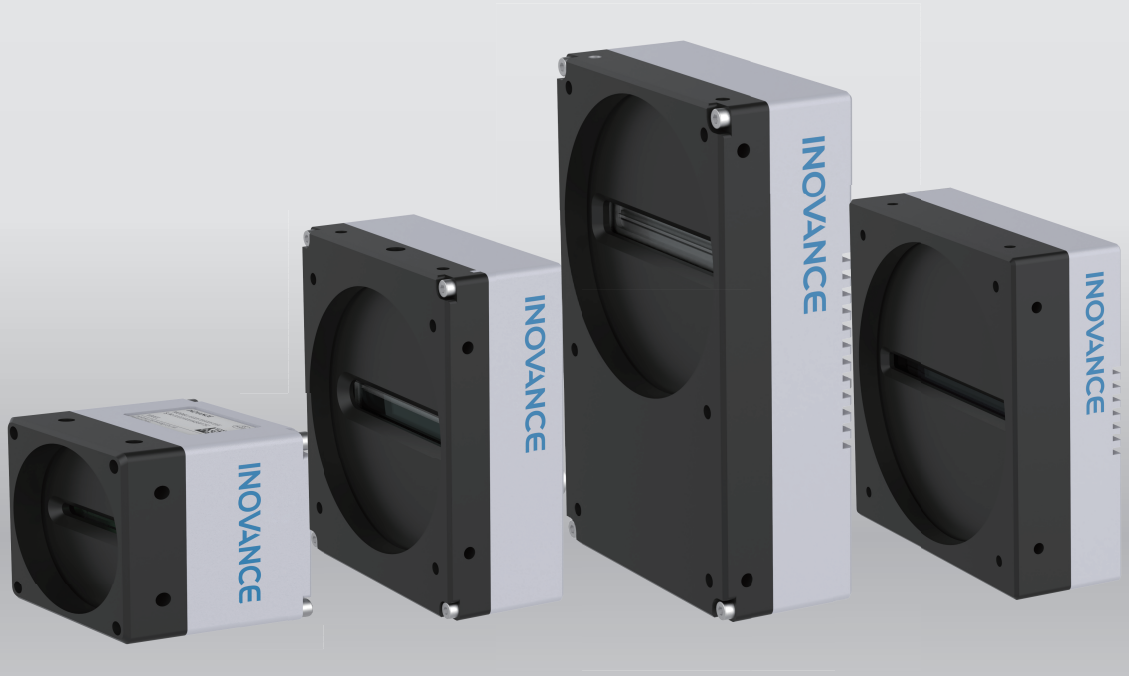
INOVANCE

Advancing industrial technology,
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CameraLink Series Line Scan Camera

User Guide

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

Data code PS00017498A03

Legal Information

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Due to continuous updates and improvements of products and technologies, the content of this documentation may not fully match the actual products. In the event of any discrepancies, the actual products shall prevail.

The contents are subject to change without notice due to product upgrade.

Waste Disposal

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

Qualified Personnel

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 CameraLink series line scan camera utilizes the standard CameraLink interface and supports configurations including Base, Medium, Full, and Deca outputs. It offers features such as spatial correction, white balance, and parallax correction. The camera supports GPIO triggering, CC1 triggering, and free-run mode, with adjustable or trigger-controlled parameters for exposure time, Gain, Offset, Gamma, TDI, DSNU, and PRNU. It also includes real-time temperature monitoring and supports GenCP protocol and GenICam standards.

This guide introduces the product model specifications, outline dimensions, physical interfaces, camera communication, GenICam standard, camera software operation, etc.

Revision History

Revision date	Version	Description
April 2026	A03	Added *"7.1 Compliance with CE, RoHS, and KC Certifications" on page 77*. Added *"7.2 Referenced Standards and Specifications" on page 77*.
June 2025	A02	Added description about 3 new CameraLink models.
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 ways:

- Visit *https://www.inovance.com/global*, and choose Service&Support > Support > Documentation Download.
- Scan the QR code on the product with your smart phone.
- Scan the QR code below to install My Inovance app, where you can search for and download user guides.

Warranty

Inovance provides warranty service within the warranty period (as specified in your order) for any fault or damage that is not caused by improper operation of the user. Maintenance will be charged after the warranty expires.

Within the warranty period, maintenance will be charged for 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 (natural disaster, earthquake, and lightning strike)

The maintenance is charged according to the latest Price List of Inovance. If otherwise agreed upon, the terms and conditions in the agreement shall prevail.

For details, see Product Warranty Card.

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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
CAUTION • 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
DANGER • 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.
WARNING • 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



- 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.



- 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



- 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



- 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



- 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.



- 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
DANGER . 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.
WARNING . 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
WARNING . 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.

Warning

- 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

Camera features

- Standard CameraLink interface, configurable for Base, Medium, Full, or Deca output
- Color cameras support spatial correction, white balance, and parallax correction.
- GPIO trigger, CC1 trigger, and free-run mode
- Adjustable exposure time (manual or trigger-controlled)
- Adjustable parameters: Gain, Offset, Gamma, TDI, DSNU, PRNU
- Real-time temperature monitoring
- Compliant with GenCP protocol and GenICam standard.
- Camera with time-sharing strobe or near-infrared (NIR) ability

Typical applications

- FPD
- PCB AOI/AVI
- Solar panel inspection
- Glass inspection
- Print inspection

1.2 Model and Nameplate

Model description

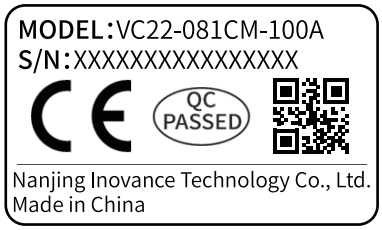
VC 22 - 081 C M - 100A
① ② ③ ④ ⑤ ⑥

① **VC: Industrial camera**	④ **Interface/Feature** C: CameraLink
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 081: 8K1 lines 083: 8K3 lines 081: 8K1 lines	⑥ **Line rate** 017: 17 kHz 050A: 50 kHz 070: 70 kHz 033: 33 kHz 100A: 100 kHz

Note

- [1]: The first digit in the final position represents the line count, for example, 162 represents 16K2 lines and 081 indicates 8K1 lines.

Nameplate



1.3 Product Dimensions

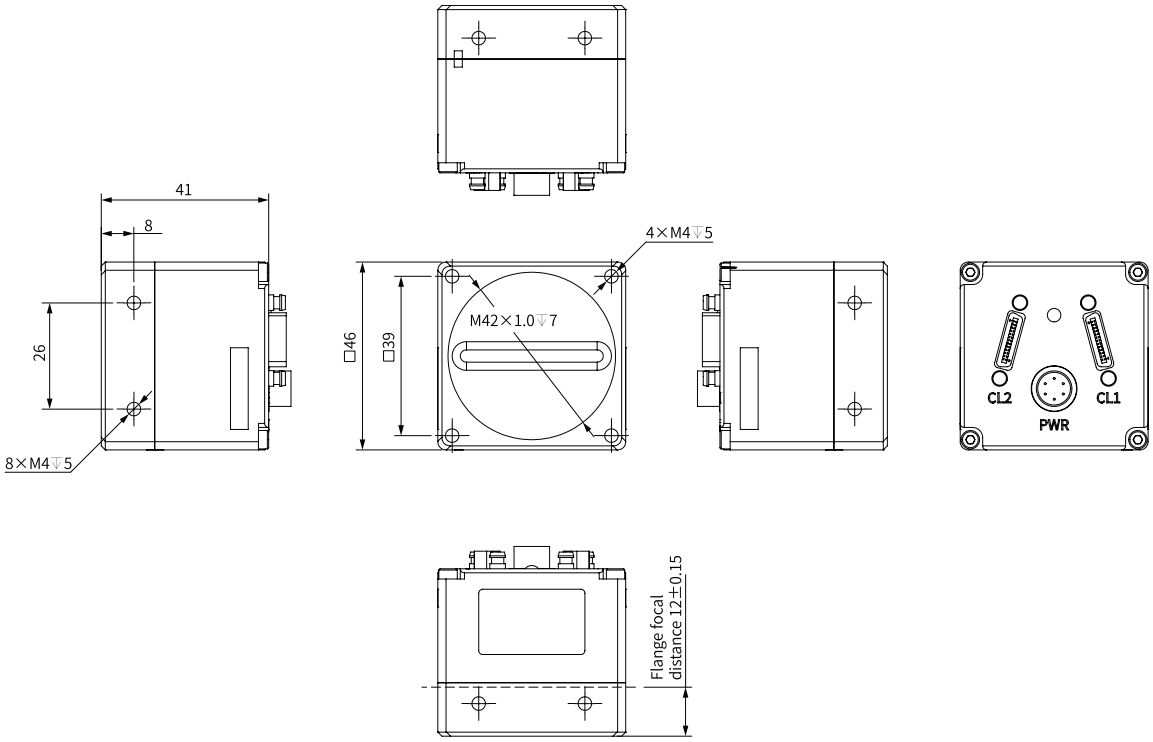


Figure 1-1 Outline dimensions of VC22-041CM-178, VC22-042CM-040, VC22-046CC-040, and VC22-048CCN-040 (unit: mm)

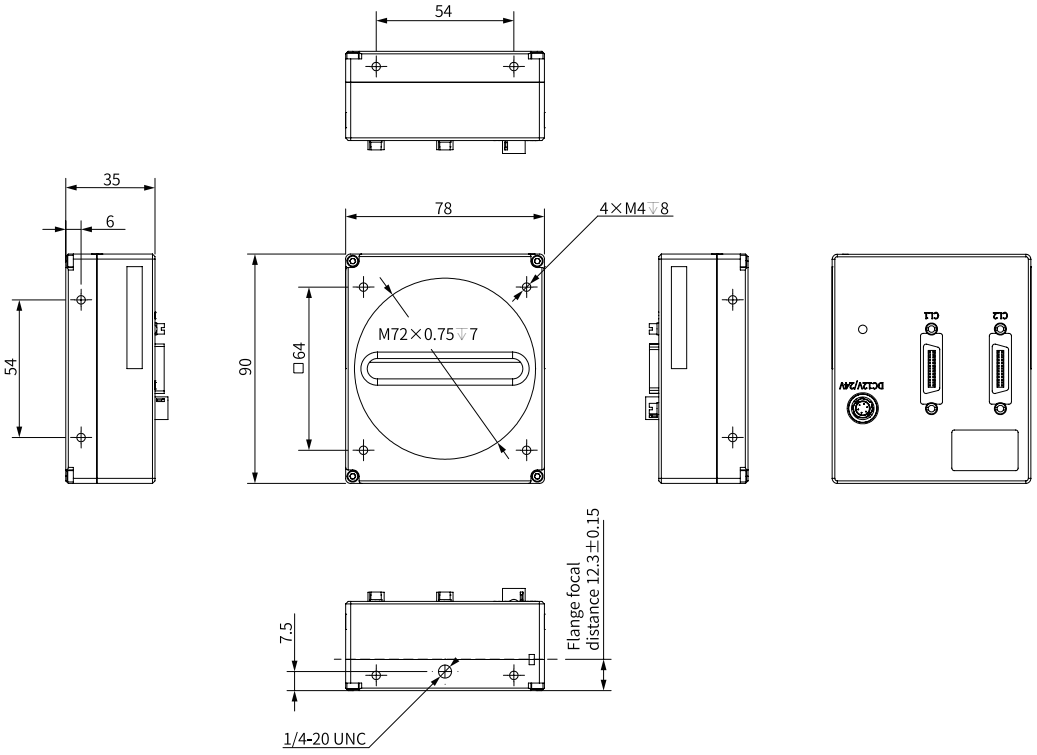


Figure 1-2 Outline dimensions of VC22-081CM-070 and VC22-161CM-050 (unit: mm)

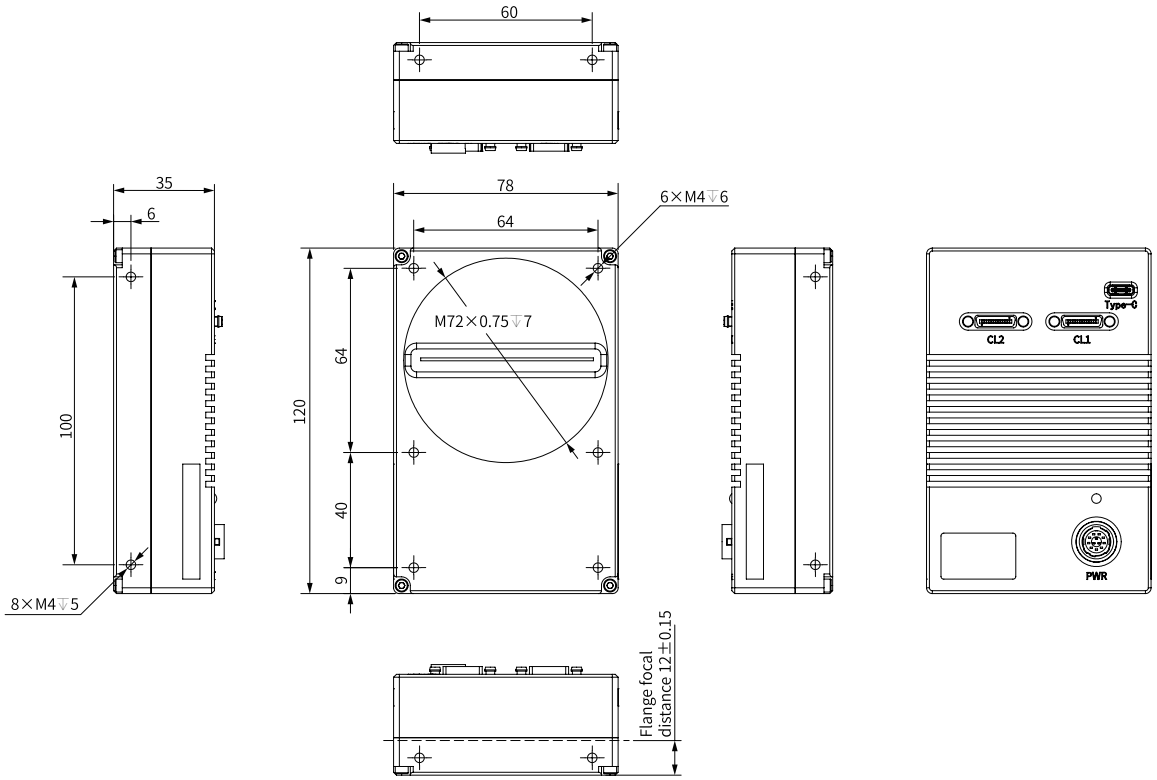


Figure 1-3 Outline dimensions of VC22-081CM-100A, VC22-083CC-033, VC22-081CM-100, VC22-162CC-017, and VC22-162CM-050 (unit: mm)

