are displayed under the property bar. You can modify the ROI of the camera according to the step size and the min. width.
Height	The actual height of output images, in pixels. Each camera has max. height, you can set a height as instructed.
OffSetX	The horizontal offset of the image, starting from the upper-left corner. The max. value is determined by the value of Width.
ReverseX	The horizontal flipping of images. The flip is based on the original size of the sensor, not images after the ROI.
PixelFormat	The format of output images. The supported formats differ depending on the models.
PixelSize	The number of bits that a pixel occupies in different image formats.
PixelColorFilter	The filter model used during image processing in the current image output format.
PixelDynamic Range Min	The min. value of pixel brightness.
PixelDynamic Range Max	The max. value of pixel brightness.
TestImageSelector	Test image type 1: Off, TestImage1 (static image), and TestImage2 (dynamic image). Test image type 2: GradualMonoBar (gradient image from black to white), MonoBar (multiple gradient images from black to white), and ObliqueMonoBar (rhombic image) Note: Test images are only used for tests. We recommend you keep the default width of a test image when you use it.

ImageFormatControl

Parameter	Description
SensorColorType	The color type of the sensor: Color or Mono (black and white).
PixelSizeInput	The bit depth of the images output by the sensor.

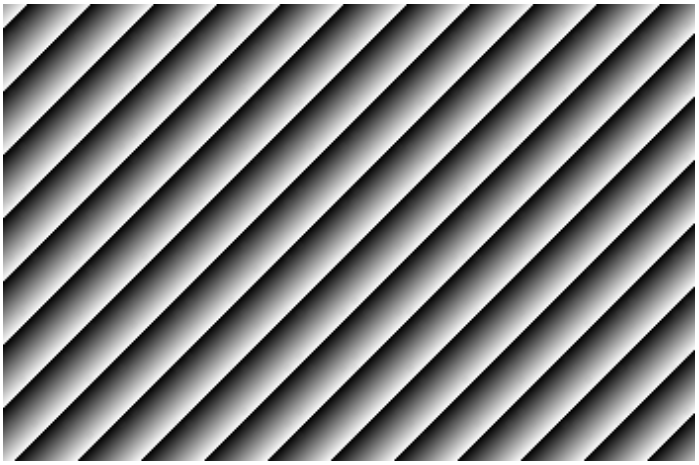
Testimage (Test Mode)

The camera supports test mode. When the camera is in test mode, the camera does not output real-time images, but images generated by the internal program. When real-time images are abnormal, you can determine the cause by checking whether images in test mode have similar issues. This function is disabled by default. In this case, images output by the camera are data collected in real time.

- You can enable test mode by setting TestImageSelector to On. The default value is Off.
- After enabling test mode, images displayed in the live window of the capture card software switches to test images. The type of test images depends on test mode.

Gradient image from black to white :

Rhombic image :

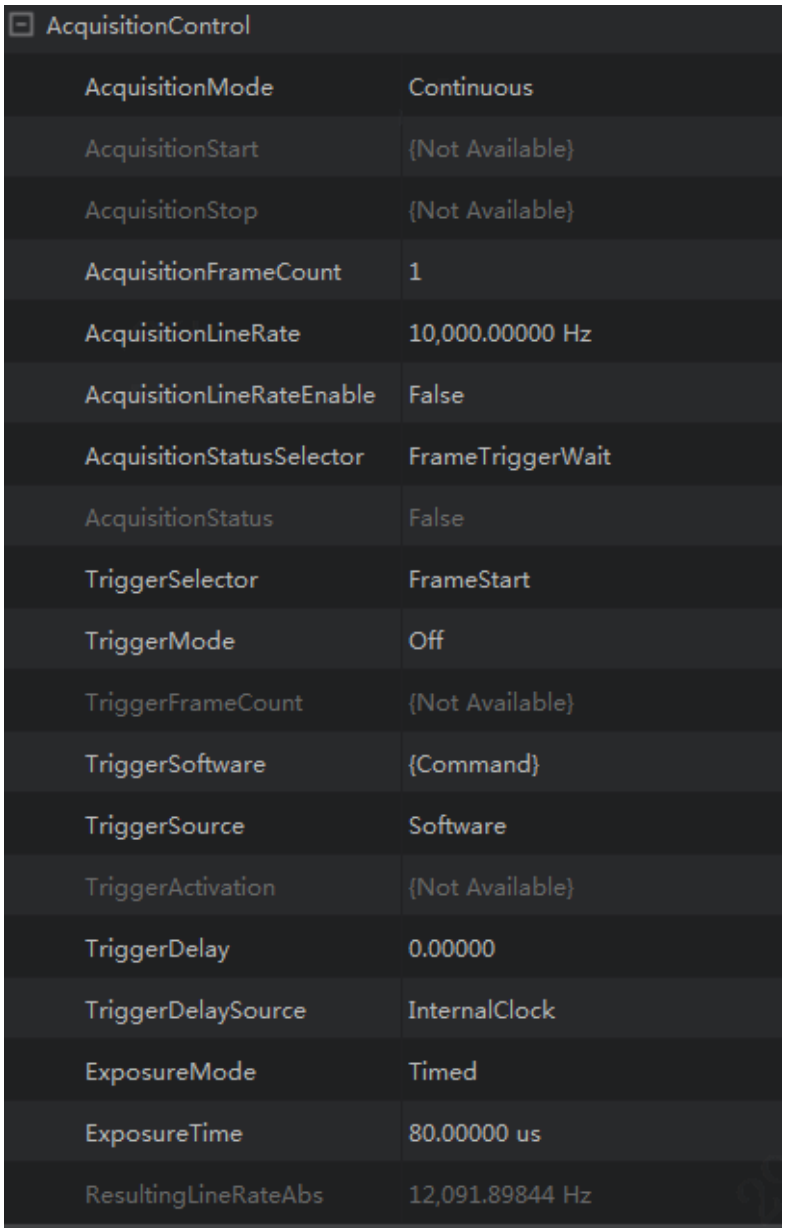


i	Supported test images varies with different models.

AcquisitionControl

In AcquisitionControl, you can set the image capture mode, trigger mode, exposure time, and other parameters of the camera.

	The specific format supported by the industrial camera should be based on the format supported by the camera.



AcquisitionControl

Parameter	Description
AcquisitionMode	● SingleFrame: The camera captures a frame at a time and stops pulling stream after capture. ● MultiFrame: The camera captures multiple frames specified by AcquisitionFrameCount and stops pulling stream after capture. ● Continuous: The camera keeps capturing until AcquisitionStop is called.
AcquisitionStart	The SDK starts or stops pulling stream.
AcquisitionStop	
FrameTimeout	Under the frame and line trigger, set a period, when the frame signal comes, if not enough lines are acquired within the period, the camera fills in the remaining lines as black and outputs a whole image.
AcquisitionFrameCount	The number of images captured at a time. Note:The parameter is available only when you set AcquisitionMode to MultiFrame.
AcquisitionLineRate	The frame rate of images. The parameter is available when you set AcquisitionFrameRateEnable to True.
AcquisitionLineRateEnable	
AcquisitionStatusSelector	Select a trigger state to view.
AcquisitionStatus	Select AcquisitionTriggerWait or FrameTriggerWait from AcquisitionStatusSelector, and then check AcquisitionStatus. True means image capture waits to be triggered, and False means image capture has been triggered.
TriggerSelector	The type of the trigger. Select FrameStart or FrameActive from TriggerSelector, working with LineStart, and then select On or Off from TriggerMode to enable or disable the trigger mode. TriggerFramesCount: The upper limit of captured images. Note：Burst means that the camera can capture multiple images after a single signal is triggered.
TriggerMode	
TriggerFramesCount	
TriggerSoftware	The trigger method. Includes SoftwareTrigger and lineN (hardware trigger).
TriggerSource	
TriggerActivation	● If you select SoftwareTrigger, you can generate a software trigger by clicking TriggerSoftware or calling an API. ● If you select lineN, and set TriggerActivation to RisingEdge, FallingEdge or AnyEdge (available on select models), a hardware trigger is generated when external cables generate signals of rising or falling edges. Note：You can separately select trigger sources for AcquisitionStart and FrameStart.
TriggerDelay	The trigger delay, which is the period between the time when the camera receives a trigger signal and the time when the trigger takes effect. The parameter is available for both software trigger and hardware trigger.
TriggerDelaySource	The source of trigger delay. LightTriggerDelay is used to set the delay time from when the camera receives the trigger signal to when LightTrigger outputs the conduction of the optocoupler. The conduction time of the optocoupler is from the start of LightTrigger to the end of the exposure. Note：During the delay, the camera cannot receive new triggers. Otherwise, the camera needs to stop and acquire the stream again to return to normal.
ExposureMode	The mode exposure time, including Timed and TriggerWidth. ● For Timed, the exposure time is the value of ExposureTime. ● For TriggerWidth, the exposure time is the pulse width of hardware trigger. Note：TriggerWidth is only available for select models.
ExposureTargetBrightness	The automatic exposure, including Off, Once, and Continuous. You can set a target value of brightness, and then apply exposure once or continuously to increase it. The value ranges from 0–100.
ExposureAuto	
ExposureTime	The exposure time.
AcquisitionLineRateEnable	The theoretical frame rate of the camera. The theoretical frame rate of the camera depends on network bandwidth, pixel format, image resolution and exposure time. The exposure time takes priority by default. When the exposure time is larger than the reciprocal of frame rate, the frame rate will be decreased priorly, instead of limiting the maximum exposure time.

LineFrequency

Line scan cameras have the following 2 working modes in terms of line frequency.

■ Freerun

- Exposure: The shorter the exposure time, the higher the horizontal scan rate.
- Pixel format: In the same conditions, the more bytes the pixel format occupies, the lower the horizontal scan rate.
- Bandwidth: The larger the bandwidth of the Ethernet card, the more data can be transmitted per second.
- Lossless compression: When the camera is used with the best SDK, image data is transmitted to the computer in different image transmission modes, and the computer parses the original image data through the SDK, which further improves the line frequency.

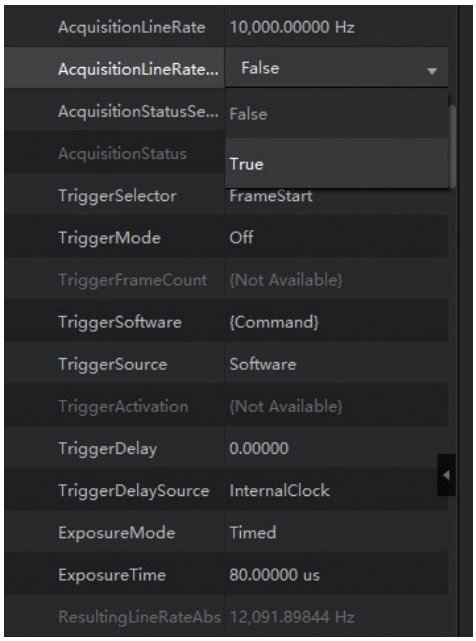
■ Line trigger

- When the line signal frequency is less than the theoretical line frequency, the line frequency is the line signal frequency.
- When the line signal frequency is instantaneously or continuously greater than the theoretical line frequency, the line frequency is the theoretical line frequency, and line signals might lose.

	• The image lossless compression functions supported by different cameras are different. In addition, contact local technical support to obtain the lossless compressed version firmware. • Theoretical line frequency: The max. line frequency calculated under the current environment of the camera and its own parameter configuration, namely ResultingLineRateAbs.

