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CoaXPress Series Line Scan Camera

User Guide

Industrial Automation | Intelligent Elevator | New Energy Vehicle | Industrial Robot | Rail Transit

Data code PS00017499A02

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The storage, use, and disposal of this product (including optional accessories) must comply with local laws and regulations.

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The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel can identify the risks of the product/system and prevent possible dangers.

Proper Use of the Product

Proper transportation, storage, assembly, installation, commissioning, operation, and maintenance are required to ensure the safe operation of the product without any problems. The required ambient conditions must be met. All operations must follow the guidelines provided in this documentation.

Preface

Introduction

The image acquisition devices mentioned in this guide utilize the CoaXPress interface for fast, real-time transmission of uncompressed images. The CoaXPress frame grabber software can be used for image data acquisition and parameter configuration.

This guide provides information about the product models, physical dimensions, physical interfaces, camera installation and software operation, camera usage, and troubleshooting procedures.

Note

- The drawings in the user guide are shown for illustration only and may be different from the product. Actual products may vary.
- The user guide is subject to change due to product upgrade, specification modification as well as efforts to improve the accuracy and convenience of the guide.

Revision History

Date	Version	Description
June 2025	A02	Added model descriptions.
February 2025	A01	Corrected minor errors.
September 2024	A00	Initial release.

Access to the Guide

This guide is not delivered with the product. You can obtain the PDF version in the following way:

- Visit *www.inovance.com*, go to Support > Download, search by keyword, and then download the PDF file.
- **QR code**: Scan the QR code on the product with your smart phone.
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For faults and damage incurred during normal use in the warranty period, Inovance provides free repair service. (For details of the warranty period, see the purchase order.) A maintenance fee will be charged out of the warranty period.

Even in the warranty period, a maintenance fee will be charged for repair of the following damage:

- Damage caused by operations not following the instructions in the guide
- Damage caused by fire, flood, or abnormal voltage
- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product
- Damage or secondary damage caused by force majeure (such as natural disaster, earthquake, and lightning strike)

The maintenance fee will be charged according to our latest Price List if not otherwise agreed upon.

For details, see the Product Warranty Card.

Table of Contents

Legal Information 1
Preface 1
Safety Precautions 4
1 Product Information 8
1.1 Product Introduction 8
1.2 Model and Nameplate 8
1.3 Product Dimensions 9
1.4 Technical Specifications 10
1.5 Spectrum Response Curve Charts 11
2 Camera Hardware 14
2.1 Power Supply Interface 14
2.2 Indicator 14
3 Operating Environment and Conditions 17
3.1 Operating Environment and Heat Dissipation 17
3.2 Protection Against Electrostatic Discharge, Electromagnetic Interference, Lightning, and Power Surges 17
4 Camera Installation and Software Installation 19
4.1 Camera Installation 19
4.2 Frame Grabber Software Operation 20
4.3 Camera Basic Functions 20
5 Common Faults 41
6 Service and Support 42

Safety Precautions

Safety Disclaimer

- This chapter presents essential safety instructions for a proper use of the equipment. Before operating the equipment, read through the guide and comprehend all the safety instructions. Failure to comply with the safety precautions may result in equipment damage, severe physical injuries, or even death.
- "DANGER", "WARNING", and "CAUTION" items in this guide do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
- Use this product in environments meeting the design and specification requirements; otherwise, a fault may occur. Noncompliance-caused malfunction or damage to parts are not covered in product quality warranty.
- Inovance shall not be held liable for any physical injuries or property damage caused by improper use.

Safety Levels and Definitions

DANGER indicates that failure to comply with the notice will result in severe personal injuries or even death.

WARNING indicates that failure to comply with the notice may result in severe personal injuries or even death.

CAUTION indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage.

Safety Precautions

- Some drawings in the guide shows the product without covers or protective guards to display more details. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- Product illustrations in this guide are for reference only. Actual products may vary.

Unpacking
WARNING • Do not install the product when you find that the product and its accessories have any damage or corrosion or they have been used. • Do not install the product when there is water inside the product or any of its parts is missing or damaged. • Do not install the product when the product name is inconsistent with that in the packing list.
CAUTION • Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking. • Unpack the product layer by layer. Do not strike the package violently. • Check the surface of the equipment and accessories for any damage, rust, and scratches. • Check whether the package contents are consistent with the packing list before unpacking.

Storage and Transportation
 • Package the product strictly before transporting it, and use an enclosed container for long-distance transportation. • Avoid storage and transportation in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration. • Avoid product and component dropping and strong vibration during transportation. • Never transport this product with materials that harm or have negative impacts on this product. • Store and transport the equipment based on the storage and transportation requirements. Failure to comply will result in equipment damage.

Installation
 • The product installation process must strictly comply with all electrical safety regulations of the country and region of use. • Installation can be performed only by professionals with a qualification certificate or experience in installing and maintaining low-voltage systems and experience and qualifications in related work, or professionals with basic knowledge and operational skills in low-voltage wiring and low-voltage electronic circuit connections. Non-professionals are not allowed to operate on the equipment. • Never install indoor products in environments where they may be exposed to rain or moisture. Failure to comply may result in fires or electric shocks. • Place the products in a location without direct sunlight, away from heat sources such as heaters and flames.
 • Read through the guide and safety instructions before installation. • Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply will result in mechanical hazards. • Do not modify the product.

Wiring

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by only professionals.
- Be sure to use a power adapter provided by a reputable manufacturer. The power adapter must comply with limited power source (LPS) requirements of the safety specifications. For specific requirements, see the product's technical specifications.

WARNING

- Wiring cables must meet diameter and shielding requirements.
- After wiring is done, check that all cables are connected properly and no screws, washers, or exposed cables are left inside the equipment. Failure to comply may result in electric shocks or equipment damage.
- Reasonably assess the wiring space and do not pull the cables.
- Shield the cables properly or do not route the product cable together with high-power equipment cables.
- After wiring is done, check that all cables are connected properly and no screws, washers, or exposed cables are left inside the equipment. Failure to comply may result in electric shocks or equipment damage.
- During wiring, follow proper electrostatic discharge (ESD) procedures and wear an anti-static wrist strap. Failure to comply can result in damage to the equipment or internal product circuits.

Power-on

DANGER

- Before power-on, make sure that the product is installed properly with reliable wiring.
- Check that the power supply meets equipment requirements before power-on to prevent equipment damage or fire.

Operation

DANGER

- Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply will result in electric shocks.
- Do not touch any heatsink components of the product to check temperature. Failure to comply may result in burns.

Maintenance

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by only professionals.
- Do not maintain the equipment while power is on. Failure to comply may result in electric shocks.

WARNING

- Do not directly touch the image sensor. When cleaning it, use a soft and clean cloth slightly dampened with alcohol to wipe the sensor.
- Attach the dust cover to the equipment not in use to prevent contamination of the image sensor.
- Perform routine and periodic inspection and maintenance on the equipment and keep a maintenance record.

Repair
 • Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by only professionals. • Do not repair the equipment while power is on. Failure to comply may result in electric shocks.
 • When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly. • Replace quick-wear parts of the equipment in according with the replacement instructions. • After the equipment is replaced, check the wiring and set parameters again.

Disposal
 • Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, personal injuries, or even death. • Recycle retired equipment by observing industry waste disposal standards to avoid environmental pollution.

Electromagnetic Interference Prevention Precautions

This product may cause radio interference in life. In this case, users may need to take practical measures to address the interference.



- Do not place the product in any place with electromagnetic interference.
- When using shielded cables, ensure the integrity.
- Product control lines and industrial light source power cables must be wired separately to prevent bundled wiring.
- Product power cables must be wired separately from data cables and signal cables.
- If the product is frequently powered on and off, enhance voltage stabilization and isolation.
- Insulate any unused cables of the product.
- During product installation and use, prevent high-voltage leakage and similar phenomena.
- Use network cables with the shielding function to connect to the product.

1 Product Information

1.1 Product Introduction

Product description

The image acquisition devices mentioned in this guide utilize the CoaXPress (CXP) interface for fast, real-time transmission of uncompressed images. The CXP frame grabber software can be used for image data acquisition and parameter configuration.

Camera features

- Supports gain adjustment, exposure time, and Gamma, DSNU, and PRNU functions.
- Color cameras support spatial correction, white balance, and parallax correction.
- Supports GPIO triggering, CXP triggering, and free-run mode.
- Transmits data through CXP-6/CXP-10/CXP-12 interfaces.
- Compliant with the CXP protocol and GenICam standard.
- Supports temperature monitoring.

1.2 Model and Nameplate

Model description

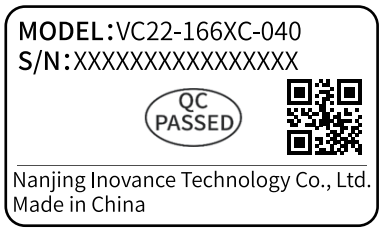
VC ① 22 ② - 166 ③ X ④ C ⑤ - 040 ⑥

① **VC: Industrial camera**	④ **Interface/Feature** X: CoaXPress
② **Series bit 1** 22: 2D line scan	⑤ **Color** C: Color M: Black-white
③ **Resolution**[1] 162: 16K2 lines 163: 16K3 lines 166: 16K6 lines	⑥ **Line rate** 040: 40 kHz 050: 50 kHz 090: 90 kHz

Note

[1]: The last digit represents the line count, for example, 162 represents 16K2 lines.

