



3D Laser Line Profiler (DL3000 Series)

User Manual



Foreword

Model

This manual is applicable to the iRAYPLE DL3000 Series 3D Laser Line Profiler.

Applicable Scope

This manual is applicable to the engineer and technical personnel of the 3D laser line profiler.

General

This manual introduces the product information, functions, installation, operations of the 3D Laser Line Profiler (hereinafter referred to as the “camera”). Read carefully before using the camera, and keep the manual safe for future reference.

Required Documents

Please visit our official website to obtain the technical documents of the 3D laser line profiler, such as appearance drawing, data sheet, structure drawing, software, etc.

Safety Instructions

The following categorized signal words with defined meaning might appear in the manual.

Table 1-1 Signal Word Description

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

Table 1-2 Revision History

Version Number	Content	Release Date
V1.0.0	First Release	Jun. 2026

Important Safeguards and Warnings

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

Electrical Requirements

- Improper use of the battery might result in a fire or explosion.
- Make sure to use the same model when replacing the battery.
- Use the power cords that are recommended for the region and conform to the rated.
- Use the standard power adapter; otherwise, it might result in personal injury and device damage.
- The power source shall conform to the requirement of the Safety Extra Low Voltage (SELV) standard, and supply power with rated voltage which conforms to Limited Power Source requirement according to IEC60950-1. Please note that the power supply requirement is subject to the device label.

Storage and Installation

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

Operation and Maintenance

- Before unpacking, please check whether the packaging is intact, damaged, damp, serious deformation, etc.
- When unpacking, please check whether the equipment and related accessories are missing, inconsistent model, damaged, rusted, water ingress, etc.
- When using the camera, please do not touch the housing and the heat sink devices of the camera to avoid burning.
- When running camera, please do not touch the terminals of the camera and supporting devices to avoid electric shock.
- When running the camera, if there is any abnormal situations, such as smoke or peculiar smell, please cut off the power and contact our after-sales service department as soon as possible.
- Do not clean and maintain the camera when it is powered on.

- Please clean device body with a piece of soft dry cloth. If the dirt is difficult to remove, please use a clean soft cloth with a small amount of neutral detergent to gently wipe it off, and then wipe it dry. Don't use detergent with strong abrasiveness and volatile solvents like ethyl alcohol, benzene, and diluent; otherwise the coating on the surface will be damaged and the performance of the device will be degraded.
- Do not disassemble or modify the camera by yourself. Do not directly touch the image sensor with your hand. If the camera is not working properly, please contact out aftersales service department for handling the problems. The functional abnormalities or component damage caused by misoperations or not comply with the relevant regulations are not within the scope of the camera quality assurance services.
- Use the accessories suggested by the manufacturer. Installation and maintenance must be performed by qualified professionals.
- Do not install or place the device in a location that exposes it to sunlight or heat sources.
- Keep the System away from dampness, dust or soot.
- Keep the device installed horizontally or on a stable place to prevent it from falling.
- Do not drip or splash liquid onto the device, and make sure that there is no object filled with liquid on the device to prevent liquid from flowing into it.
- Install the device in a well-ventilated place, and do not block the ventilation.
- Operate the device within the rated range of power input and output.
- Do not dissemble the device.
- Transport, use, and store the device under the allowed humidity and temperature conditions.
- The laser level adopted in the camera is CLASS 2M or CLASS 3R. Please do not directly stare at the beam or trough the optical instruments. The system shall take corresponding protective measures according to the relevant regulations, such as IEC60825.

Table of Contents

Foreword.....	I
Important Safeguards and Warnings.....	II
1 Overview and Requirements.....	1
1.1 Overview.....	1
1.2 Features.....	1
1.3 Naming Rule and Glossary.....	1
1.3.1 Naming Rule.....	1
1.3.2 Glossary.....	2
1.4 Environment Requirement.....	3
1.5 How to Avoid EMI and ESD.....	4
1.6 Product Cleaning.....	4
1.6.1 Shell Cleaning.....	4
1.6.2 Filter Cleaning.....	4
2 Product Appearance and Interface Definition.....	6
2.1 Product Appearance.....	6
2.2 Interface Definition.....	7
2.2.1 Network Interface.....	7
2.2.2 IO Interface (19-Pin M16).....	7
2.3 Indicator Light.....	9
3 Hardware and Software Installation.....	10
3.1 Install Camera.....	10
3.1.1 Camera and Accessory.....	10
3.1.2 Camera Installation.....	10
3.2 3DMVviewer Installation and System Configuration.....	11
3.2.1 3DMVviewer Installation.....	11
3.2.2 System Environment Configuration.....	12
3.3 Client Operations.....	15
3.3.1 Software and Device Connection.....	15
3.3.2 Main Interface.....	16
4 Commissioning.....	18
4.1 Commissioning Procedure.....	18
4.2 Property Tree.....	18
4.3 Raw Image.....	19
4.4 Depth Image.....	20
4.5 Intensity Image.....	22
4.6 Cloud Image.....	23
5 IO Wiring and Electrical Characteristics.....	24

5.1 External Power Requirements.....	24
5.1.1 Wiring Requirement.....	24
5.1.2 Isolation Requirement.....	24
5.1.3 Installation Requirement.....	25
5.2 Opto-isolated Input.....	25
5.2.1 Opto-isolated Input Case 1.....	27
5.2.2 Opto-isolated Input Case 2.....	28
5.2.3 Opto-isolated Input Case 3.....	28
5.2.4 Opto-isolated Input Case 4.....	28
5.2.5 Opto-isolated Input Case 5.....	29
5.2.6 Opto-isolated Input Case 6.....	29
5.3 Opto-isolated Output.....	29
5.3.1 Opto-isolated Output Case 1.....	33
5.3.2 Opto-isolated Output Case 2.....	33
5.3.3 Opto-isolated Output Case 3.....	33
5.3.4 Opto-isolated Output Case 4.....	34
5.4 Differential IO and Single End Input.....	34
5.4.1 Differential Input.....	34
5.4.2 Differential Output.....	35
5.4.3 Single End Input.....	36
6 Image Property.....	38
6.1 Laser Control.....	38
6.2 ROI and Shield Zone.....	38
6.2.1 ROI.....	38
6.2.2 Shield Zone.....	39
6.3 Acquisition Control.....	40
6.3.1 Free Run.....	41
6.3.2 Line Trigger.....	42
6.3.3 Frame Trigger.....	42
6.3.4 Rotary Encoder and Frequency Converter.....	43
6.3.5 Signal Counter.....	45
6.4 HDR.....	45
6.5 Mirroring.....	46
6.6 Gain.....	47
6.6.1 GainRaw.....	47
6.6.2 LLCControl.....	47
6.7 Gamma Correction.....	47
7 Algorithm Parameter.....	49
7.1 Laser Line Extraction Algorithm.....	49
7.1.1 Extract Candidate Point.....	49

7.1.2	Filter Candidate Point.....	49
7.1.3	Laser Line Filtering.....	50
7.1.4	Filter Out Isolated Point.....	51
7.1.5	Laser Line Interpolation.....	51
7.1.6	Laser Line Filter.....	51
7.2	Depth Image Algorithm.....	52
7.2.1	Depth Image Property.....	52
7.2.2	Depth Image Post-processing.....	52
8	Calibration.....	54
8.1	Static Calibration.....	54
8.2	Dynamic Calibration.....	55
9	Device Control and Others.....	56
9.1	DeviceControl.....	56
9.2	TransportLayerControl.....	56
9.3	UserSetControl.....	58
9.3.1	Save User Parameters.....	58
9.3.2	Load User Parameters.....	59
9.3.3	Set Default Parameters.....	59
9.4	Import Property and Export Property	60
9.5	Image Save.....	60
9.6	Image File Viewer.....	61
9.7	Firmware Upgrade.....	61
Appendix 1	Legal Information.....	63

1 Overview and Requirements

1.1 Overview

The DL3000 series 3D laser line profiler has the built-in high-precision point cloud reconstruction algorithm, single-frame HDR, and data fusion algorithm to realize the function of high-precision 3D point cloud data output in real time based on the laser triangle measurement principle. The DL3000 series 3D laser line profiler can support up to 3200 contour points, 20 kHz frequency, and linearity of $\pm 0.01\%$. The iRayple 3D laser line profiler has already been applied in step difference measurement, flatness measurement, volume measurement, etc., in many industries, such as the 3C, Li-ion, photovoltaic, etc.

1.2 Features

- Self-development applicable client software.
- GigE Ethernet port, with fast and stable transmission speed.
- High-precision 3D measurement capability with accuracy up to the micron level.
- Built-in aviation connector to prevent dust and rain.
- Up to 20 kHz scan rate.



For detailed parameters, see the corresponding technical specifications.

1.3 Naming Rule and Glossary

1.3.1 Naming Rule

Figure 1-1 Product Model Name

DL3080B-S2

Table 1-1 Product Model Name Description

Field	DL	3	080	B	S2	H
Item	Category	Contour point quantity	Installation clear distance (CD)	Wavelength	Version	Scan Speed

Field	DL	3	080	B	S2	H
Description	High-precision line laser	3 = 3000 series	050: about 50 mm 060: about 60mm 080: about 80mm 160: about 160mm 200: about 200mm 400: about 400mm	B: Blue; Wavelength: 405 nm R: Red; Wavelength: 650nm I: Infrared; WaveLength : 850 nm	-	H: Higher Frame Rate None: Low Frame Rate

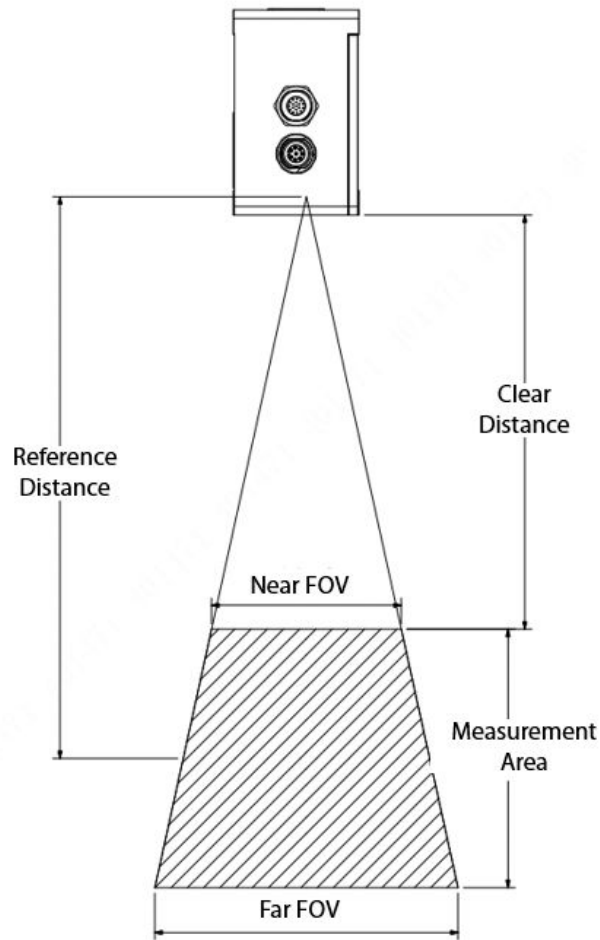
1.3.2 Glossary

This section introduces the relevant glossaries of product which will be mentioned in this manual.

Table 1-2 Glossary Description

Glossary	Description
Scanning Frequency	The number of the images acquired by the camera per unit time.
Measurement Range	The measuring distance range of the device.
Clear Distance	The vertical distance from the optical window on the laser device side to the nearest measurable surface of pbject.
Reference Distance	The best imaging distance of the camera.
Near FOV	The FOV size corresponding to the closest end of the measurement range from the device.
Benchmark FOV	The FOV size corresponding to the distance between the measurement range and the standard labeled point of the device.
Far FOV	The FOV size corresponding to the farthest end of the measurement range from the device.
X-axis Resolution	The spacing of the adjacent points in the single contour data.
Z-axis Resolution	The maximum deviation value of the measurement result, which is measured by repeated measurement of the same target.
Z-axis Linearity	The deviation between the measured value of the camera and the actual value within the measurement range.

Figure 1-2 Measurement Range Diagram



1.4 Environment Requirement

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

- Storage Temperature: $-30^{\circ}\text{C} \sim +80^{\circ}\text{C}$ ($-22^{\circ}\text{F} \sim +176^{\circ}\text{F}$).
- Storage Humidity: 20 % ~ 80 %, non-condensing.



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



For detailed parameters, see the corresponding technical specifications.

1.5 How to Avoid EMI and ESD

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

- Use high-quality cables with a shielding function, which can play a good role in shielding EMI and ESD. Use high-quality shielded cables, which can play a good role in shielding EMI and ESD.
- Appropriate cable length is important. If the cable length is longer than expected, please fold the redundant part instead of looping it.
- Data transmission cable is suggested to be paralleled with the power cable.
- Avoid paralleling the cables with the cables that have high current and voltage inside, such as the stepper motor drive, and solenoid valve. Do not place the camera cables close to the interfering devices mentioned above.
- Connect all the grounding (GND) wires to a single point. For example, a distribution board can be used to connect the grounding wires of the whole system to a single point. This is done to avoid plenty of ground circuits (which are a major cause of EMI problems). Connect all the grounding (GND) wires to a single point. For example, a distribution board can be used to connect the grounding wires of the whole system to a single point. This is done to avoid plenty of ground circuits (which are a major cause of EMI problems).
- Adopt a line filter for the main power supply of the camera, or a separate power supply for the camera is recommended.
- Please keep the camera and cable away from the device generating sparks, such as brushed motors, relays, etc. A metal shielding shell is recommended if necessary.
- The humidity in the installation environment shall be properly controlled. Dry air is easy to produce ESD in.
- Unused terminals of the power cable should be insulated and wrapped. Do not be exposed and suspended.

1.6 Product Cleaning

1.6.1 Shell Cleaning

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

1.6.2 Filter Cleaning

Avoid cleaning the filter of camera with cloth. We recommend you use the **dust stick** to stick the dust or dirt off.

Procedure

- Step 1 Please make sure the power of the camera is disconnected.
- Step 2 Take a clean **dust stick**, and don't touch the sticky tip at the top of the dust stick with your finger.
- Step 3 Place the **dust stick** at an included angle of about 45° with the filter. Lightly stick the dirty area on the surface of the filter.
- Step 4 Rotate the **dust stick** and repeatedly stick the dirt. The **dust stick** shall be discarded after being stuck up to 10 times.
- Step 5 If the dirt or dust still exists, repeat the steps mentioned above until the dirt is cleaned up.

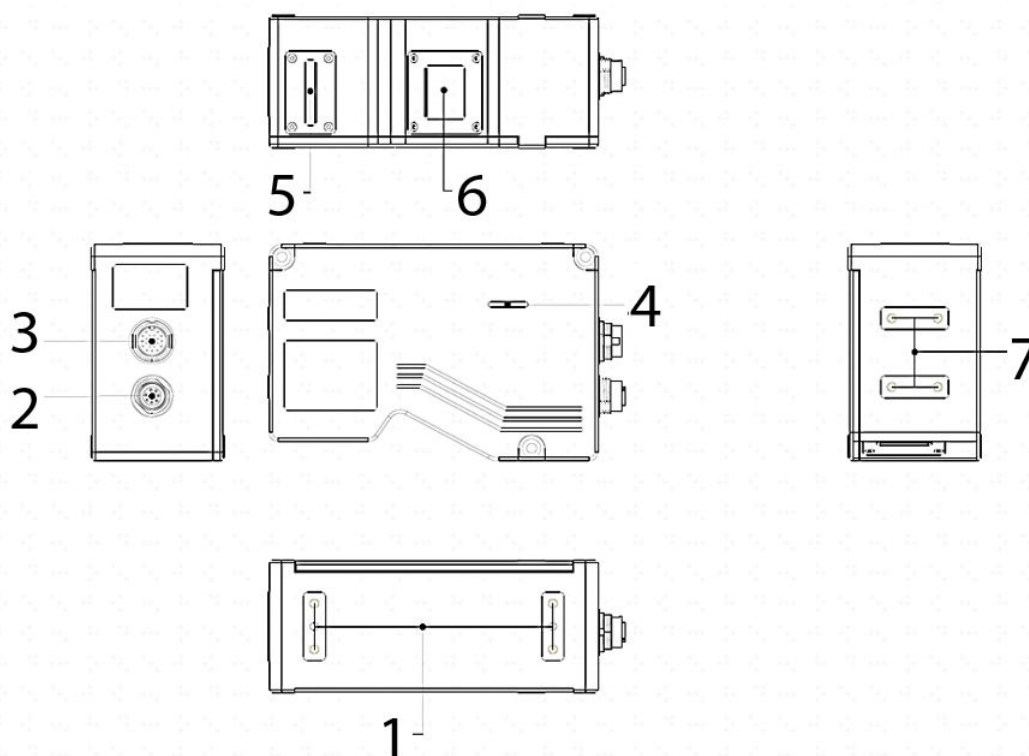


Do not disassemble the camera and clean the sensor by yourself. If you cannot clean the dirt on the outer surface of the filter or there is other dirt, please contact our after-sales service department and return the camera to our factory for cleaning.

2 Product Appearance and Interface Definition

2.1 Product Appearance

Figure 2-1 Appearance Diagram



The interface descriptions of the 3D Laser Line Profiler are as follows.

Table 2-1 Appearance Description

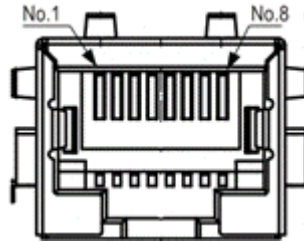
No.	Interface	Description
1	Screw Hole	These screw holes are for fixing the camera. The screw holes are distributed on the top, bottom, or sides of the camera, which may vary depending on the camera model.
2	M12 Aviation Connector	GigE network interface for transmitting data.
3	M16 Aviation Connector	Power and I/O interface for supplying multiple functions, such as camera powering, I/O port, serial port, etc.
4	Indicator Light	It indicates the operating status of camera. For more details of indicator light, please refer to 2.3 Indicator Light .
5	Laser Window	For emitting the laser.
6	Photosensitive Sensor Window	For acquiring the images.

2.2 Interface Definition

2.2.1 Network Interface

The DL3000 series 3D laser line profiler adopts the RJ-45 network connector to connect network cable. the diagram of RJ-45 pins is as follows. Please carefully identify the orientation of the network port.

Figure 2-2 RJ-45 Connector Diagram



The signal definitions of the RJ-45 network connector are described in the table below.

Table 2-2 Signal Definition Description

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



Please manually lock the screws of the RJ-45 connector. Do not use the electric screwdriver. Do not lock the screw too tightly to avoid damaging the network connector. The torque during locking should not exceed 0.15 Nm.

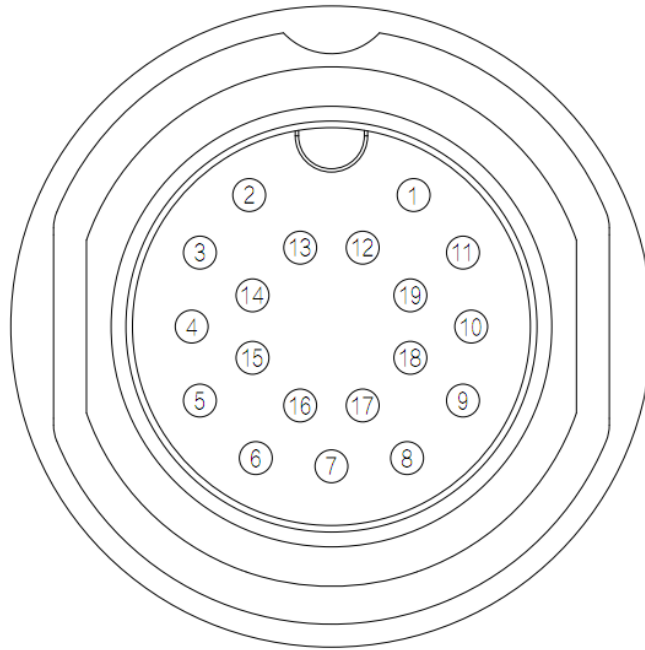


Please use the CAT 5e cable or higher specification. The CAT 6 shielded network cable is recommended to ensure the quality of transmission signal.