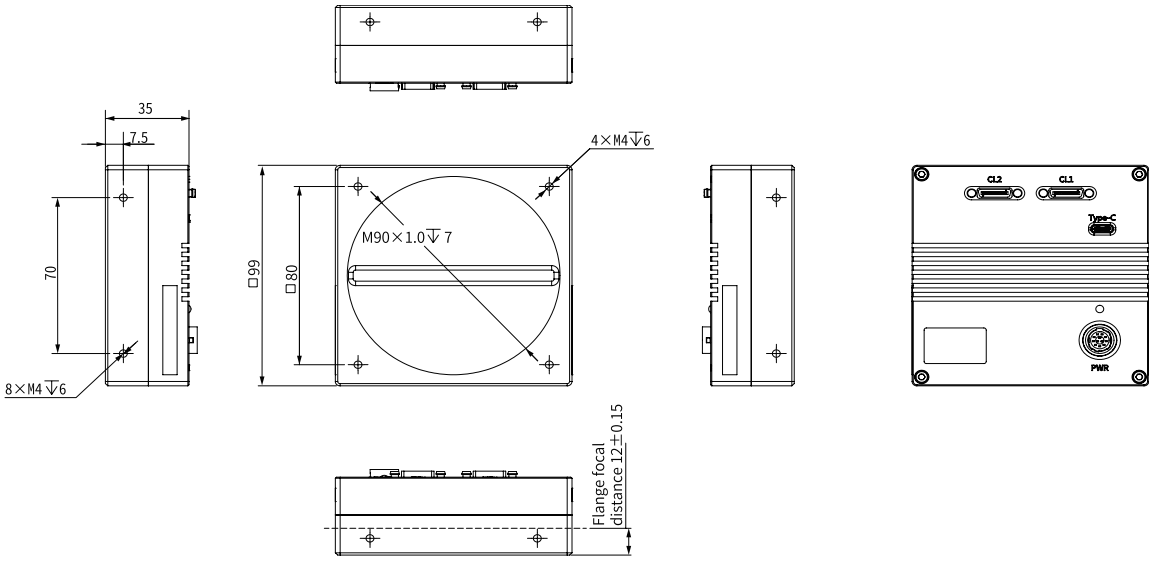


Figure 1-4 Outline dimensions of VC22-162CM-050A, VC22-163CC-017, and VC22-166CC-017 (unit: mm)

1.4 Technical Specifications

Item	VC22-041CM-178	VC22-042CM-040	VC22-046CC-040	VC22-048CCN-040 (NIR)
Resolution	4096 x 1	4096 x 2	4096 x 6	4096 x 8
Pixel size (μm)	7 x 7	7 x 7	7 x 7	7 x 7
Sensor array size (mm)	28.6	28.6	28.6	28.6
Maximum line rate (kHz)	178	40	40	40
Data clock (MHz)	65/85	20/40/60/65/85	20/40/60/65/85	20/40/60/65/85
Data depth (bit)	8/10	8/10/12	8	8
Color	Mono	Mono	RGB	RGB+NIR
Dynamic range (dB)	63	71	71	71
Lens interface size	M42 x 1	M42 x 1	M42 x 1	M42 x 1
Transmission mode	Base/Medium/Full/Deca	Base/Medium	Base/Medium/Full/Deca	Dual Base/Full
Power consumption (W)	< 5	< 5	< 5	< 5

Item	VC22-041CM-178	VC22-042CM-040	VC22-046CC-040	VC22-048CCN-040 (NIR)
Power supply (VDC)	12 to 24	12 to 24	12 to 24	12 to 24
Operating temperature	0°C to 50°C	0°C to 50°C	0°C to 50°C	0°C to 50°C
Weight (g)	< 130	< 130	< 130	< 130
Outline dimension (mm)	46 x 46 x 41	46 x 46 x 41	46 x 46 x 41	46 x 46 x 41
Flange focal distance (mm)	12±0.15	12±0.15	12±0.15	12±0.15

Item	VC22-081CM-070	VC22-161CM-050
Resolution	81921	16384 x 1
Pixel size (μm)	7 x 7	3.5 x 3.5
Sensor array size (mm)	58	58
Maximum line rate (kHz)	70	50
Data clock (MHz)	80	85
Data depth (bit)	8/10	8/10
Color	Mono	Mono
Dynamic range (dB)	65	65
Lens interface size (mm)	M72 x 0.75	M72 x 0.75
Transmission mode	CameraLink	CameraLink
Power consumption (W)	< 5	< 8
Power supply (VDC)	12 to 24	12 to 24
Operating temperature	0°C to 55°C	0°C to 50°C
Weight (g)	< 360	< 360

Item	VC22-081CM-070	VC22-161CM-050
Outline dimension (mm)	78 x 90 x 35	78 x 90 x 35
Flange focal distance (mm)	12.3±0.15	12.3±0.15

Item	VC22-083CC-033	VC22-081CM-100	VC22-162CC-017	VC22-162CM-050
Resolution	8192 x 3	8192 x 1	16384 x 2	16384 x 2
Pixel size (μm)	7 x 7	7 x 7	3.5 x 3.5	3.5 x 3.5
Sensor array size (mm)	57.3	57.3	57.3	57.3
Maximum line rate (kHz)	33	100	17	50
Data clock (MHz)	65/85	65/85	65/85	65/85
Data depth (bit)	8	8/10	8	8/10
Color	RGB	Mono	RGB	Mono
Dynamic range (dB)	65	65	65	65
Transmission mode	Base, Medium, Full, and Deca	Base, Medium, Full, and Deca	Base, Medium, Full, and Deca	Base, Medium, Full, and Deca
Power consumption (W)	< 9	< 9	< 9	< 9
Power supply (VDC)	12 to 24	12 to 24	12 to 24	12 to 24
Operating temperature	0°C to 50°C	0°C to 50°C	0°C to 50°C	0°C to 50°C
Weight (g)	< 500	< 500	< 500	< 500
Outline dimension (mm)	78 x 120 x 35	78 x 120 x 35	78 x 120 x 35	78 x 120 x 35
Flange focal distance (mm)	12±0.15	12±0.15	12±0.15	12±0.15

Table 1–1 Performance parameters of time-sharing strobe CameraLink line scan cameras

Item	VC22-081CM-100A
Resolution	8192 x 1
Pixel size (μm)	7 x 7

Item	VC22-081CM-100A
Sensor array size (mm)	57.3
Maximum line rate (kHz)	100
Data clock (MHz)	65/85
Data Depth (bit)	8/10
Color	Mono
Dynamic range (dB)	65
Lens interface size (mm)	M72 x 0.75
Transmission mode	CameraLink & Power CameraLink Base or Medium or Full
Power consumption (W)	< 8
Power supply (VDC)	12 to 24
Operating temperature	0°C to 50°C
Weight (g)	< 500
Outline dimension (mm)	78 x 120 x 35
Flange focal distance (mm)	12±0.15

Item	VC22-162CM-050A	VC22-163CC-017	VC22-166CC-017
Resolution	16384 x 2	16384 x 3	16384 x 6
TDI mode	Supported	Not supported	Supported
Pixel size (μm)	5 x 5	5 x 5	5 x 5
Sensor array size (mm)	82	82	82
Maximum line rate (kHz)	50	17	17
Data depth (bit)	8/10	8	8
Color	Mono	RGB	RGB

Item	VC22-162CM-050A	VC22-163CC-017	VC22-166CC-017
Dynamic range (dB)	64	64	64
Lens interface size (mm)	M90 x 0.75	M90 x 0.75	M90 x 0.75
Transmission mode	CameraLink	CameraLink	CameraLink
Power consumption (W)	< 11	< 11	< 11
Power supply (VDC)	12 to 24	12 to 24	12 to 24
Operating temperature	0°C to 50°C	0°C to 50°C	0°C to 50°C
Weight (g)	530	530	530
Outline dimension (mm)	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