■ Enable line frequency

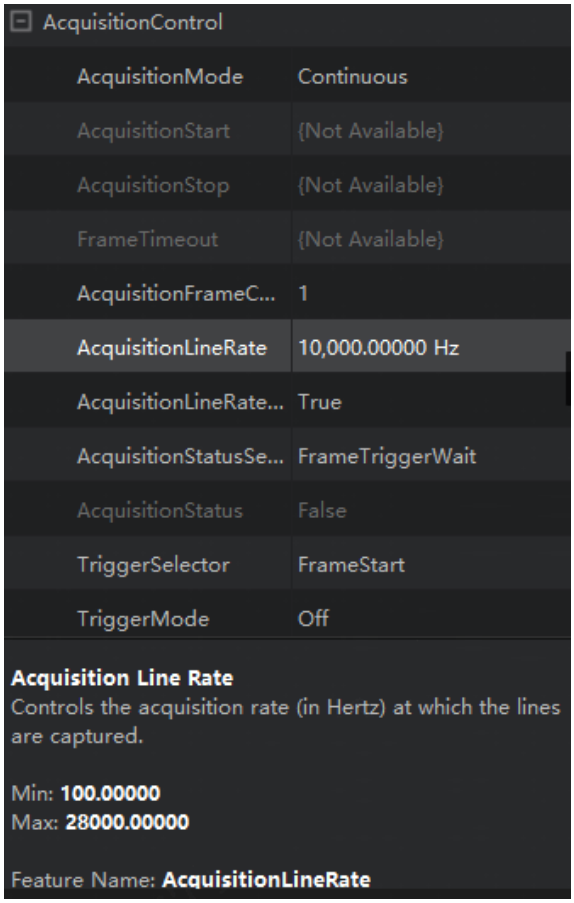
Set AcquisitionLineRateEnable to set a value as line frequency. It is the upper limit of the line frequency of the camera. When the camera is limited by the trigger signal or exposure value, the real-time line frequency might be less than the specific value.



- Connect to the camera through ICentral, display all parameters, and then find AcquisitionControl.
- Adjust line frequency by setting AcquisitionLineRate. You can also view the max. and min. line frequency.

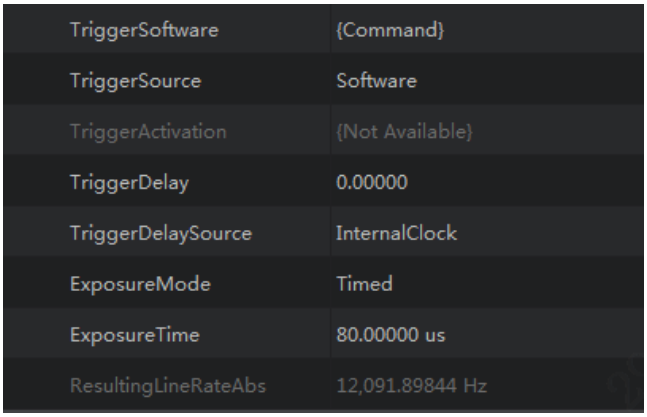
	● If the max. line frequency of the camera is lower than the defined value, the camera captures images based on the actual frequency. ● If the max. line frequency of the camera is greater than the defined value, the camera captures images based on the set value.

LineFrequency



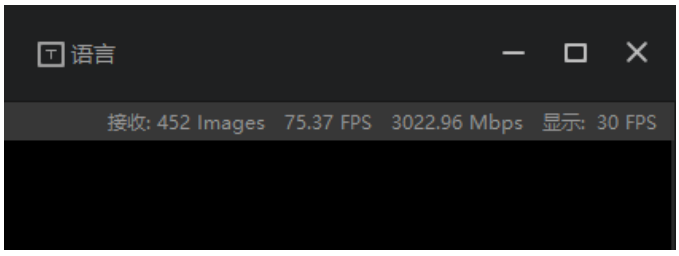
AcquisitionLineRate

- You can view the theoretical line frequency when the camera acquires stream through ResultingLineRateAbs.



ResultingLineRateAbs

- View the real-time frame rate of the line scan camera in the upper-right corner of Client, and calculate the real-time line frequency by multiplying the frame rate by the line height.



LineFrequency

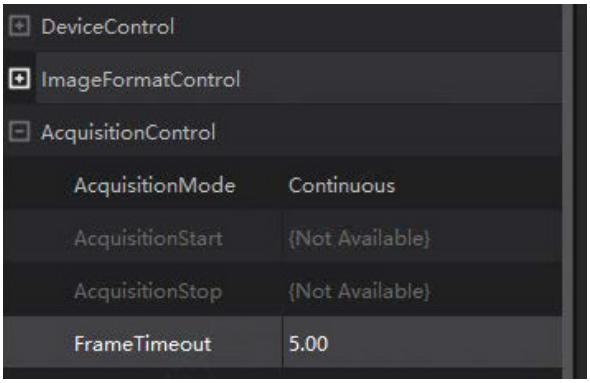
■ FrameTimeout

In the frame + line trigger mode, when the number of frame signals reach the set line height, but the subsequent line signals does not, the image will only be output after the line signal reaches the set line height. If a slight error occurs in the roller, the roller might have made one turn, but the image is not displayed. This affects the production rate.

In special circumstances, if the line signal does not reach the defined line height, the camera will wait for the subsequent line signal. At this time, the frame signal will be filtered out and frame loss will occur.

To avoid the above exceptions, turn on frame timeout, set the max. duration of one frame. If there are no enough line signals within this time, the camera will blacken the remaining lines and output a frame of image.

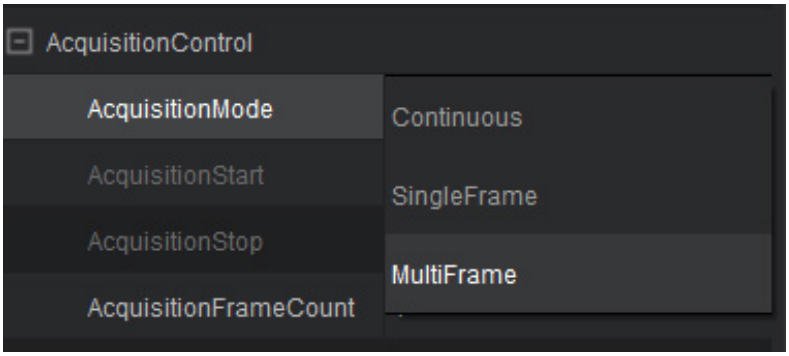
For details, see AcquisitionControl. Set FrameTimeout, and then start acquiring stream.



	To use the function, you must enable frame trigger and line trigger at the same time.

AcquisitionMode

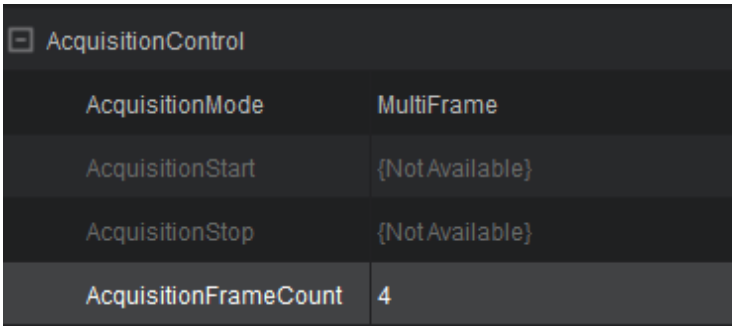
3 acquisition modes are available: Continuous acquisition, single-frame acquisition, and multi-frame acquisition.



Multi-frame acquisition

Step 1 Click AcquisitionMode to select a mode.

Step 2 SetAcquisitionFrameCount.



Number of acquisition frames

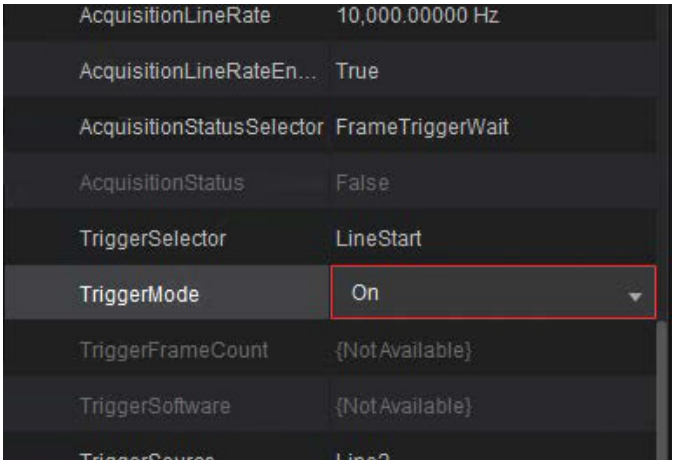
Parameter	Description
SingleFrame	The camera starts capturing and stops after one capture.
Continuous	● The camera starts and keeps capturing. ● When the number of acquired lines reaches the height of the image, one image will be output, and then the camera keeps outputting images in this mode.
MultiFrame	Configure the frame rate (1–255) in AcquisitionFrameCount. ● The camera starts and keeps capturing. ● When the number of acquisition lines reaches the height of the image, one image will be generated, and then the images will be continuously generated in this mode, until the generated images reaches the value defined in AcquisitionFrameCount.

TriggerMode

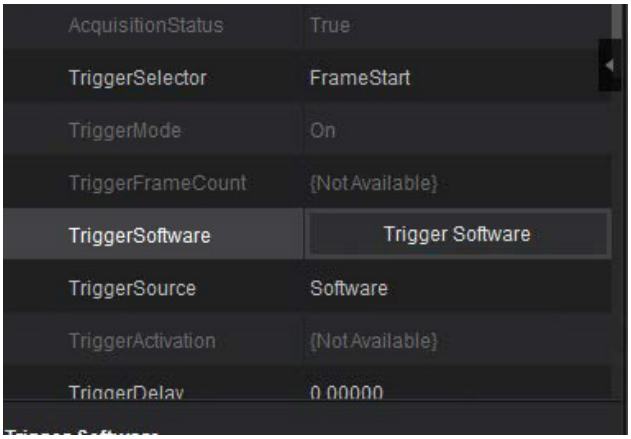
Trigger modes of a line scan camera include line trigger, frame trigger and line + frame trigger. The trigger mode is determined by TriggerSelector and TriggerMode in AcquisitionControl.

■ Trigger Type

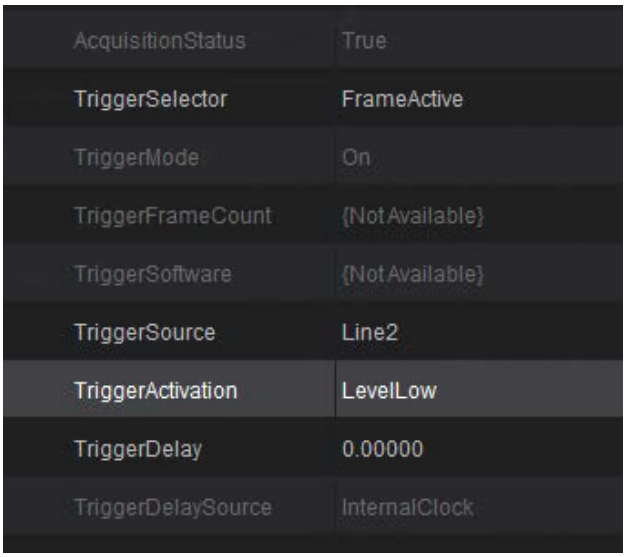
● Line trigger (LineStart): Outputs one line after receiving a trigger signal, and outputs a frame of image when the received signals meet the defined image height. The trigger condition of the trigger signal can be set as rising edge, falling edge or transition edge (includes rising edge and falling edge, only available on select models).