2.2.2 IO Interface (19-Pin M16)

The 3D laser line profiler adopts the cable with the 19-pin M16 aviation connector. Please perform the development based on the latest customized cable. It includes the power, opto-isolated input, opto-isolated output, two pairs of differential/single-ended inputs, two pairs of differential inputs/ outputs, and one safety protection line of laser.

Figure 2-3 M16 IO Connector 19-Pin Diagram



The definitions of 19-Pin M16 connector are described in the table below.

Table 2-3 M16 IO Connector 19-Pin Definition

Pin No.	Color	Name	Description
1	Red	POWER_IN	Power Input
2	Black	POWER_GND LASER_SAFE_GND	Power supply ground Laser Safety input GND
3	Yellow-Black	OPT_IN0	Opto-isolated input 0
4	Yellow	OPT_IN1	Opto-isolated input 1
5	Purple-White	OPT_IN_GND	Opto-isolated input GND
6	Yellow-Blue	OPT_OUT0	Opto-isolated output 0
7	Yellow-Brown	OPT_OUT1	Opto-isolated output 1
8	White-Black	OPT_OUT_GND	Opto-isolated output ground
9	Gray	LASER_SAFE_IN	Laser safety input
10	White-Orange	DIFF_IN0_P	Positive differential input 0 and single-ended input 0
11	Orange	DIFF_IN0_N	Negative differential input 0 and reserved single-ended input
12	White-Green	DIFF_IN1_P	Positive differential input 1 and single-ended input 1
13	Green	DIFF_IN1_N	Negative differential input 1 and reserved single-ended input

Pin No.	Color	Name	Description
14	White-Blue	DIFF_INOUT2_P	Positive differential IO 2
15	Blue	DIFF_INOUT2_N	Negative differential IO 2
16	White-Brown	DIFF_INOUT3_P	Positive differential IO 3
17	Brown	DIFF_INOUT3_N	Negative differential IO 3
18	White	NA	Reserved
19	Purple		



The color definitions of pins are applicable only for the HuaRay's IO power cable.

2.3 Indicator Light

The status descriptions of the indicator light of the 3D laser line profiler are described in the table below.

Table 2-4 Indicator Light Status Description

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

3 Hardware and Software Installation

3.1 Install Camera

3.1.1 Camera and Accessory

Please check the accessory list before camera installation.

Table 3-1 Accessory List

No.	Item	Quantity	Description
1	DL3000 Series Laser Line Profiler	1	Check whether the device model is right.
2	(Optional) I/O Power Cable (3/5/10/20 meters)	1	Check whether the I/O power cable is applicable to the camera.
3	(Optional) RJ45-to-M12 Network Cable (2/5/10/20 meters)	1	Check whether the network cable is applicable to the camera.
4	Power Adapter	1	Use the proper DC power adapter, or purchase one according to the technical document.
5	Calibration Block	1	For the calibration commissioning of the camera.
6	Others	1	Mounting plate, screws, etc.



- The quantity of the accessories mentioned in the list is only for one camera.
- This accessory table is only for the recommendation; therefore, you can prepare the accessory according to your actual needs.

3.1.2 Camera Installation

Procedure

Step 1 Remove the stickers on the image sensor and laser windows. Do not touch windows with your fingers directly.

Step 2 Fix the camera to the installation position with the mounting plate.



Make sure the installation position is in a well-ventilated area. You can also install the additional heat-dissipation parts on the camera or add a fan to accelerate the heat dissipation.

Step 3 Connect the M12 connector of the network cable to the port marked with "NET" on the camera. Connect the other end of the network cable to the network card of PC, or to the switch and then connect it to the network card of the PC.

Step 4 Wiring the I/O power cable to the port marked with "POWER" on the camera; connect the other end of the I/O power cable to the DC power or other external devices.

3.2 3DMVviewer Installation and System Configuration

3.2.1 3DMVviewer Installation

In order to facilitate users to use the camera, we provide the client software of 3DMVviewer. 3DMVviewer can be installed on 32-/64-bit Windows 7/10/11.



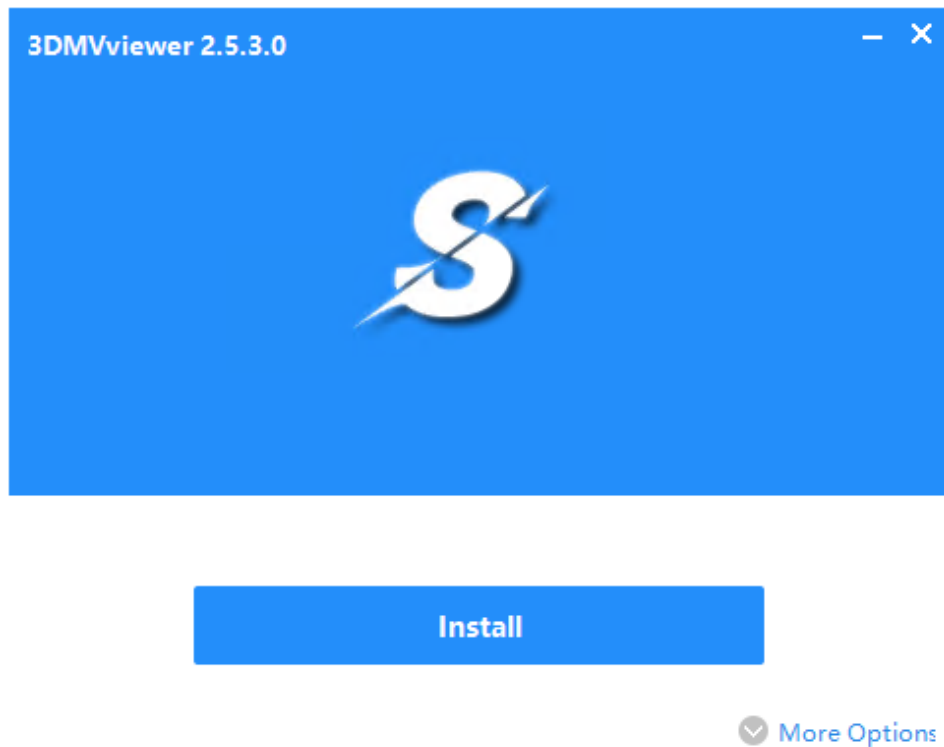
- Please visit our **official website** to obtain the latest installation package of the 3DMVviewer.
- Download Path: **Support** > **Download Center** > **Machine Vision** > **Software**.

The procedures of software installation are as follows.

Procedure

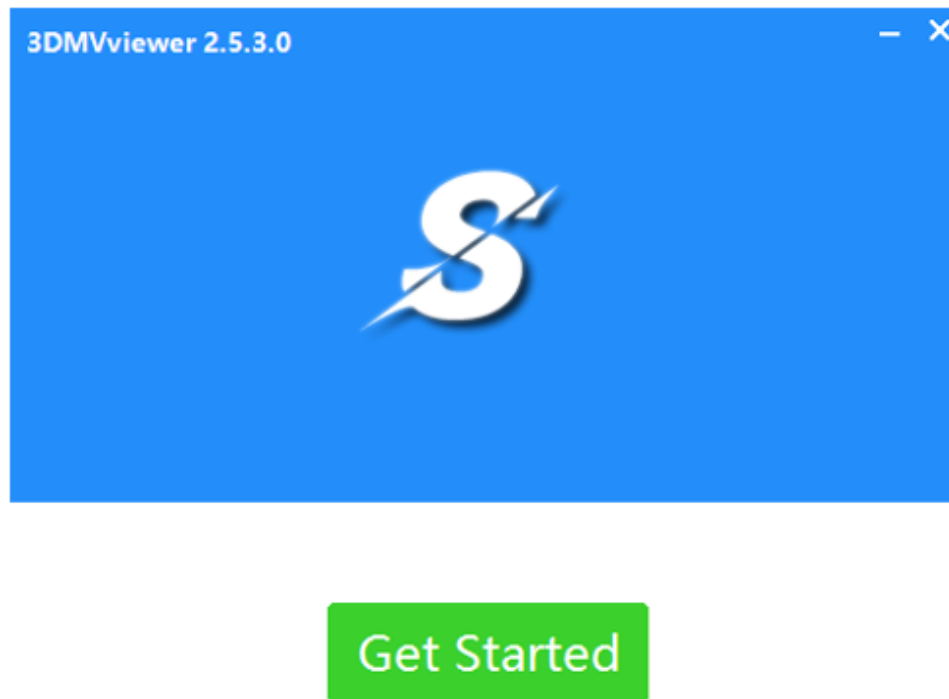
- Step 1 Double-click the installation package, and the installation interface of the 3DMVviewer will pop up. Select the installation path, and click **Install**.

Figure 3-1 Standard Installation



- Step 2 After the installation is completed, click **Get Started**.

Figure 3-2 Installation Complete



3.2.2 System Environment Configuration

3.2.2.1 Disable Firewall

Procedure

- Step 1 Take the operating system of 64-bit Windows 10 as an example to illustrate how to find "Firewall" settings on your PC. Click **This PC > Properties > Control Panel > System Security > Windows Defender**.
- Step 2 Click the **Turn Windows Defender Firewall on or off**.
- Step 3 Select **Turn off Windows Defender Firewall** in every network setting.
- Step 4 Disable the anti-virus software.
- Step 5 Click **OK**.

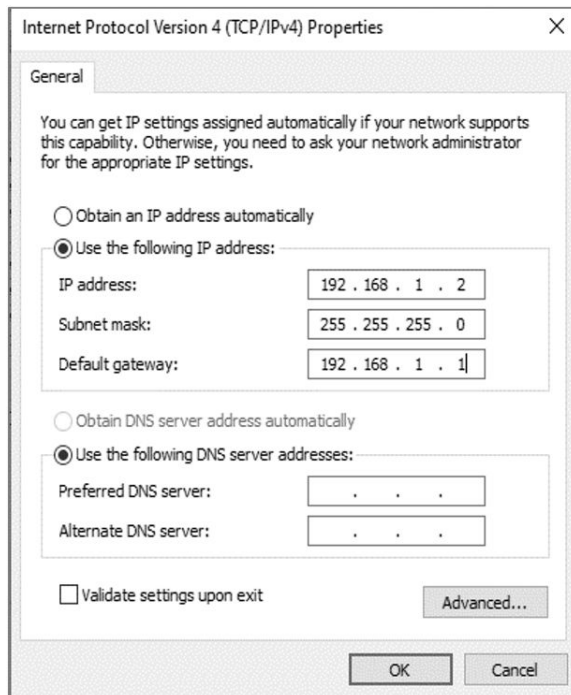
3.2.2.2 Enable Static IP

Compared with the dynamic IP, the static IP can shorten the device search time, so we recommend you to configure the network to the static IP address.

Procedure

- Step 1 Click **Control Panel > Network and Internet > Network and Sharing Center > Change Adapter Configuration**.
- Step 2 Connect the frame grabber of the industrial camera, and select the frame grabber in the device list.
- Step 3 Configure the network port to use the static IP. Please refer to the figure below.

Figure 3-3 Set Static IP Address



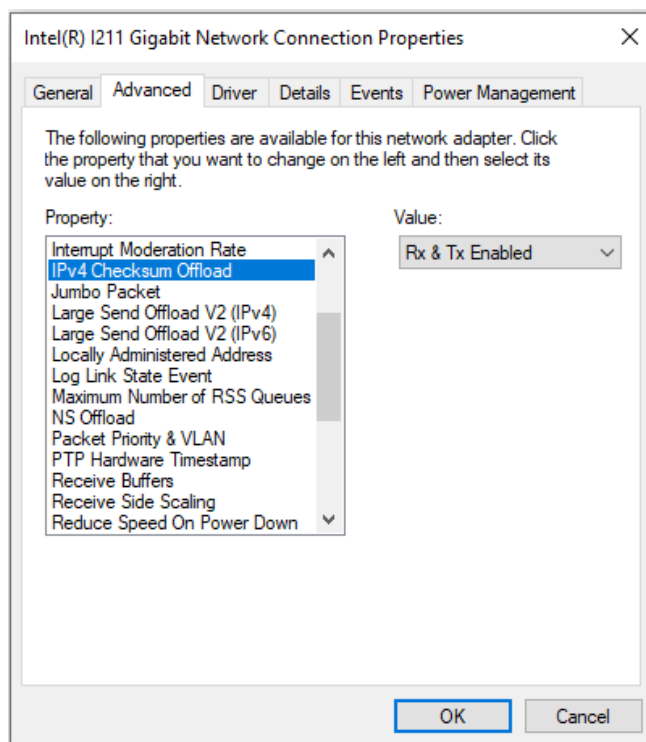
3.2.2.3 Enable Jumbo Frame

The procedures of Jumbo Frame enabling are as follows.

Procedure

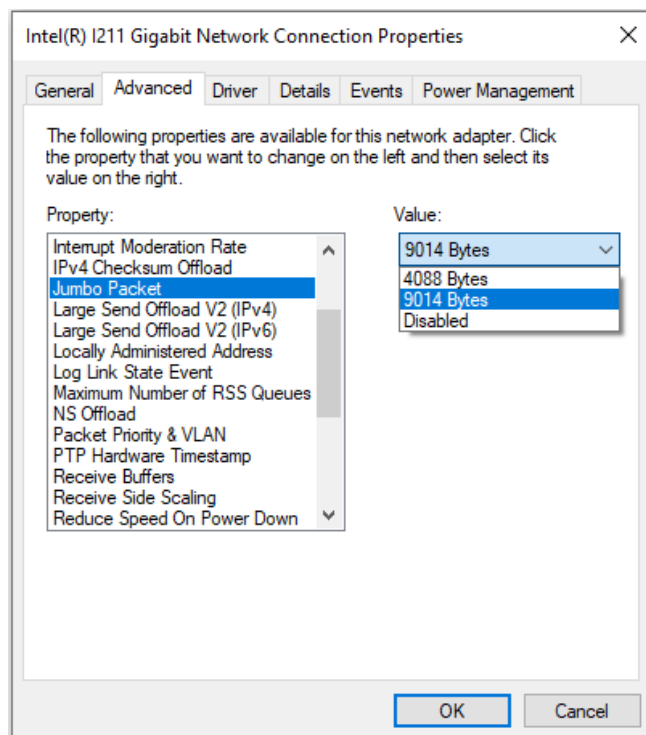
- Step 1 Click **Control Panel > Network and Internet > Network and Sharing Center > Change Adapter Configuration > Configure > Advanced**.

Figure 3-4 Set NIC



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

Figure 3-5 Set Jumbo Frame To 9014 Bytes



3.3 Client Operations

3.3.1 Software and Device Connection

3.3.1.1 Search Device

Double-click the 3DMVviewer to open the software. The device list will display the devices in the same network segment with the PC. You also can click **Refresh** at the top right corner to refresh the list.

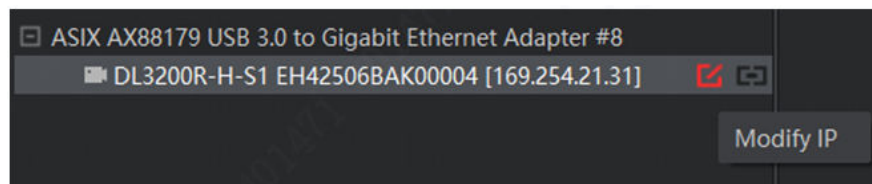
3.3.1.2 Set IP Address

If the found camera is unconnectable, you will need to manually set the IP address of the camera.

Procedure

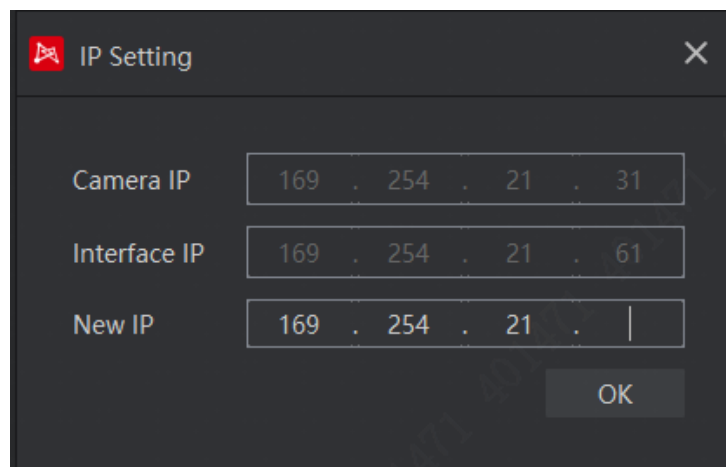
- Step 1 Hover the mouse on the camera in the device list; the **Modify IP** will be displayed at the right side of the device.

Figure 3-6 Set IP Address



- Step 2 Click **Modify IP** to enter configuration interface; you need to configure the IP address of camera, and then click **OK**.

Figure 3-7 IP Setting Window



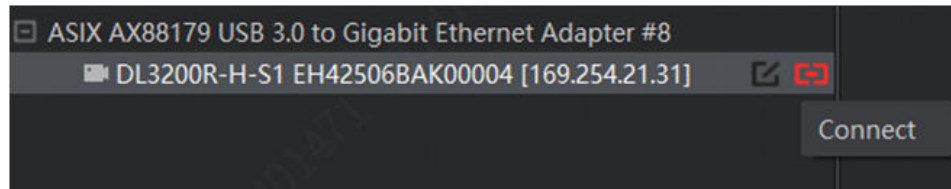
3.3.1.3 Connect Device

Double-click the camera that needs to be connected, or click **Connect** to complete the camera connection.



The Connect icon will be displayed at the right side of the camera name in the device list, as shown in the figure below.

Figure 3-8 Connect Device



3.3.2 Main Interface

After connecting the device, the main interface of the 3DMVviewer will be like the figure below.

Figure 3-9 3DMVviewer Main Interface

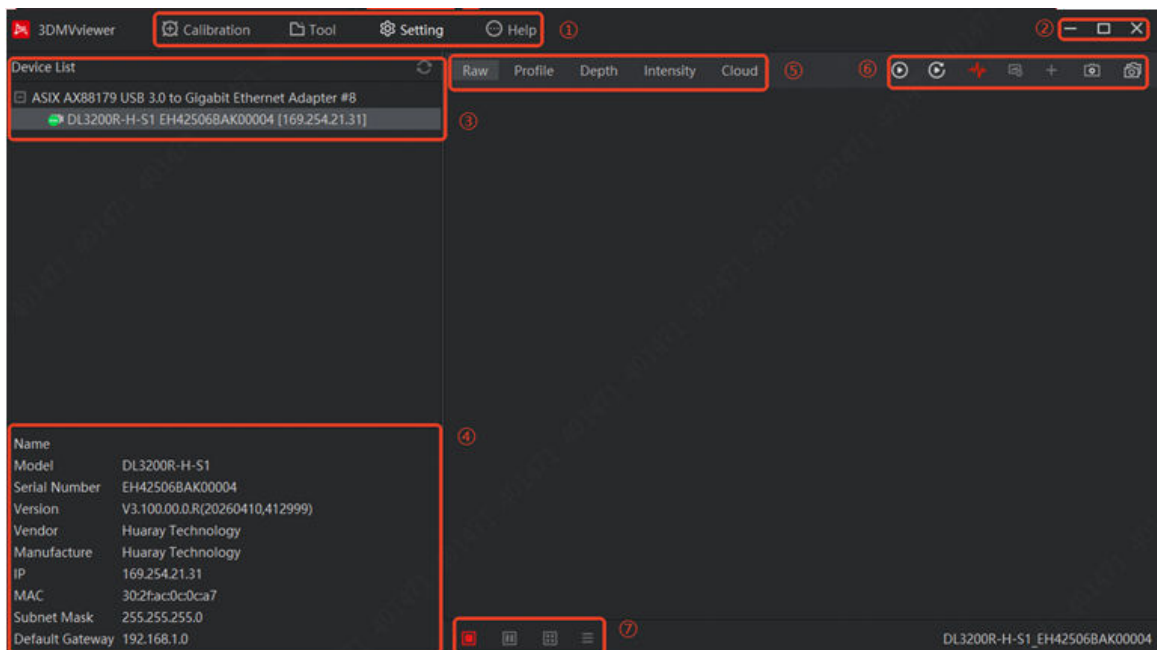
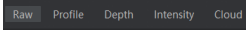
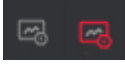


Table 3-2 Main Interface Description

No.	Name	Icon	Description
1	Menu Bar	NA	It provides the relevant functions of calibration, tools, settings, and help.  For more detailed operation instructions of the 3DMVviewer, please click "Help" in the menu bar.
2	Window Operation		Maximize/Restore/Minimize the window.