1.5 Spectrum Response Curve

Spectrum response curve

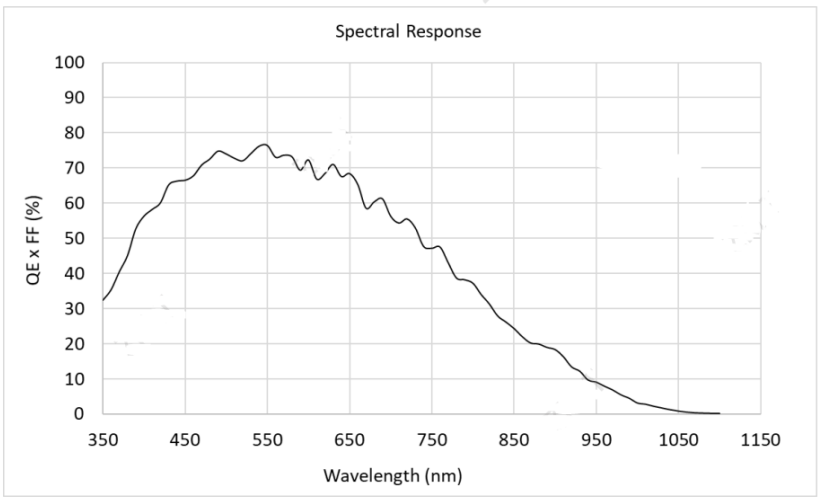


Figure 1-5 VC22-041CM-178

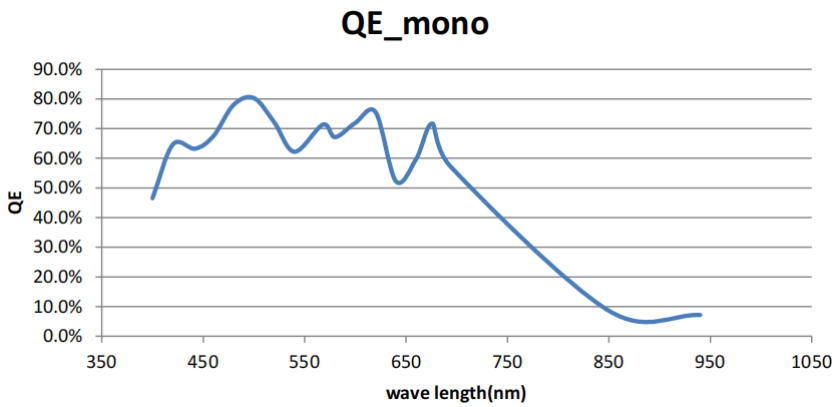


Figure 1-6 VC22-042CM-040

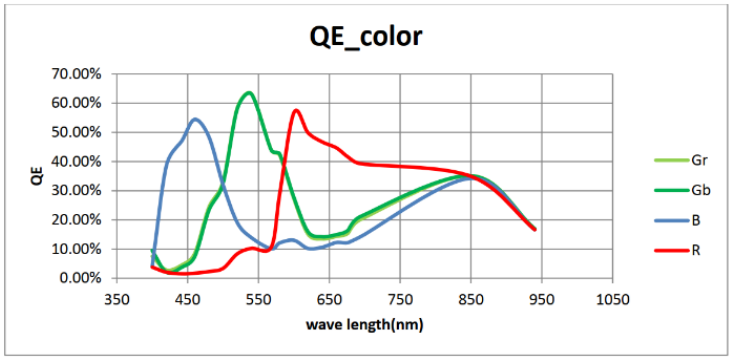


Figure 1-7 VC22-046CC-040

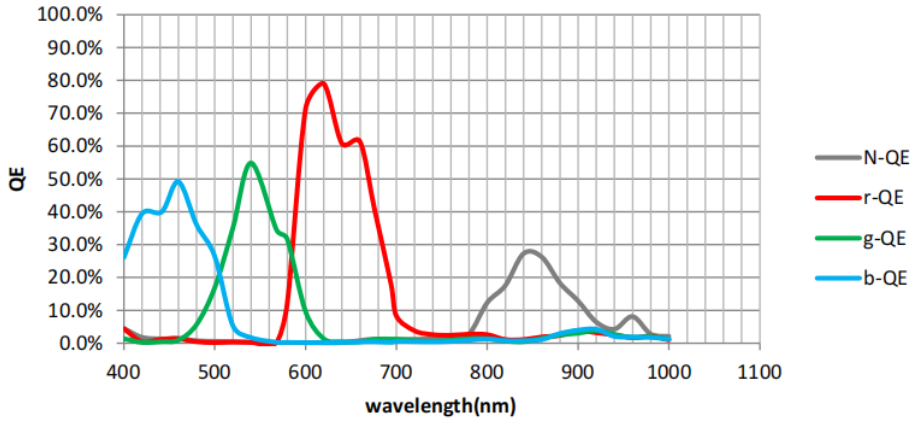


Figure 1-8 VC22-048CCN-040

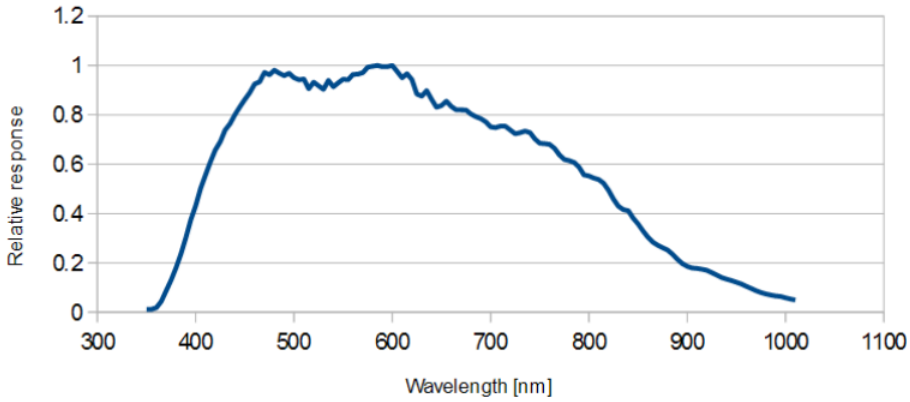


Figure 1-9 VC22-081CM-070 and VC22-161CM-050

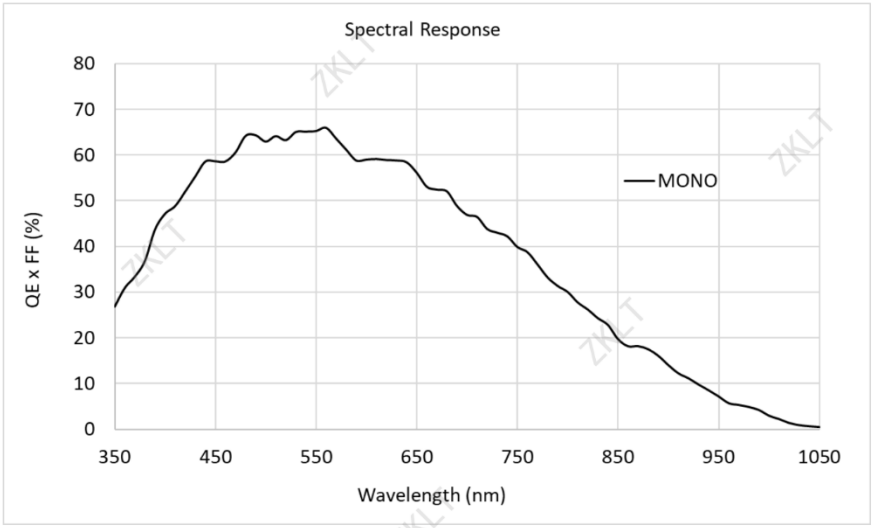


Figure 1-10 VC22-081CM-100

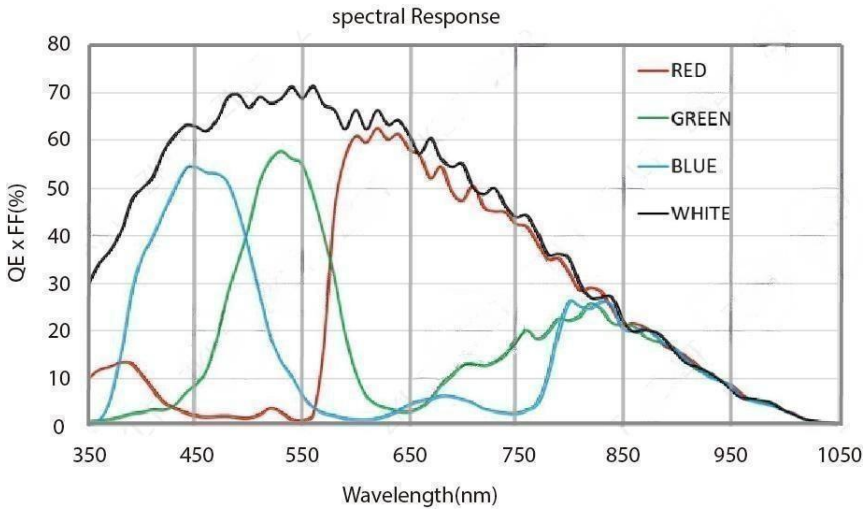


Figure 1-11 VC22-083CC-033

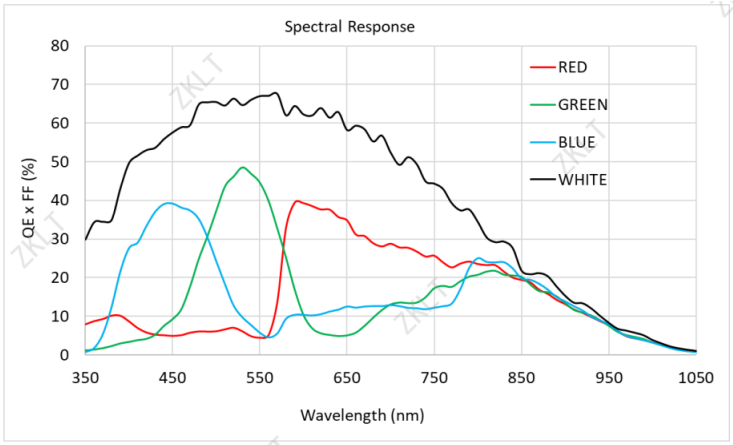


Figure 1-12 VC22-162CC-017 and VC22-162CM-050

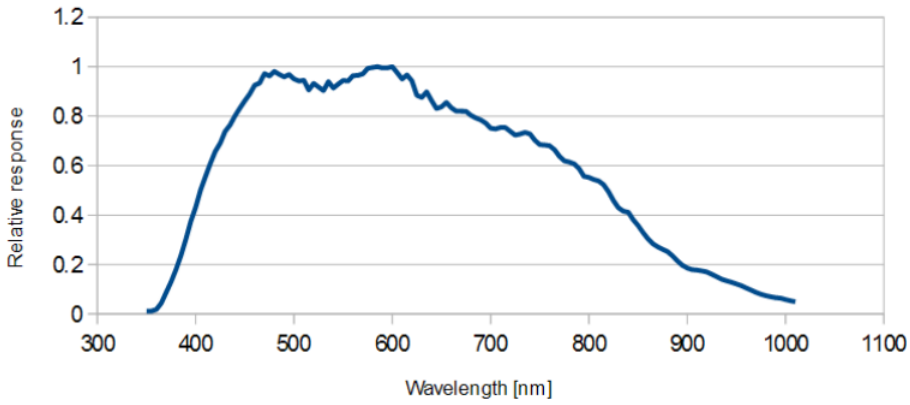


Figure 1-13 VC22-081CM-100A

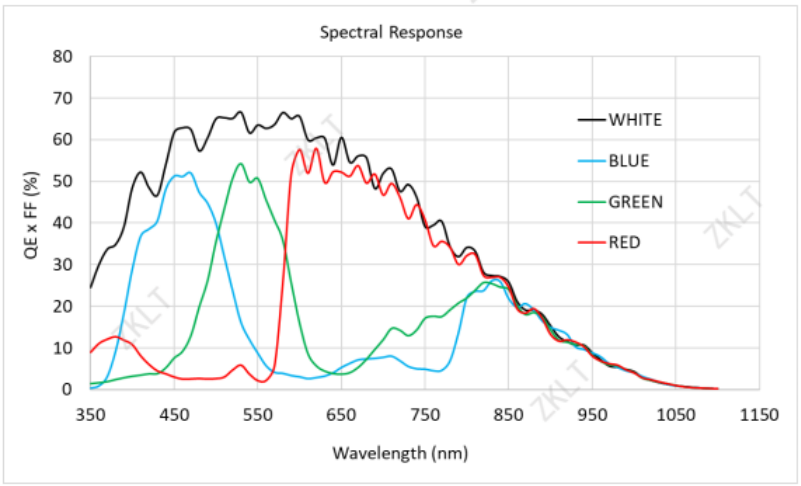


Figure 1-14 VC22-166CC-017 and VC22-163CC-017

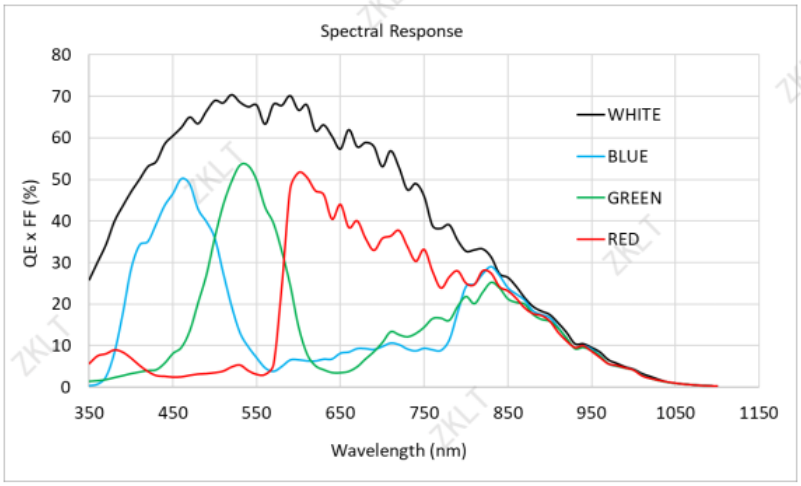


Figure 1-15 VC22-162CM-050A

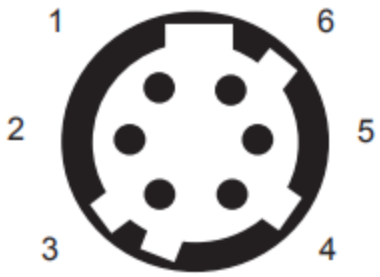
2 Camera Hardware

2.1 Power Supply Interface

The power supply and I/O interfaces of the camera are divided into 6-pin interfaces (VC22-081CM-070, VC22-161CM-050, VC22-041CM-178, VC22-042CM-040, VC22-046CC-040, and VC22-048CCN-040), 12-pin interfaces (VC22-162CM-050A, VC22-166CC-017, VC22-163CC-017, VC22-081CM-100, VC22-083CC-033, VC22-162CC-017, and VC22-162CM-050), and time-sharing strobe interfaces (VC22-081CM-100A). The following describes the details.

6-pin power supply interface

The camera's power supply and I/O interfaces use a 6-pin connector.

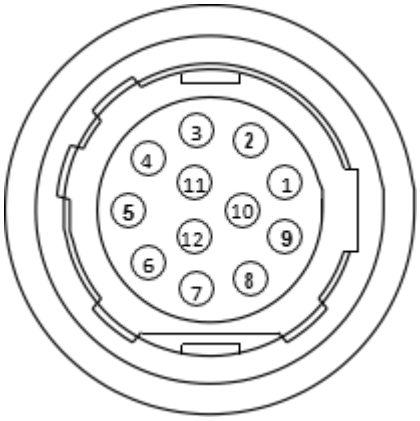


Pin definitions are as below:

Pin	Signal
1	PWR
2	PWR
3	PWR
4	GND
5	GND
6	GND

12-pin power supply interface

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

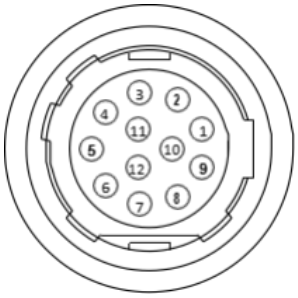


Pin definitions are as below:

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

Time-sharing strobe interface

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



Pin definitions are as below:

Pin	Signal	Remarks
1	Power-	Power negative
2	Power+	Power positive
3	OUTPUT2	Output 2
4	OUTPUT8	Output 8
5	OUTPUT6	Output 6
6	OUTPUT4	Output 4
7	OUTPUT3	Output 3
8	OUTPUT5	Output 5
9	OUTPUT7	Output 7
10	OUTPUT1	Output 1
11	INPUT0	Input
12	DIG_GND	Digital ground

Power supply connection

The camera uses a 12 VDC to 24 VDC power supply.

2.2 Indicator

Indicator signal

Indicator (Green)	Camera Status
Steady ON	Continuous: Normal
Flashing once per second	Trigger mode: No trigger signal is input.
Flashing three times per second	Camera failed
Flashing frequently	Trigger mode: Normal

2.3 Cable Selection

CameraLink interface

Standard CameraLink interface: In Base mode, only CL1 is connected. In Medium/Full/10Tap modes, both CL1 and CL2 are connected. Only CL1 includes a communication serial port.

Table 2–1 CL1 (Base)

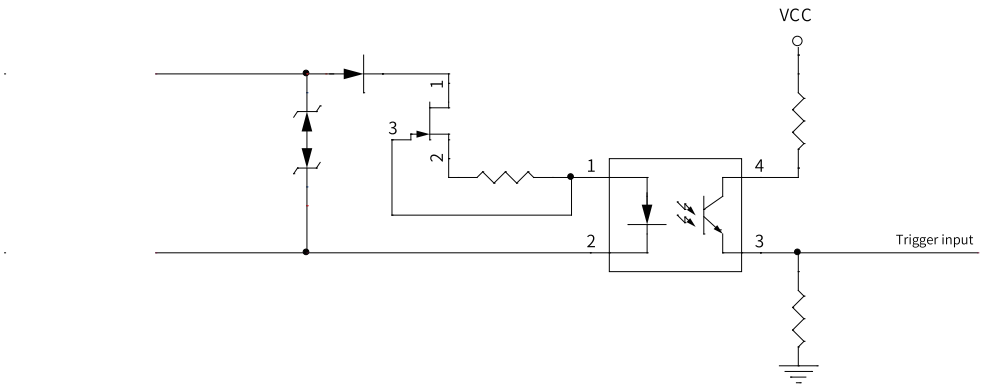
Pin	Signal	Pin	Signal
1	POCL PWR	14	GND
2	CL_X0-	15	CL_X0+
3	CL_X1–	16	CL_X1+
4	CL_X2–	17	CL_X2+
5	CL_XCLK-	18	CL_XCLK+
6	CL_X3–	19	CL_X3+
7	SERTC+	20	SERTC-
8	SERTFG-	21	SERTFG+
9	CL_CC1–	22	CL_CC1+
10	CL_CC2+	23	CL_CC2–
11	CL_CC3-	24	CL_CC3+
12	CL_CC4+	25	CL_CC4–
13	GND	26	POCL PWR

Table 2–2 CL2 (Medium/Full)

Pin	Signal	Pin	Signal
1	POCL PWR	14	GND
2	CL_Y0–	15	CL_Y0+
3	CL_Y1–	16	CL_Y1+
4	CL_Y2–	17	CL_Y2+
5	CL_YCLK-	18	CL_YCLK+
6	CL_Y3–	19	CL_Y3+
7	Not used	20	Not used
8	CL_Z0–	21	CL_Z0+
9	CL_Z1–	22	CL_Z1+
10	CL_Z2–	23	CL_Z2+
11	CL_YCLK-	24	CL_YCLK+
12	CL_Z3-	25	CL_Z3+
13	GND	26	POCL PWR

Trigger Input

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



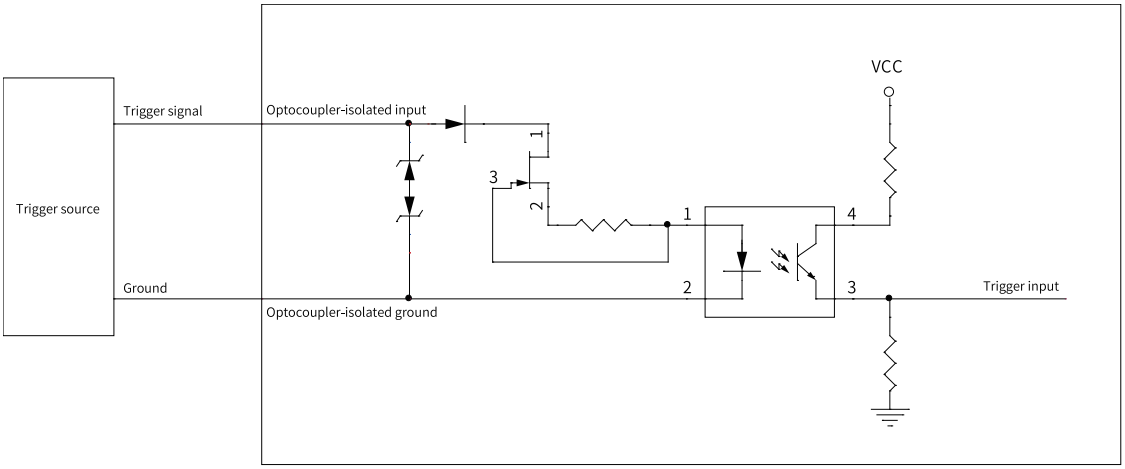
The trigger input uses an optocoupler input, supporting a wide voltage range (3 VDC to 24 VDC).

Table 2–3 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 V and cannot be exceeded.