● Frame trigger (FrameStart): Outputs a frame of image after receiving a trigger signal (rising edge or falling edge).



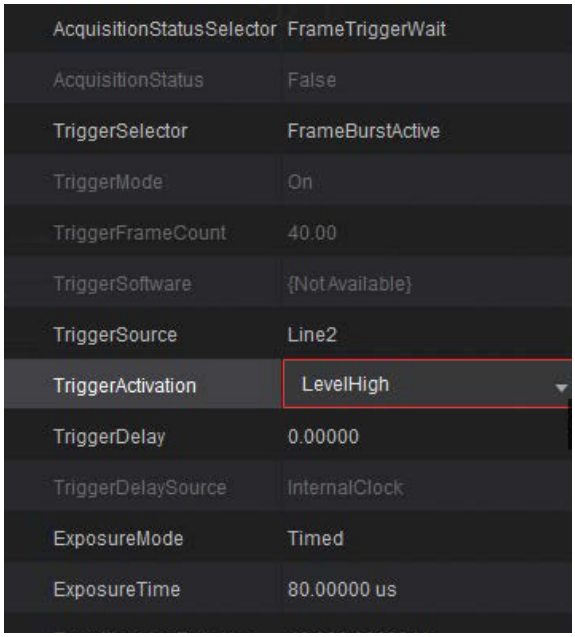
● FrameActive: After receiving a high level (low level) signal, multiple lines are collected within the effective range of the signal pulse width. After the number of lines collected meets the set line height, the image is output. If the signal pulse width is too short or the line trigger is enabled, a sufficient number of lines are not collected within the valid range of the signal pulse width, the image will be output according to the actual line height.



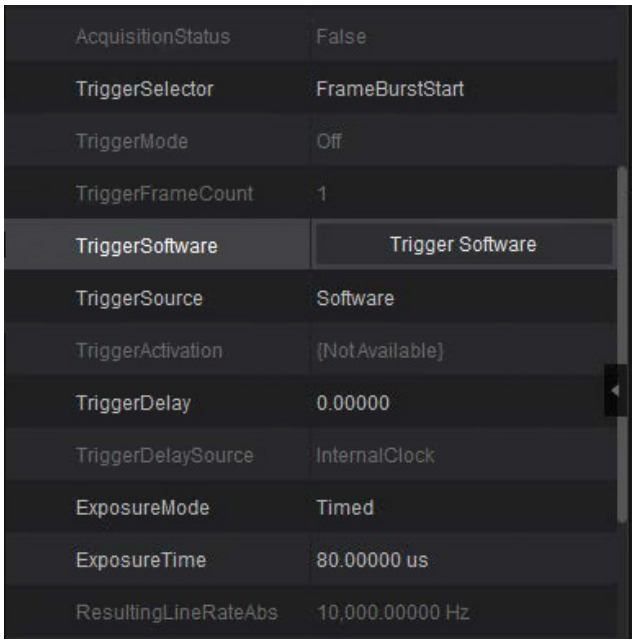
TriggerMode

- FrameBurstActive: When a high level (low level) signal is received, multiple lines are collected within the effective range of the signal pulse width. Different from FrameActive, FrameBurstActive always collect images within the effective range of the signal pulse width, and can output all the collected image data according to the set line height. Details of the output logic is as follows:

	The adaptive line height is the max. number of line heights that can be continuously collected in the effective area of the high level (low level) of the signal pulse width in FrameBurstActive mode.



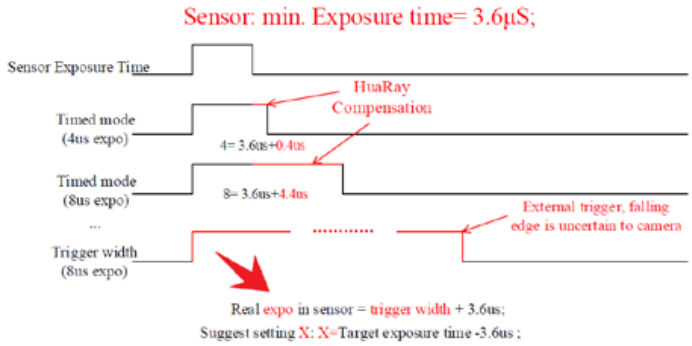
- FrameBurstStart: Multi-frame mode of frame trigger mode. Outputs multiple images according to the define line height after receiving a trigger signal rising edge (falling edge) upon receiving a rising edge (falling edge). The number of images depends on the value defined in TriggerFrameCount.



- Line+Frame Trigger: In the use of multiple trigger signals, we can turn on a frame trigger and line trigger at the same time, so that the output effect fits our use of the environment and the pattern of object movement.

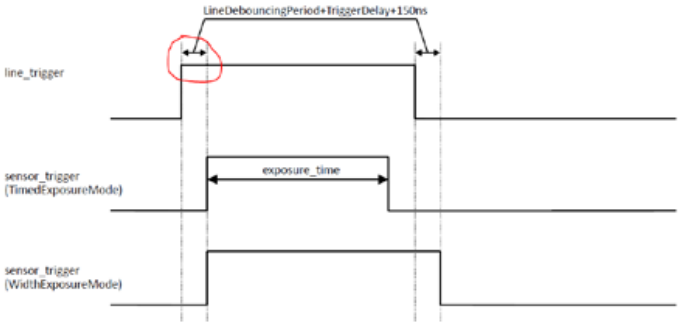
TriggerMode

● Sensor Exposure Logic: The sensor of each camera has a min. value. When you set the exposure value of the camera on the client, the sensor automatically calculates a multiple of its accuracy, add it to the minimum value of the camera to reach the set exposure. For example, the min. exposure value of the sensor is 3.6 μs, and if you set the exposure to 4 μs, the multiple calculated by the sensor is 0.4 μs, allowing 3.6 μs + 0.4 μs = 4 μs.



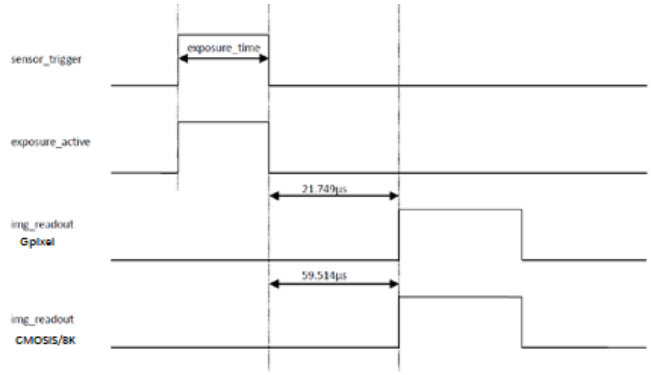
The relationship between the sensor and the line trigger signal is as follows:

- First signal: line trigger signal. The delay in the dotted line is the filter + signal delay + 150 ns. The filter and the signal delay can delay the actual response to the sensor. If the 2 coefficients are 0, the sensor starts to expose 150 ns after the trigger signal arrives.
- Second signal: the actual exposure signal of the sensor when its working mode is timed exposure. The exposure value is based on that of the actual setting.
- Third signal: the actual exposure signal when its working mode is pulse width exposure, which will delay the line trigger signal accordingly.



The relationship between the actual exposure and stream acquiring is as follows:

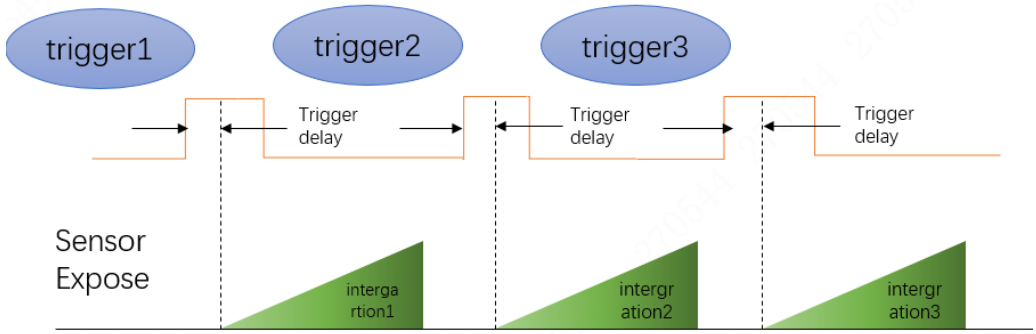
- The first signal is the actual exposure signal of the sensor.
- The second signal is the exposureactive signal output by the camera.
- The third and fourth signals are the signals of actual stream acquiring of the camera.



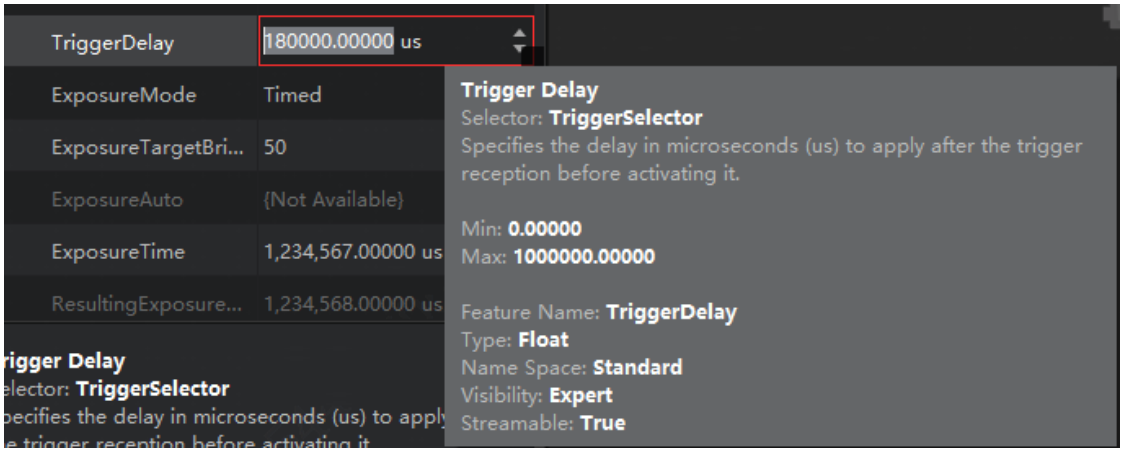
TriggerMode

■ TriggerDelay

You can set a delay time between the camera receives and responds to the trigger signal to start image acquisition, and the camera will capture the image after this time.



The delay time is configured through TriggerDelay with μs as unit and ranges from 0–1000000 μs, namely, 0–1 s.