No.	Name	Icon	Description
			Close the software.
3	Device List		Click the icon to manually refresh the information of the connected devices.
			It indicates the device is ready to be connected.
			It indicates the device is connected.
			It indicates the device is occupied by other software.
			Device cannot be connected, please manually configure the IP address of the device.
			For manually configuring the IP address of the device.
			It sets whether the device is disconnected.
4	Device Information	NA	For displaying the interface information of the 3DMVviewer and the device information of the camera.
5	Image Information		It includes the raw image, profile image, depth image, intensity image, and cloud image.
6	Tool Bar		Start/Stop streaming.
			Save one image or multiple images.
			It sets whether the center line is displayed.
			It sets whether the score of laser ray is displayed.
			It sets whether the auxiliary cross line is displayed.
7	Image Information		It includes 1*1, 1*2, and 2*2.

4 Commissioning

4.1 Commissioning Procedure

You need to perform the image effect commissioning after completing the hardware installation. The flow diagram of commissioning is shown as follows.

Figure 4-1 Commissioning Flow Diagram



4.2 Property Tree

Right-click the device in the device list and click the **Device Property** to enter the Property Tree interface, as shown in the figure below.

Figure 4-2 Property Tree

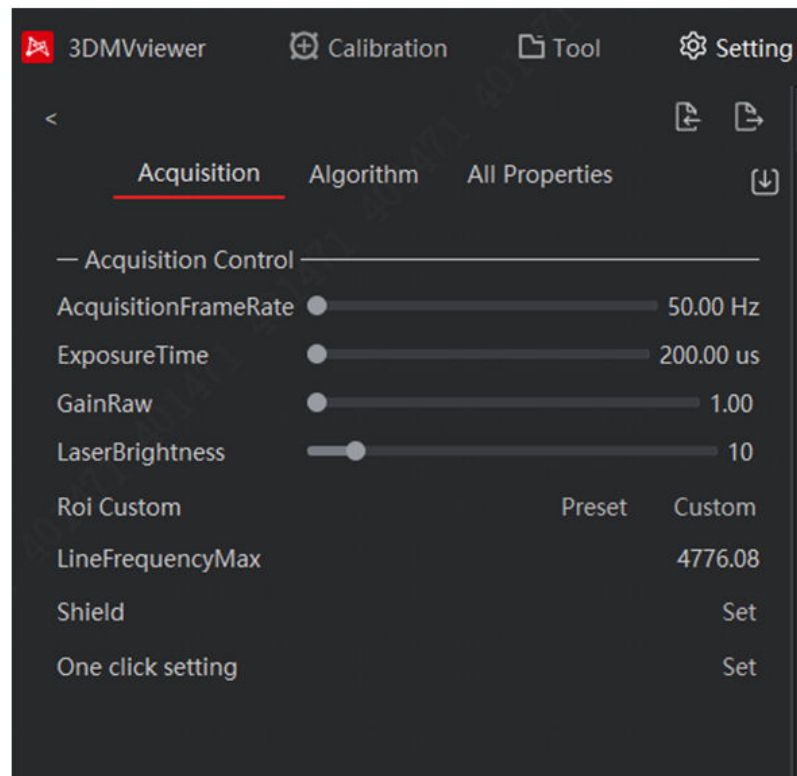


Table 4-1 Property Tree Description

Category	Parameter	Description
Acquisition	Acquisition Frame Rate	It controls the acquisition frequency of camera.
	Exposure Time	The longer the exposure time, the brighter the image, and the lower the acquisition line frequency.

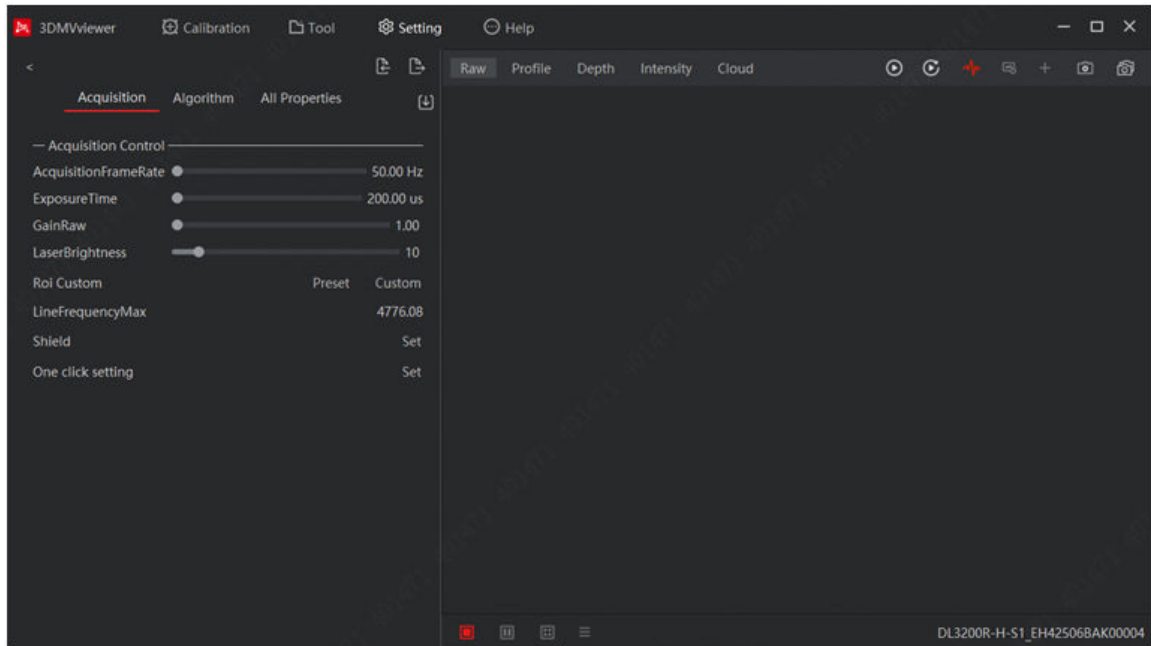
Category	Parameter	Description
	GainRaw	If the exposure time of camera cannot be adjusted because of the acquisition line frequency limitation, you can configure the GainRaw.
	Laser Brightness	It controls the brightness of the laser rays.
	ROI Custom	You can click Custom to adjust the size of ROI box to increase the acquisition frame rate.
	Line Frequency Max	It shows the maximum acquisition line frequency based on the current size of ROI box.
	Shield	You can click Set to add the shield box to shield the interference points.
	One Click Setting	You can click Set to configure the parameters of triggering of camera.
Algorithm	Trigger Interval	It controls the interval value between two adjacent frames of images at the Y-axis direction. Unit: μm .
	Mean Filter Enable	It sets whether the function of mean filter is enabled.
	Median Filter Enable	It sets whether the function of median filter is enabled.
	Depth Image Filter	It sets whether the depth image filter function is enabled.
	CaptureLines	It controls the number of lines of the acquired image.
	Gray Threshold	It controls the grayscale threshold of the laser ray.
	DepthImageOffsetX	It controls the offset value of the depth image at the Z-axis direction. Unit: μm .
	DepthImageOffsetZ	It controls the offset value of the depth image at the Z-axis direction. Unit: μm .
	DepthImageScaleX	It controls the interval value at the X-axis direction. Unit: μm .
	DepthImageScaleZ	It controls the interval value at the Z-axis direction. Unit: μm .
	Max Gap Filling	It controls the maximum allowed padding interval for a single line on the image. Unit: μm .
All Properties	NA	It includes all the parameters of camera.

4.3 Raw Image

Click the Raw tab in the image display area, and manually adjust the ROI box and configure the image parameters according to the effect.

- ROI Parameter: For shielding the invalid area to reduce the output bandwidth and improve the output frame rate. For the detailed procedures of the ROI settings, please refer to the user manual.
- Image Parameter: It includes many parameters of image, such as the light source, exposure time, Algorithm, etc. You can adjust the image brightness to completely extract the laser center lines referring to the laser ray.

Figure 4-3 3DMVviewer Raw Image Interface



The following content includes the image problems and solutions.

- Over Exposure: We recommend you reduce the exposure time, gain, and laser intensity firstly.
- Under Exposure: We recommend you increase the laser intensity and exposure time first. If the image is still underexposed, you can increase the gain value.
- Interferential Light:
 - ◇ Check the source of the interference light, and adjust the camera angle or environmental light angle.
 - ◇ Draw an ROI box to shield the area with the interferential light.
 - ◇ Adjust the SingleHDR and parameters of the laser extraction algorithm.
- Image with Many Noises: Lower the gain value.
- Max Frame Rate Value Does Not Meet the Expectation: Reduce the ROI size.

4.4 Depth Image

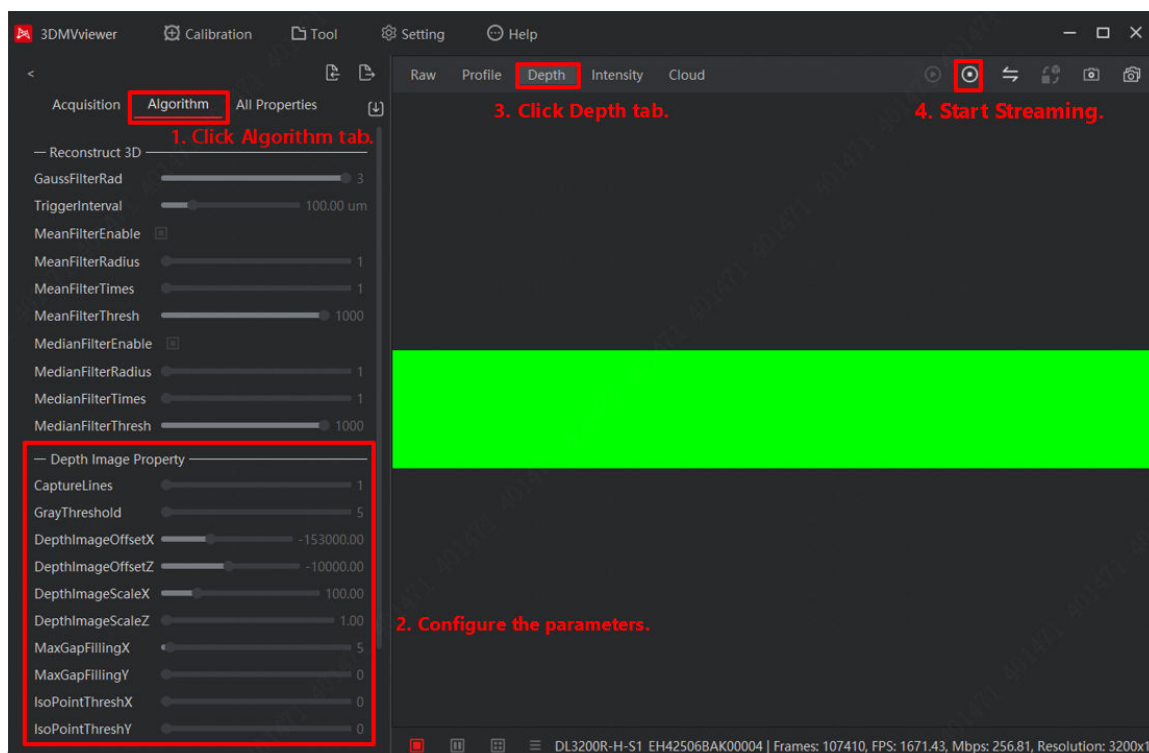
The depth image consists of a 2D image with pixel values representing height and attributes of depth image. In the traditional 2D image, the greater the grayscale value, the brighter the object; in the depth image, the greater the grayscale, the higher the spatial position of the object.



- The formats of depth image include the unsigned mono16 and signed mono16.
- Pixel Value Range: [1, 65535]

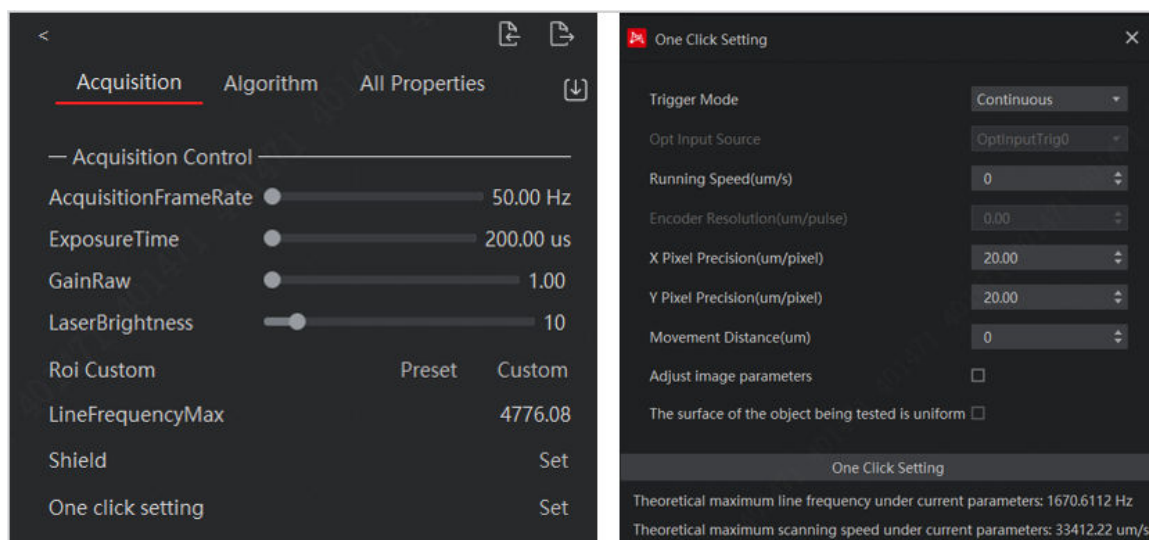
After optimizing the raw image, configure the properties of the depth image to acquire images; the main properties include the GrayThreshold, CaptureLines, DepthImageScaleX/Y/Z, etc.

Figure 4-4 3DMVviewer Depth Image Interface



- One Click Setting: after configuring the Running Speed, Encoder Resolution, X/Y Pixel Precision, Movement Distance, it will convert data and send data to the camera. If the length-width ratio of image is 1:1, the Encoder Resolution equals the DepthImageScaleX/Y.

Figure 4-5 One Click Setting



- Trigger Mode: after selecting the trigger mode, the parameters will be updated automatically.

Table 4-2 Trigger Mode Description

Parameter	Description
Continuous	It controls the acquisition frequency of camera.

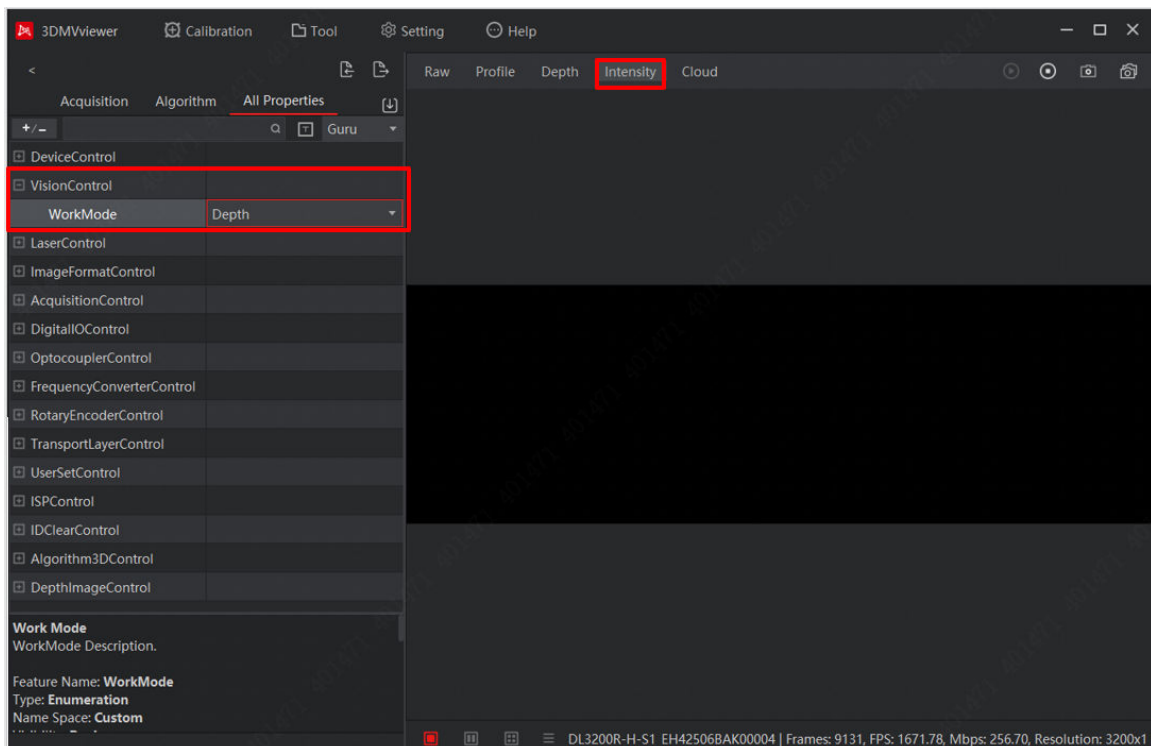
Parameter	Description
Row Trigger	It acquires images according to the encoder signal. For more details, please refer to the I/O interface description.
Frame Trigger	The camera controls the acquiring frequency; the external signals or software trigger signal sets whether the camera is acquiring images; configure the Opt Input Source to the corresponding wiring. For more details, please refer to the I/O interface description.
Row+Frame Trigger	The encoder controls the acquisition frequency; the external signal or software trigger signal sets whether the camera is acquiring images.

- Running Speed: you can configure this parameter according to the actual conditions. Unit: $\mu\text{m/s}$.
- Encoder Resolution: it indicates the physical distance representing the pulse output by the encoder. Unit: μm .
- X/Y Pixel Precession: it controls the physical size of each pixel in the depth image.
- Movement Distance: it controls the total travel of motion of test environment.

4.5 Intensity Image

The intensity image is generated by averaging the valid pixels in the row where the center point of the raw image is located. The intensity image and depth image belong to a binding relationship, which means that the intensity images will be output with the depth images in the depth image mode. You can click the Intensity tab on the top of the image display area to view the intensity image.