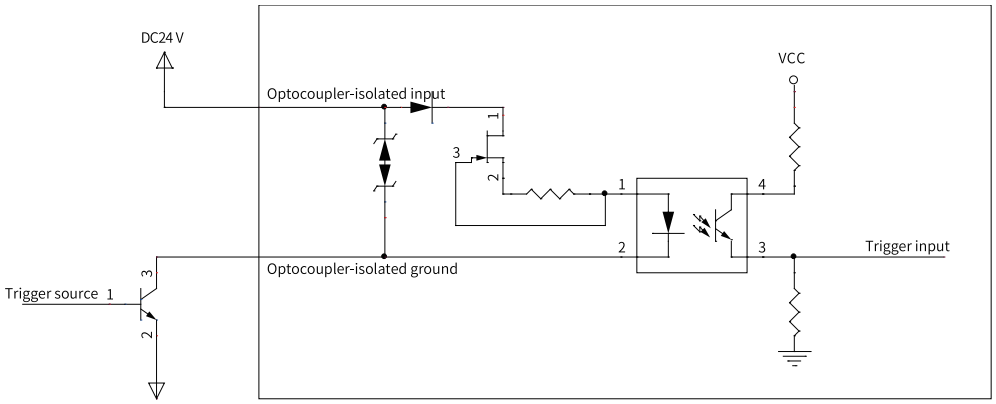
1. **Connection method 1 for the trigger signal**

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



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

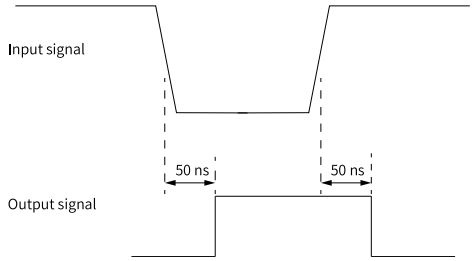
   For switch-type trigger signal sources like optocouplers or PLCs, connect as shown below:



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.

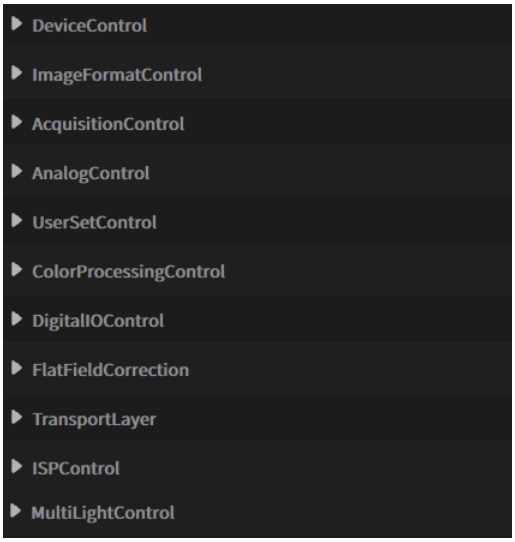


3 Camera Software Operation

Camera parameter navigation

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 11 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 3–1 Function

Property	Function Description
Device Control	Displays the device information and modifies the device name.
Image Format Control	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 I/O Control	Sets different I/O signals.
User Set Control	Saves or loads camera parameter groups and configures the default enabled parameter group.

Property	Function Description
Transport Layer	Configures transmission protocol parameters for the camera.
Multi Light Control	Sets the signal and capture parameters of multi-light source control, which is only supported by time-sharing strobe cameras.

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.

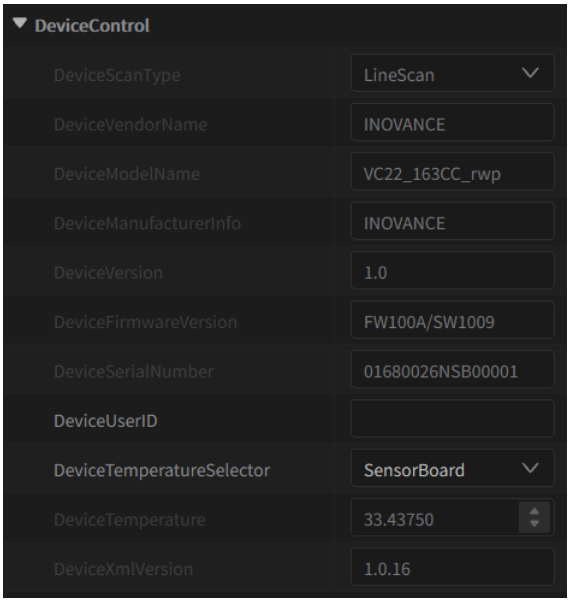


Table 3–2 Camera basic information

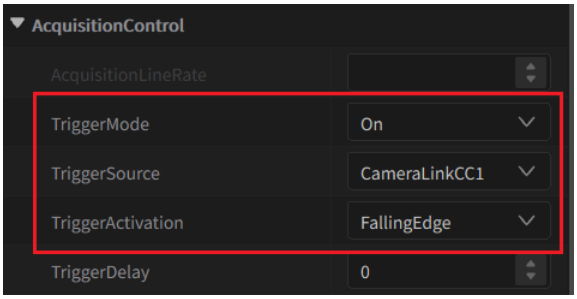
Parameter	Read/Write	Function Description
Device Scan Type	Read-only	Camera type. LineScan indicates a line scan camera.
Device Vendor Name	Read-only	Device manufacturer name
Device Model Name	Read-only	Device model
Device Manufacture Info	Read-only	Device manufacturer information
Device Version	Read-only	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
DeviceXmlVersion	Read-only	XML file version

Trigger mode

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: CameraLinkCC1 (CC1 trigger), Line0 (I/O interface), and Line1 (I/O interface). Some camera models only support 1 or 2 trigger modes. See your camera for details.

When CC1 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).

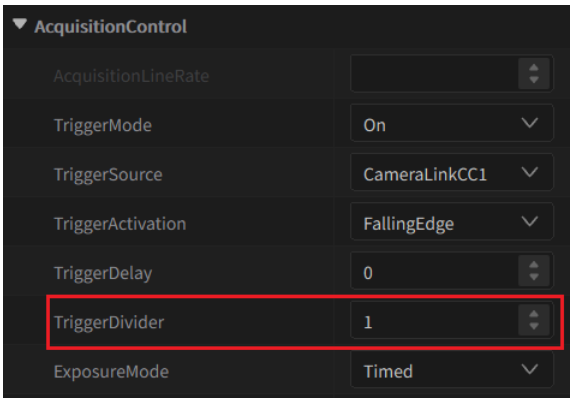


TriggerDivider

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.

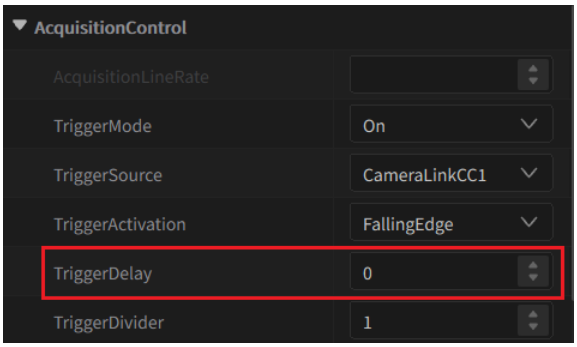
Caution

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.

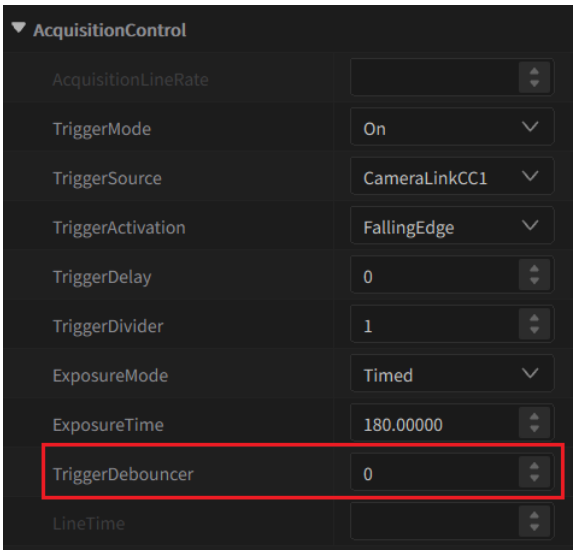


Caution

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

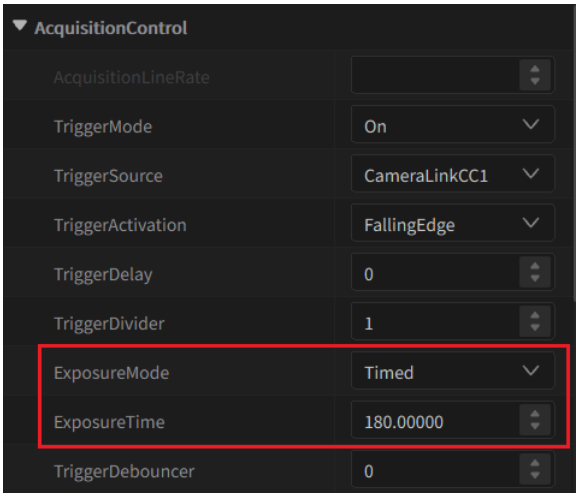
The camera supports two exposure modes: internal register mode and PWC (Pulse Width Control). This is configured by the ExposureMode parameter under the AcquisitionControl property.

- 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.

Caution

The exposure time must be smaller than the line time. For details, see “ Line rate” on page 29.

- 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:

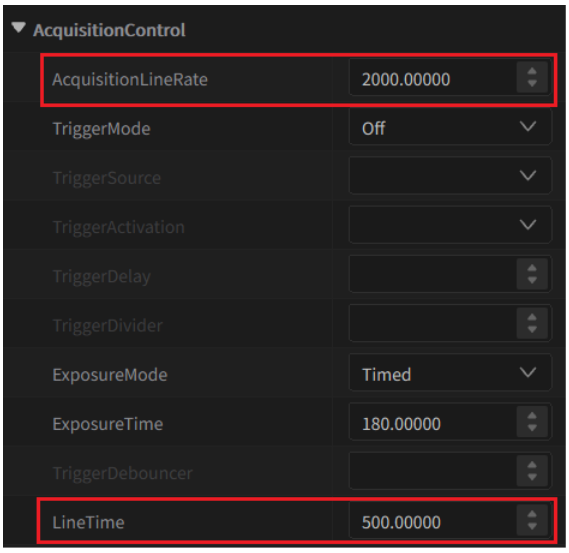
- Exposure time: Shorter exposure times allow higher line rates.
- Pixel format: Different pixel formats occupy different byte sizes. Under the same conditions, formats with larger byte sizes reduce the line rate.
- Tag count: More Taps increase data throughput and thus the line rates.

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

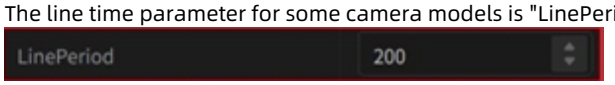
LineTime: in the unit of μs

AcquisitionLineRate = 1000000/LineTime



Caution

The line time parameter for some camera models is "LinePeriod", as shown in the following figure.



CL image output arrangement

When outputting images through CameraLink, the camera supports multiple pixel arrangement orders, and the required number of CameraLink ports varies accordingly. Monochrome cameras support 5 modes: base_1X2, base_1X3, medium_1X4, full_1X8, and deca_1X10. Color cameras support 4 modes: base_1X3, medium_1X6, full_1X8, and deca_1X10. This can be set by CLDeviceTapGeometry under the TransportLayer property, as shown in the following figure.

The following table lists the pixel arrangement orders of the monochrome cameras and the number of bits required.



Table 3–3 Data arrangement of monochrome cameras

Output Mode	Number of Bits	CL Port	Arrangement Order
base_1X2	8 and 10	1	01010101
base_1X3	8 and 10	1	012012
medium_1X4	8 and 10	2	012301234
full_1X8	8 and 10	2	01234567
deca_1X10	8	2	0123456789

The following table lists the pixel arrangement orders of the color cameras and the number of bits required.

Table 3–4 Data arrangement of color cameras

Output mode	Number of Bits	CL Port	Arrangement Order
base_1X3	8	1	See the following figure.
medium_1X6	8	2	See the following figure.
full_1X8	8	2	See the following figure.
deca_1X10	8	2	See the following figure.

Table 3–5 Base

CL Port A	Red 1	Red 2	-	-	-	Red 4095	Red 4096
CL Port B	Green 1	Green 2	-	-	-	Green 4095	Green 4096
CL Port C	Blue 1	Blue 2	-	-	-	Blue 4095	Blue 4096

Table 3–6 Medium

CL Port A	Red 1	Red 3	-	-	-	Red 4093	Red 4095
CL Port B	Green 1	Green 3	-	-	-	Green 4093	Green 4095
CL Port C	Blue 1	Blue 3	-	-	-	Blue 4093	Blue 4095
CL Port D	Red 2	Red 4	-	-	-	Red 4094	Red 4096
CL Port E	Green 2	Green 4	-	-	-	Green 4094	Green 4096
CL Port F	Blue 2	Blue 4	-	-	-	Blue 4094	Blue 4096

Table 3–7 Full

CL Port A	Red 1	Blue 3	Green 6	-	-	-	Red 4094
CL Port B	Green 1	Red 4	Blue 6	-	-	-	Green 4094
CL Port C	Blue 1	Green 4	Red 7	-	-	-	Blue 4095
CL Port D	Red 2	Blue 4	Green 7	-	-	-	Red 4095
CL Port E	Green 2	Red 5	Blue 7	-	-	-	Red 4095
CL Port F	Blue 2	Green 5	Red 8	-	-	-	Green 4096
CL Port G	Red 3	Blue 5	Green 8	-	-	-	Blue 4096
CL Port H	Green 3	Red 6	Blue 8	-	-	-	Red 4096

Table 3–8 Deca

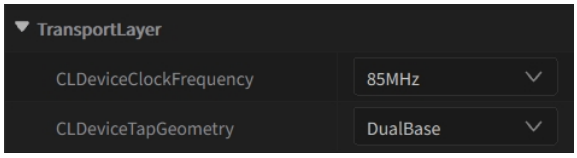
CL Port A	Red 1	Green 4	Blue 7	-	Red 2041	Green 2044	Blue 2047
CL Port B	Green 1	Blue 4	Red 8	-	Green 2041	Blue 2044	Red 2048
CL Port C	Blue 1	Red 5	Green 8	-	Blue 2041	Red 2045	Green 2048
CL Port D	Red 2	Green 5	Blue 8	-	Red 2042	Green 2045	Blue 2048
CL Port E	Green 2	Blue 5	Red 9	-	Green 2042	Blue 2045	X
CL Port F	Blue 2	Red 6	Green 9	-	Blue 2042	Red 2046	X
CL Port G	Red 3	Green 6	Blue 9	-	Red 2043	Green 2046	X
CL Port H	Green 3	Blue 6	Red 10	-	Green 2043	Blue 2046	X
CL Port I	Blue 3	Red 7	Green 10	-	Blue 2043	Red 2047	X
CL Port J	Red 4	Green 7	Blue 10	-	Red 2044	Green 2047	X

Caution

- For color cameras in medium_1X6 mode, since the pixel arrangement order supported by the frame grabber is not entirely uniform, all cameras additionally support two different arrangements: ABCDEF and EDAFCB. These can be configured by ColorArrangement under the TransportLayer property, as shown in the following figure.