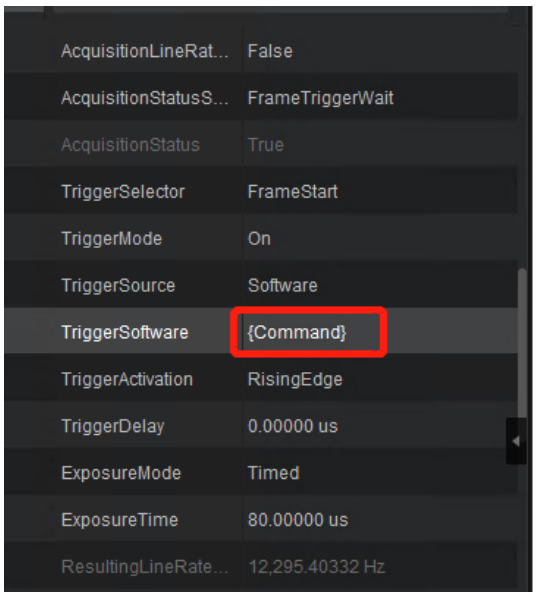


TriggerMode

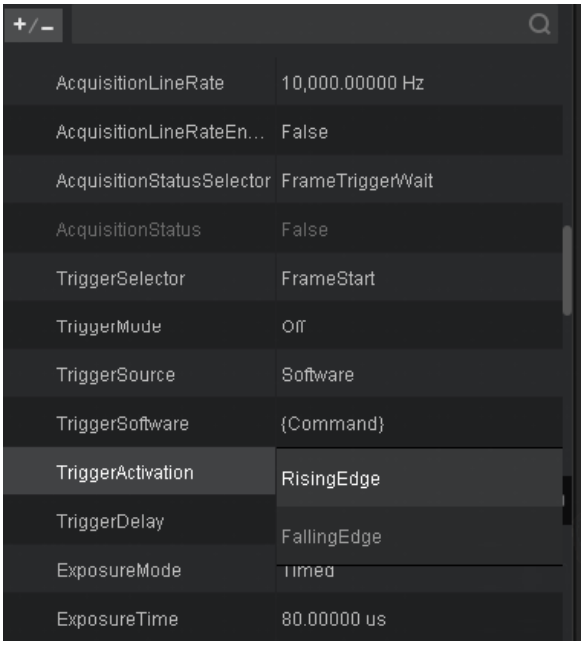
■ TriggerSource

- Software trigger: Select Trigger Software from AcquisitionControl > TriggerSoftware to send trigger signals through the software.
- I/O trigger: The trigger signal enters the camera from external devices through the I/O interface. For the specific wiring of the camera I/O interface.

Based on the actual cable connection, set TriggerSelector to FrameBurstActive, TriggerMode to On, TriggerSource to line2 and TriggerActivation to LevelHigh. After completing the configuration, wire line 2 according to the cable specifications. After that, images can be generated after receiving signals.



1. Trigger signal is divided into RisingEdge and FallingEdge.
2. After selecting the trigger signal source, choose whether the trigger signal is RisingEdge or FallingEdge.
3. When setting up the trigger, you need to synchronize the settings on the software of the capture card connected to the actual camera to make it effective.



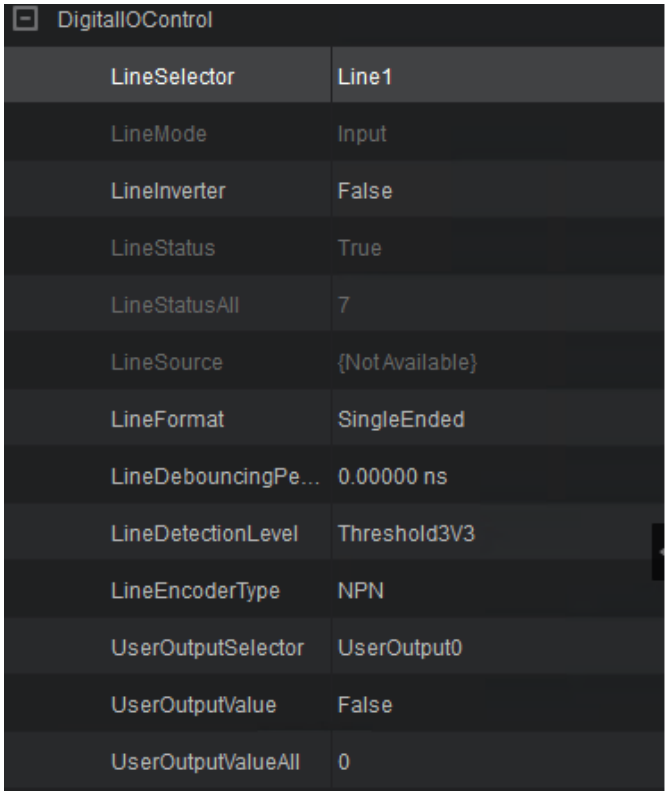
DigitalIOControl

In DigitalIOControl, you can manage different I/O input or output signals.

The output signal triggered by the camera can be used to control external devices such as alarm light, light source and PLC. The trigger output signal can be realized in two ways: Level inversion and Output 2.

IOControl settings

Configure parameters in DigitalIOControl.



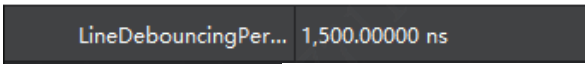
Parameter	Descriptions
LineSelector	The IO cable to be configured.
LineMode	The output mode of the selected IO cable, including Input and Output.
LineInverter	Specifies whether to reverse signals. True: Reverse signals. False: Not reverse signals.
LineStatus	Indicates the status of the selected physical input or output cables.
LineStatusAll	Returns the status of all usable cables.
LineSource	You can select a trigger source if the IO cable set as output. The following trigger sources are supported: ● ExposureActive: Outputs signal when exposure starts. ● FrameTriggerWait: Outputs waiting status signals of frame trigger. ● Timer0Active: Outputs signals when the timer0 reached its limit. ● UserOutput0: Output the value of UserCustom0. ● AcquisitionTriggerWait: Outputs waiting status signals of acquisition trigger. ● LightTrigger: Outputs the signal of light source control. ● FrameActive: Signals of starting frame output.
LineFormat	The trigger type of the selected IO cable. For differences between differential and single-end cable connection, see IO electrical specifications.
LineDebouncingPeriod	The length of debouncing. You can set the parameter if the IO cable is set as input. Note: Pulse widths smaller than the set value will not be considered as an effective trigger input.
Line Detection Level	The threshold voltage for single-end signal.
LineEncoderType	The signal type, including PNP,NPN, and NoPull.
UserOutputSelector	The output group.
UserOutputValue	The output value of the output group.
UserOutputValueAll	Set the output value of all output groups to 0 or 1.

DigitalIOControl

Singal Debouncing

LineDebouncingPeriod: Signal debouncing, also known as filtering, is only supported in input mode. The level signal of the corresponding port is filtered according to the defined value. Signal will be filtered out when the signal value is smaller than the debouncing value. This significantly shields the environment from signal clutters.

For example, set LineDebouncingPeriod to 1500 ns.



Before filtering

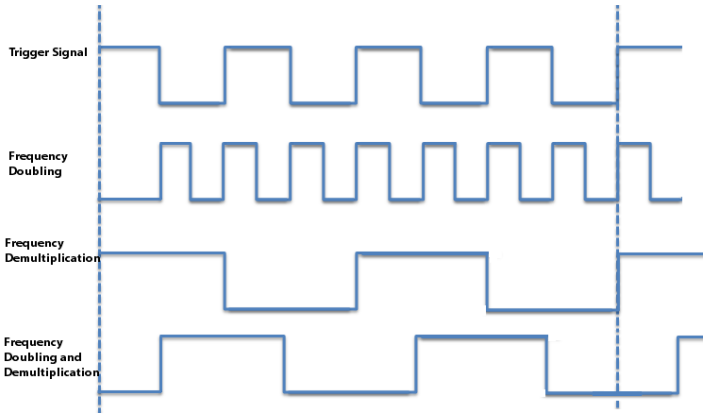
After filtering

When the value of LineDebouncerPeriod is greater than the value of the level signal, as shown in the example above, if the filtering level is greater than 5000 ns, the camera will not generate streams. Therefore, when setting LineDebouncerPeriod, make sure that its value is smaller than the high or low level.

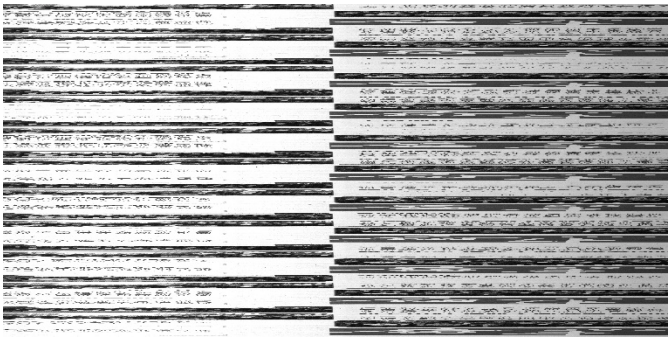
FrequencyConverterControl

Speed up or slow down the specific signals. When external signals trigger the camera to start working, the image quality might be poor, for example, severely stretched or compressed. The frequency division and multiplication function can be used to adjust signal frequency to increase or decrease line scan rate.

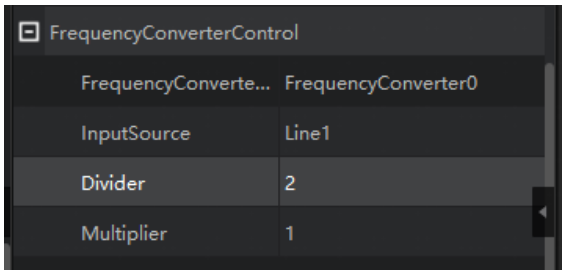
- The frequency converter is only available when line trigger is enabled.
- Frequency division and multiplication is to adjust the aspect ratio, so when adjusting this function, it is necessary to confirm that the image is not stretched and compressed due to external signal interference.

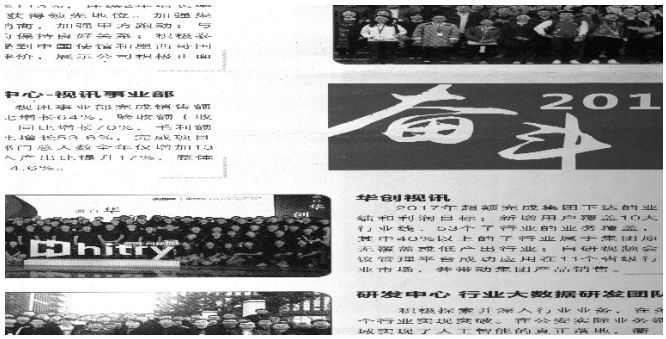


● For example, the image line height is 2048, the theoretical line frequency is 28000, and the frame rate is 0.5 fps. The image is severely compressed. The horizontal scan rate (2048) of trigger signal is lower than movement speed of object, and cannot be changed. You can adjust the image by adjusting the frequency multiplication index.



Step1:Select frequency controller from FrequencyConverterSelector.
Step2:Set the signal source in InputSource.
Step3:Select Divider or MultIplier to set the divider or multiplier index.
Set Multiplier to 13, so that the line frequency is increased to 2048 × 13 = 26624. You can use divider for adjustment when the image is stretched. Set Multiplier and Divider to 3 and 2 respectively to get the 1.5 multiplication effect.





Parameter	Description
FrequencyConverterSelector	The frequency converter.
InputSource	The input signal source for the frequency converter to process.
Divider	The divider index.
Multiplier	The multiplier index.

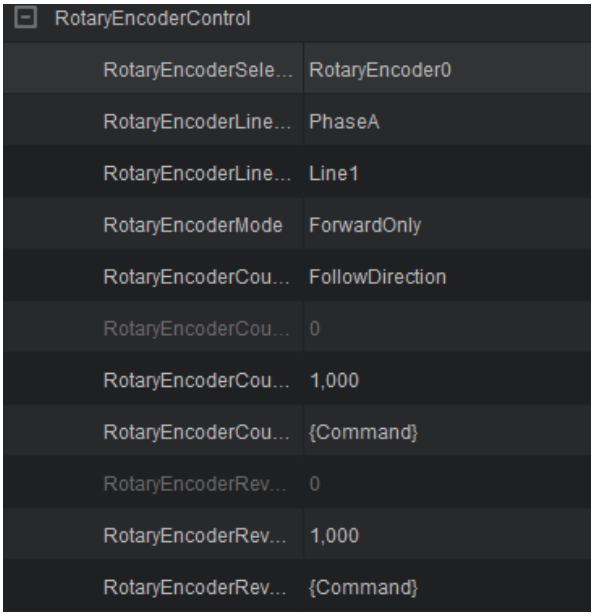
RotaryEncoderControl

Encoders can convert the roller's angular displacement into an electrical signal, and the signal frequency is proportional to the angular displacement speed. The line scan camera can use this signal to perform line trigger. When the max. running speed of the roller does not exceed the upper limit of the encoder's signal accuracy, there is no abnormal stretching compression in the images taken compared with the actual ones.