Nameplate



1.3 Product Dimensions

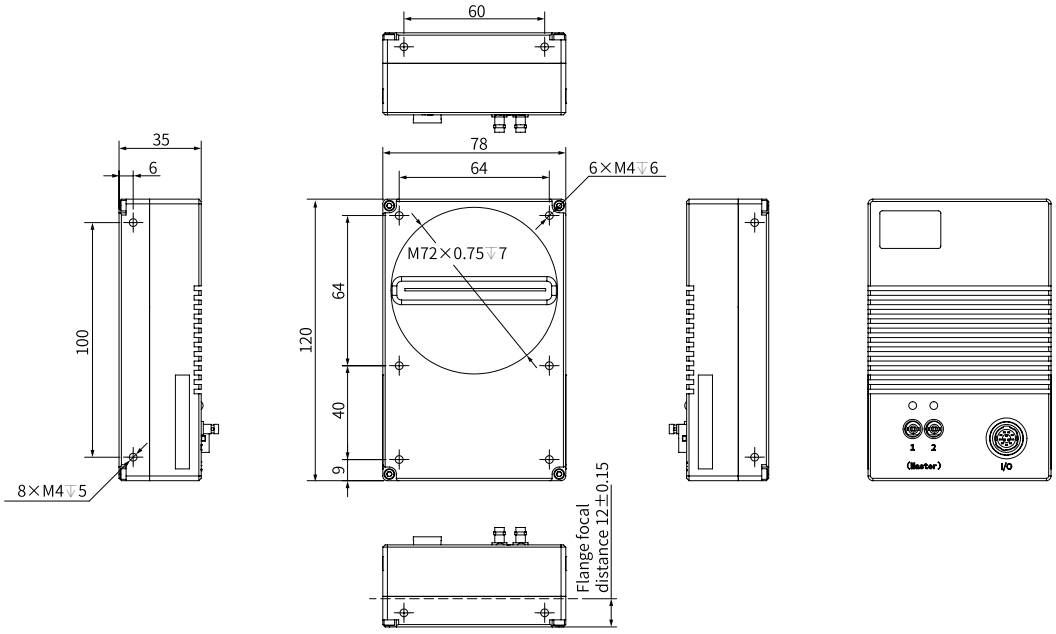


Figure 1-1 Outline dimensions of VC22-083XC-060, VC22-081XM-220, VC22-161XM-080, and VC22-162XC-050 (unit: mm)

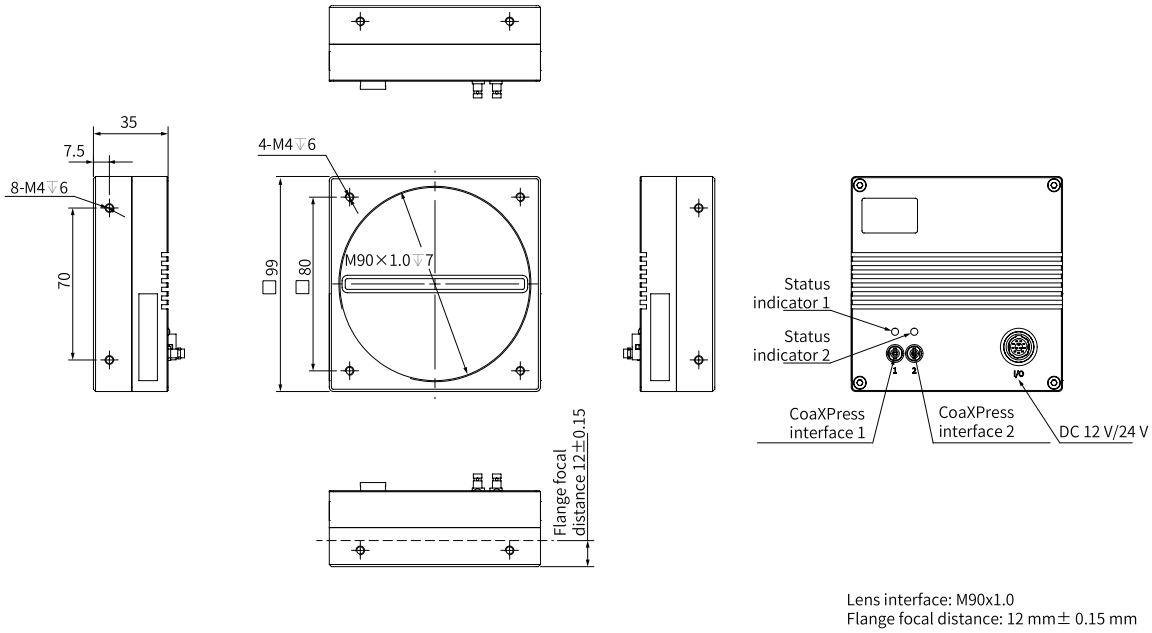


Figure 1-2 Outline dimensions of VC22-162XM-090, VC22-163XC-050, and VC22-166XC-040 (unit: mm)

1.4 Technical Specifications

Model	VC22-083XC-060	VC22-081XM-220	VC22-161XM-080	VC22-162XC-050	VC22-162XM-090	VC22-163XC-050	VC22-166XC-040
Resolution	8192 x 3	8192 x 1	16384 x 1	16384 x 2	16384 x 2	16384 x 3	16384 x 6
TDI mode	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Supported
Pixel size (μm)	7 x 7	7 x 7	3.5 x 3.5	3.5 x 3.5	5 x 5	5 x 5	5 x 5
Sensor array size (mm)	58	58	58	58	82	82	82
Maximum line rate (kHz)	60	220	80	50	90	49.5	40
Data depth (bit)	8/10	8/10	8/10	8/10	8/10	8/10	8/10
Color specifications	RGB	Mono	Mono	RGB	Mono	RGB	RGB
Dynamic range (dB)	66	66	65	65	64	64	64
Lens interface (mm)	M72 x 0.75	M72 x 0.75	M72 x 0.75	M72 x 0.75	M90 x 0.75	M90 x 0.75	M90 x 0.75
Transmission mode	CXP	CXP	CXP	CXP	CXP	CXP	CXP
Color	Color	Black-white	Black-white	Color	Black-white	Color	Color

Model	VC22-083XC-060	VC22-081XM-220	VC22-161XM-080	VC22-162XC-050	VC22-162XM-090	VC22-163XC-050	VC22-166XC-040
Power supply (VDC)	PoCXP/12 to 24	PoCXP/12 to 24	PoCXP/12 to 24	PoCXP/12 to 24	PoCXP/12 to 24	PoCXP/12 to 24	PoCXP/12 to 24
Power consumption (W)	< 9	< 9	< 9	< 9	< 11	< 11	< 11
Operating temperature	0°C to 50°C	0°C to 50°C	0°C to 50°C	0°C to 50°C	0°C to 50°C	0°C to 50°C	0°C to 50°C
Weight (g)	460	460	460	460	510	510	510
Outline dimension (mm)	78 x 120 x 35	78 x 120 x 35	78 x 120 x 35	78 x 120 x 35	99 x 99 x 35	99 x 99 x 35	99 x 99 x 35
Flange focal distance (mm)	12±0.15	12±0.15	12±0.15	12±0.15	12±0.15	12±0.15	12±0.15

1.5 Spectrum Response Curve Charts

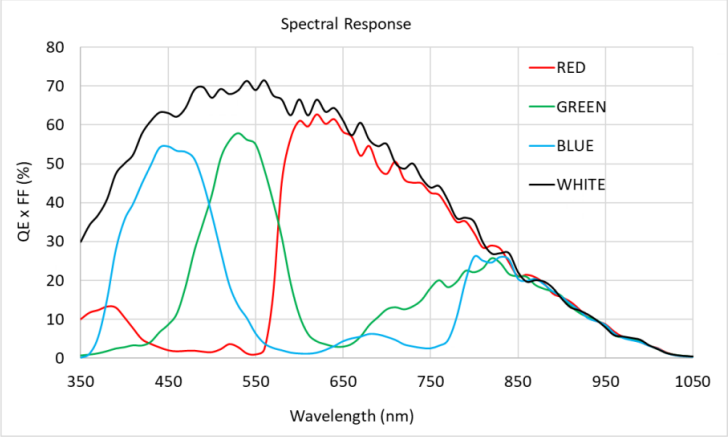


Figure 1-3 VC22-083XC-060

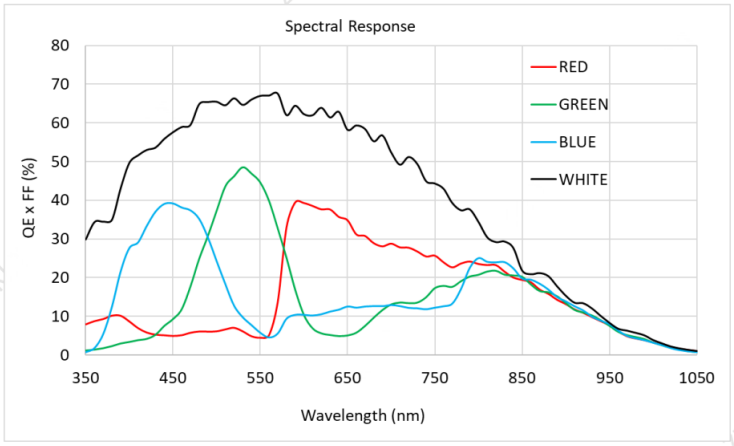


Figure 1-4 VC22-162XC-050 and VC22-161XM-080

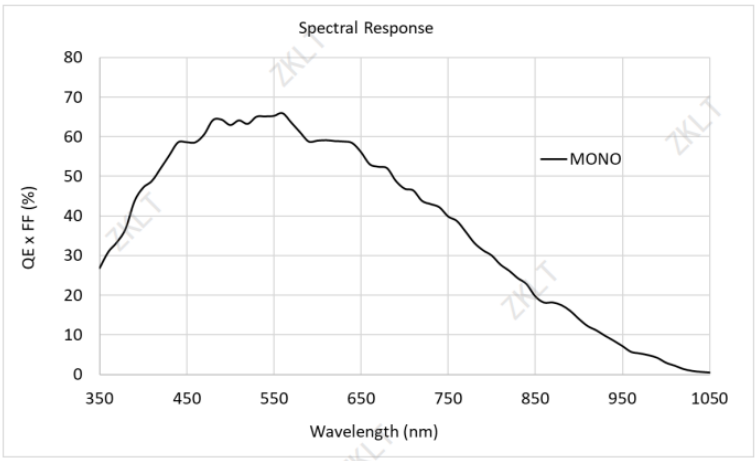


Figure 1-5 VC22-081XM-220

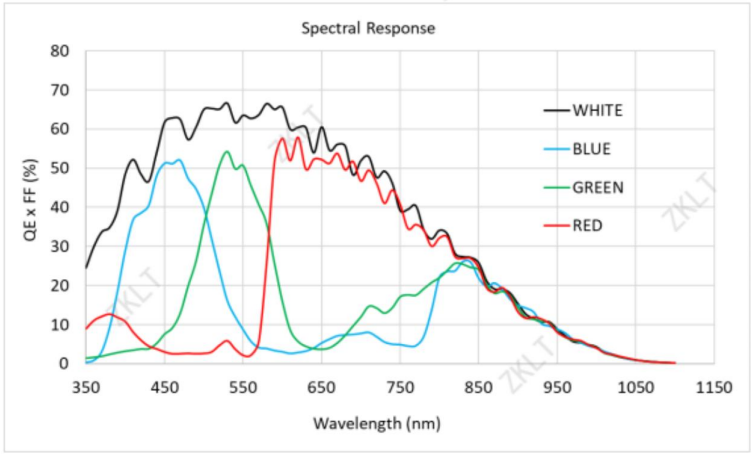


Figure 1-6 VC22-163XC-050 and VC22-166XC-040

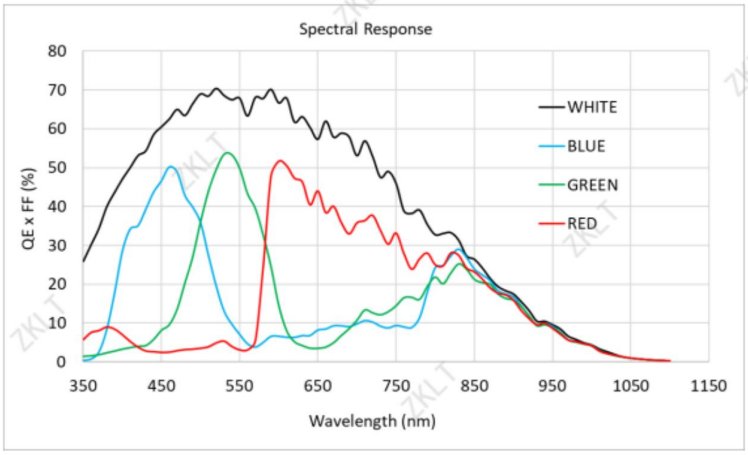


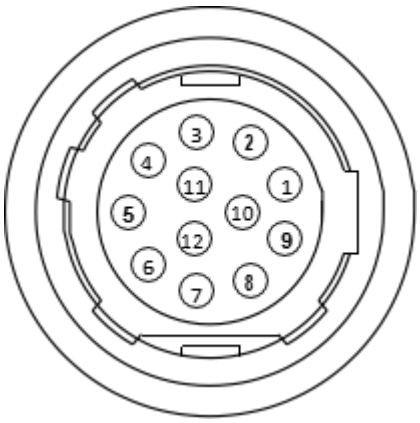
Figure 1-7 VC22-162XM-090

2 Camera Hardware

2.1 Power Supply Interface

Power supply interface

The camera's power supply and I/O interfaces use a 12-pin connector.