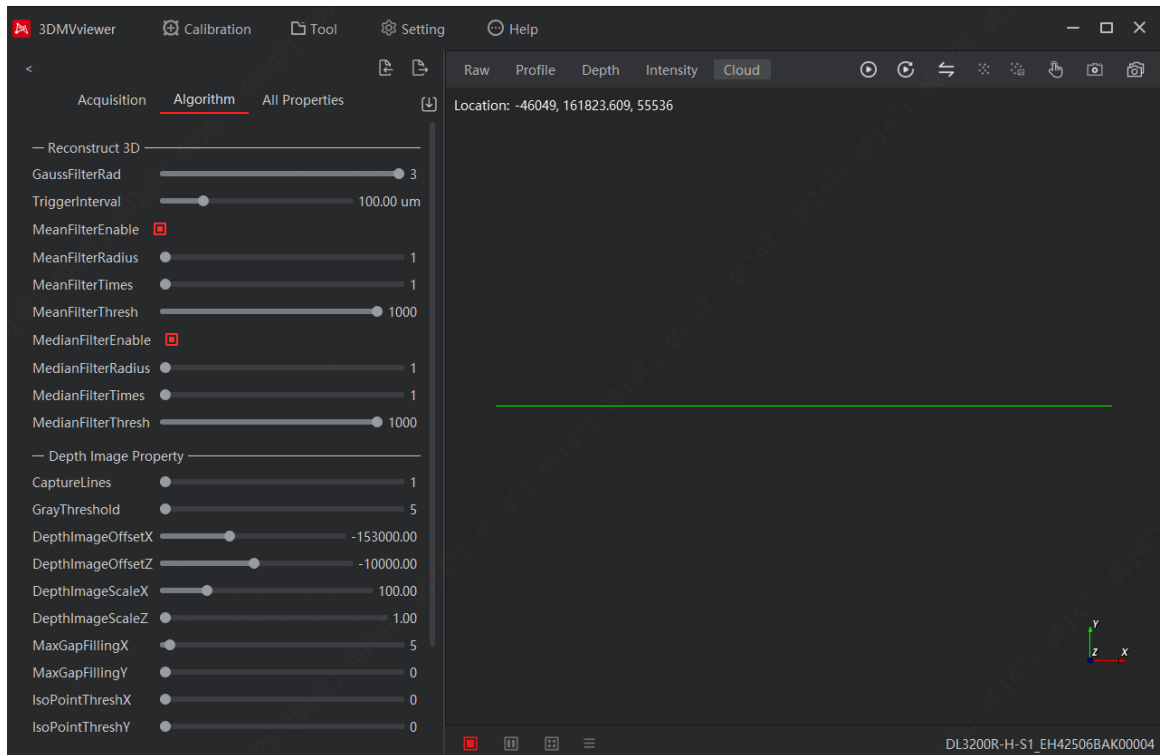
Figure 4-6 Intensity Image



4.6 Cloud Image

The cloud image is a visual representation of a collection of many points in three-dimensional space. Each point describes the position of the project's surface by coordinates (X, Y, Z) and may contain some additional information, such as the color, reflection intensity, etc.

Figure 4-7 Cloud Image



5 IO Wiring and Electrical Characteristics

5.1 External Power Requirements

- Use the power cords that are recommended for the region and conform to the rated specifications.
- Use the standard power adapter. We will assume no responsibility for any problems caused by using a nonstandard power adapter.
- Use the power supply that meets the requirements of SELV and PELV. The specific power supply requirements are subject to the equipment label.

5.1.1 Wiring Requirement

It is very important to perform the reasonable grounding and wiring to the camera, which ensures the system has the optimal operating performance and provides better electronic noise protection for the camera.

Ensure the power of camera is disconnected before wiring and grounding. Ensure the power supplies of the devices connected to the camera are also disconnected.



WARNING

- Please follow appropriate safety precautions and check whether the power of camera is disconnected. Installation or wiring of camera and other equipment while powering may cause electric shock or equipment damage.
- For the specific application, the grounding scheme is that the camera and other equipment are linked to a single point to the ground. This single grounding point should be directly connected to the system ground. We recommend you connect all the common points of the AC power to the same single ground point and also recommend you ground the common point (M), which is the power port of the sensor (24VDC).
- All ground wires should be as short as possible and use a thicker wire diameter (2mm or 14AWG).
- Consider the safety grounding requirements and proper protection of isolation devices when selecting the grounding position.
- Avoid placing the low-voltage signal cable and communication cable in the same routing slot as AC lines and DC lines with high-voltage high-speed switches. Use cables with the shielding feature can obtain the optimal electronic noise resistance. Generally, the optimal effects can be obtained by grounding the shielding layer.
- Add the overcurrent protection device in the circuit when using the external power supply to connect the input circuit.
- We recommend that you separately power the camera and its connected sensors to avoid the interference noise conducted on the power cable when using the camera in the scenarios with potentially strong interference sources, such as motor drives and frequency converters.

5.1.2 Isolation Requirement

To avoid unexpected current flowing into the system, the camera is electrically isolated in appropriate parts. When wiring, please consider the following isolation requirements:



- The signal cable with Ethernet connector couples to the internal GND through a varistor, and the maximum withstand voltage is 65 VDC.
- The maximum withstand voltage between the isolated signals and the other external non-isolated interface (signal) is 100 VAC/ 140 VDC.



- Unless otherwise specified, the metal shield of the M12/M16 aviation connector is not insulated from the camera housing. Avoid the PD (Potential Difference) between the devices or due to the positive grounding environment causing the PD between the internal common terminals; otherwise, it will lead to the failure of connected peripheral devices such as computers or hosts.
- The optocoupler isolation design of the camera cannot be used as the safety isolation.
- All low voltage circuits connected to the camera, such as the power supply, must be safely isolated from AC lines and other high voltage environments. All the isolations must meet various safety standards.



DANGER

- Do not connect the device to the non-isolated AC power or single isolation power; otherwise, it will generate unsafe voltages in safety circuits, such as sensor circuits and communication circuits.
- Such high voltages can lead to death or serious life injuries and equipment damage.
- Use the high-to-low voltage converter to ensure the circuit safety.

5.1.3 Installation Requirement

When installing a camera, please separate the camera from the device that generates high voltage and high electronic noise.

The camera adopts natural convection heat-dissipation design; therefore, ensure there is sufficient space around the camera to improve the heat-dissipation efficiency.



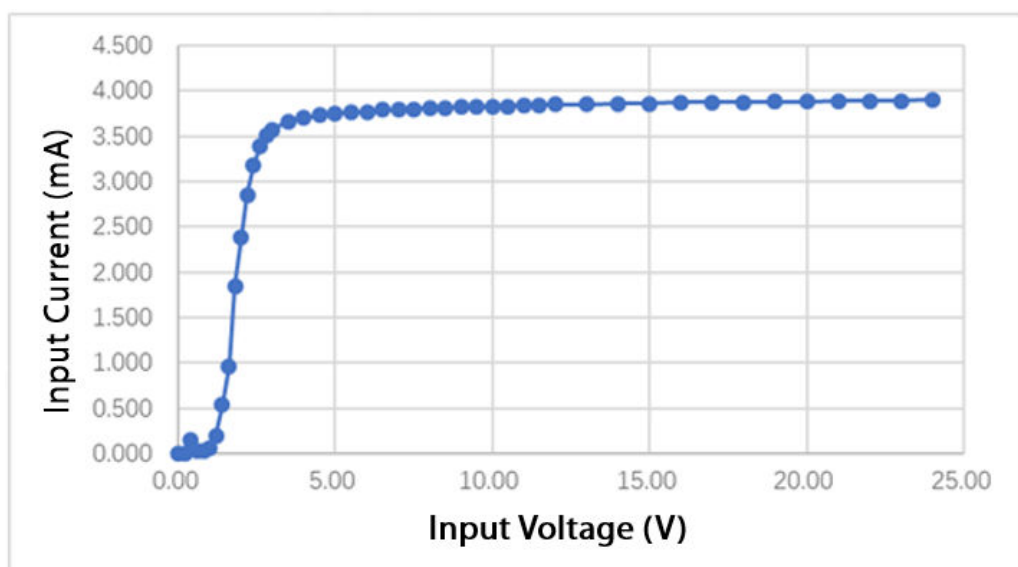
Please reserve sufficient space for the cable outlet and bending. If the cable outlet space is too narrow, it may cause damage to the interface of camera due to the additional force.

5.2 Opto-isolated Input

Table 5-1 Parameter Description

Input Voltage	Description
+26.0 VDC	Limiting voltage. Input voltage must not exceed this limit. Otherwise, it may cause damage to the equipment.
+0 VDC ~ +24 VDC	Security working voltage range of I/O input
+0 VDC ~ +1.4 VDC	Logic 0
>+1.4V ~ +2.2VDC	The input status changes, and the logic status is unsteady within this voltage range.
>+2.2 VDC	Logic 1

Figure 5-1 Sink Current and Input Voltage of Opto-isolated IO Input



- Values in the line chart are obtained at an environmental temperature of 25°C (+77°F). Therefore, the actual values may vary among the different models of the camera in the different environments.
- The maximum input current of the opto-isolated input can be up to 4 mA.

Figure 5-2 Input Signal Amplitude and Trigger Delay

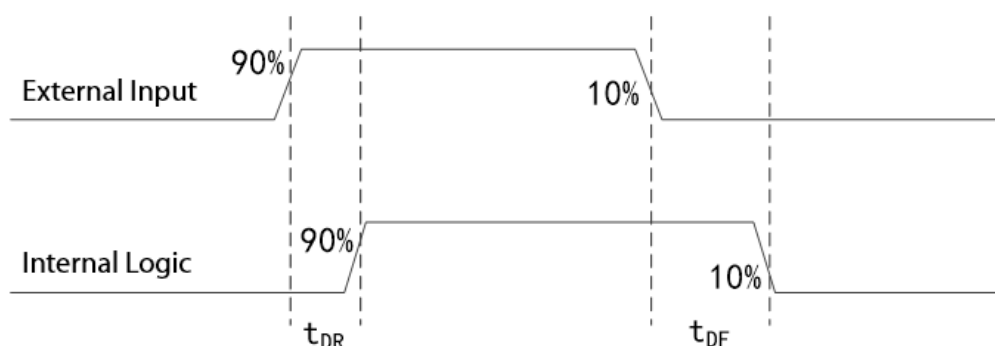


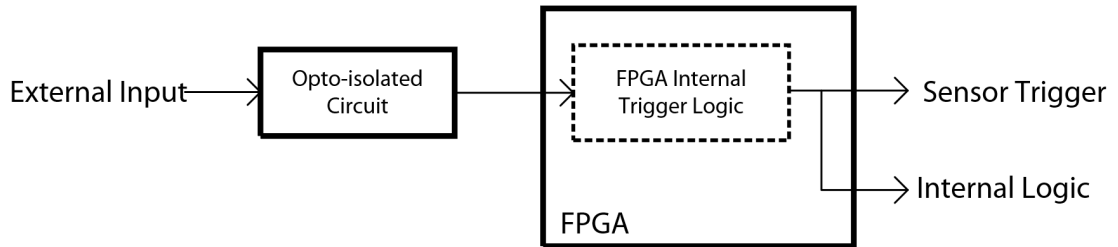
Table 5-2 Input Signal Amplitude and Trigger Delay

Input Signal Amplitude (Vp-p)	Rising Edge Trigger Delay t_{DR} (us)	Falling Edge Trigger Delay t_{DF} (us)
3.00	4.282	17.316
5.00	4.074	17.670
9.00	4.016	17.798
10.00	4.010	17.816



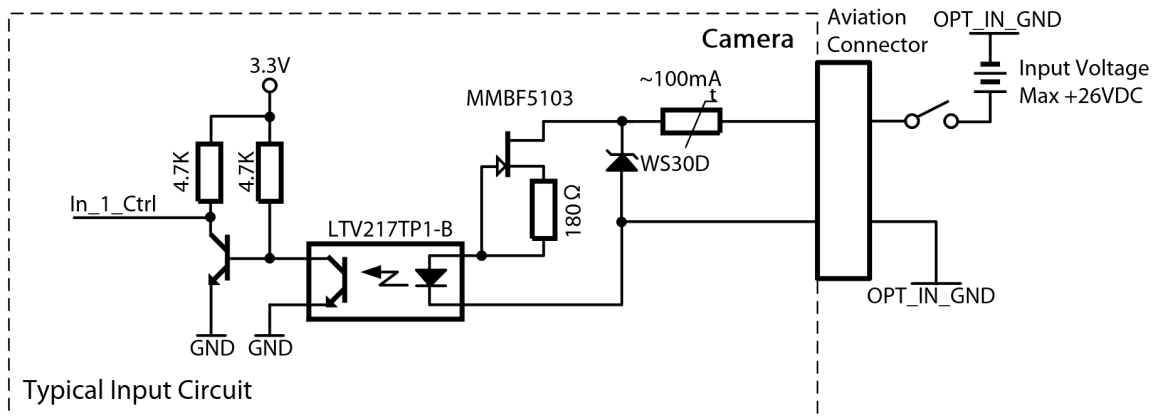
The trigger delay measurement measures the time delay value from external opto-isolated input port to the FPGA input pin, which means the internal logic delay of the FPGA is not included.

Figure 5-3 Trigger Delay Measurement Logic Diagram



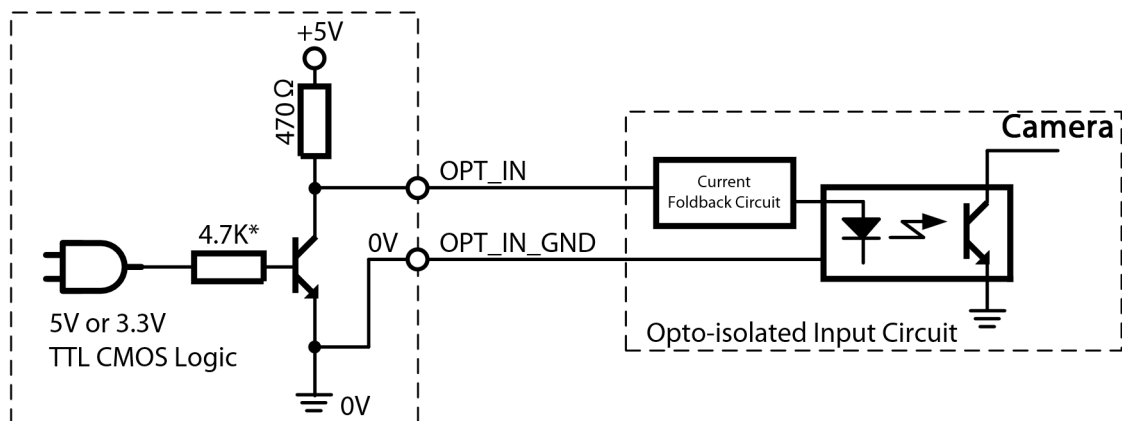
The values mentioned above are measured when the environment temperature is at 25 °C (+77 °F). The opto-isolated input port supports the shortest input positive pulse of 3.2 μ s (typical value) and the shortest input negative pulse of 18 μ s (typical value).

Figure 5-4 Opto-isolated Input Circuit



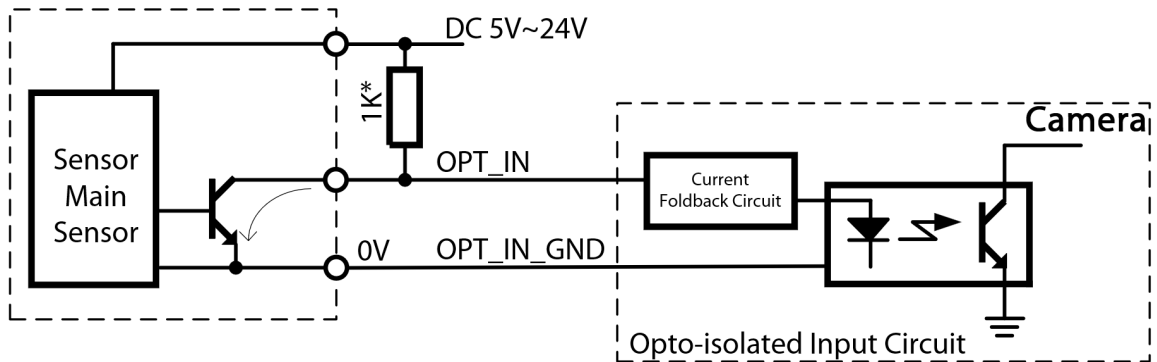
5.2.1 Opto-isolated Input Case 1

Figure 5-5 Interfacing with TTL/CMOS Logic



5.2.2 Opto-isolated Input Case 2

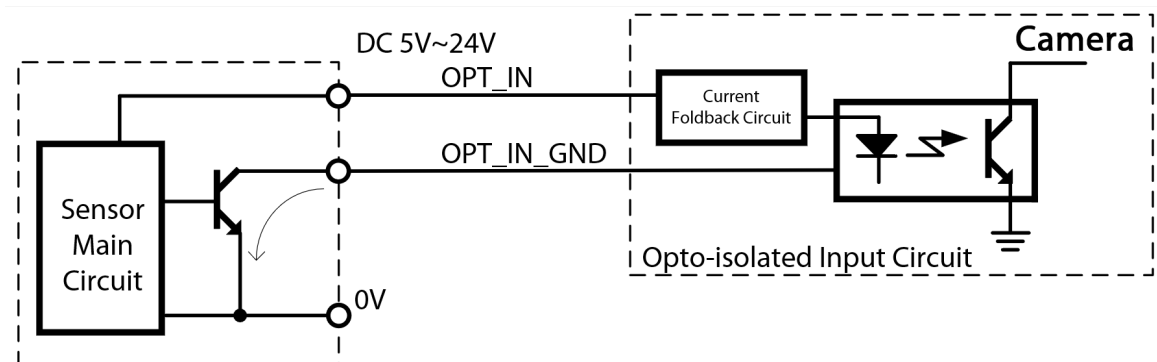
Figure 5-6 Sensor (NPN Output with Pull-up Resistor)



In this case, you need to add a pull-up resistor to the powering part of sensor. The resistance value should be applicable. Ensure that the high-low level meets the requirements of opto-isolated input of camera.