Step1:Click RotaryEncoderSelector to select an encoder.
Step2:Click RotaryEncoderLineSelector to select the encoder phase.
Step3:Select line of rotary encoder. You can select from PhaseA and PhaseB, which influences the forward and reverse direction of the movement platform.
Step4:Click RotaryEncoderMode to set the direction of the encoder.
The trigger mode of rotary encoding is divided into 2 modes: ForwardOnly and AnyDirection. When the platform translation trigger signal reaches the set line height, a frame will be triggered.

- ForwardOnly: Images are output when the encoder rotates in a forward direction. During rotation in a reverse direction, RotaryEncoderReverseCounter will record the number of reversed signals. Then, the number of reversed signals will be reduced during rotation in a forward direction, and the images are output until the number is reduced to 0. This achieves debouncing.
- AnyDirection: Images will be generated when the encoder rotates in any direction.

	The value of RotaryEncoderReverseCounterMax must be greater than the max. reverse signals. Otherwise, debouncing will fail.



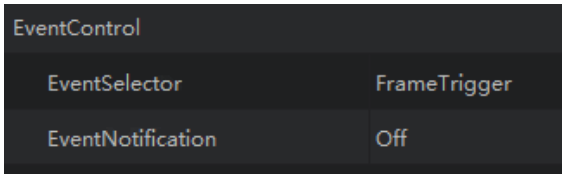
Advantages of encoder trigger:

- The output signal frequency of the encoder is proportional to the speed of the object, ensuring that the signal frequency is synchronized with the speed of the object's movement.
- The output pulse is used as the trigger signal of the line scan camera to synchronize the acquisition frequency of the camera with the movement speed of object.
- Images can be captured normally in the scene of non-uniform motion.
- When objects jitter in the application environment, set RotaryEncoderMode to ForwardOnly to eliminate the image impact caused by jitter.

Parameter	Descriptions
RotaryEncoderSelector	The rotary encoder.
RotaryEncoderLineSelector	The encoder phase.
RotaryEncoderLineSource	The signal source of the rotary encoder phase.
RotaryEncoderMode	The frame output mode of the encoder.
RotaryEncoderCounterMode	The counting mode of the encoder.
RotaryEncoderCounter	The current value of the rotary encoder.
RotaryEncoderCounterMax	Specifies that counting restarts when the counter cleared.
RotaryEncoderCounterReset	Clear the counter.
RotaryEncoderReverseCounter	The number recorded by the reverse counter.
RotaryEncoderReverseCounterMax	Specifies that counting restarts when the reverse counter cleared.
RotaryEncoderReverseCounterReset	Clear the reverse counter.

EventControl

In EventControl, you can enable event notification and select the type of events that trigger notifications.

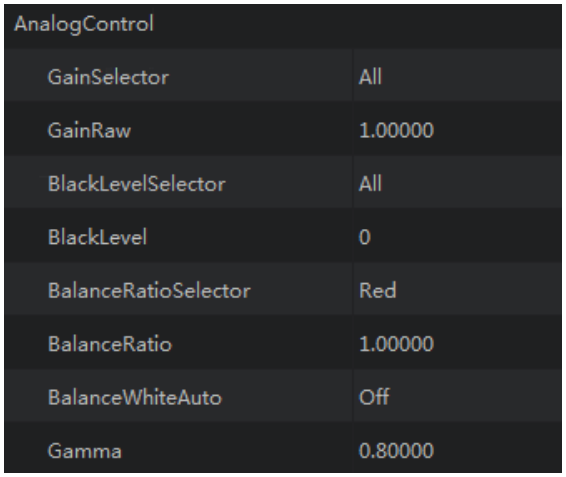


Parameter	Descriptions
EventSelector	The type of events that can trigger notifications. ● FrameTrigger: Sends frame trigger signals to the sensor. ● FrameStart: Receives frame trigger. ● AcquisitionStart: Starts image acquisition. ● ReadOut: The current frame ends trigger.
EventNotification	Specifies whether to notify upper-level software after the preceding event types are selected. ON: yes. OFF: no.

AnalogControl

In AnalogControl, you can adjust the image analog signals collected by the camera, including gain, black level, white balance, and Gamma correction. The analog gain is an internal property of the sensor.

When pulling streams to acquire images, the camera performs FPN correction, deducts black level, and then correct white balance.



Parameter	Descriptions
GainSelector	Not available. Leave it as default.
GainRaw	The larger the value, the brighter the image. The available setting range is different depending on the models. The default value is 1. Note：Analog gain takes priority.
BlackLevelSelector	The channel for which black level is configured. Black level is used to eliminate the impact caused by the dark current of the sensor. For example, under fully dark conditions, the image brightness is larger than 0, which is the dark current of the sensor. You can adjust the black level to make the channel brightness closer to that of the actual image. The value ranges from 0 to 255. ● Off: Set BlackLevel to the black level calculated by the algorithm. ● Once: The algorithm sets BlackLevel for once according to the return value of the sensor, and then BlackLevelAuto changes to Off. ● Continues: The algorithm continuously sets BlackLevel according to the return value of the sensor. Note：The black level changes along with the temperature. We recommend you obtain the value when the temperature is constant.
BlackLevel	
BlackLevelAuto	
BalanceRatioSelector	Select the Red, Green or Blue channel to set the white balance. Adjust the image color by setting R, G and B to make the image more vivid. ● If BalanceWhiteAuto is set to Off, and you can set the value of Red, Green and Blue channels. ● If BalanceWhiteAuto is set to Once, the camera performs auto white balance for a period and then stops it based on the current situation. ● If BalanceWhiteAuto is set to Continues, the camera continuously performs white balance. Note：White balance correction is only applicable for color cameras. The white balance of black and white cameras is 1 by default.
BalanceRatio	
BalanceWhiteAuto	

AnalogControl

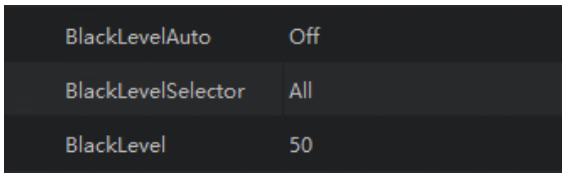
Parameter	Descriptions
Gamma	Gamma is a non-linear correction of the image data due to non-linear response of the display. The larger the Gamma value, the darker the image. The range is 0–3.99998. 1 means no gamma process.
SensorBOC	Specifies whether to enable auto black level correction for the sensor. If the function is enabled, the black level output by the sensor is a constant value instead of changing with the temperature. This helps adjust the brightness change of images and eliminate the impact of black blocks on white blocks.

BlackLevel

Black level helps you adjust the gray value offset of the output data. The gray value offset determines the average gray value when the sensor is not sensitive (the lens is covered). Different bit depth modes have different black level parameters.

If you need to set the black level, enter a value for Black Level.

Generally, the black level of cameras is corrected before delivery. If the contrast of light and dark fields needs to be enhanced or decreased in actual use, you can adjust the black level.



Gain

The camera gain is divided into analog gain and digital gain. The noise of digital gain is more obvious than that of analog gain. We recommend you use analog gain.

- Analog gain can multiply the image analog signal of the sensor.
- Digital gain can amplify the electrical signal of the image after FPGA conversion. The higher the parameter value, the stronger the gain, the higher the brightness, and the more the noise.

■ Analog Gain

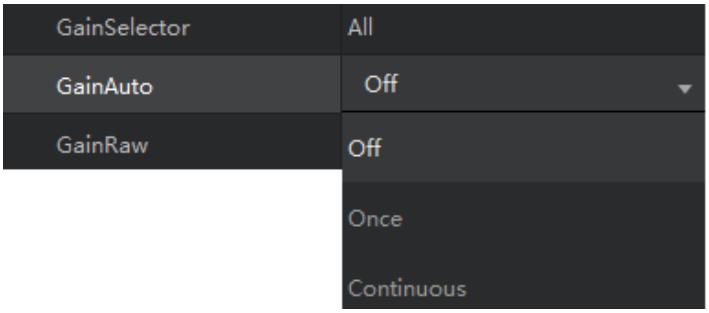
Gain parameter settings include Off, Once and Continuous. Gain value ranges from 1–32. A large value is not recommended. During FPN, when the analog gain value is the actual analog gain level of the sensor, the FPN effect is the best.

We recommend you perform FPN correction at the gain level of your target image to achieve the best effect. See the following table for details. For example, for Mars8001-L13gm , if you set the analog gain to 7, the actual analog gain of the sensor will be adjusted to 3.5, and then multiplied by 2. In this scenario, if you need to do FPN calibration, adjust the gain level to 3.5 to achieve the best effect. You can restore the gain level to 7 after FPN correction.

Camera model	Analog gain level number	Analog gain level
Mars2048C-L49gc	1	
Mars2048C-L49gm		
Mars2048G-L49gc	5	1 1.4 1.6 2.4 3.2
Mars2048G-L49gm		
Mars4096C-L28gc	2	1 4
Mars4096C-L28gm	1	
Mars4096G-L28gc	5	1 1.4 1.6 2.4 3.2
Mars4096G-L28gm		
Mars8001-L13gm	2	1 3.5

AnalogControl

GainAuto



Analog gain mode	Parameter	Description
Manual	Off	Adjust the analog gain according to the value set in GainRaw. Most cameras only support setting a specific target value.
Automatic once	Once	Automatically run analog gain for a period of time according to the scenario. When reaching the set target, the camera stops running analog gain.
Continuous	Continuous	Automatically and continuously adjust the analog gain according to the scenario.

Only select models support GainAuto. For details, refer to the corresponding product specifications.

■ Digital Gain

Set DigitalShift under ISPControl (ranges from 0–4). The higher the value, the stronger the gain, the higher the brightness, and the more the noise.

AnalogControl

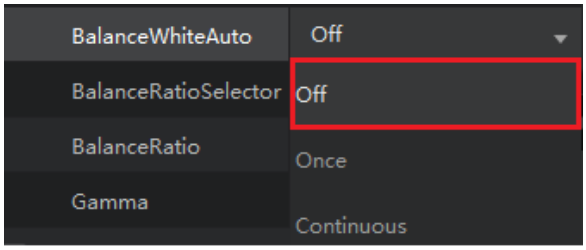
WhiteBalance

White balance allows you to adjust the corresponding R/G/B values to compensate for color cast that occurs when capturing images in different light sources. It keeps the white parts of the image white under different color temperature. White balance supports Off, Once and Continuous mode.

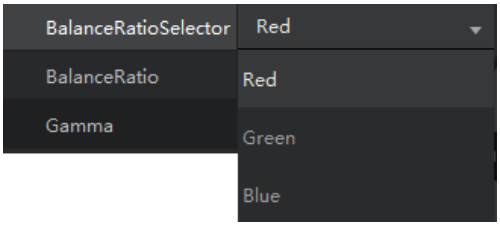
WB Mode	Parameter	Working Mode
Manual	Off	You can manually set the value of Red, Green and Blue channels under BlackLevelSelector and BalanceRatio.
Automatic once	Once	Runs white balance adjustment automatically for a period and then stops based on the current situation.
Continuous	Continuous	Automatically and continuously adjust the white balance according to the scenario.