Pin definitions are as below:

Pin	Signal	Description
1	Power–	Power negative
2	Power+	Power positive
3	FLASH+	LINE0 output+
4	TRIGGER+	LINE0 input+
5	-	NC
6	TTL-TRIGGER+	LINE1 input/TDI scan direction
7	TTL-OUT	LINE1 output
8	-	NC
9	TRIGGER–	LINE0 input–
10	FLASH–	LINE0 output–
11	-	NC
12	DIG_GND	Digital ground

Power supply connection

The camera supports Power-over-CoaXPress (PoCXP) for direct power supply, and can also be externally powered through a 12 VDC to 24 VDC input.

2.2 Indicator

Indicator signal

The following table describes statuses corresponding to indicator signals.

Indicator Signal	Definition
Red indicator ON	The camera is faulty.
Orange indicator flashing	No trigger signal is input in the specified trigger mode.
Green indicator flashing frequently	The camera is transmitting data.
Steady green	No data is transmitted.

Cable selection

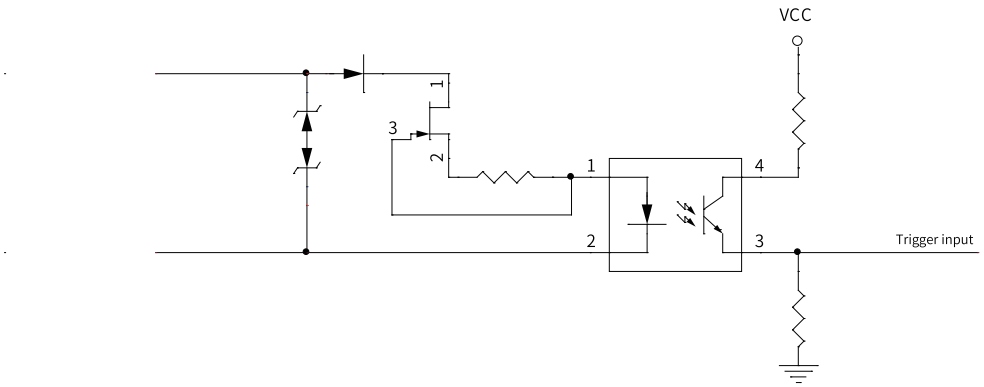
The camera uses Micro-BNC connectors. Due to high data throughput, industrial-grade CXP cables are strongly recommended to ensure transmission quality. Longer cables and higher data volumes demand superior cable quality. Poor-quality cables may cause excessive data retransmission and packet loss. The maximum recommended cable length is 30 meters.

The camera has three connectors at the rear:

- Two Micro-BNC interfaces for powering the CXP1 channel.
- 12-pin I/O connector supplying 12 VDC to 24 VDC power and providing trigger input and trigger output for the camera.

Trigger input

The following figure shows the internal circuit for the trigger signal input.



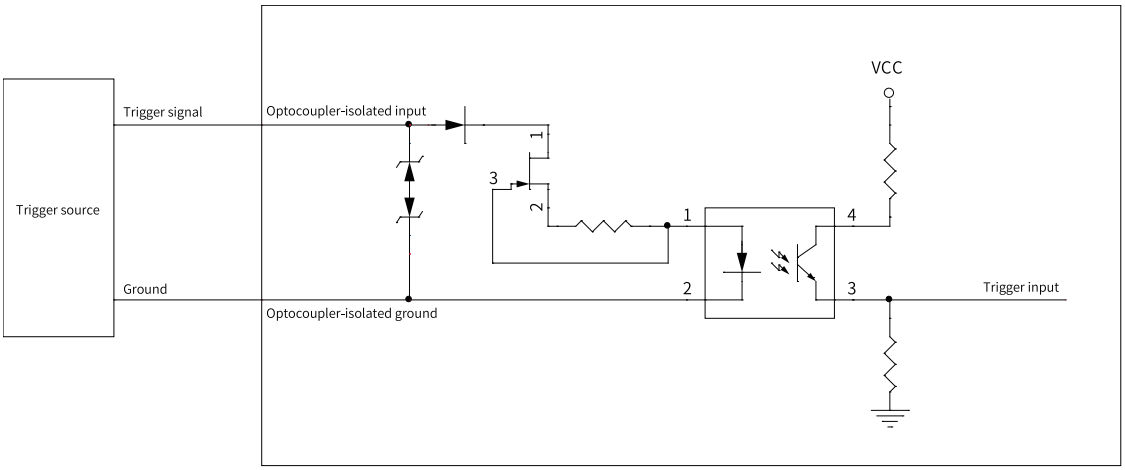
The trigger input uses an optocoupler input, supporting a wide voltage range (3 VDC to 24 VDC).

Table 2–1 Trigger input voltage range

Input Voltage	Description
0 VDC to 24 VDC	Recommended input voltage range
< 1.5 VDC	The Trigger signal is low.
1.5 VDC to 3 VDC	The Trigger signal is indeterminate (avoid this range).
> 3 VDC	The Trigger signal is high.
30 VDC	The maximum input voltage is 30 VDC and cannot be exceeded.

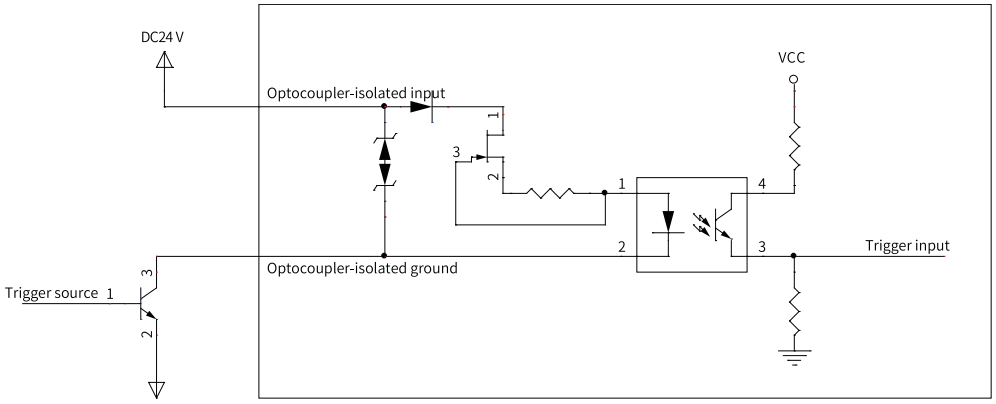
1. **Connection method 1 for the trigger signal**

   For TTL, RS485, or RS422 signal inputs, connect as shown below:



2. **Connection method 2 for the trigger signal**

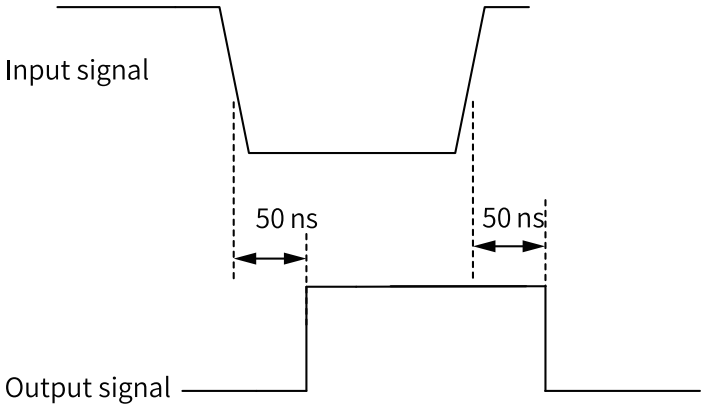
   For switch-type trigger signal sources like optocouplers or PLCs, connect as shown below:



3. **Delay of trigger signal**

   For optocoupler trigger signal input, due to the optocoupler's inherent response time, the trigger signal experiences a slight delay, as shown in the following figure.

   - Input signal: external signal sent to the camera.
   - Output signal: signal after optocoupler processing.



3 Operating Environment and Conditions

3.1 Operating Environment and Heat Dissipation

Operating environment

Item	Description
Operating temperature	0°C to 50°C
Ambient humidity	20% RH to 80% RH, without condensation
Storage temperature	–30°C to +70°C
Storage humidity	20% RH to 80% RH, without condensation

Heat dissipation

To effectively control temperature, the following methods are recommended:

- The operating environment temperature should not exceed 30°C. Use an air-conditioned environment for operation.
- Install the camera on a thermally conductive surface, such as metal. Ensure the metal base has sufficient surface area to dissipate heat efficiently.
- Maintain adequate airflow around the camera to enhance dissipation.

3.2 Protection Against Electrostatic Discharge, Electromagnetic Interference, Lightning, and Power Surges

CXP cameras are often deployed in industrial environments where equipment may generate electromagnetic interference (EMI) and electrostatic discharge (ESD). Excessive EMI or ESD can disrupt camera operation, causing issues such as data packet loss, false triggering, or image noise.

Lightning in natural environments can directly or indirectly couple onto camera cables or power cables. Poor grounding or inadequate protective devices may fail to dissipate this energy, potentially causing permanent damage to the camera.

Power surges caused by lightning or the switching of high-power grid equipment can also exceed the camera's operating voltage range if the power supply lacks proper protection, leading to permanent damage to the camera.

Although CXP cameras incorporate internal protection against lightning, surges, EMI, and ESD, additional precautions in installation and environmental setup are strongly recommended to minimize these risks.

Fundamental protection principles

This section describes basic protection methods that should be implemented during system design whenever possible.

- Use shielded cables for power control, and avoid coiling them. Power and network cables may run in parallel but must not be twisted together.

- Keep power and network cables away from high-current, high-voltage, or frequently switched equipment (such as stepper motors). Never route cables in parallel with such devices, as their strong electromagnetic radiation can couple onto camera transmission cables.
- Connect the protective grounds of all devices to a single-point protective ground to avoid multi-point grounding. Multi-point grounding creates voltage differentials between devices, forming loops that couple electromagnetic interference.
- Power the camera's switch-mode power supply and the PC from the same AC power strip to ensure shared grounding and prevent multi-point grounding. Avoid connecting high-power electromechanical devices to this AC power source.
- Install ferrite cores on the camera's power control cables to absorb EMI signals.
- Maintain moderate ambient humidity and use anti-static wristbands, clothing, and footwear during operation to reduce ESD generation.