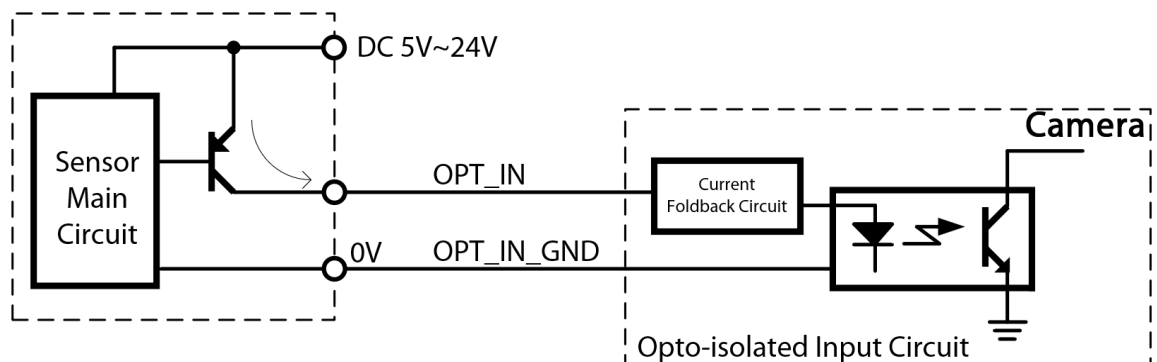
5.2.3 Opto-isolated Input Case 3

Figure 5-7 Sensor (NPN Output without Pull-up Resistor)



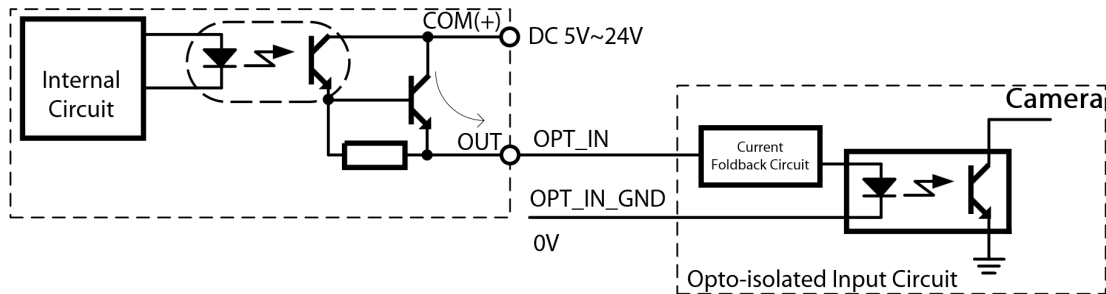
5.2.4 Opto-isolated Input Case 4

Figure 5-8 Sensor (PNP Output)



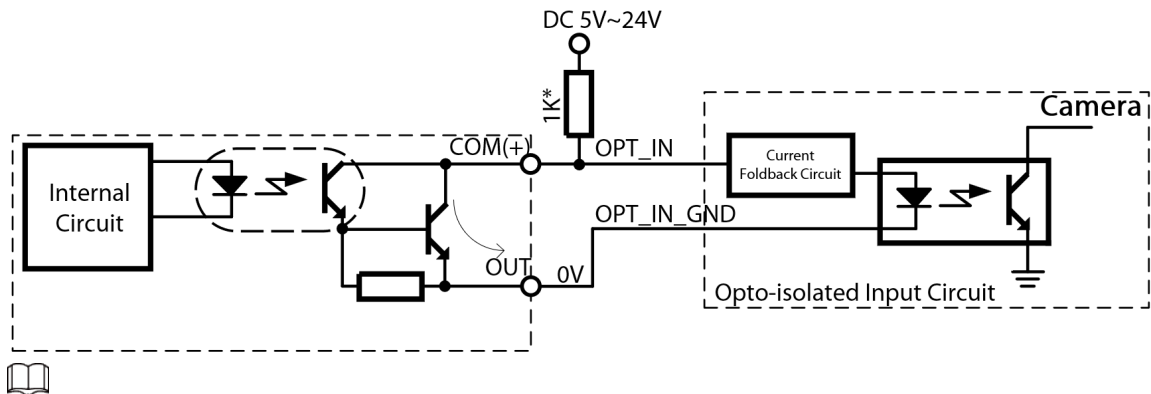
5.2.5 Opto-isolated Input Case 5

Figure 5-9 PLC (PNP or Sourcing)



5.2.6 Opto-isolated Input Case 6

Figure 5-10 PLC (PNP or Sinking)



In this case, you need to add a pull-up resistor to the external powering part. The resistance value should be applicable. Ensure that the high-low level meets the requirements of the opto-isolated input of camera.

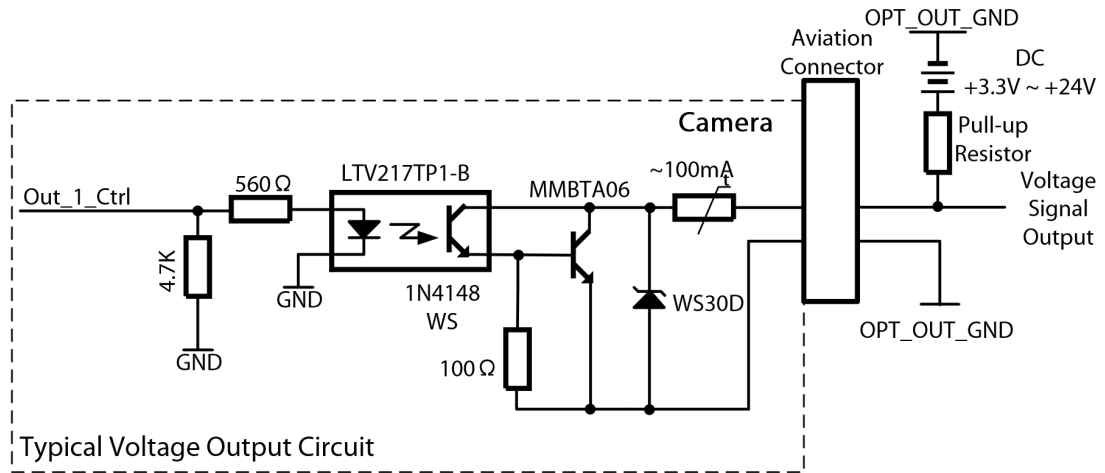
5.3 Opto-isolated Output

Table 5-3 Parameter Description

Voltage	Description
+26.0 VDC	Limiting voltage. Input voltage must not exceed this limit. Otherwise, it may cause damage to the equipment.
<+3.3 VDC	May cause damage to I/O output.
+3.3 VDC ~ +24 VDC	Security working range of I/O output

The opto-isolated output is Sinking type (NPN) output, and the OPT_OUT_GND is opto-isolated common terminal.

Figure 5-11 Opto-isolated Output Circuit Diagram



The pull-up resistance value complies with the maximum allowed current of the opto-isolated output port under the defined voltage. The larger the resistance value, the smaller the optocoupler forward voltage drop, the more slowly the output wave changes and the weaker the control over external devices. The recommended optocoupler value is 270 Ω, 560 Ω and 1 kΩ when the voltage is 5 V, 12 V, and 24 V respectively.

The rising/falling time and the rising/falling edge trigger delay time in the different voltage values when using the 1 kΩ pull-up resistor are shown in the figure and table below.

Figure 5-12 Delay Relationship Between External Power Voltage and Output Rising/Falling

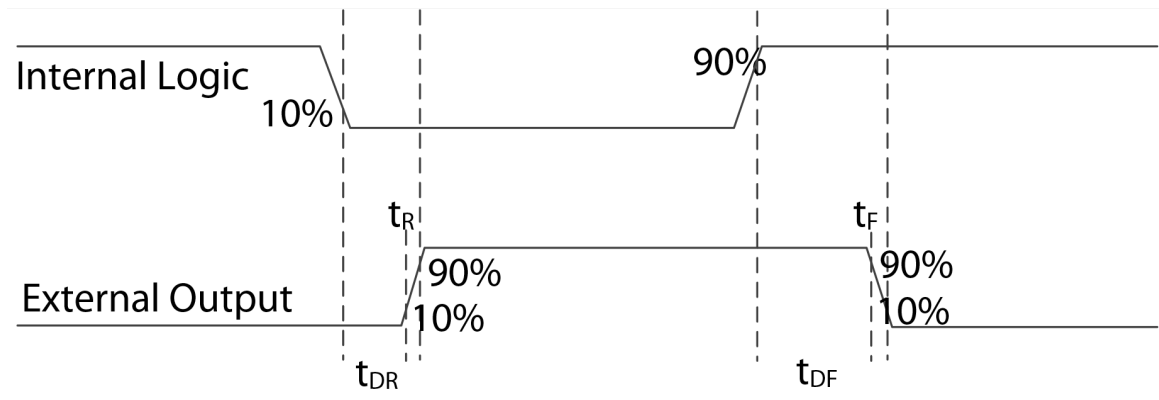


Table 5-4 Delay Relationship Description

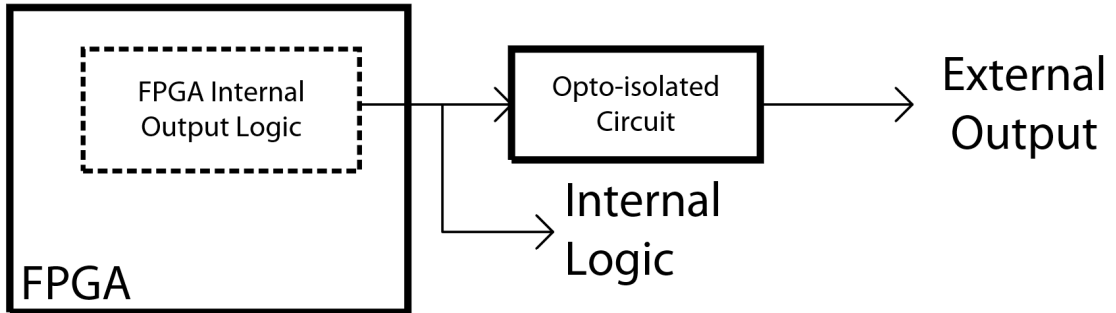
External Power Voltage (V)	Rising Time t_R (us)	Falling Time t_R (us)	Rising Edge Trigger Delay t_{DR} (us)	Falling Edge Trigger Delay t_{DR} (us)
5	19.70	3.20	39.9	8.06
12	24.06	5.22	44.8	11.8
24	30.11	8.10	44.8	53.2



The output delay is the time delay from FPGA internal logic output to external opto-isolator output pin. Therefore, the FPGA internal logic delay is not included. Values in the table are obtained at an

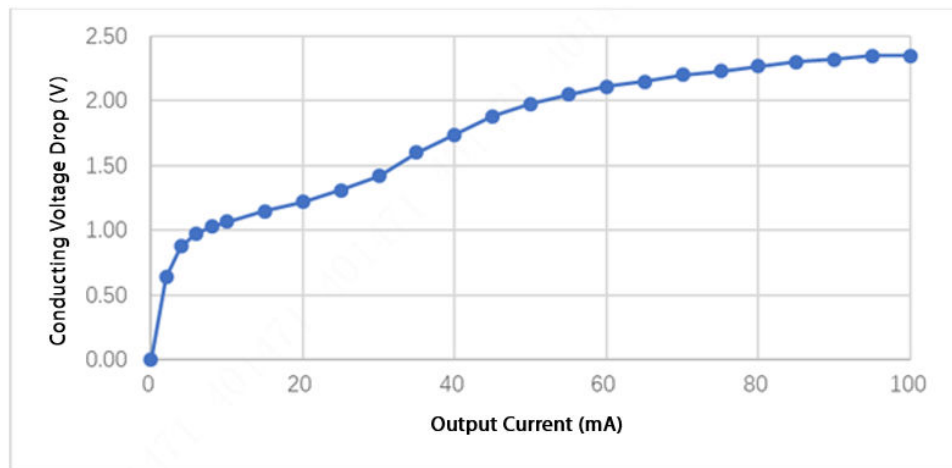
environmental temperature of 25°C (+77°F). Therefore, the actual values may vary among the different models of the camera in the different environments.

Figure 5-13 Output Delay Logic Diagram



The relation between the conducting voltage drop (between GPIO and OPT_IN_GND) and output current (flows into GPIO pin) is shown in the line chart below.

Figure 5-14 Opto-isolated Output Conducting Voltage Drop and Output Current



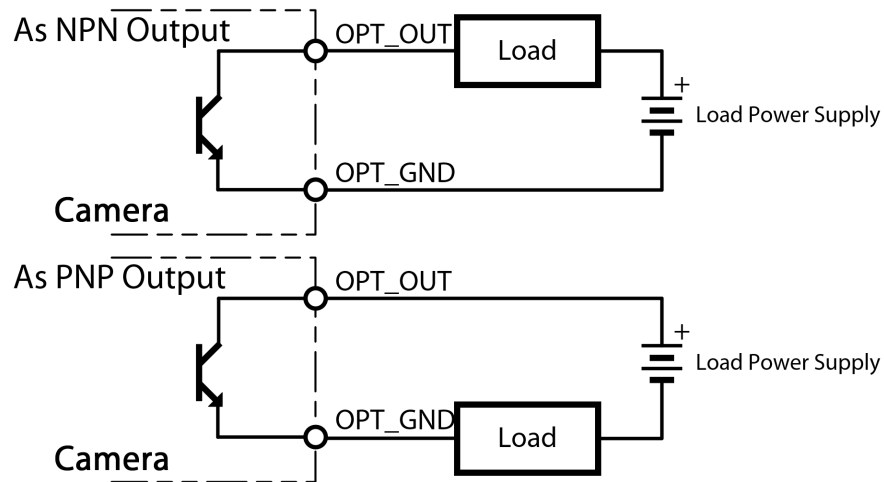
The maximum conducting voltage drop at the opto-isolated output end is 2.35V. This result is obtained under the maximum output current of 100mA.



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

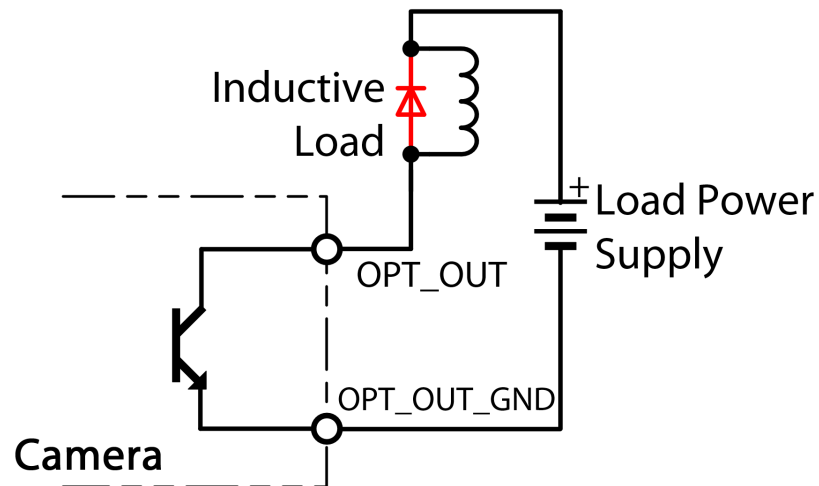
The transistor output port of device is separated from the internal loop by using an opto-isolator. Therefore, the transistor output port can be used as NPN output or PNP output.

Figure 5-15 Camera Transistor Output Circuit Diagram



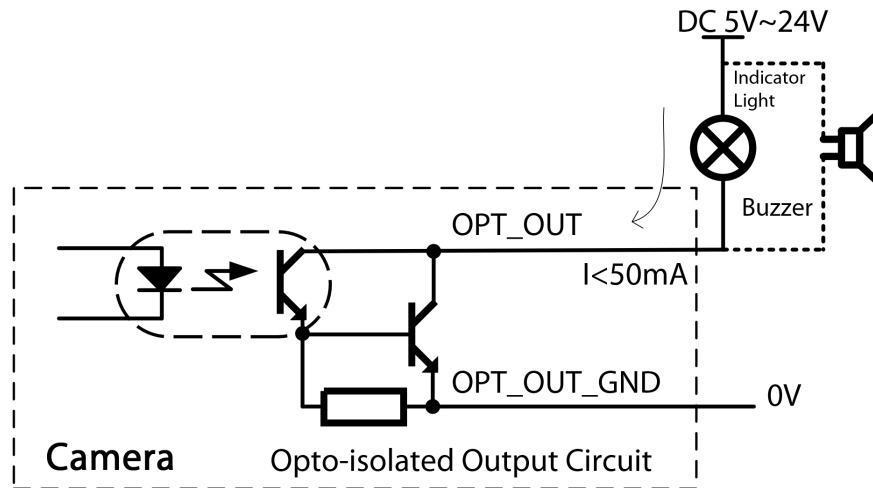
- The allowed maximum current of opto-isolated output is 100mA; therefore, do not apply the voltage or connect a load on the output terminals that exceeds the maximum value.
- Do not replace the fuse of the interface without the professional instructions. If the fuse blows due to the overcurrent, please contact our after-sales to provide the maintenance service.
- To drive the inductive load using camera output signals, such as the relay, please use the relay with built-in free-wheeling diodes or use the 1N4007 external free-wheeling diodes. Otherwise, the overvoltage will cause damage on the output interface.

Figure 5-16 Inductive Load



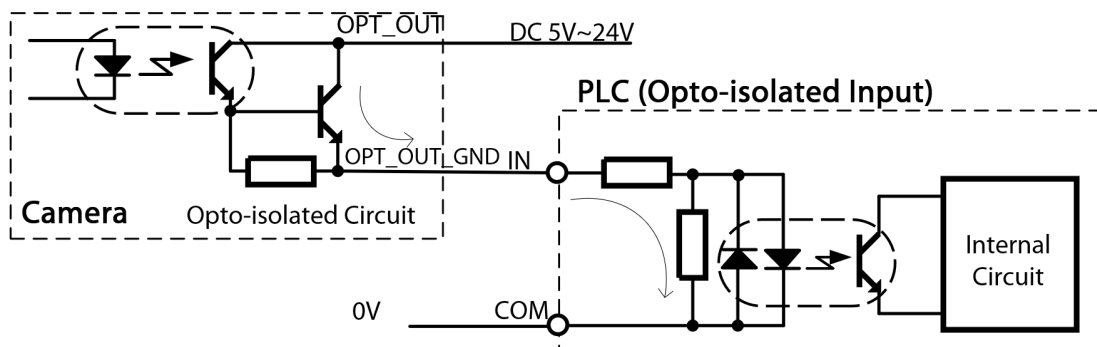
5.3.1 Opto-isolated Output Case 1

Figure 5-17 Opto-isolated Output Case 1



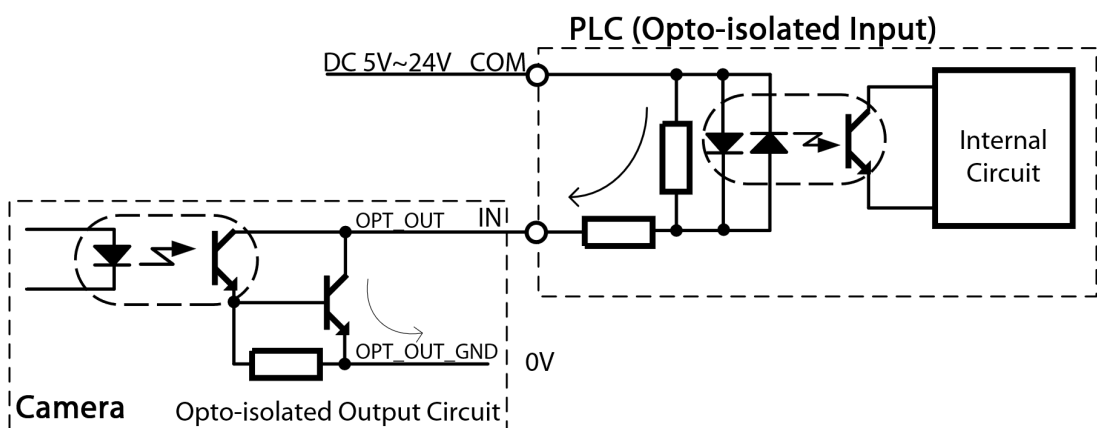
5.3.2 Opto-isolated Output Case 2

Figure 5-18 Opto-isolated Output Case 2



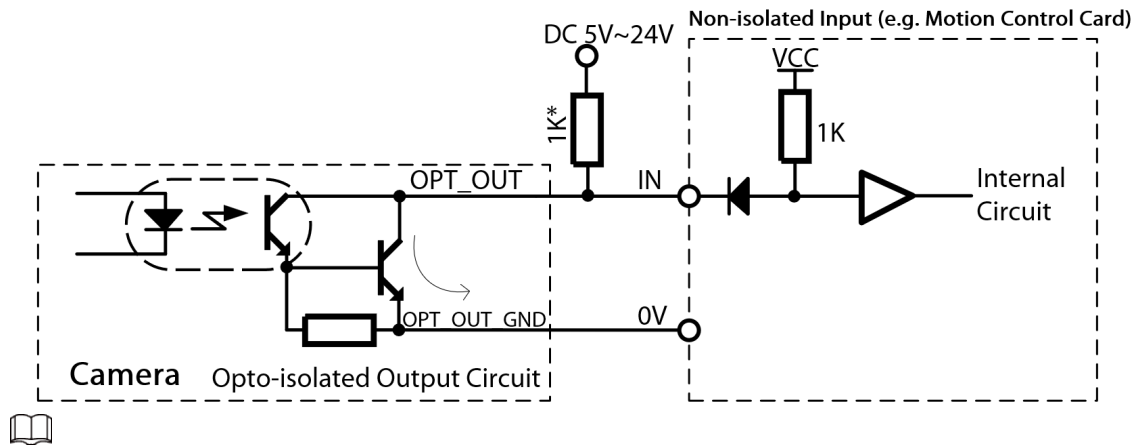
5.3.3 Opto-isolated Output Case 3

Figure 5-19 Opto-isolated Output Case 3



5.3.4 Opto-isolated Output Case 4

Figure 5-20 Opto-isolated Output Case 4



In this case, you need to add a pull-up resistor to the external powering part of camera. The resistance value should be applicable. Ensure that the high-low level meets the input requirements of opposite end interface.