- For near-infrared cameras, the CLDeviceTapGeometry only supports DualBase and Full modes, as shown in the following figure.



In DualBase mode, CL1 outputs color images, with the pixel arrangement order being the same as that in the color camera Base mode. CL2 outputs monochrome images, with the pixel arrangement order being the same as that in the monochrome camera Base mode.The following table lists specific pixel arrangement orders in Full mode.

Table 3–9 Full

CL Port A	Red 1	Blue 3	-	Red 4094	NIR1	-	NIR 4089
CL Port B	Green 1	Red 4	-	Green 4094	NIR2	-	NIR 4090
CL Port C	Blue 1	Green 4	-	Blue 4095	NIR3	-	NIR 4091
CL Port D	Red 2	Blue 4	-	Red 4095	NIR4	-	NIR 4092
CL Port E	Green 2	Red 5	-	Red 4095	NIR5	-	NIR 4093
CL Port F	Blue 2	Green 5	-	Green 4096	NIR6	-	NIR 4094
CL Port G	Red 3	Blue 5	-	Blue 4096	NIR7	-	NIR 4095
CL Port H	Green 3	Red 6	-	Red 4096	NIR8	-	NIR 4096

CL clock frequency

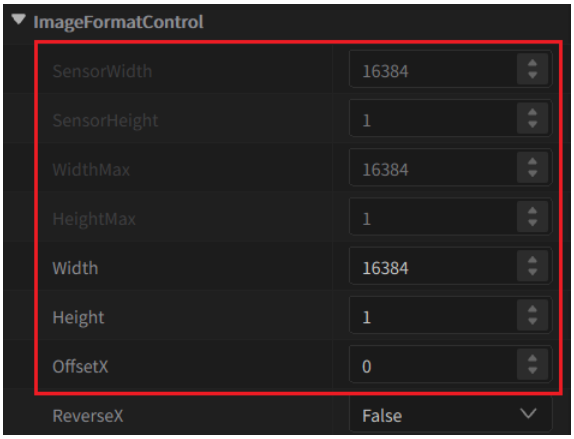
The camera supports multiple CameraLink output frequencies, including 20 MHz, 40 MHz, 60 MHz, 65 MHz, and 85 MHz, depending on the specific model. This is configured by CLDeviceClockFrequency under the TransportLayer property, as shown below.



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. It is fixed to 16K, that is 16384.
- SensorHeight: Sensor height (hardware property). It is 1 for line scan cameras.
- WidthMax: Maximum horizontal resolution of the camera (determined by the sensor, 16384).
- 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.

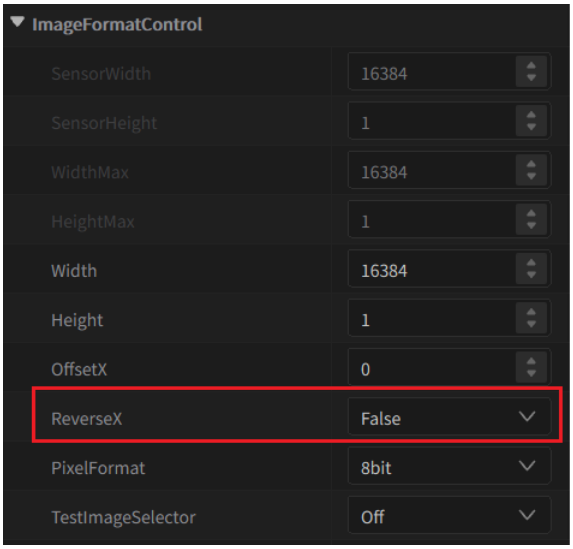


Note

- Some camera models do not support ROI. See the camera in use for details.
- 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.

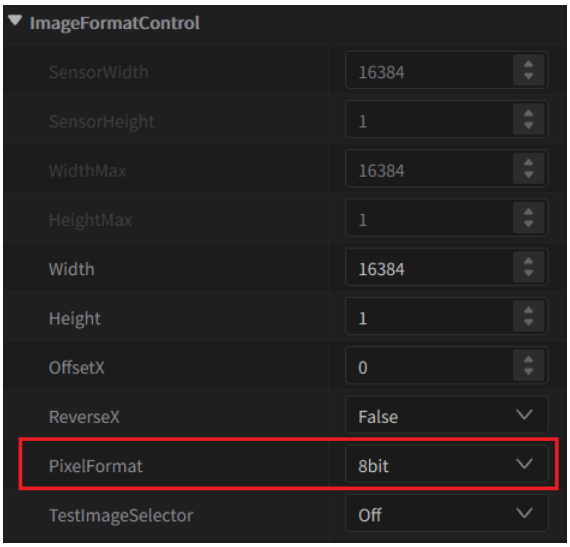
Mirroring

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

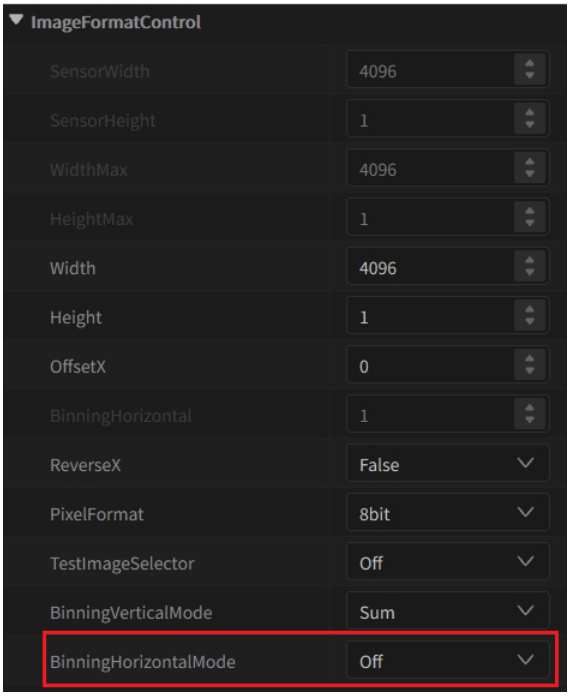
PixelFormat sets the bit depth per pixel. Monochrome cameras support 8 bits and 10 bits, while color cameras support 8 bits only. This parameter is configured by the PixelFormat parameter under the ImageFormatControl property, as shown below:



BinningHorizontalMode

Some camera models support horizontal binning of images, which combines two sensor columns to enhance image quality. This parameter is configured by the BinningHorizontalMode parameter under the ImageFormatControl property. Three modes are supported:

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



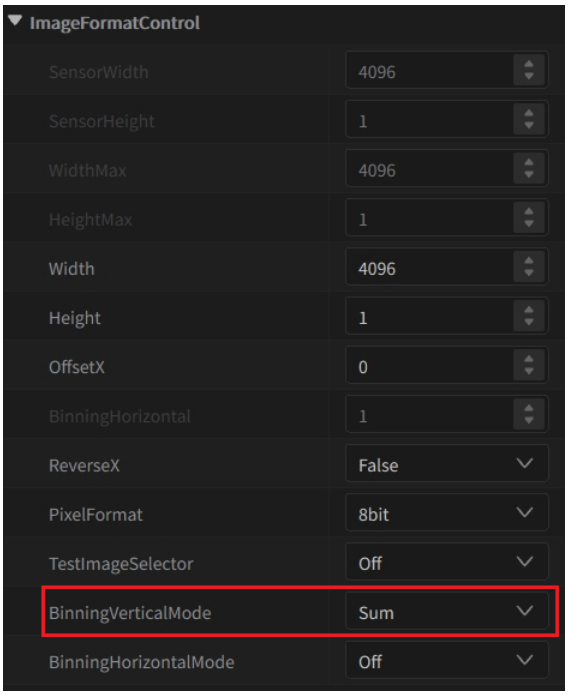
Caution

When horizontal binning is enabled, the image width will be reduced to 1/2 of its original size. The frame grabber must be reconfigured with the new image width to capture correct images.

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:

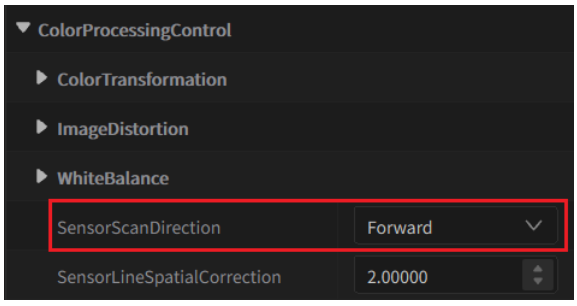
- Off: Disables vertical binning.
- Sum: 2-line summation mode (adjacent lines are summed into one output), improving image brightness and sensitivity.
- Avg: 2-line averaging mode (adjacent lines are averaged into one output), reducing image noise.



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:

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

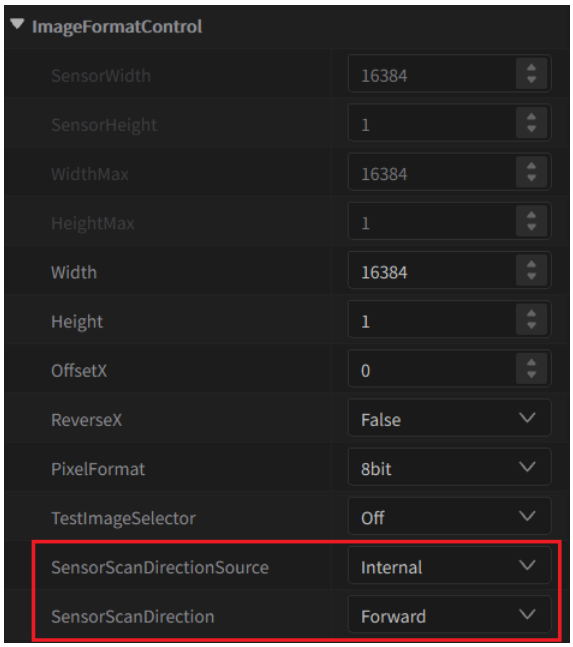


- SensorScanDirection under the ImageFormatControl property. SensorScanDirectionSource under the same property sets the control source:
  - Internal: camera internal source.
  - GPIO: External source through GPIO.
  - GPIOInvert: Inverted GPIO source.

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.



TDI

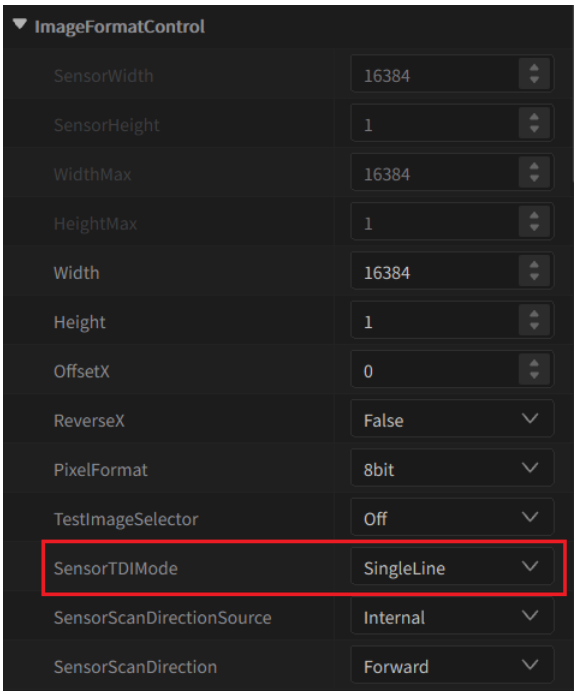
Multi-line cameras support Time Delay Integration (TDI), a technique that enhances light sensitivity by algorithmically integrating multiple sensor line exposures. It features high sensitivity and wide dynamic range.

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.

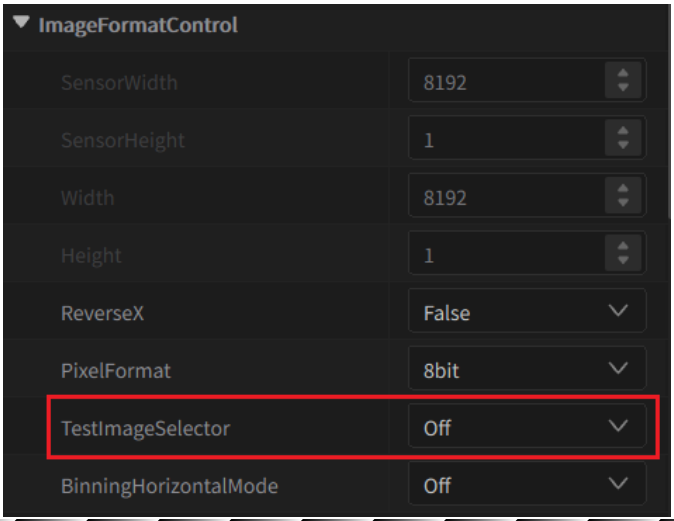
Caution

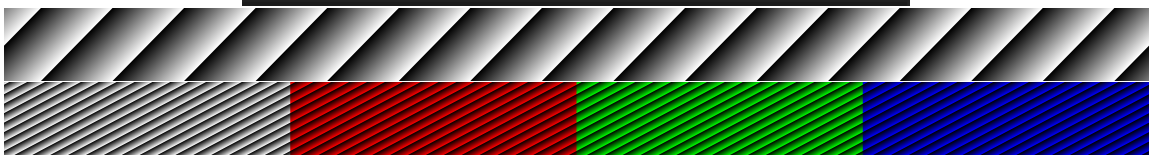
TDI must be used in combination with SensorScanDirection (the scan direction must be correct) under Image Format Control; otherwise, the image will become blurred.



Test pattern

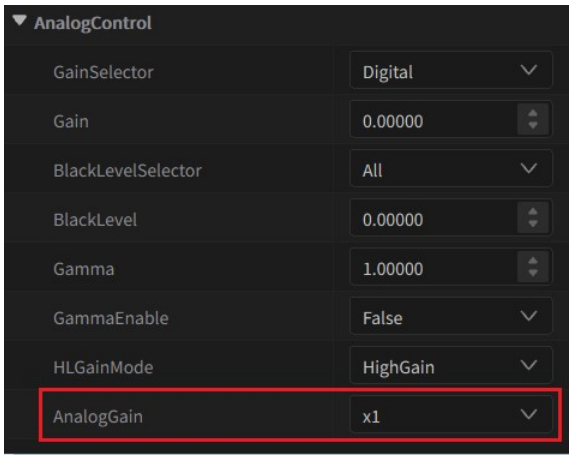
Under the ImageFormatControl property, when TestImageSelector is Off, the camera outputs sensor-captured images. When it is set to TestPattern, the camera outputs test patterns (different patterns for monochrome and color cameras), as shown below:





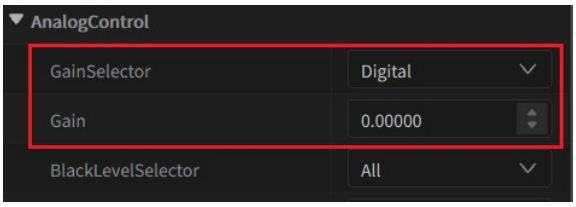
Analog gain

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.