Device installation example

The camera is mounted on a metal surface for improved heat dissipation, with the metal itself placed on an insulating base. The camera is grounded through the shielded CXP cable connected to the PC, which then provides a shared ground connection. Do not mount the camera on grounded metal surfaces, as this may create multiple ground points and degrade EMI performance.

Use an iron-cased switched-mode power supply to ensure optimal shielding and heat dissipation. Unshielded power adapters are not recommended for practical applications. The shielding ground of the switched-mode power supply is connected to earth through the ground cable in the AC power cable through the power outlet.

Mount trigger sources and strobe lights on metal surfaces. Ground these devices using either a dedicated ground cable, or the ground cable in the AC power cable.

4 Camera Installation and Software Installation

4.1 Camera Installation

Installation procedure

1. Secure the camera to the installation position. Install a compatible lens onto the camera. Ensure the camera is not powered on during this step. Connect the camera to the CXP frame grabber using a CXP cable.
2. Select the correct CXP cable based on the cable protocol, interface type, and implementation method.
3. The camera has two CXP interfaces. Data can be transmitted through 1 or 2 CXP interfaces. The number of interfaces used affects the available data bandwidth and maximum line rate.
4. CXP interface (CXP1/CXP2) silkscreens on the camera back vary by camera model. Refer to the table below for details.

Table 4–1 Relationship between camera interface and acquisition mode

Number of Interfaces Used	Silkscreen
1	1
2	1 and 2

5. Connect the power and I/O cables to a compatible power adapter or switched-mode power supply. For I/O interface definitions, see *"2.1 Power Supply Interface" on page 14*.

Note

The supported acquisition mode depends on the camera, the frame grabber, and the number of CXP interfaces used.

Required accessories

To properly use the CXP industrial camera, prepare the following items before installation.

Table 4–2 Camera accessories

No.	Component	Quantity	Description
1	Camera unit	1	The camera described in this guide
2	Frame grabber	1	CXP-compatible frame grabber
3	I/O cable	1	12-pin cable (purchased separately; select based on camera model)
4	CXP cable	1/2	The camera end of the CXP cable uses the Micro-BNC connector. The connector type at the frame grabber end depends on the frame grabber model. Use 1 or 2 CXP cables to transmit data. When 2 CXP cables are used, ensure they are of equal length.
5	Lens	1	It must match the camera's lens mount (purchased separately).
6	Adapter ring	1	It is required if a lens with a non-native mount is used (purchased separately).

4.2 Frame Grabber Software Operation

Software installation

The frame grabber software is used to configure frame grabber parameters, view or adjust camera settings, and capture images. It supports all frame grabbers compliant with the CoaXPress protocol and GenICam standard. See the specific frame grabber's user guide for installation details.

Note

The display content in the device manager varies with the frame grabber software of the different manufacturers. See the actual frame grabber in use.

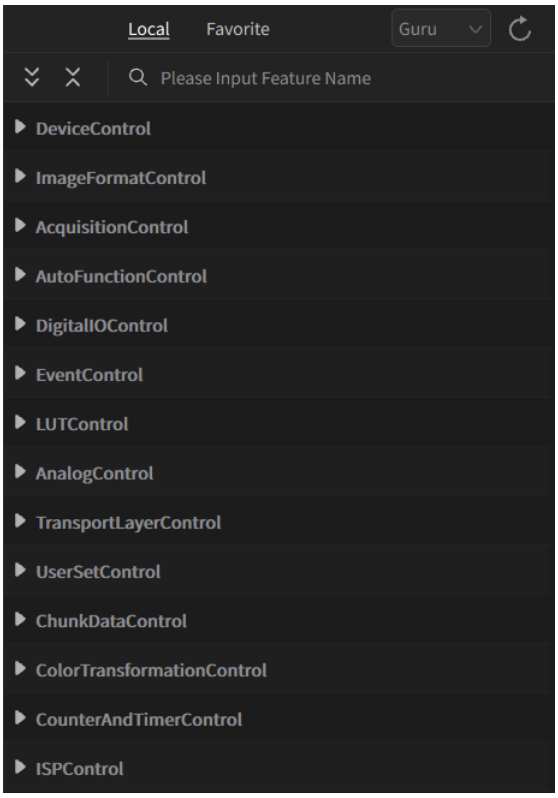
Software operation

After the camera is installed properly, set camera basic parameters in the frame grabber software. Failure to configure parameters or incorrect configuration may prevent the camera from outputting images normally. For detailed steps, see the frame grabber user guide.

4.3 Camera Basic Functions

The camera complies with the GenICam standard, and parameter naming follows the Standard Feature Naming Convention (SFNC). The same camera will display identical parameter names across different frame grabbers. However, different cameras may display different parameters on the frame grabbers.

Camera parameters are divided into thirteen major categories, generally displayed in a property tree, as shown in the following figure.



The functional overview of the property tree is summarized in the table below.

Table 4–3 Function

Property	Function Description
Device Control	Displays the device information and modifies the device name.
ImageFormatControl	Displays and configures the camera's resolution, mirroring function, pixel format, region of interest (ROI), and test patterns.
Acquisition Control	Displays and configures the camera's acquisition mode, frame rate, trigger mode, and exposure time.
Analog Control	Displays and configures the camera's analog signal, including the gain, black level, and Gamma correction.
Color Processing Control	Configures color correction parameters and white balance for color cameras to make the image colors vibrant and vivid.
ISP Control	Performs algorithmic image processing, including brightness, contrast, and noise reduction.
Flat Field Correction	Performs camera sensor calibration, including bright field correction and dark field correction.
Digital IO Control	Sets different I/O signals.
File Access Control	Displays information about parameter groups for cameras supporting file access.
User Set Control	Saves or loads camera parameter groups and configures the default enabled parameter group.
Bootstrap CoaXPress	Configures CXP protocol parameters.

Device management

Under the ImageFormatControl property of the camera, you can view basic camera information, modify custom names, and check device temperature, as shown in the following figure.

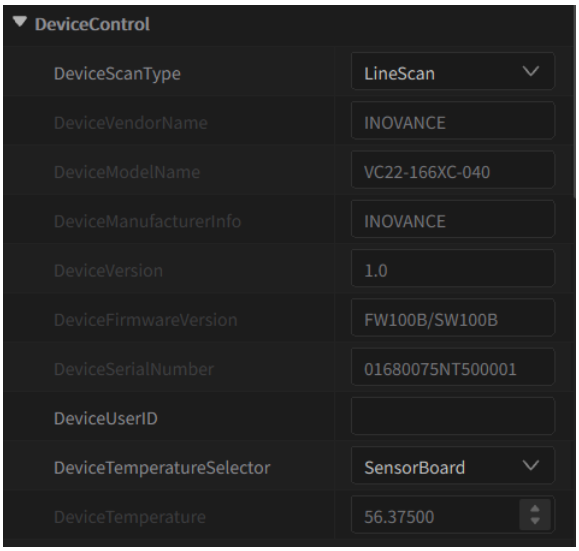


Table 4–4 Camera basic information

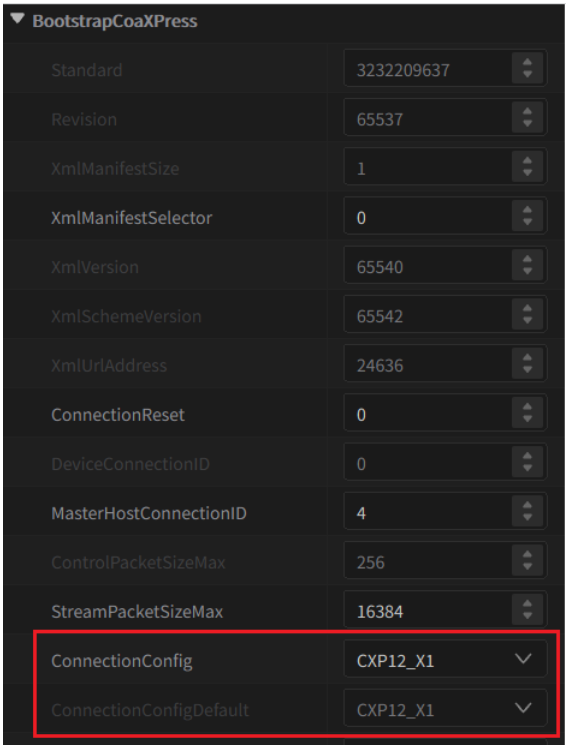
Parameter	Read/Write	Function Description
Device Scan Type	Read-only	Camera type. LineScan indicates a line scan camera.
Device Vendor Name	Read-only	Device manufacturer name
Device Model Name	Read-only	Device model
Device Manufacture Info	Read-only	Device manufacturer information
Device Version	Read-only	Device version
Device Firmware Version	Read-only	Firmware Version
Device Serial Number	Read-only	Device serial number
Device User ID	Read/Write	Device name. This parameter is left blank by default. You can customize the device name.
Device Temperature Selector	Read/Write	Device temperature selector. You can view the real-time temperature of the main board, Sensor, or FPGA.
Device Temperature	Read	The real-time temperature

CXP channel settings

Under the BootstrapCoaXPress property of the camera, you can use ConnectionConfig to set the CXP channels. The following 14 channels are supported:

CXP1_X1, CXP2_X1, CXP3_X1, CXP5_X1, CXP6_X1, CXP10_X1, CXP12_X1, CXP1_X2, CXP2_X2, CXP3_X2, CXP5_X2, CXP6_X2, CXP10_X2, and CXP12_X2. Different channels have different maximum line rates.

ConnectionConfigDefault displays the default channel format upon power-on and cannot be modified.



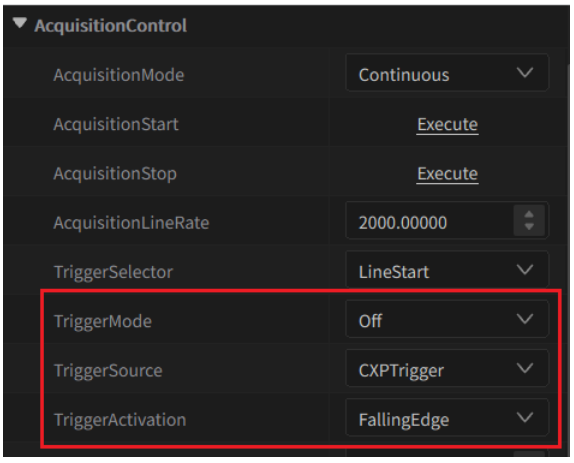
TriggerMode

The camera supports two modes: Off and On.

- This is controlled by the TriggerMode parameter under the AcquisitionControl property, with the default being Off (continuous mode).
- When TriggerMode is set to On (trigger mode), the camera is externally triggered, and the TriggerSource takes effect.