Due to the difference in the light source in each scene, the actual response of camera to RGB is different from the image capture by eyes, we need to do the white balance again.

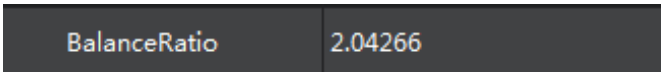
Step1: Place a white paper in the view of the camera. , Click AnalogControl, and then set BalanceWhiteAuto to Once. White balance is completed if Once changes back to Off.



Step2: If the color of images is greenish, try increase exposure value (exposure time). Select R/G/B channels to be adjusted under BlackRatioSelector.



Step3: Adjust the BalanceRatio to a reasonable value among 0–15. Do the same for R/G/B.

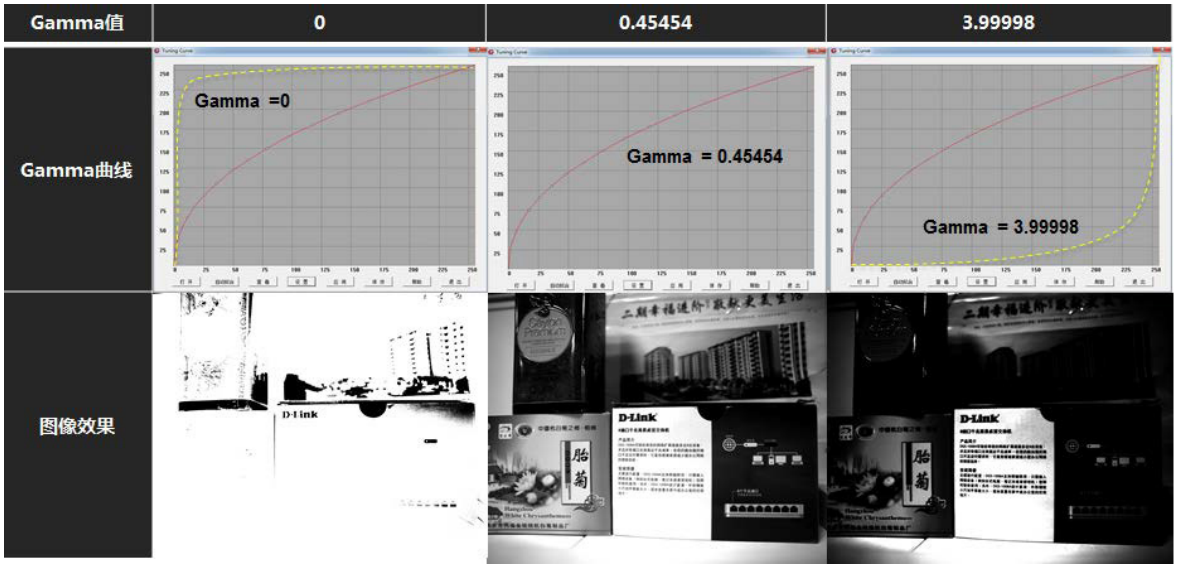


- During white balancing, images can not be overexposed. Click the image to view the gray value, and adjust the exposure value to make sure that the gray value is between 100 and 200.
- Save the parameters after correction to avoid repeated configuration in case of unexpected occasions.
- When the light source and the color temperature of the camera location change, you need to calibrate the white balance again.

AnalogControl

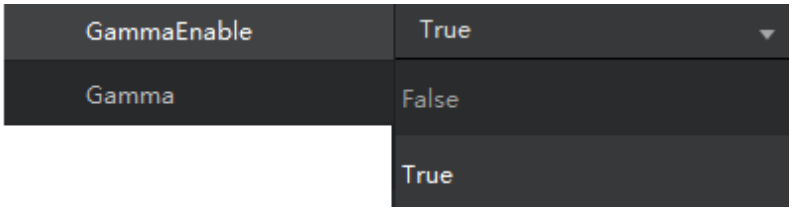
Gamma

Gamma is a non-linear correction of the image data due to non-linear response of the display. The larger the Gamma value, the darker the image. Gamma coefficient ranges from 0 to 3.99998.



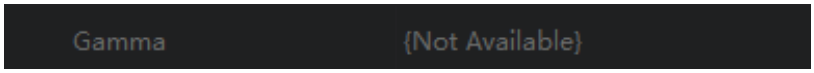
Specific operation steps:

Step1 GammaEnable Select True and the Gamma value can be selected.



Step2 Adjust the Gamma value to make the image brightness meet the requirements.

Step3 GammaEnable When False is selected, the gamma value cannot be selected.

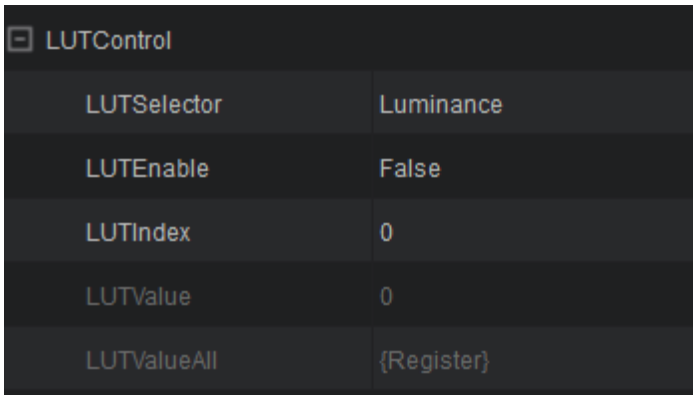


i	Gamma and LookUpTable are on opposite sides. When Gamma is enabled, LUT is unavailable. To make it available, set Gamma value to 1.

LUTControl

In LUTControl, you can stretch or highlight the grayscale range of interest areas in a linear curve or a custom mapping curve.

i	LUT and Gamma are mutually exclusive. When Gamma is enabled, LUT will not take effect. To make it available, set Gamma value to 1.



Parameter	Description
LUTSelector	The channel of LUTControl. Note：Only Luminance is supported.
LUTEnable	Specifies whether to enable LUTControl.
LUTIndex	The number points in the lookup table. The value range is 0-4095.
LUTValue	The value of LUTIndex.
LUTValueAll	Change the value of all indexes to the same one.

TransportLayerControl

TransportLayerControl	
PayloadSize	8,388,608
GevActiveLinkCount	1
GevInterfaceSelector	0
GevLinkSpeed	1,000
GevMACAddress	
GevSupportedOptionSelector	SingleLink
GevSupportedOption	True
GevCurrentIPConfigurationLLA	True
GevCurrentIPConfigurationDHCP	False
GevCurrentIPConfigurationPersistentIP	False
GevCurrentIPAddress	
GevCurrentSubnetMask	
GevCurrentDefaultGateway	0.0.0.0
GevIPConfigurationStatus	LLA
GevFirstURL	Lo
GevSecondURL	
GevNumberOfInterfaces	1
GevPersistentIPAddress	0.0.0.0
GevPersistentSubnetMask	0.0.0.0
GevPersistentDefaultGateway	0.0.0.0
GevMessageChannelCount	1
GevStreamChannelCount	1
GevHeartbeatTimeout	3,000
GevTimestampTickFrequency	125,000,000
GevTimestampControlLatch	{Command}
GevTimestampControlReset	{Command}
GevTimestampValue	0

GevGVCPExtendedStatusCodesSelector	Version1_1
GevGVCPExtendedStatusCodes	False
GevGVCPPendingAck	False
GevGVCPHeartbeatDisable	False
GevGVCPPendingTimeout	200
GevGVSPExtendedIDMode	Off
GevCCP	ControlAccess
GevPrimaryApplicationSocket	63,849
GevPrimaryApplicationIPAddress	
GevMCPHostPort	63,848
GevMCDA	
GevMCTT	300
GevMCRC	3
GevMCSP	1,024
GevStreamChannelSelector	0
GevSCPInterfaceIndex	0
GevSCPHostPort	63,857
GevSCPSFireTestPacket	False
GevSCPSDoNotFragment	True
GevSCPSPacketSize	6,380
GevSCPD	0
GevSCDA	
GevSCSP	20,202
FrameTriggerCount	0
FrameTriggerLostCount	0
LineTriggerCount	1
LineTriggerLostCount	0
StatTriggerCountReset	{Command}

TransportLayerControl

Parameter	Description
PayloadSize	The length of each message.
GevActiveLinkCount	The number of logical channels currently connected.
GevInterfaceSelector	The number of Ethernet ports. It is 0 by default.
GevLinkSpeed	The negotiated rate of the current Ethernet port.
GevMACAddress	Device MAC address.
GevCurrentIPconfigurationLLA	Enable LLA function. When setting GevCurrentIPconfigurationLLA to True, you can set the IP address in LLA mode after the device is powered on.
GevCurrentIPconfigurationDHCP	Enable DHCP function. When setting GevCurrentIPconfigurationDHCP to True, you can set the IP address in DHCP mode. In this case, the IP address can be automatically obtained.
GevCurrentIPconfigurationPersistentIP	Static IP function. When setting GevCurrentIPconfigurationPersistentIP to True, you can set the IP address in static mode after the device is powered on. Note: Priority level of 3 IP configurations is static IP > DHCP > LLA.
GevCurrentIPAddress	The IP address of the device.
GevCurrentSubnetMask	Subnet mask of the current device.
GevCurrentDefaultGateway	Gateway of the current device.
GevIPConfigurationStatus	Displays the assigning method of the current IP address, including LLA, DHCP and static IP.
GevFirstURL	Acquires the first URL address of GenICam XML.
GevSecondURL	Acquires the second URL address of GenICam XML.
GevNumberOfInterface	Displays the number of logic channels that the device supports.
GevPersistentIPAddress	Static IP address of the device.
GevPersistentSubnetMask	Subnet mask of device static IP.
GevPersistentDefaultGateway	Gateway of device static IP.
GevMessageChannelCount	Displays the number of message channels that the device supports.
GevStreamChannelCount	Displays the number of streaming channels that the device supports.
GevHeartbeatTimeout	Heartbeat timeout period.
GevTimestampTickFrequency	Frequency of timestamp.
GevTimestampControlLatch	Latch the current timestamp into GevTimestampValue.
GevTimestampControlReset	Used to reset the internal timestamp.
GevTimestampValue	Used to store the latched timestamp.
GevGVCPExtendStatusCodesSelector	The version of GigE Vision for extended status code output.
GevGVCPExtendStatusCodes	Outputs extended status code or not.
GevGVCPPendingAck	Reports to Pending_ACK or not when command timed out.
GevGVCPHeartbeatDisable	Disable heartbeat detection of GVCP.
GevGVCPPendingTimeout	Timeout period of GVCP command execution.
GevGVSPExtendedIDMode	Enable GVSP extended ID code.
GevCCP	Controls the permissions of applications to access the camera. ● ExclusiveAccess: The application that connected to the camera can can modify the register. ● ControlAccess: The application that connected to the camera can can read the register, but cannot modify it.
GevPrimaryApplicationSocket	Displays the UDP source port of the application that connected to the camera.
GevPrimaryApplicationIPAddress	Displays the IP address of the application that connected to the camera.
GevMCPHostPort	The destination port of the camera message channel.
GevMCDA	The destination address of the camera message channel.
GevMCTT	Timeout period of message channel.

TransportLayerControl

Parameter	Description
GevMCRC	The max. number of message channel retransmissions.
GevMCSP	Displays the source port of message channel.
GevStreamChannelSelector	Select the streaming channel number if the camera supports multiple streaming channels.
GevSCPinterfaceIndex	Displays the logic channel of device.
GevSCPHostPort	The port number used by the streaming channel of the camera.
GevSCPSFireTestPacket	Sends a test message.
GevSCPSDoNotFragment	If the message is too long, whether to send the message in fragments and add fragmentation position 1 in the IP header.
GevSCPSPacketSize	The message length of the streaming channel.
GevSCPD	The interval between messages. Note: Changing the value can reduce the pressure on the NIC, but the max. bandwidth will be affected and the time to get a single frame will be prolonged.
GevSCDA	The destination address of the streaming channel.
GevSCSP	The destination port of the streaming channel.