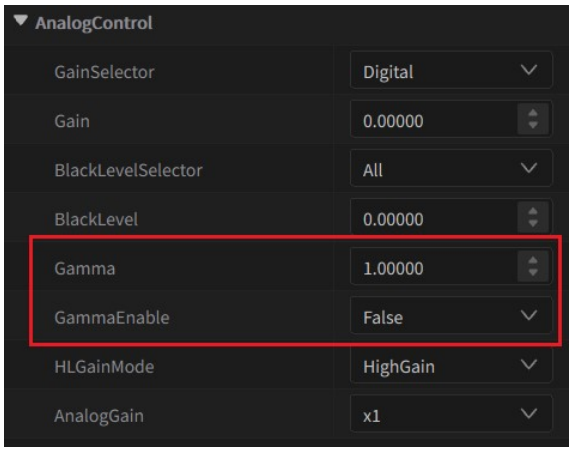
Black Level

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.



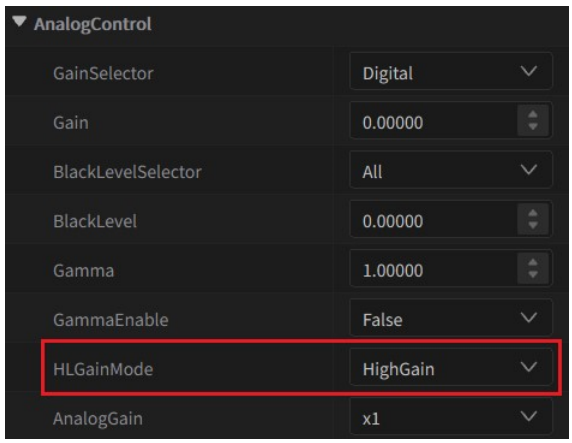
Gamma correction

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).



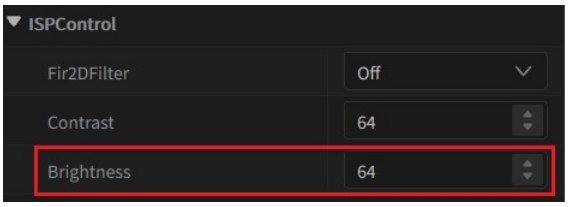
High gain mode

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.



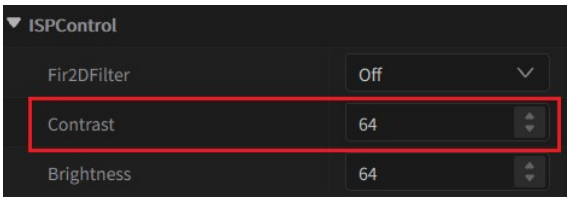
Brightness

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).



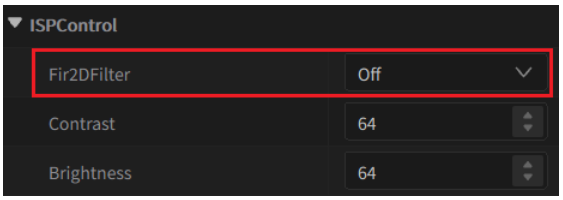
Noise reduction

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

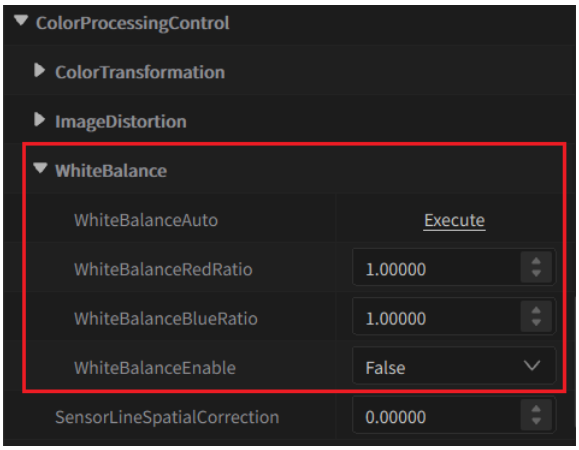
Some camera models support image filtering to reduce noise (especially salt-and-pepper noise) and smooth the image. Under the ISPControl property, set Fir2DFilter to true to enable image filtering. The default value is False.



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.

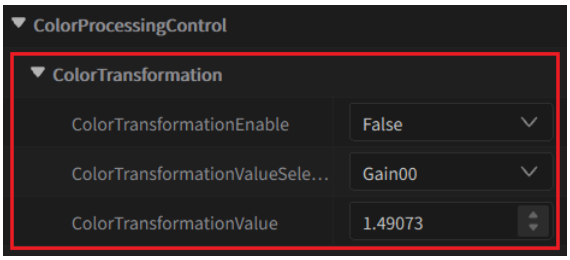
WhiteBalance under the ColorProcessingControl property includes all white balance actions. When WhiteBalanceEnable is set to True, white balance is enabled. Then, you can place a white board or paper in the camera field of view, making the white color fill the entire frame and adjust brightness to a 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.



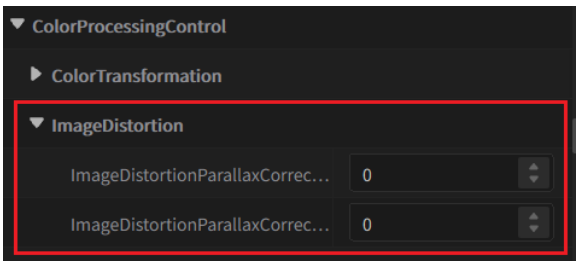
Parallax correction

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

ImageDistortion under the ColorProcessingControl property includes all options for parallax correction.

ImageDistortionParallaxCorrectionMode sets the direction of parallax correction. Values are 0 or 1. The default value is 0.

ImageDistortionParallaxCorrection sets the spatial correction coefficient. The value range is 0 to 63. The default value is 0.

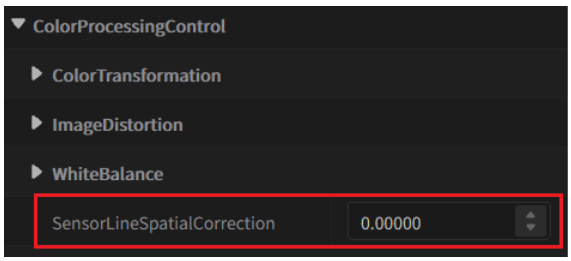


Spatial correction

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.

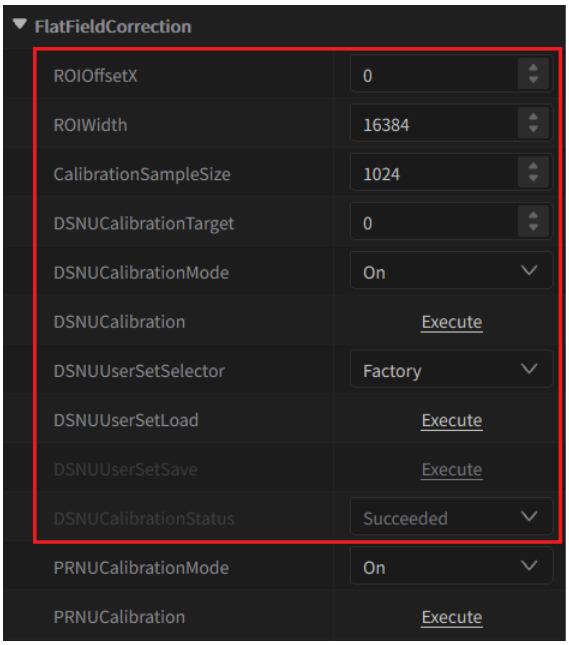
Caution

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.



The near-infrared camera supports separate DSNU for normal images and near-infrared images. The correction mode is set by FFCMode: RGB for color mode; NIR for near-infrared mode.



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.

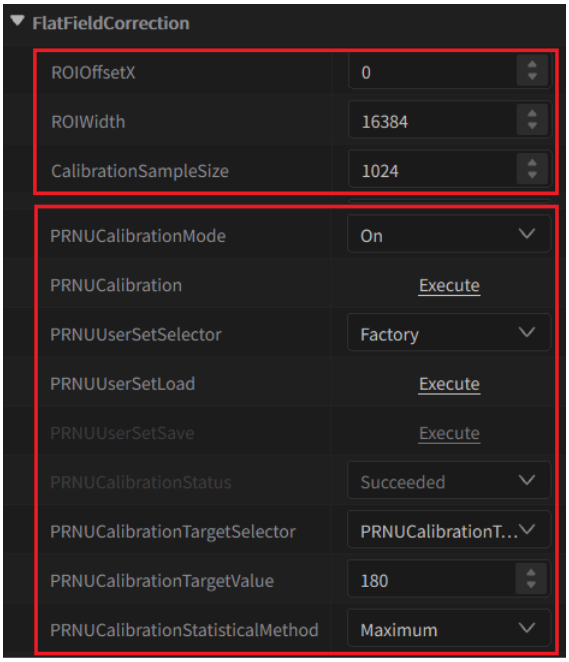




Figure 3-1 Image before correction

Figure 3-2 Image after correction

The near-infrared camera supports separate DSNU for normal images and near-infrared images. The correction mode is set by FFCMode: RGB for color mode; NIR for near-infrared mode.

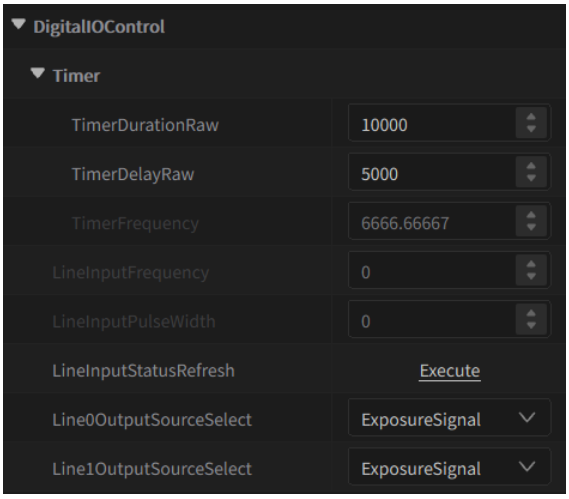


Digital I/O control

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:

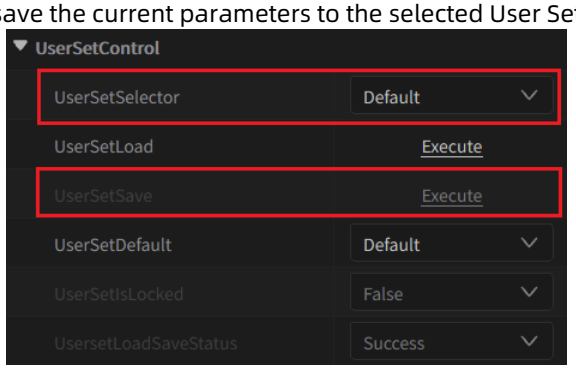
- ExposureSignal: exposure signal
- TriggerSignal: trigger signal
- LVALSignal: line valid signal
- TimerSignal: timer pulse signal
  - Timer controls the output pulse width and frequency. TimerDurationRaw sets the high-level pulse width (unit: 10 ns, minimum: 1, default: 5000).
  - TimerDelayRaw sets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



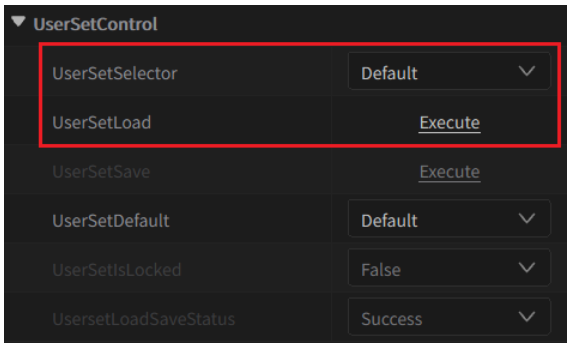
User parameter settings

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.

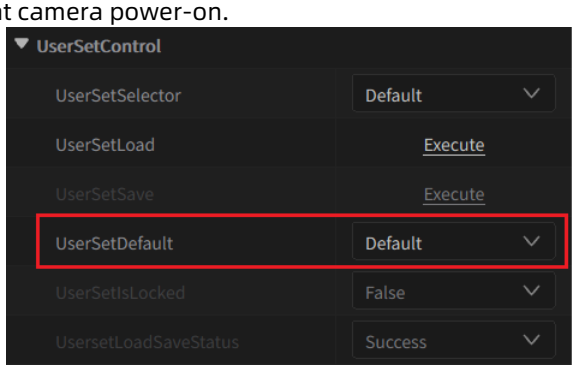
- Saving parameters: After modifying parameters, select a User Set in UserSetSelector. Click the UserSetSave button to save the current parameters to the selected User Set.



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

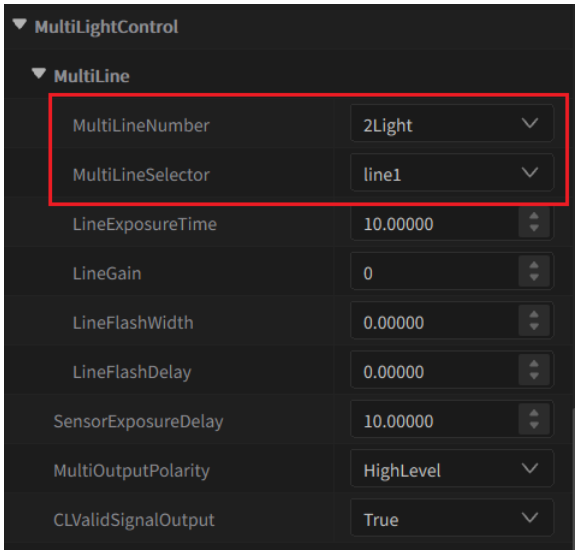


- Setting default startup parameters: From the UserSetDefault drop-down list, select the parameter set loaded at camera power-on.



Multi Light Control

The camera supports up to 8 light sources. The number of light sources under control can be set by MultiLineNumber under the MultiLine property. MultiLineSelector under the MultiLine property selects a single line light source to view and set parameters.