Three trigger source are supported: CXPTrigger (CXP trigger), Line0 (I/O interface), and Line1 (I/O interface).

When CXP or an external input is used as the trigger source, TriggerActivation can be set to FallingEdge (triggered at the falling edge) or RisingEdge (triggered at the rising edge).

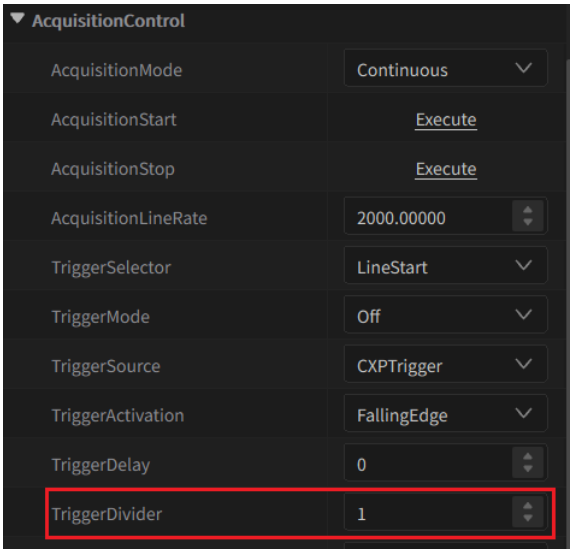


TriggerDivider

The trigger divider divides the external trigger signal for easier control. It is configured by the TriggerDivider parameter under the AcquisitionControl property, with a range of 1 to 255. A value of 1 means no division (original signal), 2 means division by 2 (½ frequency), and so on. The default value is 1.

Caution

TriggerDivider is available only when TriggerMode is set to On.

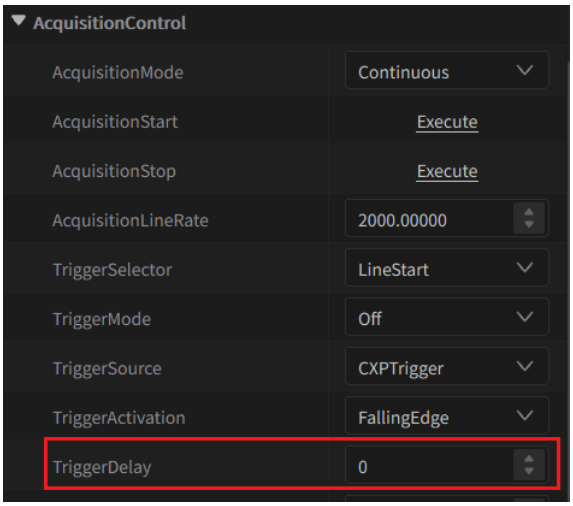


TriggerDelay

Trigger delay refers to the time interval between the camera receiving the trigger signal and its actual response. It is configured by the TriggerDelay parameter under the AcquisitionControl property, in units of 10 ns, with a range of 0 to 100000. The default value is 0.

Caution

TriggerDelay is available only when TriggerMode is set to On.

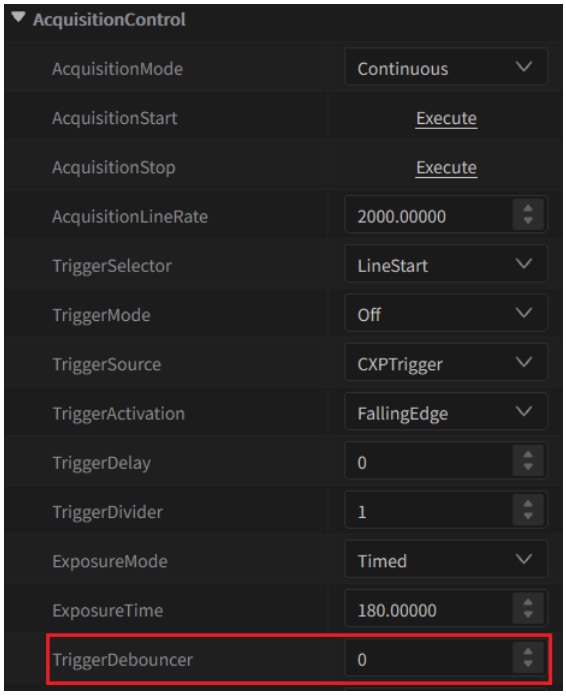


TriggerDebouncer

The trigger debouncer is primarily used to eliminate potential glitches in hardware trigger signals. The TriggerDebouncer parameter under the AcquisitionControl property sets the debounce time, in units of 10 ns, with a range of 0 to 65535. The default value is 0.

Caution

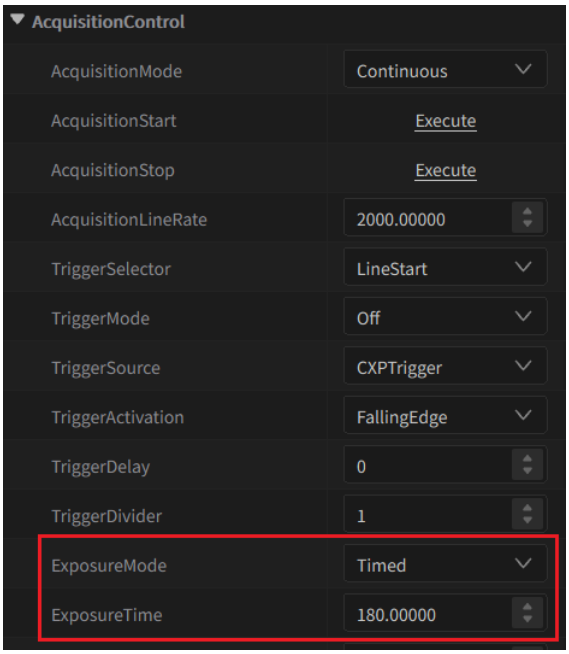
TriggerDebouncer is available only when TriggerMode is set to On.



Exposure

The camera supports two exposure modes: internal register mode and PWC (Pulse Width Control). This is configured by the ExposureMode parameter under the AcquisitionControl property.

- ExposureMode defaults to Timed (internal register mode). In this mode, the exposure time (ExposureTime) must be set in microseconds (μs), with a precision of 0.1 μs and a range of 3.0 to 32000.0.
  Note: The exposure time must be shorter than the line period (see the "Line rate" section for details).
- When ExposureMode is set to TimedTriggerControl (PWC), the camera exposure time is controlled by the pulse width of the external signal (active high).



Line rate

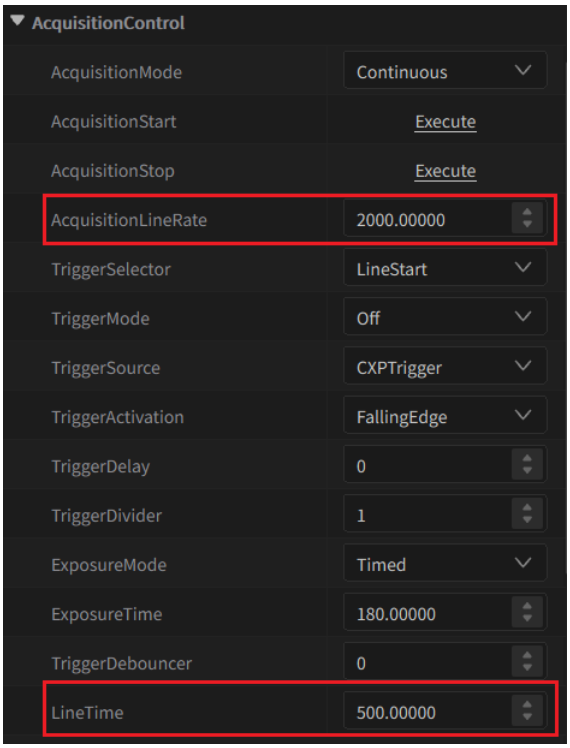
The line rate refers to the number of image lines output by the camera per second. The camera frame rate is directly proportional to the line rate and inversely proportional to the image acquisition height. Calculation formula: Fps (frame rate) = Lps (line rate)/Height (image height).

The maximum camera line rate is determined by the following factors:

- Exposure time: Shorter exposure times allow higher line rates.
- Pixel format: Different pixel formats occupy different byte sizes. Under the same conditions, formats with larger byte sizes reduce the line rate.
- CXP channel settings: More CoaXLink cables or enabled channels increase data throughput and thus the line rates.

This parameter can by configured by the AcquisitionLineRate (line rate) or LineTime (line period) under the AcquisitionControl property:

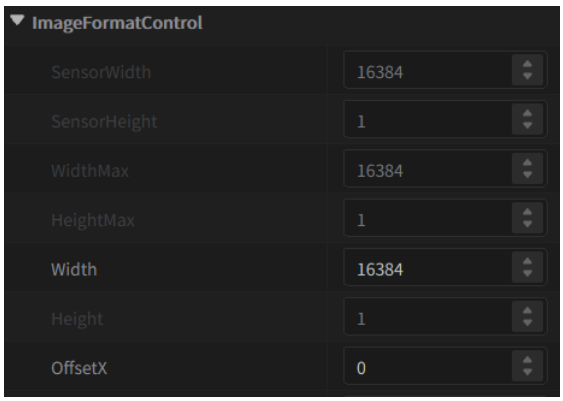
- AcquisitionLineRate: in the unit of lines/second
- LineTime: in the unit of μs
- AcquisitionLineRate = 1000000/LineTime



Resolution and ROI

The camera allows configuring the width and offset of each image line. You can customize the ROI (Region of Interest) within hardware limits. Relevant parameters under the ImageFormatControl property include:

- SensorWidth: Sensor width (hardware property), also the camera's maximum horizontal resolution.
- SensorHeight: Sensor height (hardware property). It is 1 for line scan cameras.
- WidthMax: Maximum horizontal resolution of the camera (determined by the sensor).
- HeightMax: Number of lines per frame. It is fixed at 1 for the current camera.
- Width: Horizontal resolution after ROI (user-configurable).
- Height: Image line height (determined by HeightMax). It is fixed at 1 for the current camera (non-configurable).
- OffsetX: ROI horizontal offset in pixels. Note: OffsetX + Width ⩽ WidthMax.



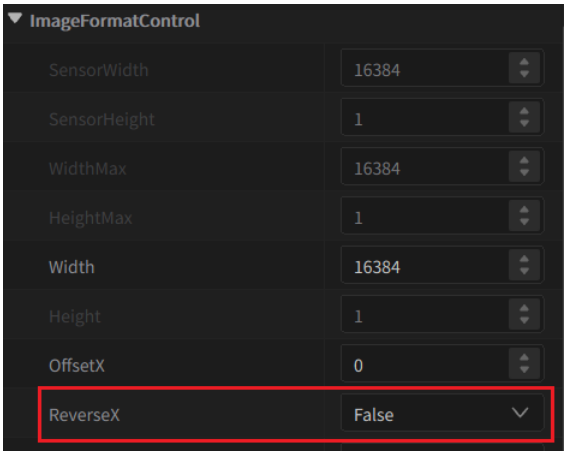
Note

Before setting the ROI, ensure the camera is not in the image acquisition state.