UserSetControl

You can save or adjust the parameters, and set the default parameters when the client starts.

Parameter	Description
UserSetSelector	The user group. User groups include Default, UserSet1, and UserSet2. Note：FPN coefficient cannot be saved or copied to other cameras.
UserSetLoad	Loads user settings as camera settings.
UserSetSave	Saves the current settings to a user group. The settings cannot be saved to the Default user group.
UserSetDefault	The default settings that take effect after the camera is powered on. For UserSet1 and UserSet2, you must set UserSetSave first.
UserSetLoadLastUserSet	The last used settings.
UserSetLoadStatus	The loading status of user settings.

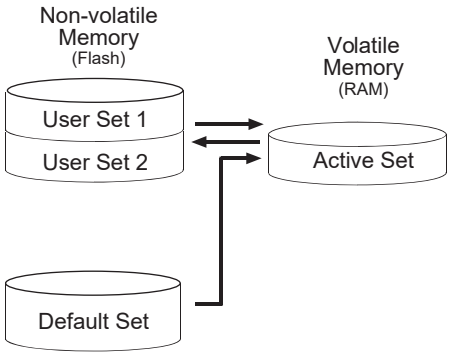
The camera can store three user sets. They serve as convenient storage locations for the camera user and have no impact on the operation of the camera.You can use iCentral application to easily set the parameters.

Active Set: The active set is the camera's current parameter settings. It is located in the camera's volatile memory and the settings are lost if the camera is reset or if power is switched off.

Default Set: The default set is the camera's factory optimized configuration. It is saved in a permanent file in the camera's non-volatile memory. It is not lost when the camera is reset or switched off.

User Sets: There are two reserved areas in the camera's non-volatile memory available for saving configuration sets. A configuration set saved in a reserved area is commonly referred to as a "user set" .

The two available user sets are called User Set 1 and User Set 2.



UserSetControl

Saving User Sets

Saving the current active set into a user set in the camera's nonvolatile memory is a three step process:

- Make changes to the camera's settings until the camera is

operating in a manner that you would like to save.

- Set the UserSetSelector parameter to UserSet1, or UserSet2.
- Execute a UserSetSave command to save the active set to the selected user set.

Saving an active set to a user set in the camera's non-volatile memory will overwrite any parameters that were previously saved in that user set.

You can set the UserSetSelector parameter and execute the UserSetSave command via iCentral. You can also set the parameters from within your application software by using the API that we provide.

Loading Saved Set or the Default Set into the Active Set

If you have saved a configuration set into the camera's non-volatile memory, you can load the saved set from the camera's non-volatile memory into the camera's active set.

When you do this, the loaded set overwrites the parameters in the active set. Since the settings in the active set control the current operation of the camera, the settings from the loaded set will now be controlling the camera.

You can also load the default set into the camera's active set.

To load an UserSet or the default set into the active set:

- Set the UserSetSelector parameter to UserSet1, UserSet2, or Default.
- Execute a UserSetLoad command to load the selected set into the active set.

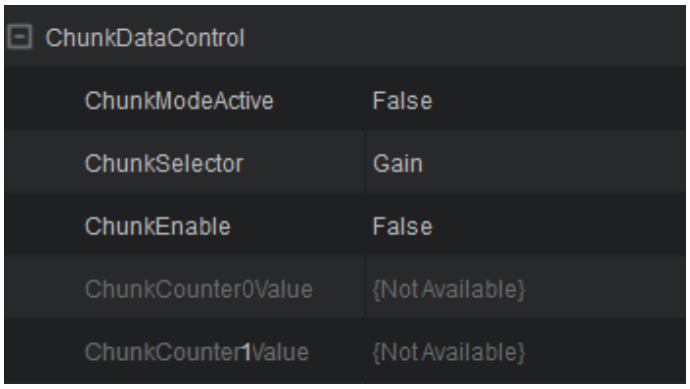
You can set the UserSetSelector parameter and execute the UserSetLoad command via iCentral. You can also set the parameters from within your application software by using the API that we provide.

	Loading a user set or default set into the active set is only allowed when the camera is idle, i.e. when it is not acquiring images continuously or does not have a single image acquisition pending. Loading the default set into the active set is a good course of action, if you have grossly misadjusted the settings in the camera and you are not sure how to recover. The default set is optimized for use in typical situations and will provide good camera performance in most cases.

ChunkDataControl

In ChunkDataControl, you can change image color.

i	Only color cameras support ChunkDataControl.

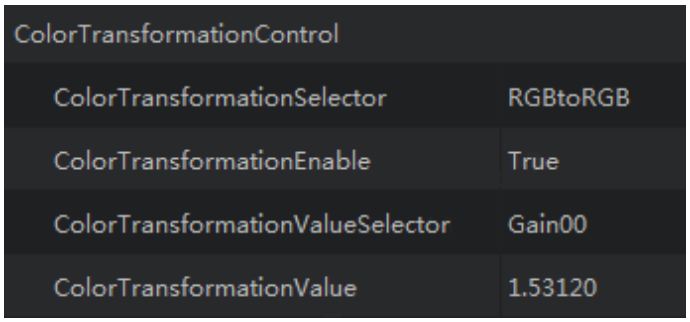


Parameter	Description
ChunkModeActive	Activates the chunk data in images.
ChunkSelector	Select the chunk data function.
ChunkEnable	Specifies whether to enable chunk data.
ChunkCounter0Value	Returns the value of PLC controller 0.
ChunkCounter1Value	Returns the value of PLC controller 1.

ColorTransformationControl

ColorTransformationControl, you can change image color.

i	Only color cameras support ColorTransformationControl.

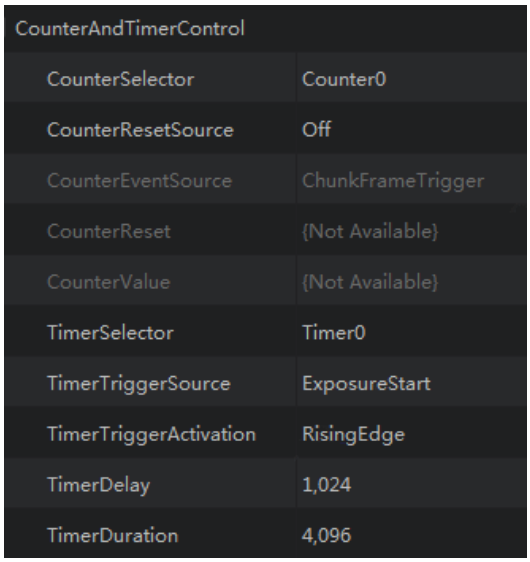


Parameter	Description
ColorTransformationSelector	Select a color transformation module to configure. RGBtoRGB and RGBtoYUV are supported.
ColorTransformationEnable	Specifies whether to enable the color transformation module. You can set RGBtoRGB and RGBtoYUV separately.
ColorTransformationValueSelect or	The type of the enhancement factor.
ColorTransformationValue	The value of the enhancement factor.

CounterAndTimerControl

The counter can divide the frequency of the externally input trigger signal to perform exposure control according to the user's logic.

i	Before you use CounterAndTimerControl, set TriggerSource.

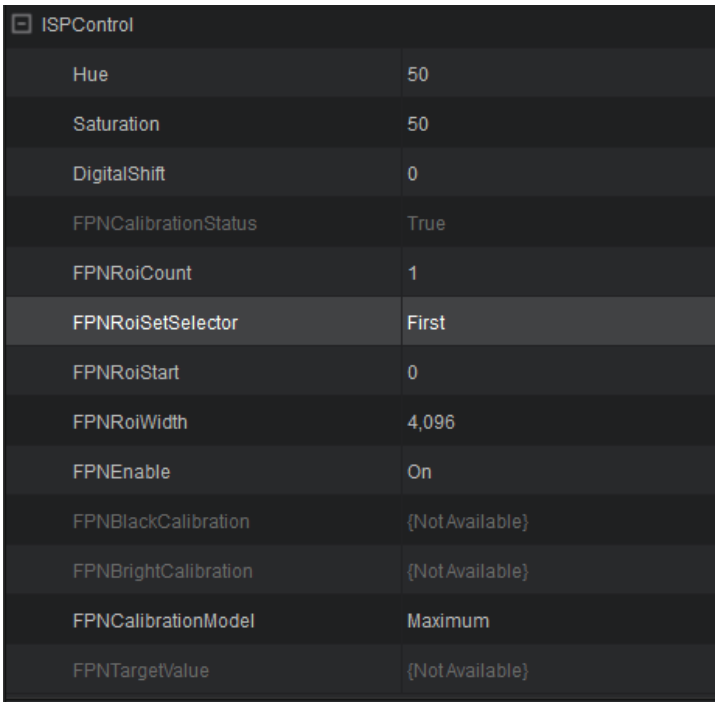


Parameter	Description
CounterSelector	● If you select Counter0, CounterEventSource is set to FrameTrigger. ● If you select Counter1, CounterEventSource is set to FrameStart.
CounterResetSource	Select the signal source to reset the counter: Off (no reset), SoftwareSignal0 (software signal reset) and Line1 (hardware signal reset).
CounterEventSource	Displays the event sources that will be added to the counting: FrameTrigger and FrameStart.
CounterReset	Reset the counter.
TimerSelector	The counter to be set. The default is Timer0.
TimerTriggerSource	The trigger source for starting the timer. The default is ExposureStart.
TimerTriggerActivation	The trigger mode for starting the timer, including RisingEdge, FallingEdge and AnyEdge (rising edge or falling edge).
TimerDelay	The delay between receiving the trigger signal and starting the timer.
TimerDuration	The duration of the timed pulse.

ISPControl

ISPControl, you can adjust the sharpness, brightness, saturation and contrast of images.

i	Hue and saturation are only available for color cameras.



Parameter	Description
Hue	Adjusts the chrominance component in HSV color space, the default value is 50.
Saturation	Adjusts the saturation component in HSV color space, the default value is 50. The higher the value, the higher the saturation and the more flamboyant the color.
DigitalShift	Increase the value of DigitalShift by one, and the image brightness is doubled.
FPNCalibrationStatus	The status of the FPN calibration. True means the image has been corrected, false means not.
FPNRoiCount	The number of effective FPN areas.
FPNRoiSetSelector	Switch effective FPN areas.
FPNRoiStart	The start point of effective FPN areas.
FPNRoiWidth	The end point of effective FPN areas.
FPNEnable	Specifies whether to enable FPN. During FPN, when the analog gain value is that of the actual sensor, the FPN effect is the best. For details, see Gain Raw.
FPNOnceEnable	Apply the FPN effects of different analog levels to other levels. Evenly apply the FPN coefficient of the level with the analog gain of 1 to the other analog gain levels (available on select models.)
FPNBlackCalibration	Specifies whether to enable dark field correction.
FPNBrightCalibration	Specifies whether to enable bright field correction.
FPNCalibrationModel	Select the FPN effect from Maximum, Average and User (custom). Average is recommended.
FPNTargetValue	Custom effect value: 50–240. The higher the value, the stronger the correction.
RestoreDefaultCalibra tion	Restores default FPN data. This covers FPN performed by users after FPN is enabled.

FPNCalibration

FPN calibration is applied to ensure image uniformity of line scan cameras.