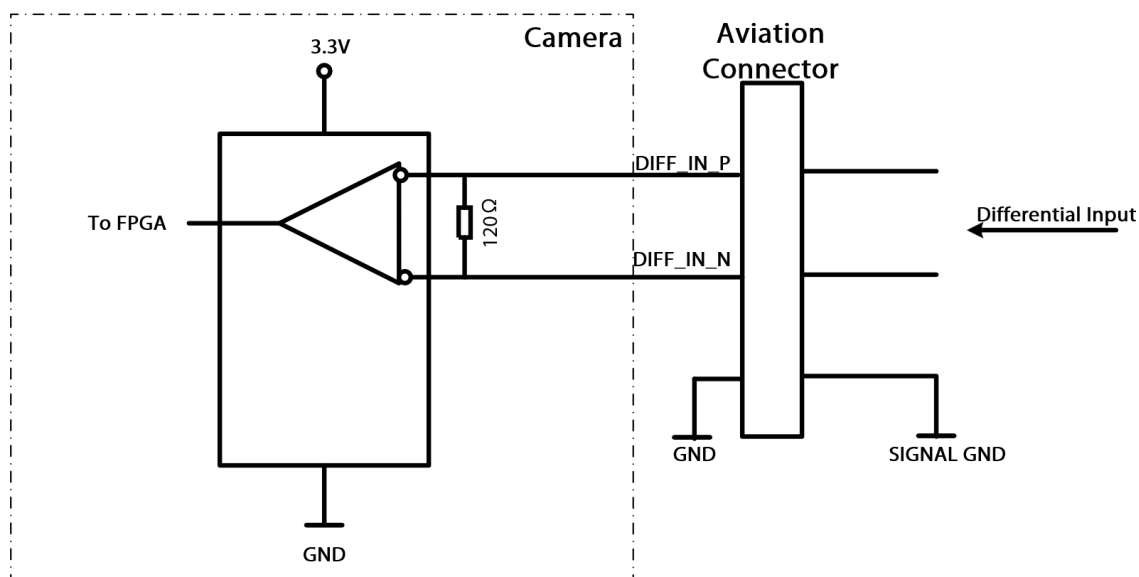
5.4 Differential IO and Single End Input

5.4.1 Differential Input

Table 5-5 Differential Input

Input Voltage		Description
Vcm	-25 V ~ +25 V	It indicates the range of the input common-mode-voltage (CMV).
Vid	+200mV	It indicates the differential input voltage (A-B). If the actual voltage is greater than this value, it indicates Logic 1.
	-200 mV ~ +200 mV	The input status changes, and the logic status is unsteady within this voltage range.
	-200 mV	It indicates the differential input voltage (A-B). If the actual voltage is less than this value, it indicates Logic 0.

Figure 5-21 Differential Input

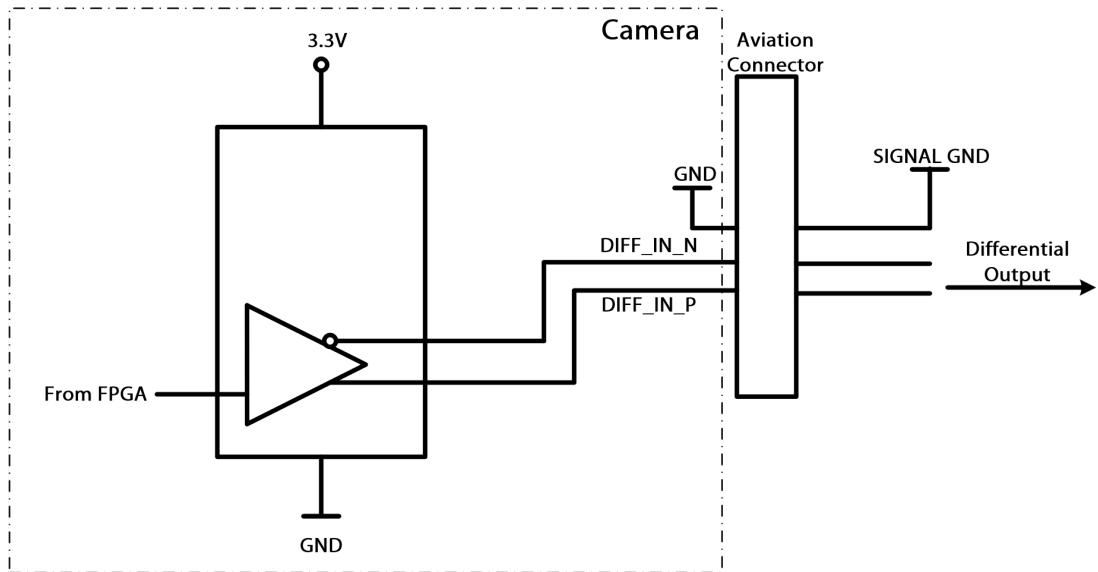


5.4.2 Differential Output

Table 5-6 Differential Output

Output Voltage		Description
VOC	+3.0V	It indicates the range of the output common-mode-voltage (CMV).
VOD	+200mV	It indicates the differential output voltage (Y-Z). If the actual voltage is greater than this value, it indicates Logic 1.
	-200 mV ~ +200 mV	The output status changes and the logic status is unsteady within this voltage range
	-200mV	It indicates the differential output voltage (Y-Z). If the actual voltage is less than this value, it indicates Logic 0.

Figure 5-22 Differential Output

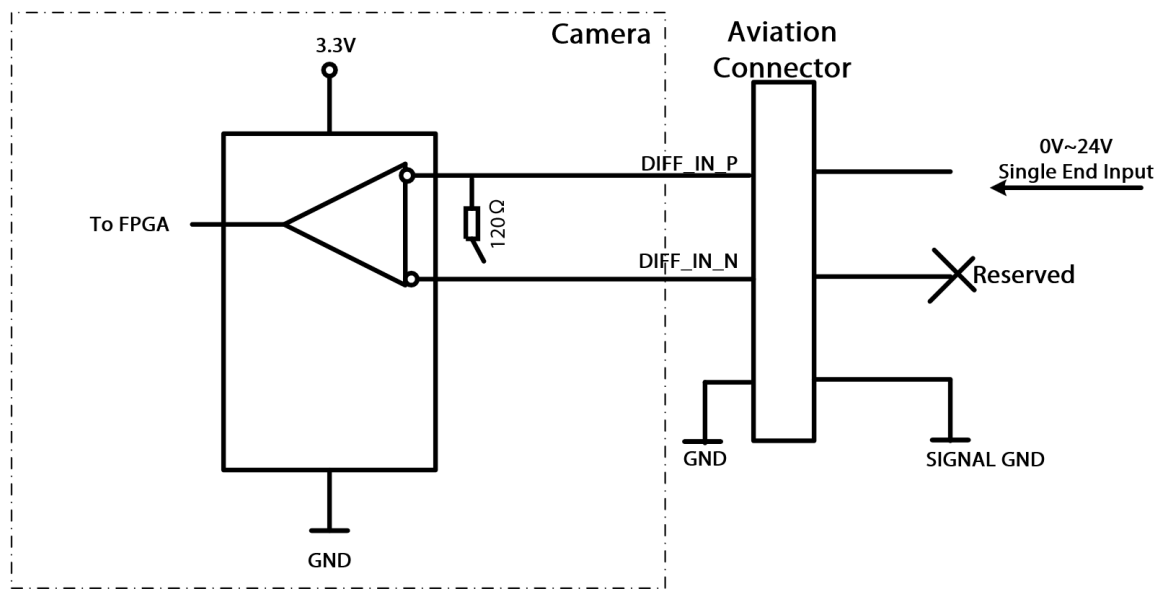


5.4.3 Single End Input

Table 5-7 Single End Input

Voltage		Description
Limit Voltage	-60.0V ~ +60.0V	Limiting voltage. Input voltage must not exceed this limit. Otherwise, it may cause damage to the equipment.
Safe Voltage	0V ~ +24.0V	Security working voltage range of input.
3.3V TTL Input	1.5V	Upper threshold voltage and lower threshold voltage.
5V TTL Input	2.5V	
12V	6V	
24V	6V	

Figure 5-23 Single End Input



6 Image Property

6.1 Laser Control

The built-in laser device in the camera can emit laser rays to the surface of the object to be measured. The LaserMode needs to be set to AlwaysOn when measuring the object. Laser Safety Level: Class2M or Class3R Do not direct light to the human eye.

Figure 6-1 LaserControl

☐ LaserControl	
LaserMode	FlashFollowExp
LaserBrightnessAuto	Off
LaserBrightness	100
LaserBrightnessValue	{Not Available}
LaserBrightnessMode	Percent

Table 6-1 LaserControl Description

Parameter	Description
LaserMode	- Off: the laser device is disabled. - AlwaysOn: the laser device is constantly on. - FlashFollowExp: strobing mode; the laser lights up when sensor is exposing.
LaserBrightnessAuto	- Off: the automatic brightness mode is disabled. - Once: the brightness adjustment only performs once.
LaserBrightness	[0, 100]

6.2 ROI and Shield Zone

6.2.1 ROI

This function can crop the raw image to improve the acquisition frequency, and it only acquires images from the valid area.

Figure 6-2 Acquisition Tab

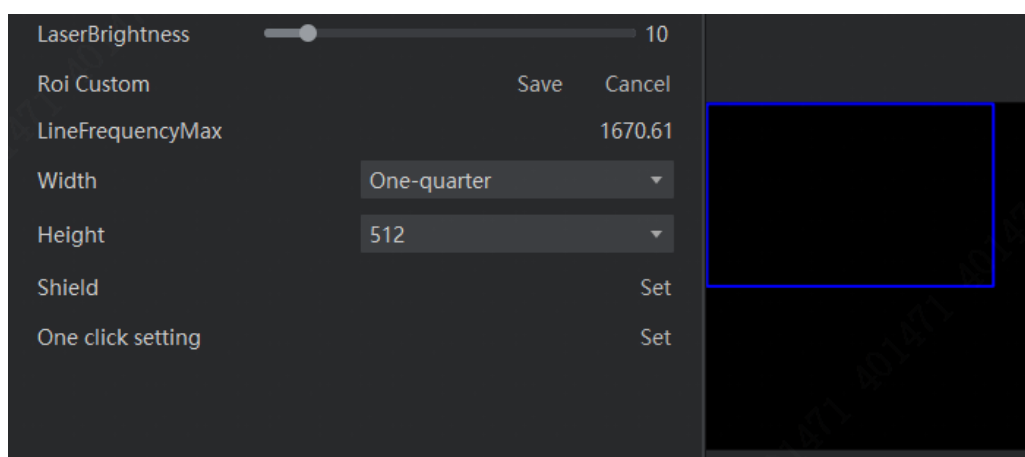


Table 6-2 ROI Parameter Description

Parameter	Description
Preset	- Width: it controls the width of the ROI box on the image in the Raw tab. - Height: it controls the height of the ROI box on the image in the Raw tab. - LineFrequencyMax: it shows the maximum frame rate after completing the configuration of the Height and Width parameters.
Custom	In this mode, you can manually adjust the size of the ROI box.

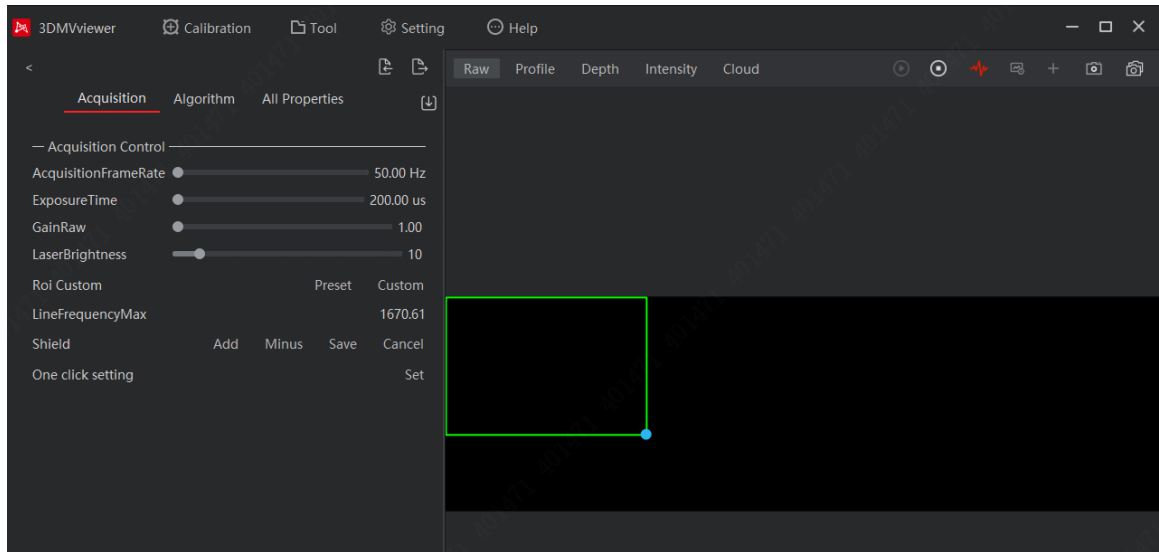
6.2.2 Shield Zone

When there are interferences in the acquired image after setting the ROI box, you can add multiple shield boxes to remove the interference points.

Procedure

- Step 1 After adjusting the ROI box, in the Raw tab, click **Play** to perform the continuous streaming.
- Step 2 Click **Acquisition** > **Shield** > **Set**.
- Step 3 Click **Add** to add a green box, and manually drag the box to cover the interference.

Figure 6-3 Shield Function



Step 4 Click **Save** to complete the drawing of the shielding box.

6.3 Acquisition Control

The trigger modes of 3D laser line profiler include the free run, line trigger, frame trigger, line and frame trigger, frequency converter trigger, and rotary encoder trigger.

- Line Trigger: this function is controlled by **Trigger Selector** and **Trigger Mode**.
- Frame Trigger: this function is controlled by the parameters of OptocouplerControl.
- Encoder Trigger: this function is controlled by the parameters of FrequencyConverterControl and RotaryEncoderControl.

Figure 6-4 Acquisition Control

AcquisitionControl	
AcquisitionFrameRate	666.66669 Hz
AcquisitionFrameRateEnable	False
TriggerSelector	FrameStart
TriggerMode	Off
TriggerSource	Software
TriggerSoftware	{Command}
TriggerActivation	{Not Available}
TriggerDelay	0.00000 us
ExposureTime	500.00000 us
ResultingExposureTime	210.00000 us
ResultingFrameRateAbs	164.31686 Hz

Table 6-3 Parameter Description

Parameter	Description
AcquisitionFrameRate	It controls the acquisition frequency (Hz) of camera.
AcquisitionFrameRateEnable	It sets whether the function of acquisition frequency is enabled.
TriggerSelector	It specifies the trigger type.
TriggerMode	It sets whether the configured trigger mode is enabled.
TriggerSource	It specifies the source of triggering, including the Software, Line0, Line1, Line2, Line3, FrequencyConverter0, and RotaryEncoder0
TriggerSoftware	It controls the software triggering command.
TriggerActivation	It specifies the mode of trigger activation.
TriggerDelay	It controls the delay duration of triggering.
ExposureTime	It controls the exposure time.
ResultingFrameRateAbs	It shows the theoretical frame rate.

6.3.1 Free Run

In the Free Run mode, the camera extracts effective contour data from an acquired image, and after extracting multiple contour data, the camera will combine them into a depth image.

- Set the **AcquisitionFrameRateEnable** to **True**.

- Configure the **AcquisitionFrameRate** to the computed acquisition frequency.

Figure 6-5 Acquisition Frame Rate

☐ AcquisitionControl	
AcquisitionFrameRate	500.00000 Hz
AcquisitionFrameRateEnable	True

6.3.2 Line Trigger

The camera outputs one line after receiving a trigger signal and outputs a frame of image when the received signals meet the defined line height. The line triggering condition can be defined as the RisingEdge, FallingEdge, or BilateralEdge in TriggerActivation.

Figure 6-6 Trigger Source

☐ AcquisitionControl	
AcquisitionFrameRate	1,000.00000 Hz
AcquisitionFrameRateEnable	False
TriggerSelector	FrameStart
TriggerMode	Off
TriggerSource	Software ▼
TriggerSoftware	Software
TriggerActivation	Line0
TriggerDelay	Line1
ExposureTime	Line2
ResultingExposureTime	Line3
ResultingFrameRateAbs	FrequencyConverter0
☐ DigitalIOControl	RotaryEncoder0

6.3.3 Frame Trigger

The camera outputs a frame of image after receiving a trigger signal (rising edge or falling edge).

Figure 6-7 OptocouplerControl

☐ OptocouplerControl	
OptEnable	False
OptInputSel	OptInputTrig0
TriggerSoftStart	{Not Available}
TriggerSoftStop	{Not Available}
OptMode	FrameCount
OptParam	1000
OptOutputSel	OptOutputTrig0
OptOutputInverter	False
OptOutputSource	LowLevel

Table 6-4 Parameter Description

Parameter	Description
OptEnable	It sets whether the frame trigger function is enabled.
OptInputsel	It specifies the input type of frame trigger, which includes the OptInputTrig0, OptInputTrig1, and OptSoftTrigger.
TriggerSoftStart	You can click Command to start streaming.
TriggerSoftStop	You can click Command to stop streaming.
OptMode	It specifies the mode of frame trigger.
OptParam	It controls the height of the output image. It should be consistent with the line height of the depth image.
OptOutputSel	It specifies the data source of the opto-coupler.
OptOutputInverter	It sets whether the inverter function of trigger signal is enabled.
OptOutputSource	It specifies the output source of the frame trigger.

6.3.4 Rotary Encoder and Frequency Converter

If the accuracy of the encoder of the trigger interval is consistent with the value of TriggerInterval, the encoder can be enabled.

Figure 6-8 RotaryEncoderControl

RotaryEncoderControl	
RotaryEncoderSelector	RotaryEncoder0
RotaryEncoderLineSelector	PhaseA
RotaryEncoderLineSource	Line0
RotaryEncoderMode	ForwardOnly
RotaryEncoderCounterMode	FollowDirection

Table 6-5 Parameter Description

Parameter	Description
RotaryEncoderSelector	It specifies the type of encoder.
RotaryEncoderLineSelector	It specifies the line of the rotary encoder, which includes the PhaseA and PhaseB.
RotaryEncoderLineSource	It specifies the external input line corresponding to the phase of encoder, which includes the Line0, Line1, Line2, and Line3.
RotaryEncoderMode	It specifies the direction of acquisition signal of encoder, which includes the ForwardOnly and AnyDirection.

When the trigger signal needs to be performed with divider and multiplier, you can configure the parameters of the FrequencyConverterControl.

Figure 6-9 RotaryEncoderControl

FrequencyConverterControl	
FrequencyConverterSelector	FrequencyConverter0
InputSource	Line0
Divider	1
Multiplier	1

Table 6-6 Parameter Description

Parameter	Description
FrequencyConverterSelector	It specifies the frequency converter type.
InputSource	It specifies the signal source that requires the frequency conversion.
Divider	It controls the value of divider.
Multiplier	It controls the value of multiplier.

6.3.5 Signal Counter

The parameters under the **Systime** are the counters for checking signal missing, overclocking.