The step for both Width and Offset X parameters is 16, and the set values must be integer multiples of this step.

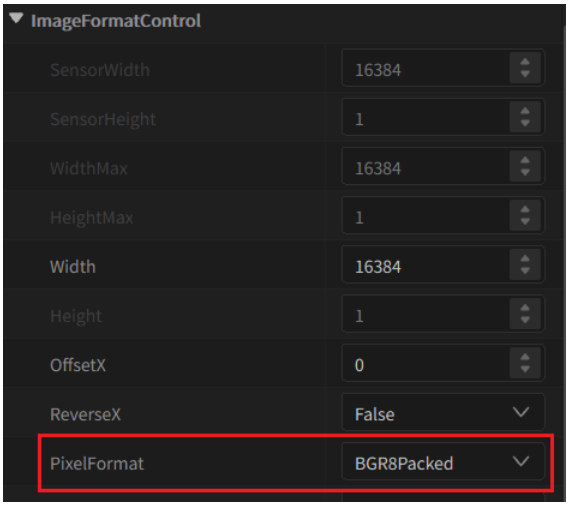
Mirroring

The camera supports horizontal mirroring of the image, this is, flipping the image left-to-right. To enable the mirroring function, enable the ReverseX parameter under the ImageFormatControl property, as shown below:



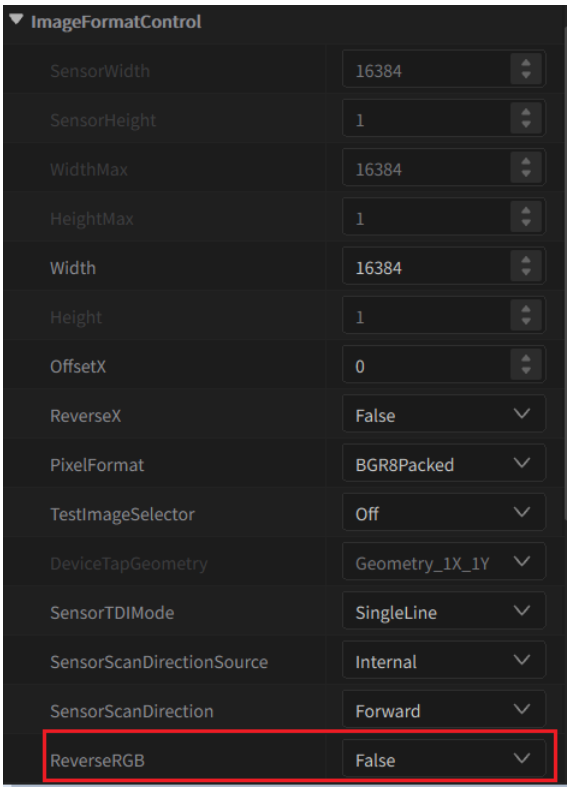
PixelFormat

PixelFormat sets the bit depth per pixel. Monochrome cameras support Mono8 and Mono10, while color cameras support BGR8Packed and BGR10. This parameter is configured by the PixelFormat parameter under the ImageFormatControl property, as shown below:



ReverseRGB

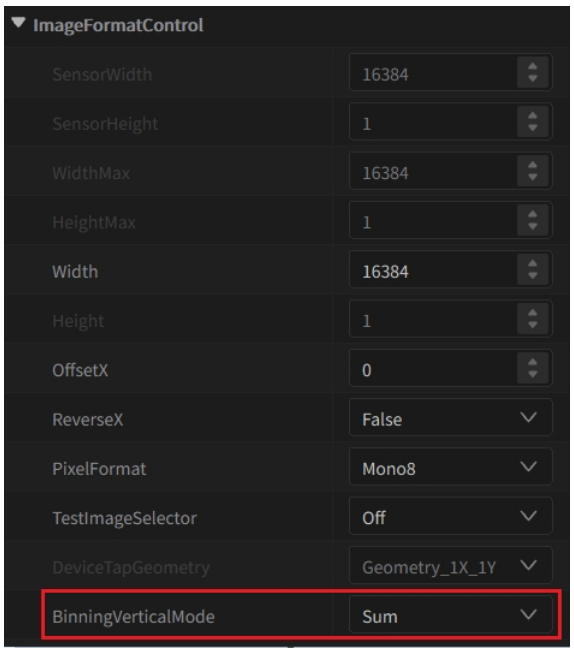
ReverseRGB sets the order of RGB3 components for color images, with False indicating RGB order and True indicating BGR order. This parameter is configured by the ReverseRGB parameter under the ImageFormatControl property, as shown below:



BinningVerticalMode

Some camera models support vertical binning of images, which combines multiple sensor lines to enhance image quality. This parameter is configured by the BinningVerticalMode parameter under the ImageFormatControl property. Three modes are supported:

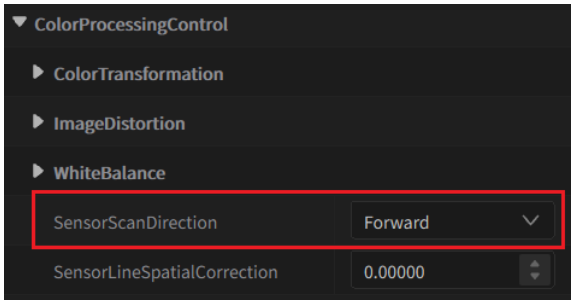
- Off: Disables vertical binning.
- Sum: 2-line summation mode (adjacent lines are summed into one output), improving image brightness and sensitivity.
- Avg: 2-line averaging mode (adjacent lines are averaged into one output), reducing image noise.



Scan direction

The camera allows configuring the sensor scan direction. Some models support internal or external control of the scan direction. The parameter location varies by model:

1. SensorScanDirection under the ColorProcessingControl property, as shown in the following figure:



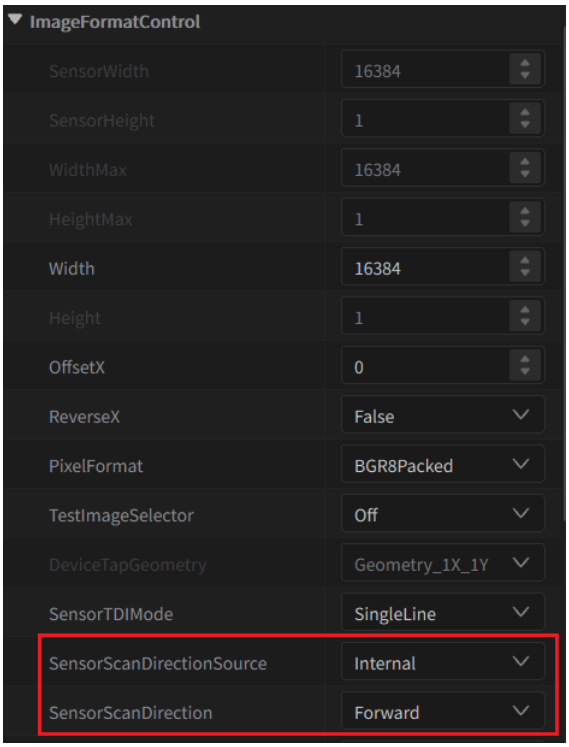
2. SensorScanDirection under the ImageFormatControl property. SensorScanDirectionSource under the same property sets the control source:

- Internal: camera internal source.
- GPIO: External source through GPIO.
- GPIOInvert: Inverted GPIO source.

When SensorScanDirectionSource is set to Internal, use SensorScanDirection to configure the direction to Forward or Reverse.

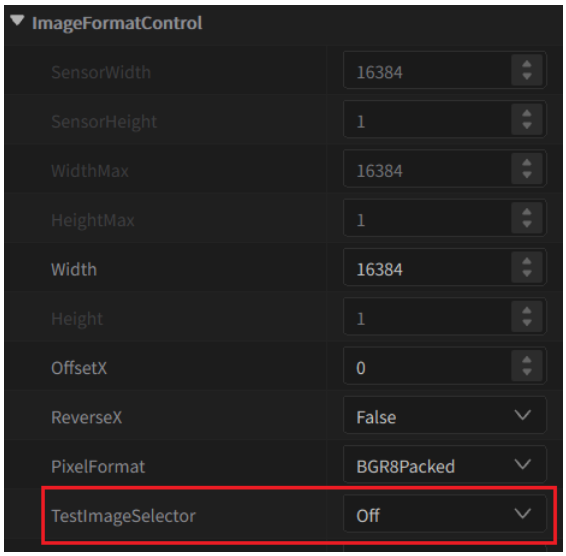
Caution

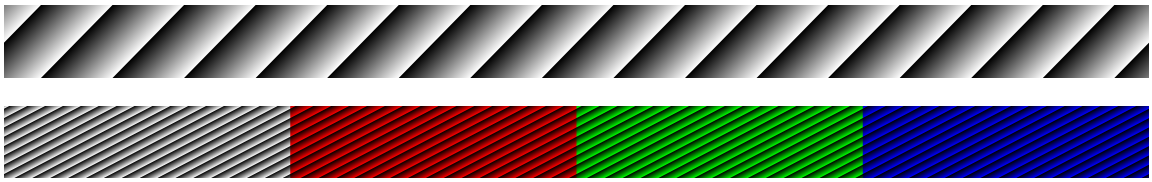
Both spatial correction and TDI require scan direction adjustment.



Test pattern

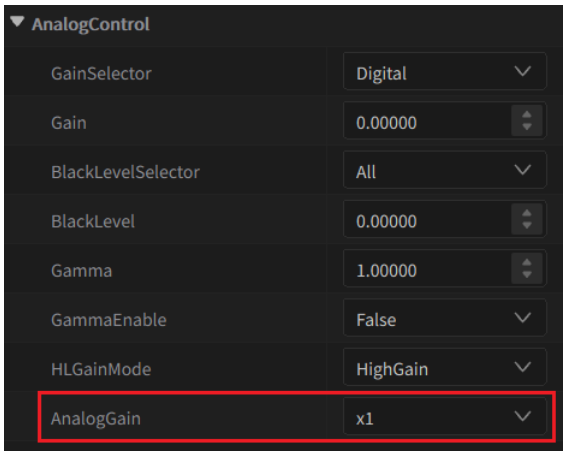
Under the ImageFormatControl property, when TestImageSelector is Off, the camera outputs sensor-captured images. When it is set to TestPattern, the camera outputs test patterns (different patterns for monochrome and color cameras), as shown below:





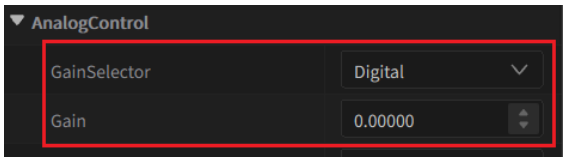
Analog gain

The AnalogGain parameter under the AnalogControl property displays the current analog gain value. Options are x1, x2, and x4 gain levels (default: x1).