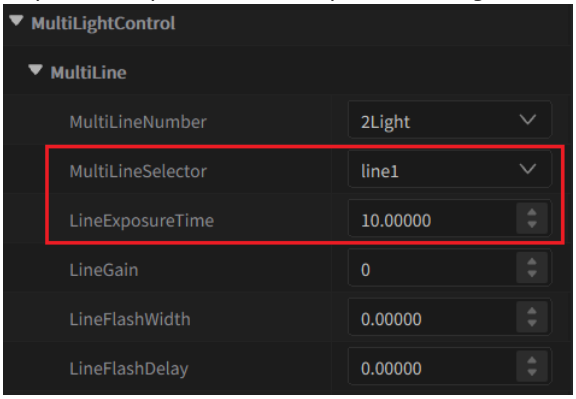


Single-line light source exposure

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.

- The ExposureMode defaults to Timed, which uses the camera's internal registers. In this mode, the exposure time of the single-line light source needs to be set. Use MultiLineSelector to choose

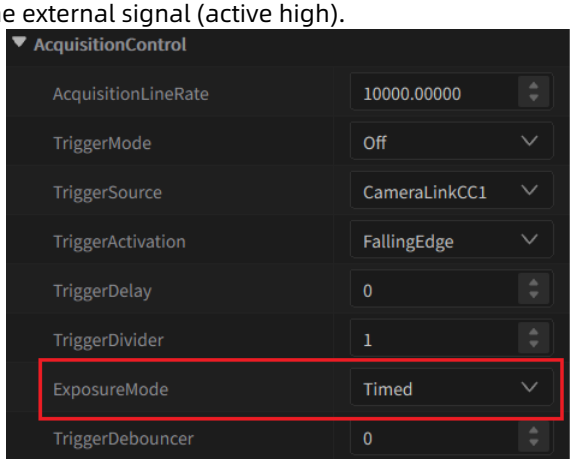
the light source number to configure, and LineExposureTime to set the exposure time of the single-line light source, in μs, with a precision of 0.1 μs and a range of 3.0 to 32000.0.



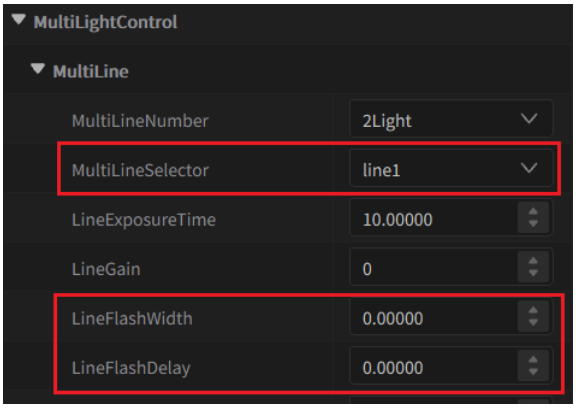
Caution

The exposure time must be smaller than the line time. For details, see *" Line rate" on page 29*.

- When ExposureMode is set to TimedTriggerControl (PWC), the camera exposure time is controlled by the pulse width of the external signal (active high).

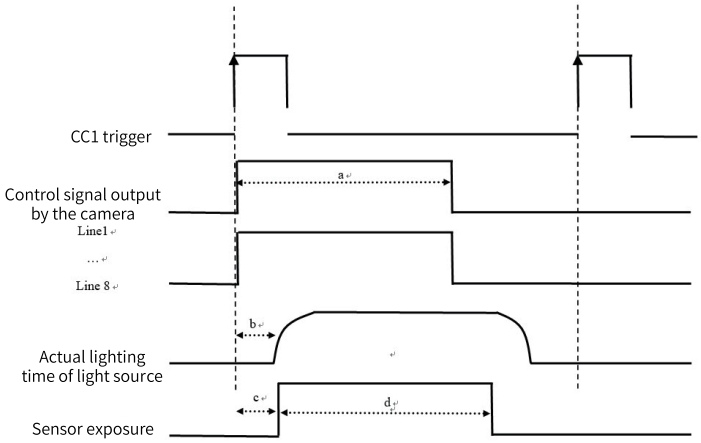


Single-line light source control signal



The single-line light source supports independent control signal settings. Use MultiLineSelector to choose the light source number to configure. LineFlashWidth sets the output signal width of the

single-line light source, and LineFlashDelay sets the control signal delay of the single-line light source. The light source control signal generation mechanism is as follows:



- a: Light source pulse width. 0: The pulse width follows the exposure time. Other values: The pulse width is the set value.
- b: Light source delay. The delay time from when the light source controller receives the signal to when it lights up (generally not used; adjust the sensor exposure delay instead).

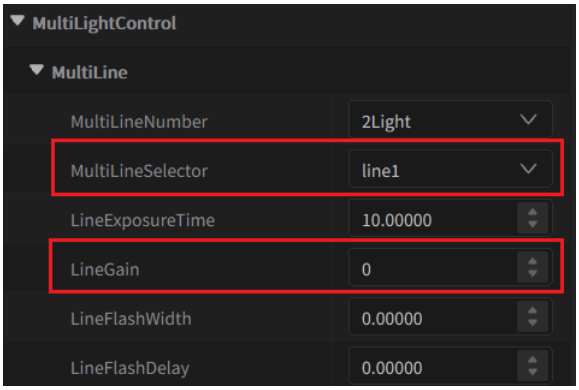
Caution

Check whether the light source controller uses rising-edge control or pulse-width control. Rising-edge control: Ensure the controller light-on duration does not exceed the camera exposure time. If the light-on duration is too short, abnormality (such as black/white lines) may appear in the image.

- c: Sensor exposure delay. Due to the response delay of the light source, the sensor exposure needs a certain delay. The default is 100 (10 μs). Adjustments can be made based on the light source and field conditions. For details, see *" Exposure delay" on page 50*.
- d: Exposure time: The sensor exposure time, which must be less than the line period minus 1 μs.

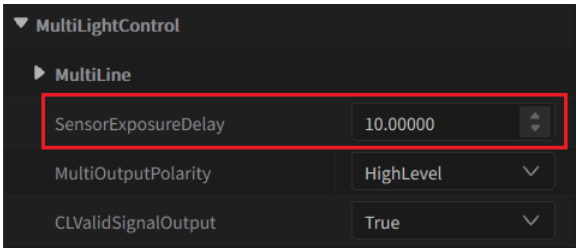
Single-line light source gain

The single-line light source supports independent gain settings. Use MultiLineSelector to choose the light source number to configure, and LineGain to set the gain value of the single-line light source, with a range of 0 to 255.



Exposure delay

The exposure delay time is primarily used to synchronize the light source activation time. It is set by SensorExposureDelay under MultiLightControl. All light sources share the same exposure delay time.



Light source pulse polarity

The light source pulse polarity determines whether the light source activates on the high or low level of the pulse signal. It is set by MultiOutputPolarity under MultiLightControl.



CameraLink DVAL signal active

The CameraLink DVAL signal is used for image data transmission verification and is used in combination with the CameraLink DVAL signal in the frame grabber. For details, see the frame grabber instructions. It is configured by CLValidSignalOutput under MultiLightControl.



4 Camera Communication

- Write command format: Command=value(CR). For example, "sreq=500(CR)" indicates setting the line time to 50 μs. Success response: >Ok
- Read command format: "Command? (CR)". For example, "sreq? (CR)" returns the current line time (req=500>Ok)?

">128" is returned for all failed operations (read/write).

"?=3(CR)" reads all parameters at once.

Note

For specific command tables, see *"6.5 Command Table of VC22-162CM-050A, VC22-166CC-017, and VC22-163CC-017" on page 71*, *"6.2 Command Table of VC22-081CM-070 and VC22-161CM-050" on page 59*, *"6.3 Command Table of VC22-081CM-100, VC22-083CC-033, VC22-162CC-017, and VC22-162CM-050" on page 62*, *"6.4 Command Table of VC22-081CM-100A" on page 67*, *"6.1 Command Table of VC22-041CM-178, VC22-042CM-040, VC22-046CC-040, and VC22-048CCN-040" on page 53*, and *"6.6 Procedure of PRNU and DSNU Commands" on page 76*.

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5 Frame Grabber Software Installation

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 CameraLink protocol and GenICam standard. See the specific frame grabber's user guide for installation details.



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.

6 Appendix: Camera Command Table

6.1 Command Table of VC22-041CM-178, VC22-042CM-040, VC22-046CC-040, and VC22-048CCN-040

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Reads all camera parameters.	-	?=3	-	-	-	Returns values of all parameters.
Reads the camera SN.	-	?=D	-	-	-	Returns the 16-bit SN of the camera directly.
Reads the camera ID.	-	?=E	fid=D012	D012	-	fid=D012
Reads the camera FPGA version.	-	?=F	ffw=1001	-	-	ffw=1001
Reads the camera ARM version.	-	?=G	stm=1001	-	-	stm=1001
Reads the DSNU and PRNU states.	-	?=9	dnu=0 pnu=0	-	-	Returns the DSNU and PRNU states.
Camera main board temperature	-	?=T	TMP=45	-	-	TMP=45
Reads user-defined data.	-	?=I	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	-	Hexadecimal string	Reads user region data (32 characters).
Writes user-defined data 1.	WUA=	-	-	-	WUA=4 838860800000	Writes the character "2" to the user region.
Writes user-defined data 2.	WUB=	-	-	-	WUB=40000	Writes the character to the user region first. Send the WUA command, and then send the WUB command. The write operation is complete.
Analog Gain	sang=	sang?	ang=0	0	0 to 2	Analog gain (0: x1; 1: x2; 2: x4)
Global gain	sgnu=	sgnu?	sgnu=0	0	0 to 255	Digital gain
Offset	soa1=	soa1?	oa1 = 0	0	0 to 255	offset

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
X Binning	sxbn=	sxbn?	xbn=0	0	0 to 2	Pixel Binning in horizontal direction (0: OFF; 1: Merge; 2: Average)
Y Binning	Sbin=	sbin?	bin=0	2	1 to 2	1: Off 2: Sum(2x)
Restore settings	-	sres?	res=0	-	0	Factory default
					1 to 3	User region
Save settings	ssav=	-	-	-	1 to 3	User region
CameraLink Out mode(VC22-041CM-178)	-	sout?	out=2	-	0	base(1x2)2Tap
					1	medium(1x4)4Tap
					2	full(1x8)8Tap
					3	deca(1x10)10Tap
					4	base(1x3)3Tap
CameraLink Out mode(VC22-042CM-040)	-	sout?	out=2	2	0	base(1x1)1Tap
					1	base(1x2)2Tap
					2	Medium(1x4)4Tap
					3	base(1x3)3Tap
CameraLink Out mode(VC22-046CC-040)	-	sout?	out=0	-	0	base(3Tap_1X)
					1	medium(6Tap_1X)
					2	full(8Tap_1X)
					3	Deca(10Tap_1X)
CameraLink Out mode(VC22-048CCN-040)	-	sout?	out=1	-	0	Dual base
					1	full
CameraLink Out PixelClock	-	scsd?	csd=1	1	0	65 MHz
					1	85 MHz
					2	20 MHz
					3	40 MHz
					4	60 MHz
Data Bit format	-	souf?	ouf=2	-	0	12bit data
					1	10bit data
					2	8bit data
Integration time	sinu=	sinu?	int=38	30	30 to 65535 (0.1 μs)	Integral time
Line period	sreu=	sreu?	req=56	56	250 to 65535 (0.1 μs)	Line time
Image mode	-	smod?	mod=0	0	0	Sensor image
					2	Test pattern

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Synchronization mode	-	ssyn?	syn=1	1	1	Free run
					2	Trigger and register control exposure
					3	ITC one trig (trigger pulse width control exposure)
FPN Computing coeff	sdfd=	sdfd?	dfd=0	0	1	Automatically calculates the FPN coefficient.
FPN recall	s+f=	-	+f=0	0	0 to 3	Loads FPN parameters from Flash.
FPN storage	s-f=	-		1	1 to 3	Saves FPN parameters to Flash.
FPN Enable	sdnu=	sdnu?	dnu=0	0	0 to 1	Enables/Disables FPN.
PRNU ROI Xoffset	sxst=	sxst?	xst=0	0	0 to 4080	PRNU statistics region setting, horizontal offset
PRNU ROI Width	swid=	swid?	wid=4096	4096	0 to 4096	PRNU statistics region setting, horizontal width
PRNU Computing coeff	sdfp=	sdfp?	dfp=0	0	1	Automatically calculates the PRNU coefficient.
PRNU recall	s+p=	-	+p=0	0	0 to 3	Loads PRNU parameters from Flash.
PRNU storage	s-p=	-		1	1 to 3	Saves PRNU parameters to Flash.
PRNU Enable	spnu=	spnu?	pnu=0	0	0 to 1	Enables/Disables PRNU.
FFC NIR Mode	sfmn=	sfmn?	fmn=0	0	0 to 1	Enables/Disables FFC NIR mode, including FPG, PRNU, and saving and loading of other parameters
Bright	sbri=	sbri?	bri=64	64	1 to 127	Adjusts the brightness.

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Contrast	scon=	scon?	con=64	64	1 to 127	Adjusts the contrast.
Gamma Enable	sgme=	sgme?	gme=0	0	0 to 1	Enables/Disables Gamma.
Gamma	sgma=	sgma?	gma=100	100	20 to 1000	Gamma coefficient x 100
FPN Computing coeff	sdfd=	sdfd?	dfd=0	0	1	Automatically calculates the FPN coefficient.
FPN recall	s+f=	-	+f=0	0	0 to 3	Loads FPN parameters from Flash.
FPN storage	s-f=	-		1	1 to 3	Saves FPN parameters to Flash.
FPN Enable	sdnu=	sdnu?	dnu=0	0	0 to 1	Enables/Disables FPN.
PRNU ROI Xoffset	sxst=	sxst?	xst=0	0	0 to 4080	PRNU statistics region setting, horizontal offset
PRNU ROI Width	swid=	swid?	wid=4096	4096	0 to 4096	PRNU statistics region setting, horizontal width
PRNU Computing coeff	sdfp=	sdfp?	dfp=0	0	1	Automatically calculates the PRNU coefficient.
PRNU recall	s+p=	-	+p=0	0	0 to 3	Loads PRNU parameters from Flash.
PRNU storage	s-p=	-		1	1 to 3	Saves PRNU parameters to Flash.
PRNU Enable	spnu=	spnu?	pnu=0	0	0 to 1	Enables/Disables PRNU.
FFC NIR Mode	sfmn=	sfmn?	fmn=0	0	0 to 1	Enables/Disables FFC NIR mode, including FPG, PRNU, and saving and loading of other parameters
Bright	sbri=	sbri?	bri=64	64	1 to 127	Adjusts the brightness.
Contrast	scon=	scon?	con=64	64	1 to 127	Adjusts the contrast.