Figure 6-10 Signal Counter

⊕ SysTime	
FrameTriggerCount	0
FrameTriggerLostCount	0
SensorTriggerCount	0
SensorFrameCount	0
FrameTriggerCountReset	{Command}

Table 6-7 Parameter Description

Parameter	Description
FrameTriggerCount	It shows the number of the differential signal triggering.
FrameTriggerLostCount	It shows the number of the lost differential triggering.
OptTriggerCount	It shows the number of the opto-isolated triggering.
SensorTriggerCount	It shows the number of the sensor triggering.
SensorFrameCount	It shows the number of the sensor signals, i.e., frame number.
FrameTriggerCountReset	It sets whether the frame trigger counter is reset.

6.4 HDR

The SingleHDR function allows multiple exposure fusion within a single frame, suppressing overexposure and increasing dynamic range. You can configure the **Single HDREnable** under the **Single HDR** to enable or disable this function. The effects are shown in the figures below.

Figure 6-11 Disable Status

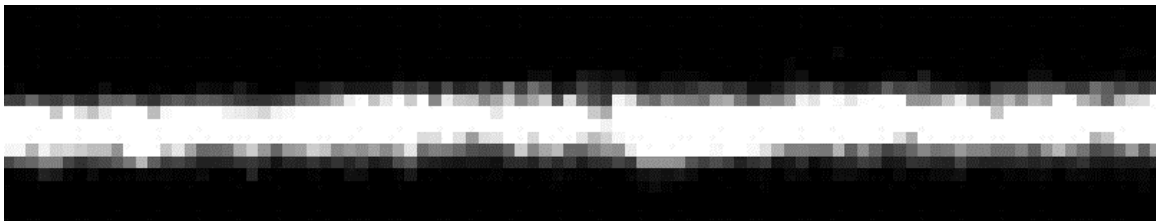
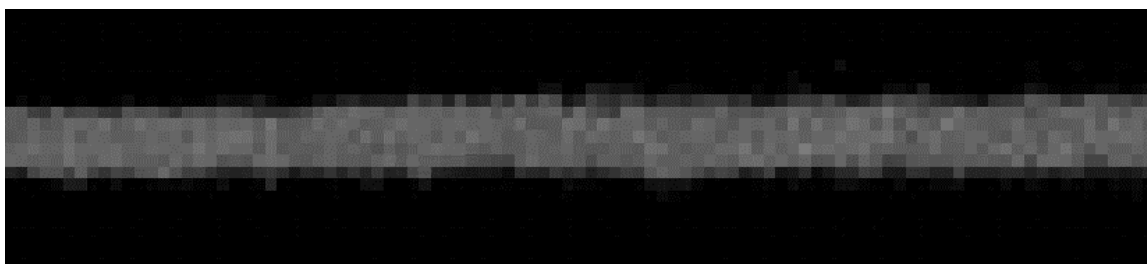
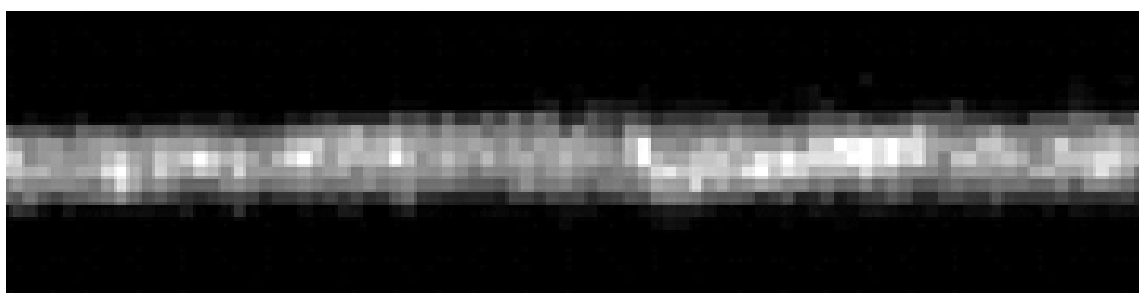


Figure 6-12 Enable Status (1)



- Exposure1: 500us
- Exposure2: 1us

Figure 6-13 Enable Status (2)



- Exposure1: 500us
- Exposure2: 100us

Table 6-8 Parameter Description

Parameter	Description
SingleHDREnable	It sets whether the single-frame HDR function is enabled.
HDRIntensity	[0,40] It controls the level of the HDR. 0 indicates the minimum dynamic range; 40 indicates the maximum dynamic range.
Exposure1	It is for suppressing the brightness of the bright area and dark area.
Exposure 2	It is for increasing the brightness of the bright area and dark area.



Exposure1 shall be greater than Exposure2.

6.5 Mirroring

You can configure the **ReverseX** under the **ImageFormatControl** to realize the image mirroring in the X-axis direction and Y-axis direction.

Figure 6-14 Image Format Control

☒ ImageFormatControl	
ReverseX	True

In ROI mode, the scene before and after mirroring remains unchanged. This function may vary depending on the camera model.

6.6 Gain

6.6.1 GainRaw

The GainRaw is the overall gain parameter of the camera. For example, if the GainRaw is set to 6.4, the total gain is 6.4x, with 3.2x analog gain and 2x digital gain. After setting the GainRaw, the camera will automatically match the most approximate analog gain to ensure that the camera prefers the analog gain.

6.6.2 LLCControl

The LightGain controls the gain of laser ray. We recommend you configure the LightGain parameter after setting the GainRaw to 2.

Figure 6-15 LLCControl

☒ LLCControl	
LightEnhanceEnable	Off
LightGain	2.00000

Table 6-9 LLCControl

Parameter	Description
LightEnhanceEnable	It sets whether the brightness enhancement function is enabled.
LightGain	It controls the gain coefficient of brightness.

6.7 Gamma Correction

The light intensity of image sensor output data and actual data irradiated on the photosensitive surface of the chip is linear relationship. however, the Gamma correction is a nonlinear mapping, which makes the original image from the sensor in line with the perception of human eye after Gamma correction. The mapping relation of gamma correction can be expressed by the formula below.

Figure 6-16 Gamma Correction Mapping Formula

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

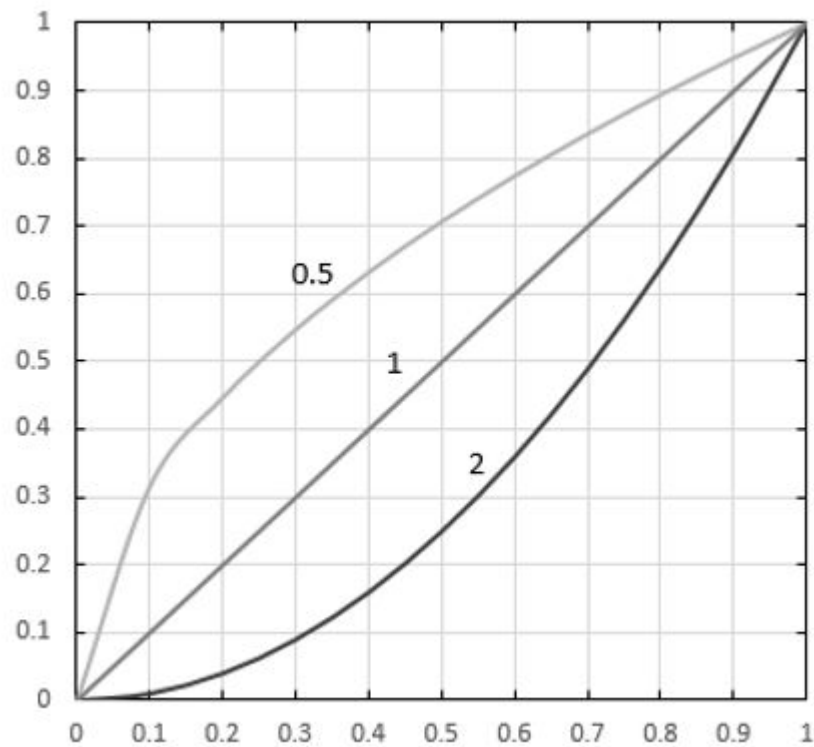
The **Gamma** is under the **AnalogControl**. The range of **Gamma** is 0 to 3.99998.

Figure 6-17 Gamma

Gamma	0.45455
-------	---------

When Gamma is 1, the image brightness is unchanged; when the Gamma is between 0 and 1, the image brightness improves; when Gamma is greater than 1, the image brightness drops.

Figure 6-18 Gamma Graph



7 Algorithm Parameter

7.1 Laser Line Extraction Algorithm

7.1.1 Extract Candidate Point

It performs the gauss filter to the raw image and extracts the candidate points of laser line from the filtered image.

Table 7-1 Parameter Description

Parameter	Description
GaussFilterRadius	It controls the radius of the gauss filter. The larger the filter radius, the smoother the image and the more serious the detail loss.
ColSelectNum	It controls the maximum number of the candidate points in each column. The one of all candidate points in each column will be selected as the extraction result according to the multi-line selection strategy.
PeakDisMin	It controls the minimum interval between candidate points in each column. If the interval of two points is less than this set value, they will not be extracted.
PeakSensitive	If increasing the value of peak sensitivity, the relatively unobvious peak points will be added to the candidate points when the number of candidate points is insufficient.

7.1.2 Filter Candidate Point

It filters the extracted candidate points according to the grayscale, width, and length.

Table 7-2 Parameter Description

Parameter	Description
LaserGrayMax	It controls the maximum grayscale after gauss filtering of the extractable laser points. If the point whose grayscale is greater than the set value, it will not be selected as the candidate point.
LaserGrayMin	It controls the minimum grayscale after gauss filtering of the extractable laser points. If the point whose grayscale is less than the set value, it will not be selected as the candidate point.
LaserWidthMax	It controls the maximum width of the extractable laser points. The maximum width can be computed according to the critical grayscale. If the point whose width is greater than the set value, it will not be selected as the candidate point.
LaserWidthMin	It controls the minimum width of the extractable laser points. The minimum width can be computed according to the critical grayscale. If the point whose width is less than the set value, it will not be selected as the candidate point.

Parameter	Description
LaserLengthMax	It controls the maximum length of the extractable laser points. This parameter indicates the number of the continuous laser points.
LaserLengthMin	It controls the minimum length of the extractable laser points. This parameter indicates the number of the continuous laser points.
ConnectDisHMax	For two consecutive laser points, the spacing between rows in which they are located must be less than the maximum connection interval i.e., height.
ConnectDisWMax	For two consecutive laser points, the spacing between columns in which they are located must be less than the maximum connection interval i.e., width.

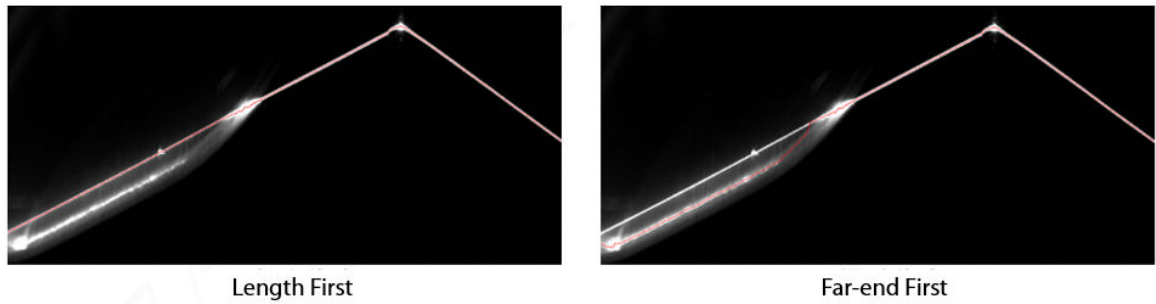
7.1.3 Laser Line Filtering

It filters the extracted laser line according to the grayscale, length, width, position, and other parameters of the laser line.

Table 7-3 Parameter Description

Parameter	Description
SelectMode	- Custom: you can configure the weights of the grayscale, length, position, and width to select the candidate point with the highest score under this weight first. - Gray: it selects the brightest candidate point in each column as the center point of the laser line. - Near: it selects the candidate point closest to the upper end, that is, near end, of each column as the center point of the laser line. - Far: it selects the candidate point closest to the lower end (far end) of each column as the center point of the laser line. - Width: it selects the candidate point with the widest width of the laser line in each column as the center point of the laser line. - Length: it selects the candidate point with the longest laser line length in each column as the center point of the laser line. - GrayLen: it selects the candidate point based on the brightness and length of it. - Invalid: if there are multiple candidate center points in the laser line in a column, it will not extract this laser line.
GrayWeight	It controls the weight of gray. This is only available when the SelectMode is set to Custom.
LengthWeight	It controls the weight of length. This is only available when the SelectMode is set to Custom.
PosHWeight	It controls the weight of position. This is only available when the SelectMode is set to Custom.
WidthWeight	It controls the weight of width. This is only available when the SelectMode is set to Custom.

Figure 7-1 Laser Line Filtering Effect



7.1.4 Filter Out Isolated Point

There may be isolated points in the laser line after screening. You can configure the IsoPtsCheckRadius to filter out the set number of the isolate points.

Table 7-4 Parameter Description

Parameter	Description
IsoPtsCheckRadius	The larger the radius of inspection of isolated point, the larger the filtering range of isolated point, and the more continuous isolated points can be filtered out.

7.1.5 Laser Line Interpolation

For locally discontinuous laser line, the interpolation can be completed by adjusting the maximum interpolation interval, and different interpolation modes can be selected according to the actual conditions.

Table 7-5 Parameter Description

Parameter	Description
InterpType	- Far: it fills the gap with a distal endpoint. - Linear: it performs the linear interpolation according to the two endpoints next to the gap. - Linear_L: it performs the linear fitting with several points at the left end of the gap and lengthens the line. - Linear_R: it performs the linear fitting with several points at the right end of the gap and lengthens the line. - Linear_LR: it performs the linear fitting with several points at the left and right ends of the gap and lengthens the line.
InterpGapMax	It performs the interpolation to fill the gap of the column that has not extractable laser points. If the interval is larger than the maximum filling gap, it will not proceed.

7.1.6 Laser Line Filter

It performs the mean filtering and median filtering to the extracted laser points.

Table 7-6 Parameter Description

Parameter	Description
MeanFilterEnable	It sets whether the mean filter function is enabled.
MeanFilterRadius	It controls the mean filter radius of the points.
MeanFilterTimes	It controls the number of times the mean filter is performed to the points.
MeanFilterThresh	It controls the threshold of the mean filter. The filter function is only valid when the distances of all pixels in the filter window is less than the threshold.
MedianFilterEnable	It sets whether the median filter function is enabled.
MedianFilterRadius	It controls the median filter radius of the points.
MedianFilterTimes	It controls the number of times the median filter is performed to the points.
MedianFilterThresh	It controls the threshold of the median filter. The filter function is only valid when the distances of all pixels in the filter window is less than the threshold.

7.2 Depth Image Algorithm

7.2.1 Depth Image Property

You can configure the offset and scale parameters of depth image to control the imaging accuracy and imaging coordinates of depth image.

Table 7-7 Parameter Description

Parameter	Description
DepthImageOffsetX	It controls the offset value of the depth image or intensity image at the X-axis direction. Unit: μm .
DepthImageOffsetZ	It controls the offset value of the depth image at the Z-axis direction. Unit: μm .
DepthImageScaleX	It controls the interval value of pixels at the X-axis direction. Unit: μm .
DepthImageScaleZ	It controls the interval value of pixels at the Z-axis direction. Unit: μm .

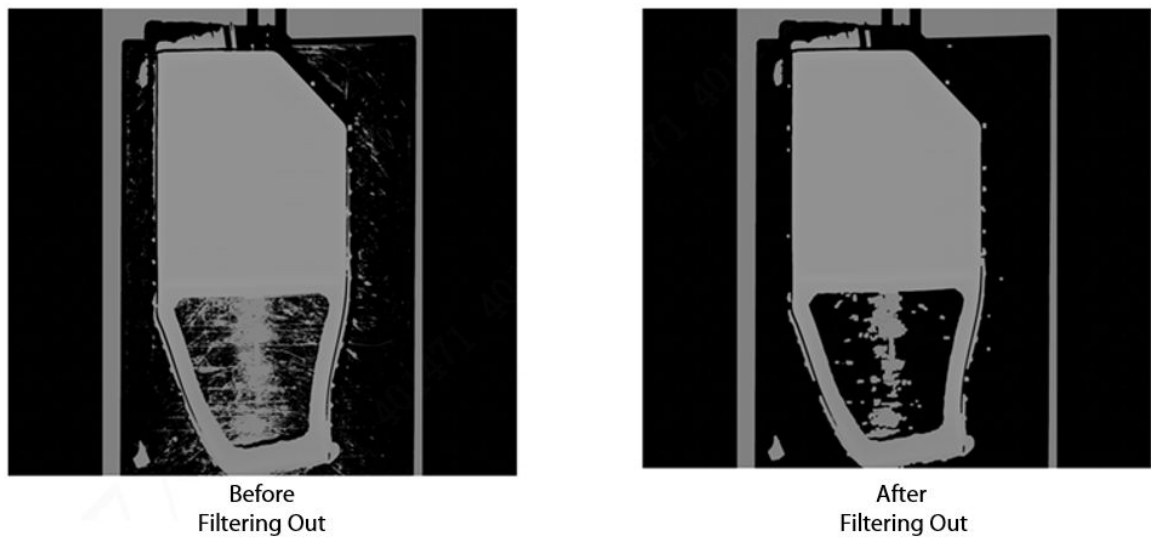
7.2.2 Depth Image Post-processing

The depth image post-processing supports the gap filling, isolate points filtering, and filter operation.

Table 7-8 Parameter Description

Parameter	Description
MaxGapFillingX	It controls the maximum padding interval of depth image. Unit: pixel.
MaxGapFillingY	It controls the maximum padding interval of depth image. Unit: pixel.
IsoPointThreshX	It controls the isolated point threshold of depth image at the X-axis direction. Unit: pixel.
IsoPointThreshY	It controls the isolated point threshold of depth image at Y-axis direction. Unit: pixel.
DepthFilterType	It specifies the filter algorithm type of depth image, which includes the mean and median.
DepthFilterRadiusX	It controls the filter radius of depth image at X-axis direction. The greater the radius, the stronger the filter. Unit: pixel.
DepthFilterRadiusY	It controls the filter radius of depth image at Y-axis direction. The greater the radius, the stronger the filter. Unit: pixel.

Figure 7-2 Isolate Points Removing Effect



8 Calibration

Errors may occur during camera installation, which affects the accuracy of the output data. You can use this function to correct installation errors and calibrate the scanning direction and scanning speed to get the more accurate point-cloud data in the system coordinate.

8.1 Static Calibration

This function is applicable for the scenario where the relative position between the camera and object does not change. It can also correct the plane spacing based on linear calibration.

Procedure

- Step 1 Place the calibration block. Configure the ROI box on the raw image so that the 3DMVviewer can completely collect the data of the calibration block. Stop the data collection.