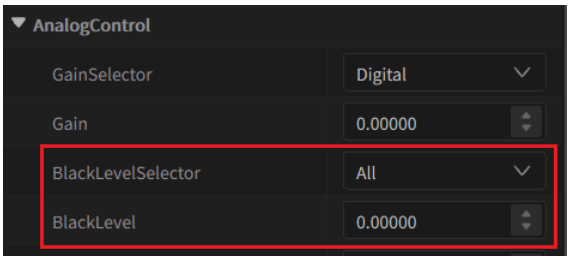
Digital gain

Under the AnalogControl property, when GainSelector is Digital (the only option), you can adjust the value after Gain within the range of 0 to 255. The default value is 0.



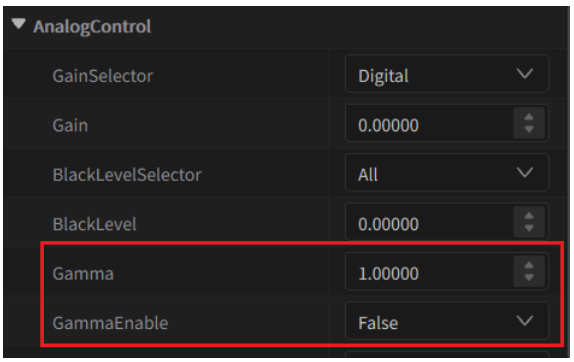
Black level

The camera supports black level adjustment to offset grayscale values. Under the AnalogControl property, when BlackLevelSelector is All (the only option), you can adjust the value after BlackLevel within the range of 0 to 255. The default value is 0.



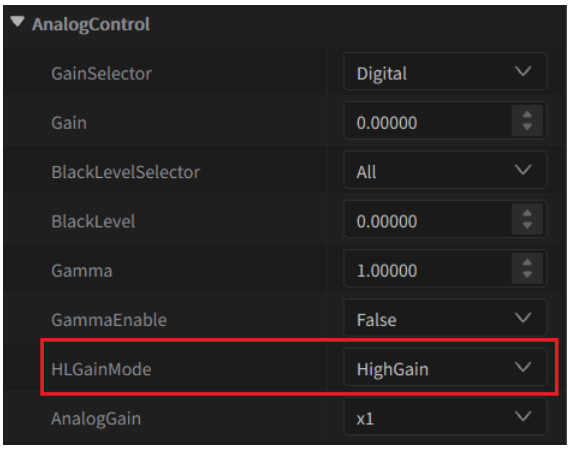
Gamma correction

The camera supports gamma correction. Under the AnalogControl property, set GammaEnable to True to enable gamma (default: False). Enter a value in the Gamma field (range: 0.21 to 5).



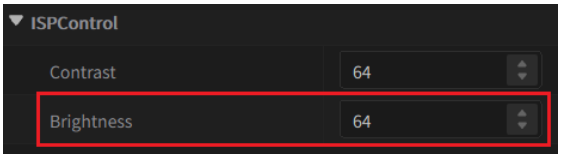
High gain mode

The camera can be set to high gain mode to significantly adjust image brightness. Under the AnalogControl property, you can set HLGainMode to HighGain or LowGain. HLGainMode is set to HighGain by default.



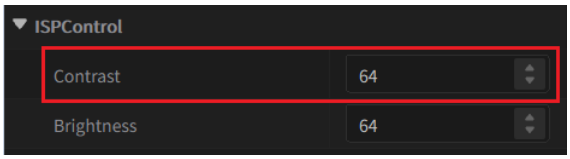
Brightness

Under the ISPControl property, adjust the Brightness value to modify image brightness within the range of 0 to 127. The default value is 64 (for original output).



Contrast

Under the ISPControl property, adjust the Contrast value to modify image contrast ratio within the range of 0 to 127. The default value is 64 (for original output).



Noise reduction

Some camera models support noise reduction to effectively remove image noise and enhance image details. Under the ISPControl property, set Denoise to True to enable the noise reduction function. The default option is False.



Filter

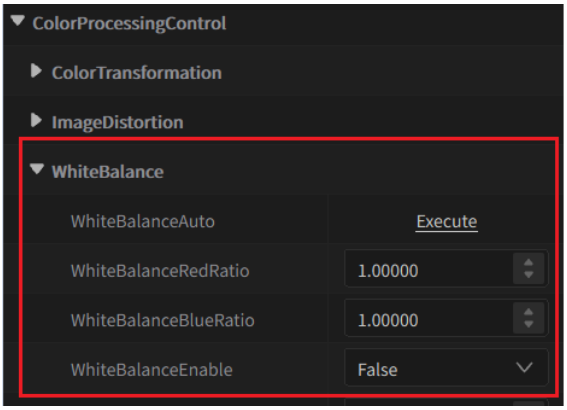
Some camera models support image filtering to reduce noise (especially salt-and-pepper noise) and smooth the image. Under the ISPControl property, set Fir2DFilter to true to enable image filtering. The default value is False.



White balance

Color cameras support white balance to correct colors under different lighting conditions. This adjusts the R, G, and B components of images to ensure white areas remain white. An ideal ratio of R:G:B is 1:1:1.

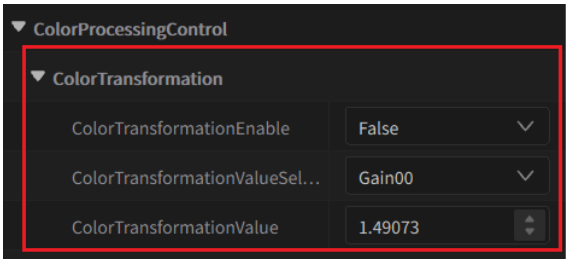
WhiteBalance under the ColorProcessingControl property includes all white balance actions. When WhiteBalanceEnable is set to True, white balance is enabled. Then, you can place a white board or paper in the camera field of view, making the white color fill the entire frame and adjust brightness to a moderate level. Click WhiteBalanceAuto to perform a white balance calibration. After completion, the camera captures a white-balanced image. WhiteBalanceRedRatio and WhiteBalanceBlueRatio display the calibrated red/blue coefficients.



Color transformation

The camera supports color transformation, which makes the overall colors of the image more vibrant through a color enhancement matrix.

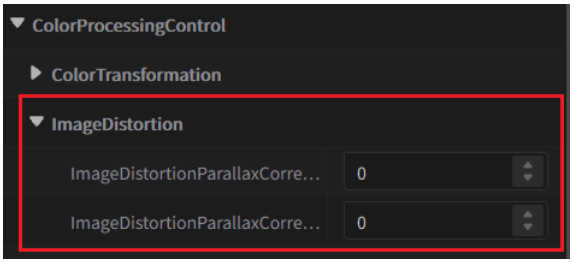
Under the ColorProcessingControl property, ColorTransformation includes all color transformation actions. Set ColorTransformationEnable to True to enable the function. Use ColorTransformationValueSelector to select the corresponding color coefficient, and enter the value in ColorTransformationValue. Modifying these values is not recommended.



Parallax correction

Parallax correction eliminates color distortion at the edges of color cameras, improving image quality.

Under the ColorProcessingControl property, ImageDistortion includes all parallax correction actions. ImageDistortionParallaxCorrectionMode sets the direction of parallax correction (0 or 1, default: 0). ImageDistortionParallaxCorrection adjusts the parallax correction parameter (range: 0 to 63, default: 0).

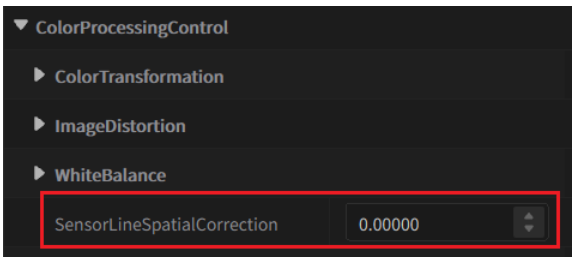


Spatial correction

Spatial correction is mainly applied to multi-line line scan cameras to align the scanning positions of each line. Only color cameras support this feature. Under ColorProcessingControl, enter the calibration parameter in SensorLineSpatialCorrection (range: 0 to 4, default: 0).

Caution

This function must be used in combination with SensorScanDirection (the sensor scan direction) under Image Format Control.



DSNU correction

Dark Signal Non-Uniformity (DSNU) correction compensates for image errors caused by uneven dark signals of across sensor pixels.

Under the FlatFieldCorrection property, select the DSNU region using ROIWidth and ROIOffsetX; set the averaging lines for DSNU using CalibrationSampleSize. Adjust the target dark field correction value (the grayscale minimum value) in DSNUCalibrationTarget. Set DSNUCalibrationMode to On to enable DSNU. Click the DSNUCalibration button to perform DSNU correction. Wait for the operation to complete.

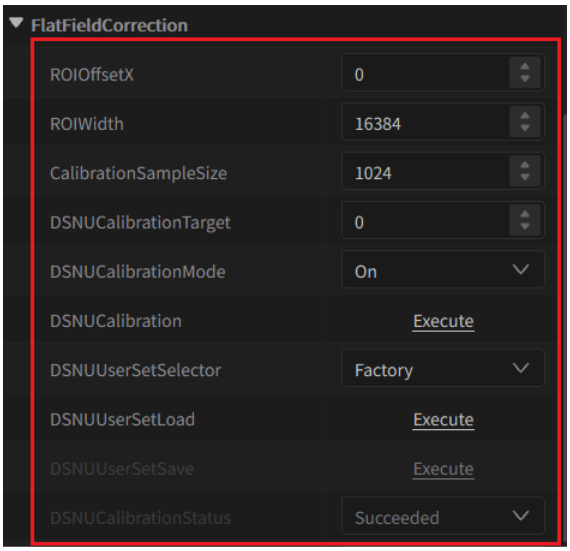
Caution

In this case, the lens must be completely blocked to allow the camera to capture a completely black image.

Saving DSNU parameters: After DSNU correction, save the DSNU parameters as follows:

1. Select a storage location using DSNUUserSetSelector: Factory: Factory settings (default, read-only). Options are UserSet1, UserSet2, and UserSet3.
2. Click the DSNUUserSetSave button. Then, the parameters are saved.

Loading DSNU parameters: In DSNUUserSetSelector, choose the desired configuration. Click the DSNUUserSetLoad button to load the parameters.



PRNU correction

Photo Response Non-Uniformity (PRNU) correction compensates for image errors caused by inconsistent pixel sensitivity across the sensor.

Under the FlatFieldCorrection property, select the PRNU region using ROIWidth and ROIOffsetX; set the average lines for PRNU using CalibrationSampleSize. Set PRNUCalibrationMode to On to enable PRNU. Click the PRNUCalibration button to perform a PRNU correction. Wait for PRNU completion.

Caution

Ensure the illumination is uniform with moderate brightness, avoiding any overexposure. If performing the PRNU test on white paper, the white paper must be in motion.

The target value for PRNU can be customized by selecting a PRNU statistical method in PRNUCalibrationStatisticalMethod. Three options are available:

- Average: Uses the average grayscale value of all pixels in the PRNU region as the target.
- Maximum: Uses the maximum grayscale value of all pixels in the PRNU region as the target.