Step1：In ISPControl, set FPNEnable to Off.

Step2：In a dark environment, completely cover the lens, and then click {Command} next to FPNBlackCalibration.; Wait for the command to take effect, and then click to capture images.

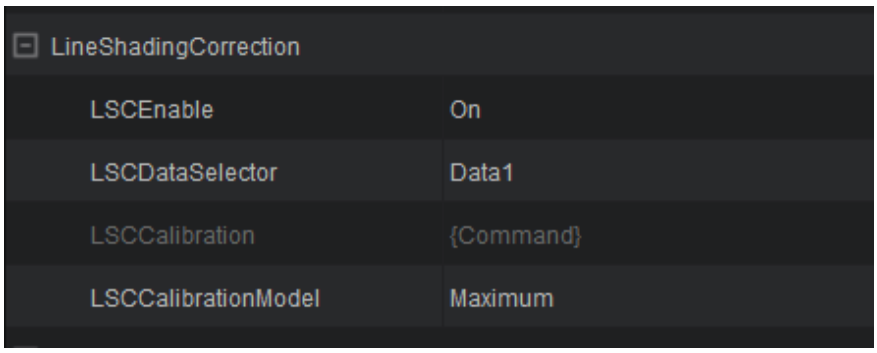
Step3：In a bright environment, place white paper in the view of the camera. The focus of the lens must be blurred to blur the overall image. Images can not be overexposed. Click the image to view the gray value, and adjust the exposure value to make sure that the gray value is between 100 and 200.

Step4：Click {Command} next to FPNBrightCalibration. Wait for the command to take effect, and then click to capture images.

Step5：Set FPNEnable to On to complete correction. If the effect is abnormal, it is possible that the edge of the dark/bright environment is bright or dark, or the lens is not blurred and the paper has much texture.

	Images must not be overexposed.

LineShadingCorrection



Based on FPN and shades caused by lens and light source, you can correct external optical environments through line shading correction.

To perform line shading correction, you must enable FPN and place a white paper or uniform plate.

- LSCEnable: Specifies whether to enable line shading correction.
- LSCDataSelector: The data for line shading correction.
- LSCCalibration: Perform line shading correction.
- LSCCalibrationModel: The correction mode, including Maximum and Average.

You use Camtool to export line shading correction coefficients and import the coefficients to other cameras of the same type. Only select models support the function.

CHAPTER 6 FAQs

No Cameras Detected

Reason:

- The camera is not started as expected.
- Abnormal network cable connection.
- The camera and the client are not one the same network segment.

Solution: Restart the camera. Check whether the network connection is correct and indicator status is normal. Make sure that the camera and the client are on the same network segment.

Cameras Detected but Failed to Connect

Reason:

- The camera is not started as expected.
- The camera and the client are not on the same network segment.
- The camera is connected to other clients.

Solution: Restart the camera, try modifying IP to make it in the same LAN with the client. You can also try disconnect other connected clients and connect the current client again.

Black Live View

Reason:

- The lens aperture is closed.
- The camera is working abnormally.

Solution: Open the aperture or restart the camera.

Unavailable External Trigger

Reason:

- Incorrect cable connection of external trigger.
- The trigger mode is not set to external trigger.

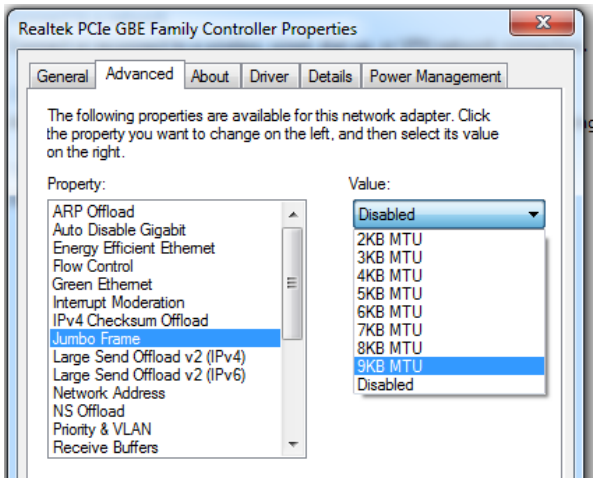
Solution: Select a right trigger mode and make sure that the external cable connection is correct.

Images Are Upside Down

Reason: The installation direction of the camera is wrong.
Solution: Go to Settings > ImageFormatControl > ReverseX in the client to correct images.

Failed Stream Acquiring

The port is not a GigE port and Jumbo is disabled. Trigger is disabled for the camera.



Stretched or Compressed Images

This section introduces a formula for adjusting line frequency to make sure that captured are not stretched or compressed.
View MM: S
ROI width: X
Speed: V
Line frequency: K=V/(S/X)

Make sure that the units of speed and view are the same. (recommended: cm/s, view unit: cm, line frequency unit: /s)

Invalid Trigger

■ IO issues

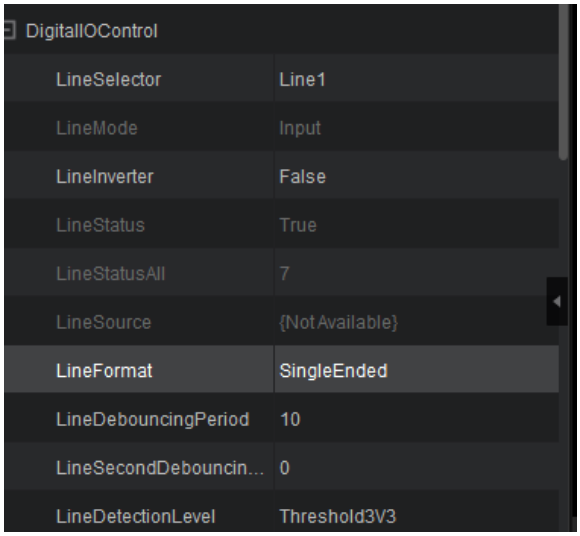
When one IO trigger fails, you can avoid the issue by using another IO as the trigger cable, or checking whether the attribute settings of the IO management terminal conform to actual signal conditions: single-end or differential filter, signal, and signal level.

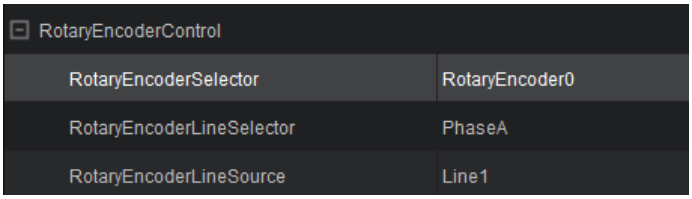
■ Encoder issues

There are many types of encoders in the market, including single-end encoders, differential encoders, incremental encoders, and absolute encoders. Therefore, you must select an appropriate encoder. In addition, the transmission distance is very important.
After the encoder is connected and a channel is selected, you can perform the following steps if the camera does not generate images:

1.Perform frame trigger for 2 lines of the encoder to check whether there is signal output.

2.Check whether the cable connection of the encoder is A+ A- B+ B-, and select lines based on Phase and PhaseB.

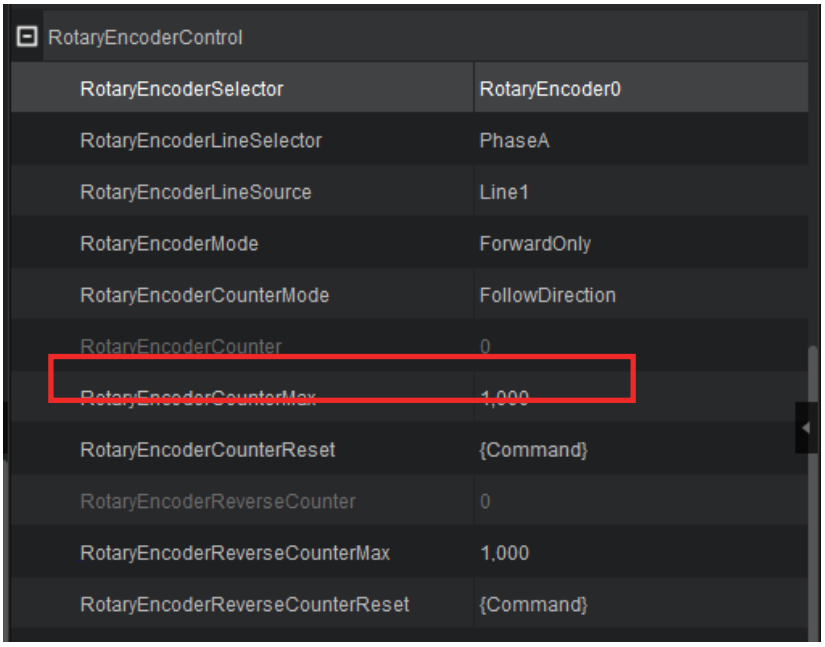




Invalid Trigger

■ Check the encoder

Check whether the value of RotaryEncoderCounterMax changes.
Check whether the debouncing counter changes when the encoder is reversed, and whether the value is set too large.



Issues Related to Debugging and Installation

■ Only a line is captured by the camera

It is possible that the sensor and the scan line is not in parallel.

■ Focus issue

Use an object (without burrs) with a clear border between the bright side and dark side to make the camera focus on the border.

■ Images of the same type of products have huge differences

The light source is not in parallel with the captured object. We recommend you install the line scan camera horizontally. If the camera is installed slantly, you can install a fixed part to unify the installation angle.

■ Errors are reported when exporting or importing camera attributes

iCentral only traverses the attribute tree of the current XML page when saving camera settings. When you modify the hidden attribute tree, such as time-sharing strobing, 4 groups of polling exposure and gain setting, iCentral only saves the exposure gain value of the polling group on the current XML page. When you import the settings to other cameras, the hidden 3 sets of polling parameters cannot be imported.

Similarly, some XML attributes might be deleted or added after the upgrade of camera firmware. If you import the settings saved in the old firmware to a camera upgraded with the new firmware, an XML import error might be reported. The impact will not be significant. However, the attributes in the imported MCF configuration that are different from the actual camera will not be processed. If your firmware versions are inconsistent and attribute trees are inconsistent, import errors will be reported. However, it will not affect the use of cameras. The inconsistent attributes will be set to default values.

■ Images stretched or compressed

Check whether lostcout has lost lines, and make sure that the external trigger frequency is less than or equal to the theoretical line frequency of the camera. After eliminating line loss, enable frequency division.

■ Line loss issue

When line trigger is enabled, the stream packet timeout needs to be set to 0. Otherwise, when the line signal interval is too large, lines will be lost.

■ Abnormal images during debugging

When changing the gain, there is a transition zone in the middle of the image. This is because the modification of the gain involves the synchronous modification of sensor level and FPGA gain. The switching speed of sensor level is less than that of FPGA gain modification, so there is a certain delay. We recommend you stop pulling streams when changing camera attributes.

CHAPTER 7 Technical Support

Technical Support

If you need advice about your camera or if you need assistance troubleshooting a problem with your camera,it's highly recommended to describe your issue in details and contact us via E-mail at support@visiondatum.com

It would be helpful if you can fill-in the following table and send to us before you contact our technical support team.

Camera Model:		Camera's SN:	
Describe the issue in as much detail as possible:			
If known, what's the cause of the issue?			
How often did/does the issue occur?			
How severe is the issue?			
Parameter set	Please connect the camera directly to PC and use iCentral to make note of the parameter when the issue occurred.		

Hangzhou Vision Datum Technology Co., Ltd.
C-5F, No.8 Xiyuan 9th Road, West Lake District Hangzhou Zhejiang 310030 China
Tel: 86-571-86888309
www.visiondatum.com

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