Figure 8-1 Start Streaming

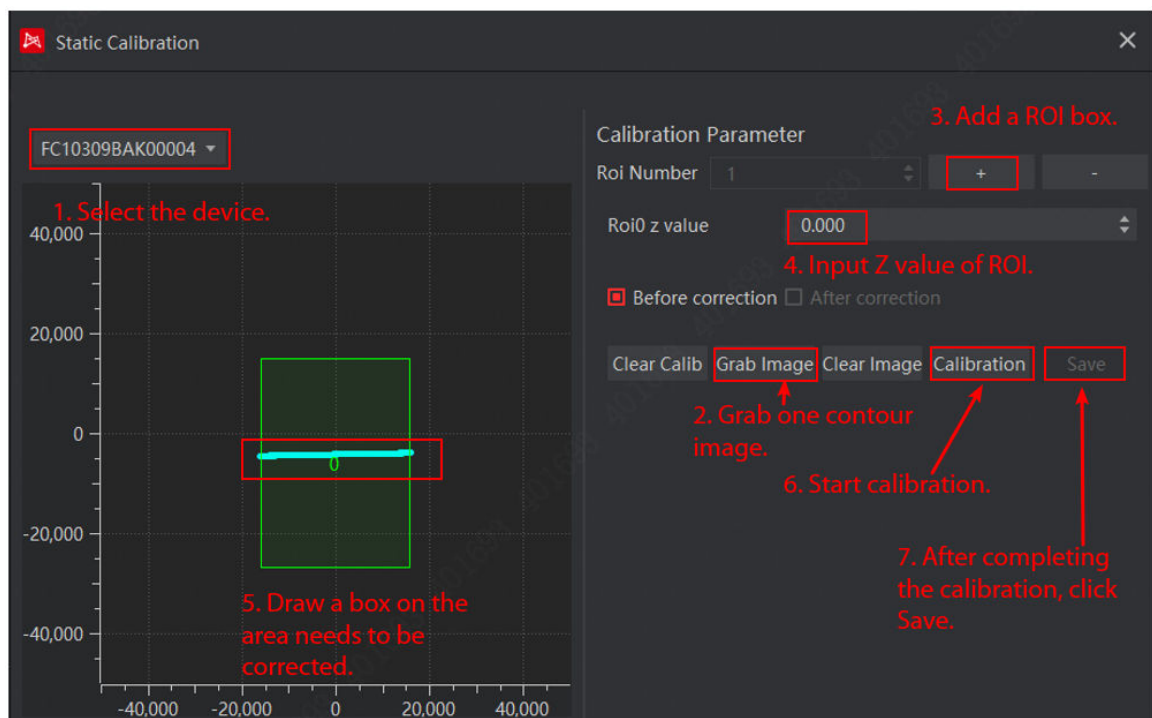


- Step 2 Click **Calibration** > **Static Calibration** > **Grab Image**. Set the value of the **ROI Number**, click **Calibration** button, and click **Save**.



The ROI number can be configured according to the actual on-site conditions.

Figure 8-2 Configuration Interface



8.2 Dynamic Calibration

This function is applicable for the motion systems such as linear conveyor belts, that is, scenarios in which the camera and object are relatively moving. It can also correct the error of translation direction on the basis of static calibration.

Procedure

- Step 1** Place the calibration block. Configure the ROI box on the raw image so that the 3DMVviewer can completely collect the data of the calibration block. Stop the data collection.

Figure 8-3 Start Streaming

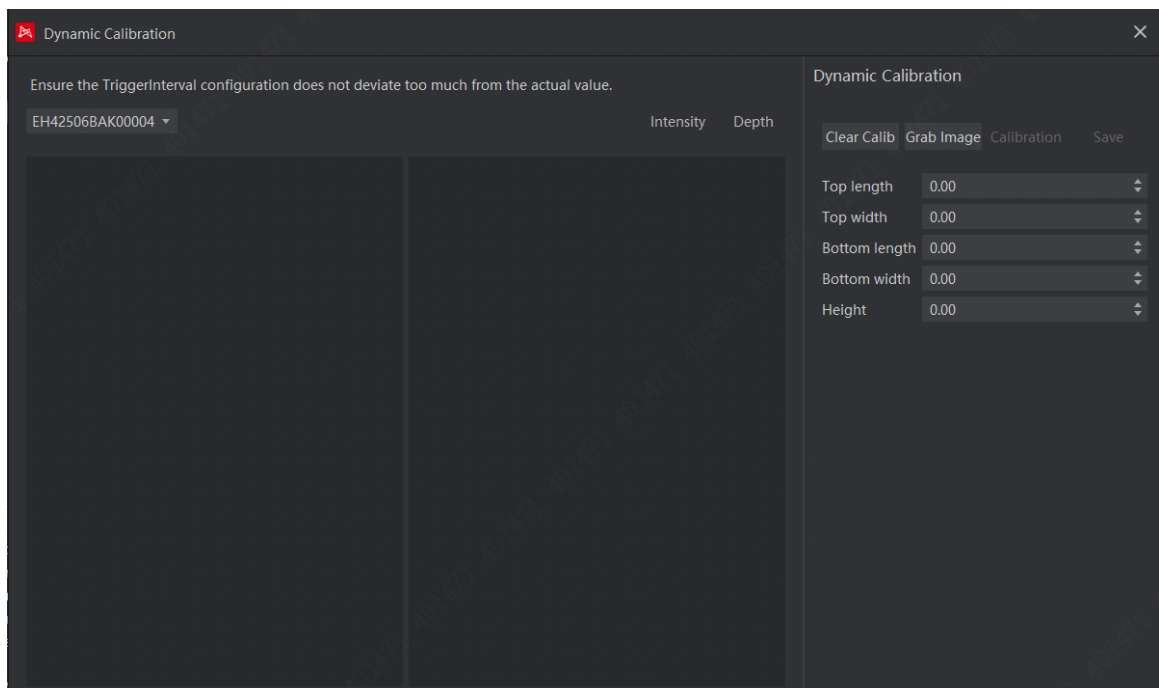


- Step 2** Click **Calibration** > **Dynamic Calibration** > **Grab Image**. Make the conveyor belt move for a certain distance. Input the dimensions of block in the Top length, Top width, Bottom length, Bottom width, and Height. Click **Calibration** > **Save**.



- For the DL3080B, the dimensions of calibration block are 30, 20, 90, 50, 20.
- The dimensions of the calibration block may vary depending on the profiler model. Please input the dimensions according to the actual condition.

Figure 8-4 Configuration Interface



9 Device Control and Others

9.1 DeviceControl

The **DeviceControl** includes the information of the device, protocol version, customized device ID, device temperature, device reset, etc. The parameters will vary depending on the models. The details are described in the table below.

Table 9-1 Parameter Description

Parameter	Description	Read/Write
DeviceType	It shows the type of the current device.	Read Only
DeviceScanType	It shows the scanning type of current camera's sensor.	Read Only
DeviceVendorName	It shows the name of the device manufacturer.	Read Only
DeviceModelName	It shows the model information of the device.	Read Only
DeviceManufacturerInfo	It shows the information of the manufacturer.	Read Only
DeviceVersion	It shows the version information of the device.	Read Only
DeviceFirmwareVersion	It shows the firmware version of the device.	Read Only
DeviceSerialNumber	It shows the serial number of the device	Read Only
DeviceUserID	It controls the device ID. Empty by default.	Read and Write
DeviceReset	It sets whether the soft reboot and parameter reset is performed.	Read and Write
DeviceTemperatureSelector	It specifies the component that needs to be monitored for temperature.	Read and Write
DeviceTemperature	It shows the temperature of specified component in DeviceTemperatureSelector .	Read Only
DeviceDevelopData	It is for development and commissioning.	Read and Write

9.2 TransportLayerControl

The parameter of the **TransportLayerControl** includes some network modes and performance information which can be configured. The parameters will vary with the models.

Table 9-2 Parameter Description

Parameter	Description	Read/Write
PayloadSize	It shows the total size of the payload, including the end-of-line, end-of-frame, or other stamp data.	Read Only
GevActiveLinkCount	It shows the effective links.	Read Only

Parameter	Description	Read/Write
GevInterfaceSelector	It specifies the interface of physical network.	Read and Write
GevLinkSpeed	It shows the transmission speed of the network interface.	Read Only
GevMACAddress	It shows the MAC address of the selected network interface.	Read Only
GevCurrentIPAddress	It shows the IP address of the selected network interface.	Read Only
GevCurrentSubnetMask	It shows the subnet mask of the network.	Read Only
GevCurrentDefaultGateway	It shows the gateway IP address of the network interface.	Read Only
DeviceManifestPrimaryURL	It shows the primary URL of the description file.	Read Only
DeviceManifestSecondaryURL	It shows the secondary URL of the description file.	Read Only
GevPersistentIPAddress	It controls the static IP address of the network interface.	Read and Write
GevPersistentSubnetMask	It controls the static subnet mask of network interface.	Read and Write
GevPersistentDefaultGateway	It controls the static gateway of the network interface.	Read and Write
GevHeartbeatTimeout	It specifies the time value of the heartbeat packet. During this set value, if the SDK heartbeat response of camera is not received, the camera occupancy status is cleared to confirm whether the camera is working properly.	Read and Write
GevTimestampControlReset	It sets whether the counter is reset.	Read and Write
GevGVCPHeartbeatDisable	It sets whether the heartbeat function is enabled.	Read and Write
GevGVCPPendingTimeout	It shows the delay time before the camera returns the response command.	Read Only
GevCCP	It specifies the access permission of the device.	Read and Write
GevPrimaryApplicationSocket	It shows the PC's port number.	Read Only
GevPrimaryApplicationIPAddress	It shows the PC's IP address.	Read Only
GevSCPSDoNotFragment	The status of this parameter will be included in every stream data packet to prevent packet fragment in the stream channel.	Read and Write
GevSCPSPacketSize	It controls the size (B) of the maximum data packet in the data transmission of camera.	Read and Write
GevSCPD	It controls the delay interval between the two packets in the data transmission.	Read and Write

Parameter	Description	Read/Write
GevSCDA	It controls the IP address of the device receiving the data stream.	Read and Write
GevSCSP	It shows the source port of the stream channel.	Read Only
FrameTriggerCount	It shows the number of the trigger signals received by the camera, including the external trigger and software trigger.	Read Only
FrameTriggerLostCount	It shows the number of the lost trigger signals of camera, including the external trigger and software trigger.	Read Only
SensorTriggerCount	It shows the number of imaging trigger signals received by sensor, including all the imaging trigger signals, which include free mode, external trigger, and software trigger, that sensor can search for.	Read Only
SensorFrameCount	It shows the number of frames output from camera in the modes of free, external trigger, and software trigger.	Read Only
FrameTriggerCountReset	It sets whether the counters are reset, including the FrameTriggerCount, FrameTriggerLostCount, SensorTriggerCount, and SensorFrameCount.	Read and Write

9.3 UserSetControl

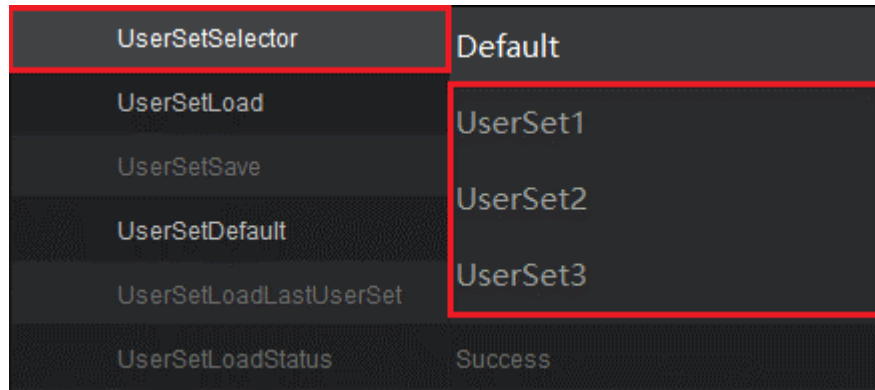
The **UserSetControl** can save and load the user-defined parameters and set default parameters. The camera supports 4 sets of parameters, including the one default parameter set and three user-defined parameter sets. The parameters configured by the user can be saved into any user-defined parameter set, and the default loading parameter set can be configured to the saved parameter set in UserSetDefault.

9.3.1 Save User Parameters

Procedure

- Step 1 After completing the parameter configuration, select the corresponding parameter set in **UserSetSelector**, as shown in the figure below.

Figure 9-1 UserSetSelector



Step 2 Click **UserSetSave** to save the configured parameters.

Figure 9-2 UserSetSave



9.3.2 Load User Parameters

Procedure

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

Step 2 Click **UserSetLoad** to load the configured parameters.

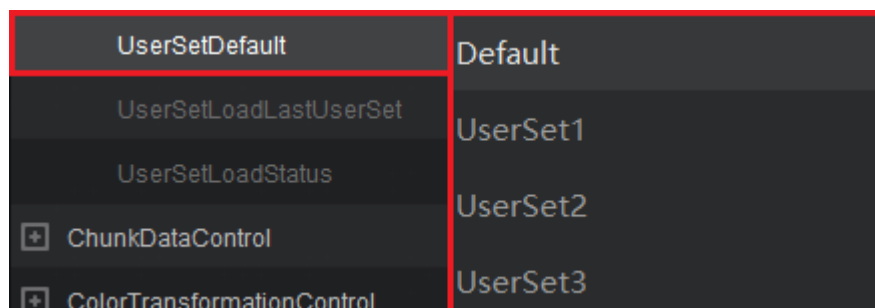
Figure 9-3 UserSetLoad



9.3.3 Set Default Parameters

You can configure the **UserSetDefault** to specify the user set that is loaded by default after the device is powered on, as shown in the figure below.

Figure 9-4 UserSetDefault

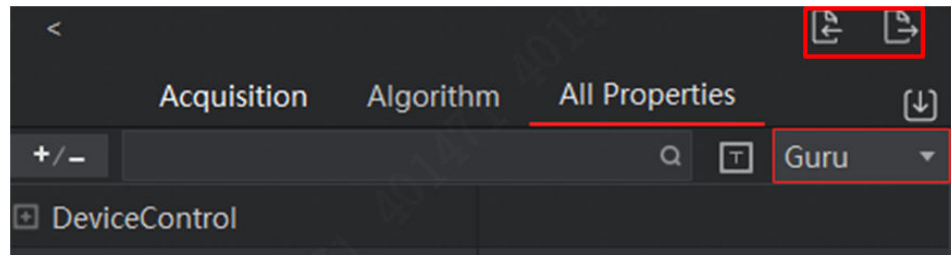


- **UserSetLoadLastUserSet** shows the current loaded parameter set.
- **UserSetLoadStatus** shows the loading status.

9.4 Import Property and Export Property

- Import Property: Click  to open file selection window, and select the file you need.
- Export Property: Click  to open the file window for selecting the saving directory.

Figure 9-5 Import Property and Export Property



9.5 Image Save

This function can save the acquired image from camera in many formats, as shown in the figure below.

Figure 9-6 Image Save

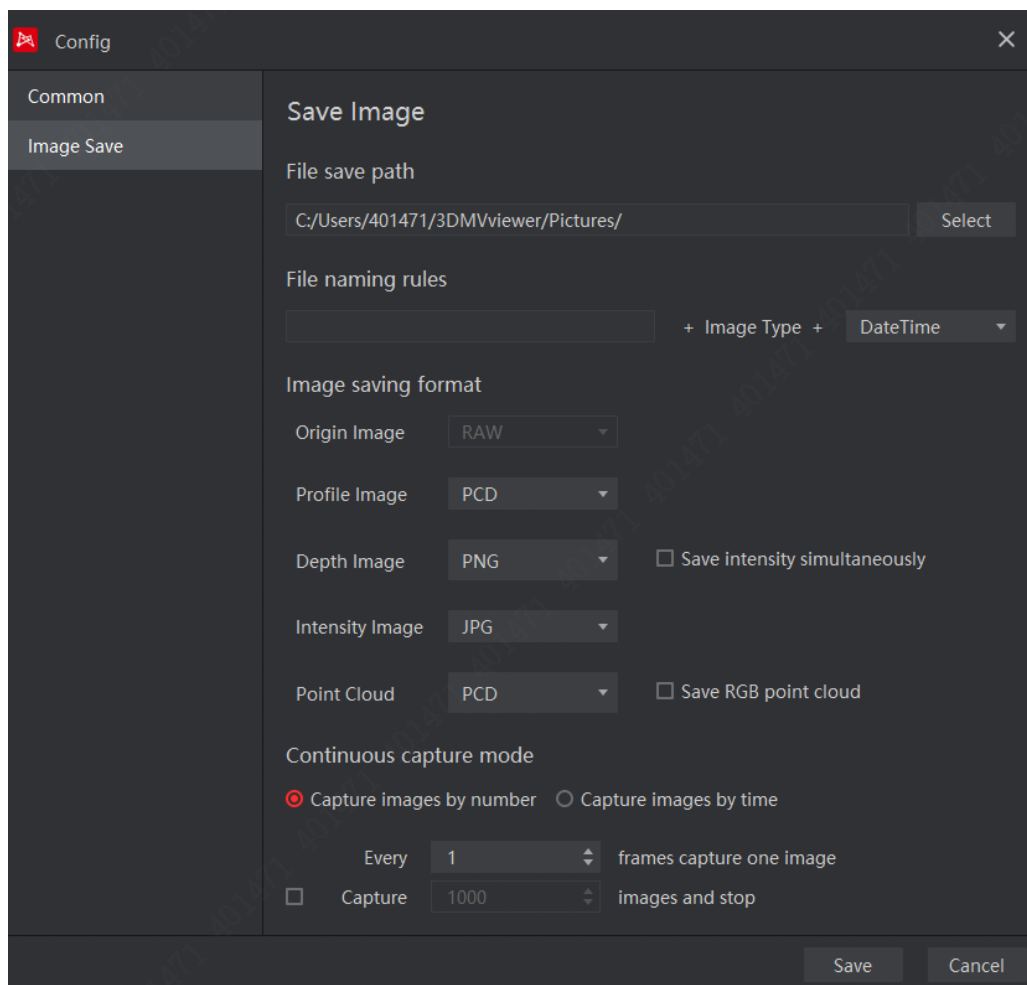


Table 9-3 Parameter Description

Parameter	Description
Origin Image	Raw by default. This parameter cannot be configured.
Contour Image	It supports RAW, PLY, PCD, and CSV.
Depth Image	It supports RAW, JPG, BMP, PNG, and TIFF.
Intensity Image	It supports RAW, JPG, BMP, PNG, and TIFF.
Point Cloud	It supports RAW, PLY, PCD, and CSV.

9.6 Image File Viewer

This image tool is mainly for viewing the offline image data, including raw image, depth image, point-cloud image.

Figure 9-7 Image File Viewer



9.7 Firmware Upgrade

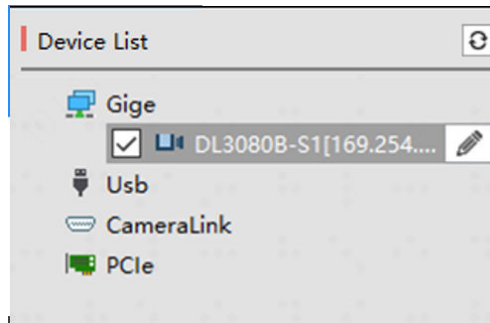
Background Information

The CamTools is for upgrading the firmware of the camera.

Procedure

- Step 1 Click **Tool** > **Upgrade**.
- Step 2 Select a device in the Device List.

Figure 9-8 Select a Device



Step 3 Select the applicable firmware package and unzip it to get a '.bin' file, as shown in the figure below.

Figure 9-9 Select Firmware



Step 4 Select the applicable firmware file and click **Start** to begin the upgrade, as shown in the figure below. After the camera upgrades successfully, the camera will reboot automatically.

Figure 9-10 Start Upgrade



Appendix 1 Legal Information

Copyright

- Copyright © 2026 ZheJiang HuaRay Technology Co., Ltd.
- This document cannot be copied, transferred, distributed, or saved in any form without the prior written permission of Zhejiang HuaRay Technology Co., LTD (hereinafter referred to as **HuaRay**). The products described in this document may contain the software that belongs to HuaRay or the third party. Without the prior written approval of the corresponding party, any person cannot (including but not limited to) copy, distribute, amend, abstract, reverse compile, decode, reverse engineer, rent, transfer, sublicense the software.

Trademark

-  and **iRAYPLE** are the trademark or registered trademark of HuaRay.
- All trademarks and registered trademarks mentioned herein are the properties of their respective owners.

Disclaimer

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

Compliance to Export Control

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

About this Document

- The manual is for reference only. If there is inconsistency between the manual and the actual product, the actual product shall prevail.
- We are not liable for any loss caused by the operations that do not comply with the Manual.
- All the designs and software are subject to change without prior written notice.
- There still might be deviation in technical data, functions and operations description, or errors in print. If there is any doubt or dispute, we reserve the right of final explanation.
- Upgrade the reader software or try other mainstream reader software if the manual (in PDF format) cannot be opened.