- TargetValue: Use the grayscale value set by users as the target. For color cameras, PRNUCalibrationTargetSelector chooses the color component and options are PRNUCalibrationTargetRed (red), PRNUCalibrationTargetGreen (green), and PRNUCalibrationTargetBlue (blue). For monochrome cameras, only PRNUCalibrationTargetGrey (Grayscale) is available. Enter the desired value in PRNUCalibrationTargetValue.

Saving PRNU parameters: After PRNU correction, save the PRNU parameters as follows:

1. In PRNUUserSetSelector, select a storage location, where Factory indicates factory settings (default, read-only). Options are UserSet1, UserSet2, and UserSet3.
2. Click the PRNUUserSetSave button. Then, the parameters are saved.

Loading PRNU parameters: In PRNUUserSetSelector, select the desired configuration. Click the PRNUUserSetLoad button to load the parameters. The selected PRNU configuration automatically loads upon power-on.

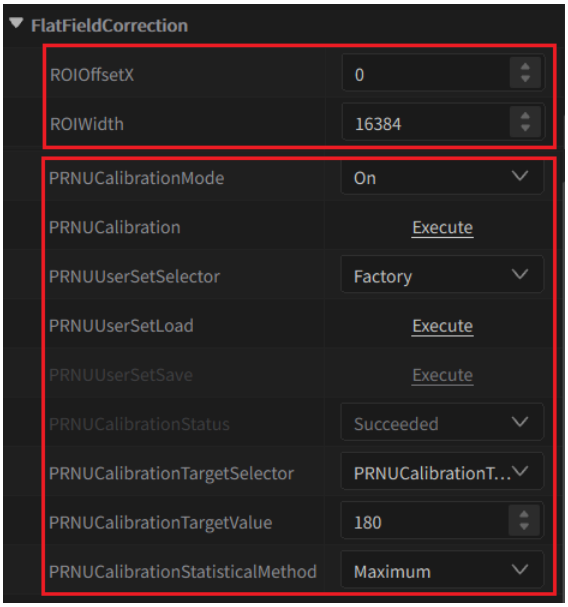




Figure 4-1 Image before correction

Figure 4-2 Image after correction

TDI

Multi-line cameras support Time Delay Integration (TDI), a technique that enhances light sensitivity by algorithmically integrating multiple sensor line exposures. It features high sensitivity and wide dynamic range.

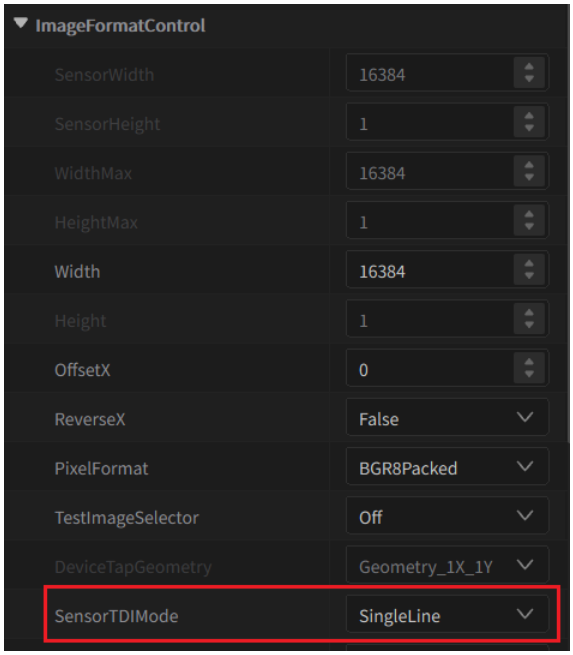
Under the ImageFormatControl property, you can set the TDI Mode mode. Three modes are available:

- SingleLine: Single-line mode (no TDI).

- TwoStagesTDI: 2-line summation mode (adjacent lines are summed into one output), improving image brightness and sensitivity.
- TwoStagesAVG: 2-line averaging mode (adjacent lines are averaged into one output), reducing image noise.

Caution

TDI must be used in combination with SensorScanDirection (the scan direction must be correct) under Image Format Control; otherwise, the image will become blurred.

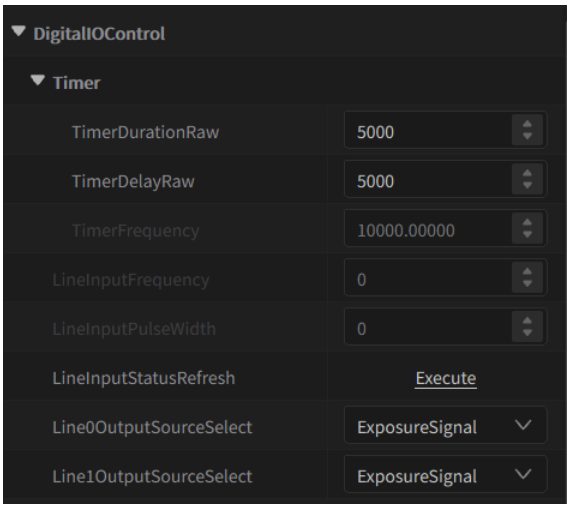


Digital I/O control

Input pulse detection: Digital I/O control can monitor the frequency and pulse width of external input trigger signals. Under the DigitalIOControl property, clicking the LineInputStatusRefresh button simultaneously updates LineInputFrequency (input pulse frequency) and LineInputPulseWidth (input pulse width), allowing real-time monitoring of camera triggering status.

Output pulse signal: Digital I/O control can generate pulse signals. Under the DigitalIOControl property, Line0OutputSourceSelect controls the pulse signal output for I/O interface Line0. Line1OutputSourceSelect controls the pulse signal output for I/O interface Line1. Both support four modes:

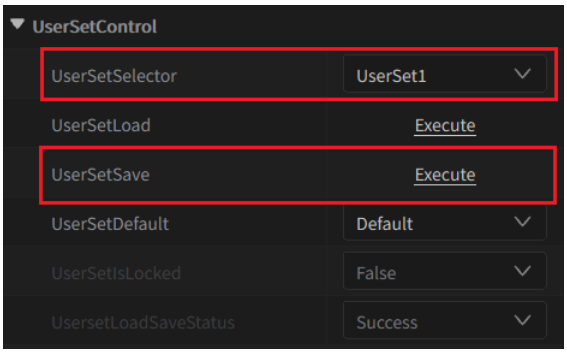
- ExposureSignal: exposure signal.
- TriggerSignal: trigger signal.
- LVALSignal: line valid signal.
- TimerSignal: timer pulse signal.
  - Timer controls the output pulse width and frequency. TimerDurationRaw sets the high-level pulse width (unit: 10 ns, minimum: 1, default: 5000).
  - TimerDelayRaw sets the low-level pulse width (unit: 10 ns, minimum: 1, default: 5000).
  - TimerFrequency displays the pulse signal frequency.



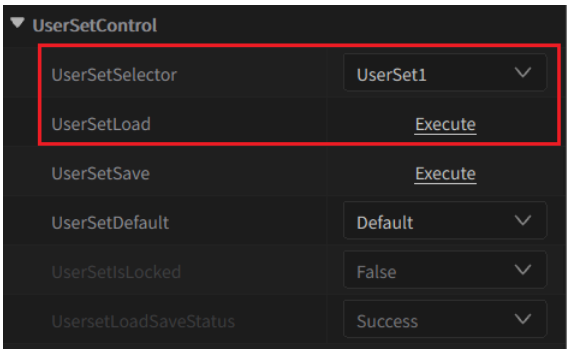
User parameter settings

The camera internally stores four parameter sets: 1 default set and 3 user-configurable sets. The parameter set can be configure with the UserSetControl property to save, load, or set default startup parameters. To prevent parameter resets after rebooting, save user parameters and set them as the default startup configuration. The procedure is as follows.

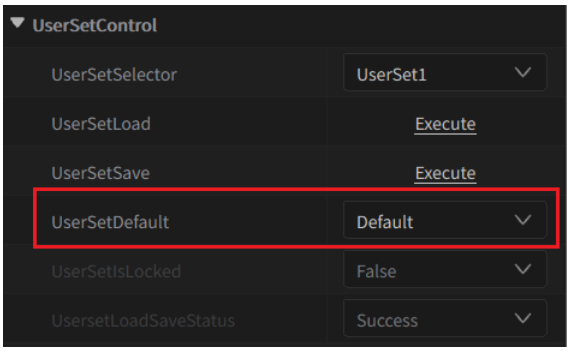
- Saving parameters: After modifying parameters, select a User Set in UserSetSelector. Click the UserSetSave button to save the current parameters to the selected User Set.



- Loading parameters: In UserSetSelector, select the desired User Set. Click the UserSetLoad button to apply the parameters to the camera.



- Setting default startup parameters: From the UserSetDefault drop-down list, select the parameter set loaded at camera power-on.


UserSetControl
UserSetSelector
UserSet1
UserSetLoad
Execute
UserSetSave
Execute
UserSetDefault
Default
UserSetIsLocked
False
UsersetLoadSaveStatus
Success

5 Common Faults

This section lists common faults and solutions. If your problem persists, contact Inovance technical support.

Problem Description	Possible Cause	Solution
The camera is not detected by the frame grabber software.	The camera is not powered on.	Check the power supply by checking the camera's LED status.
	The CXP frame grabber is abnormal.	Check the frame grabber indicator status to check whether the frame grabber is normal.
	The CXP cable connection is abnormal.	Ensure proper CXP cable connection by checking the color of the frame grabber indicator or the frame grabber software.
	An error occurred during software installation.	Check whether the software version is supported. Reinstall the frame grabber driver or software.
No image is displayed on the frame grabber software during image preview.	The parameters (such as the resolution) of the frame grabber software are not set correctly.	Check whether the parameters of the frame grabber software are set correctly. In case of any error, check the software operation section for correction.
	The camera is in trigger mode but no signal is input by the trigger source.	Disable the trigger mode.
The entire preview image is black.	The exposure time is too short or the lighting is insufficient.	Increase the exposure time or enhance lighting.
	The lens aperture is closed or the lens cap is not open.	Open the aperture or remove the lens cap.
Images cannot be captured in hardware trigger mode but can be captured in other modes.	The trigger mode is not enabled.	Enable the trigger mode.
	The trigger wiring is incorrect.	Check whether the external wiring is normal.

6 Service and Support

Should you encounter a safety accident during the use or operation of the product, or face challenges in operating and maintaining the equipment, which remain unresolved after the relevant documentation is consulted, we provide multiple channels to ensure prompt resolution:

- Channel #1: Contact service@inovance.com.
- Channel #2: Visit https://www.inovance.com/global to access document downloads, after-sales support, spare parts ordering, repair applications, and authenticity verification services.
- Channel #3: Download My Inovance app (https://zshc-eu.inovance.com/download-pc/) where you can access products info and documentation, and query product parameters.

We are committed to providing you with quick and professional technical support, and we look forward to your satisfaction and trust.

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