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Gamma Enable	sgme=	sgme?	gme=0	0	0 to 1	Enables/Disables Gamma.
Gamma	sgma=	sgma?	gma=100	100	20 to 1000	Gamma coefficient x 100
Trigger Source	-	stgs?	tgs=0	0	0	Camera internal trigger (Continuous mode)
					1	CameraLink CC1 trigger
					2	Camera Line1 trigger
Trigger Active	-	stgs?	tgs=0	0	0	Falling edge triggered
					1	Rising edge triggered
					2	High level triggered
					3	Low level triggered
Trigger Delay	stdl=	stdl?	tdl=0	0	0 to 65535	TriggerDelay
Trigger Debounce Width	stdb=	stdb?	tdb=0	0	0 to 65535	Trigger debouncing width
Window XOffset	sros=	sros?	ros=0	0	0 to 4000	Horizontal offset of image ROI output
Window Width	srow=	srow?	row=4096	4096	0 to 4096	Horizontal width of image ROI output
Flip Horizontal (Mirror)	sxfl=	sxfl?	xfl=0	0	0 to 1	Horizontal mirroring
Scan Direction	sscd=	sscd?	scd=0	0	0 to 1	Scan direction (0: Forward; 1: Reverse)
Spatial Alignment	sssa=	sssa?	ssa=416	416	0 to 65535	Color spatial correction coefficient (multiplied by 32 times)
Auto WhiteBalance	sdwb=	sdwb?	dwb=0	0	0 to 1	White balance coefficient statistics

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
WhiteBalance Enable	sawb=	sawb?	awb=1	1	0 to 1	Enables/Disables white balance.
WhiteBalanceRadio Red	swbr=	swbr?	wbr=297	297	1 to 1024	White balance coefficient of red component
WhiteBalanceRadio Blue	swbg=	swbg?	wbg=466	466	1 to 1024	White balance coefficient of blue component
CCM Enable	scme=	scme?	cme=0	0	0 to 1	Enables/Disables color correction.
CCM Radio R0	scm0=	scm0?	cm0 = 382	382	0 to 65535	Color correction array coefficient R0
CCM Radio R1	scm1=	scm1?	cm1 = 32873	32873	0 to 65535	Color correction array coefficient R1
CCM Radio R2	scm2=	scm2?	cm2 = 32788	32788	0 to 65535	Color correction array coefficient R2
CCM Radio G0	scm3=	scm3?	cm3 = 32822	32822	0 to 65535	Color correction array coefficient G0
CCM Radio G1	scm4=	scm4?	cm4 = 330	330	0 to 65535	Color correction array coefficient G1
CCM Radio G2	scm5=	scm5?	cm5 = 32788	32788	0 to 65535	Color correction array coefficient G2
CCM Radio B0	scm6=	scm6?	cm6 = 32822	32822	0 to 65535	Color correction array coefficient B0
CCM Radio B1	scm7=	scm7?	cm7 = 32873	32873	0 to 65535	Color correction array coefficient B1
CCM Radio B2	scm8=	scm8?	cm8 = 415	415	0 to 65535	Color correction array coefficient B2
CCM Offset R	scma=	scma?	cma=0	0	0 to 65535	Color correction array offset R
CCM Offset G	scmb=	scmb?	cmb=0	0	0 to 65535	Color correction array offset G

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
CCM Offset B	scmc=	scmc?	cmc=0	0	0 to 65535	Color correction array offset B
RGB/BGR PixelType	srgb=	srgb?	rgb=0	0	0	RGB/BGR pixel color arrangement order

6.2 Command Table of VC22-081CM-070 and VC22-161CM-050

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Reads all camera parameters.	-	?=3	-	-	-	Returns values of all parameters.
Reads the camera SN.	-	?=D	-	-	-	Returns the 8-bit SN of the camera directly.
Reads the camera ID.	-	?=E	fid=D015	D015	D015	Returns the camera ID.
Reads the camera FPGA version.	-	?=F	ffw=1001	-	-	Returns the FPGA version.
Reads the camera ARM version.	-	?=G	stm=1001	-	-	Returns the ARM version.
Reads the DSNU and RNU states.	-	?=9	dnu=0 pnu=0	-	-	Returns the DSNU and PRNU states.
Camera main board temperature	-	?=T	TMP=45	-	-	TMP=45
Reads user-defined data.	-	?=I	XXXXXXXXXXX-XXXXXXXXXXX-XXXXXXXX	-	Hexadecimal string	Reads use region data (32 characters)
Writes user-defined data 1.	WUA=	-	-	-	WUA=4 838860800 0 0 0	Writes the character "2" to the user region.

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Writes user-defined data 2.	WUB=	-	-	-	WUB=40000	Writes the character to the user region. Send the WUA command first, and then send the WUB command. The write operation is complete.
Gain1	sga1=	sga1?	ga1 = 1	1	0 to 700	Line1 - digital gain W
Gain2	sga2=	sga2?	ga2 = 1	1	0 to 700	Line2 - digital gain R
Gain3	sga3=	sga3?	ga3 = 1	1	0 to 700	Line3 - digital gain G
Gain4	sga4=	sga4?	ga4 = 1	1	0 to 700	Line4 - digital gain B
Offset1	soa1=	soa1?	oa1 = 44	44	0 to 255	Line1 - offsetW
Offset2	soa2=	soa2?	oa2 = 44	44	0 to 255	Line2 - offsetR
Offset3	soa3=	soa3?	oa3 = 44	44	0 to 255	Line3 - offsetG
Offset4	soa4=	soa4?	oa4 = 44	44	0 to 255	Line4 - offsetB
Analog Gain	sang=	sang?	ang=0	0	0 to 255	Sensor analog gain
Global gain	sgnu=	sgnu?	gnu=0	0	0 to 255	Global digital gain
Global offset	sncv=	sncv?	ncv=0	0	-4096 to +4095	Global offset
Restore Settings	sres=	sres?	res=0	0	0	Factory default
					1 to 4	User region
Save Settings	ssav=	-	-	-	1 to 4	User region
CameraLink Out Mode	sout=	sout?	out=0	0	0	Base (1 x 2) 2 Taps
					1	Medium (1 x 4) 4 Taps
					2	Full (1 x 8) 8 Taps
					3	Deca (1 x 10) 10 Taps
Data Bit Format	souf=	souf?	out=2	2	1	10 bit data
					2	8bit data
Integration Time	sint=	sint?	int=196	196	1 to 65531 (0.1 μs)	Integral time
Line Period	sreq=	sreq?	req=200	200	13 to 65535 (0.1 μs)	Line time

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Image Mode	smod=	smod?	mod=0	0	0	Sensor Image
					2	Test Pattern
Synchronizati-on Mode	ssyn=	ssyn?	syn=1	1	1	Free Run
					2	Trigger and register control exposure
					3	ITC One Trig (trigger pulse width control exposure)
FPN Computing coeff	sdfd=	sdfd?	dfd=0	0	1	Automatically calculates the FPN coefficient.
FPN Recall	s+f=	-	+f=0	0	0 to 4	Loads FPN parameters from Flash.
FPN Storage	s-f=	-	-	1	1 to 4	Saves FPN parameters to Flash.
FPN Enable	sdnu=	sdnu?	dun=0	0	0 to 1	Enables/Disables FPN.
PRNU ROI XOffset	sxst=	sxst?	xst=0	0	0 to 8000	Horizontal offset of image ROI output
PRNU ROI Width	swid=	swid?	wid=8192	8192	0 to 8192	Horizontal width of image ROI output
PRNU Computing Coeff	sdfp=	sdfp?	dfp=0	0	1	Automatically calculates the PRNU coefficient.
PRNU Recall	s+p=	-	+p=0	0	0 to 4	Loads PRNU parameters from Flash.
PRNU Storage	s-p=	-	-	1	1 to 4	Saves PRNU parameters to Flash.
PRNU Enable	spnu=	spnu?	pnu=0	0	0 to 1	Enables/Disables PRNU.
Bright	sbri=	sbri?	bri=64	64	1 to 127	Adjusts the brightness.
Contrast	scon=	scon?	con=64	64	1 to 127	Adjusts the contrast.
Flip Horizontal (Mirror)	sxfl=	sxfl?	xfl=0	0	0 to 1	Pixel readout direction

6.3 Command Table of VC22-081CM-100, VC22-083CC-033, VC22-162CC-017, and VC22-162CM-050

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Reads all camera parameters.	-	?=3	-	-	-	Returns values of all parameters.
Reads the camera SN.	-	?=D	-	-	-	Returns the 8-bit SN of the camera directly.
Reads the camera ID.	-	?=E	fid=D015	D015	D015	Returns the camera ID.
Reads the camera FPGA version.	-	?=F	ffw=1001	-	-	Returns the FPGA version.
Reads the camera ARM version.	-	?=G	stm=1001	-	-	Returns the ARM version.
Reads the DSNU and RNU states.	-	?=9	dnu=0 pnu=0	-	-	Returns the DSNU and PRNU states.
Camera main board temperature	-	?=T	TMP=45	-	-	TMP=45
Reads user-defined data.	-	?=I	XXXXXXXXXXX-XXXXXXXXXXX-XXXXXXXX	-	Hexadecimal string	Reads user region data (32 characters).
Writes user-defined data 1.	WUA=	-	-	-	WUA=4 83886080000 0	Writes the character "2" to the user region.
Writes user-defined data 2.	WUB=	-	-	-	WUB=40000	Writes the character to the user region. Send the WUA command first, and then send the WUB command. The write operation is complete.
CameraLink Speed	scsd=	scsd?	scsd=1	1	0: 65 MHz 1: 85 MHz	CameraLink Speed
Analog Gain	sang=	sang?	ang=0	0	0 to 2	0: x1 1: x2 2: x4
Offset1	soa1=	soa1?	oa1 = 0	0	0 to 255	Sensor Offset
Global Gain	sgnu=	sgnu?	gnu=0	0	0 to 255	Digital gain

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Y Binning	sbin=	sbin?	bin=1	0	0 to 2	Pixel Binning in vertical direction (0: OFF; 1: Merge; 2: Average)
Analog High/Low Gain	shlg=	shlg?	hlg=0	0	0 to 1	0: Hgain 1: LGain
Restore Settings	sres=	sres?	res=0	0	0	Factory default
					1 to 4	User region
Save Settings	ssav=	-	-	-	1 to 4	User region
CameraLink Out Mode (black-white)	sout=	sout?	out=0	0	0	Base (1 x 2) 2 Taps
					1	Medium (1 x 4) 4 Taps
					2	Full (1 x 8) 8 Taps
					3	Deca (1 x 10) 10 Taps
					4	Base (1 x 3) 3 Taps
CameraLink Out Mode (color)	sout=	-	out=1	1	1	Base (3Tap_ 1X)
					2	Bedium (6Tap_ 1X)
					3	Full (8Tap_1X)
					4	Deca (10Tap_ 1X)
Data Bit Format	souf=	souf?	ouf=2	2	2	8bit data
Integration Time	sint=	sint?	int=800	800	500 to 65535 (0.1 μs)	Integral time
Line Period	sreq=	sreq?	req=500	500	166 to 65535 (0.1 μs)	Line time
Image Mode	Image mode	smod?	mod=0	0	0	Sensor Image
					2	Test Pattern
Synchronizati-on Mode	ssyn=	ssyn?	ssyn=1	1	1	Free Run
					2	Trigger and register control exposure
					3	ITC One Trig (trigger pulse width control exposure)
FPN Computing coeff	sdfd=	sdfd?	dfd=0	0	1	Automatically calculates the FPN coefficient.

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
FPN Recall	s+f=	-	+f=0	0	0 to 4	Loads FPN parameters from Flash.
FPN Storage	s-f=	-	-	1	1 to 4	Saves FPN parameters to Flash.
FPN Enable	sdnu=	sdnu?	dun=0	0	0 to 1	Enables/Disables FPN.
PRNU ROI XOffset	sxst=	sxst?	xst=0	0	0 to 8000	Horizontal offset of image ROI output
PRNU ROI Width	swid=	swid?	wid=8192	8192	0 to 8192	Horizontal width of image ROI output
PRNU Computing Coeff	sdfp=	sdfp?	dfp=0	0	1	Automatically calculates the PRNU coefficient.
PRNU Recall	s+p=	-	+p=0	0	0 to 4	Loads PRNU parameters from Flash.
PRNU Storage	s-p=	-	-	1	1 to 4	Saves PRNU parameters to Flash.
PRNU Enable	spnu=	spnu?	pnu=0	0	0 to 1	Enables/Disables PRNU.
Bright	sbri=	sbri?	bri=64	64	1 to 127	Adjusts the brightness.
Contrast	scon=	scon?	con=64	64	1 to 127	Adjusts the contrast.
Trigger Source	stgs=	stgs?	tgs=0	0	0	Camera internal trigger
					1	CameraLink CC1 trigger
					2	Camera Line1 trigger
Trigger Active	stga=	stga?	tga=0	0	0	Falling edge triggered
					1	Rising edge triggered
					2	High level triggered
					3	Low level triggered

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Trigger Delay	stdl=	stdl?	tdl=0	0	0 to 65535	TriggerDelay
Trigger Debounce Width	stdb=	stdb?	tdb=0	0	0 to 65535	Trigger debouncing width
Window XOffset	sros=	sros?	ros=0	0	0 to 10200	Horizontal offset of image ROI output
Window Width	srow=	srow?	row=10240	10240	0 to 10240	Horizontal width of image ROI output
Flip Horizontal (Mirror)	sxfl=	sxfl?	xfl=0	0	0 to 1	Pixel readout direction
Gamma	sgma=	sgma?	gma=100	100	20 to 1000	Gamma coefficient x 100
Gamma Enable	sgme=	sgme?	gme=0	0	0 to 1	Enables/Disables Gamma.
The following parameters are applicable for color cameras only.						
Scan Direction	sscd=	sscd?	scd=0	0	0 to 1	Scan direction (0: Forward; 1: Reverse)
Spatial Alignment	sssa=	sssa?	ssa=416	416	0 to 65535	Color spatial correction coefficient (multiplied by 32 times)
Auto WhiteBalance	sdwb=	sdwb?	dwb=0	0	0 to 1	White balance coefficient statistics
WhiteBalance Enable	sawb=	sawb?	awb=1	1	0 to 1	Enables/Disables white balance.
WhiteBalance-Radio Red	swbr=	swbr?	wbr=297	297	1 to 1024	White balance coefficient of red component
WhiteBalance-Radio Blue	swbg=	swbg?	wbg=466	466	1 to 1024	White balance coefficient of blue component
WhiteBalance Region	swbs=	swbs?	wbs=6	6	bit[0 to 3]/1 to 15	White balance region selection (evenly divided into 4 regions horizontally)
CCM Enable	scme=	scme?	cme=0	0	0 to 1	Enables/Disables color correction.

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
CCM Radio R0	scm0=	scm0?	cm0 = 6106	6106	0 to 65535	Color correction array coefficient R0
CCM Radio R1	scm1=	scm1?	cm1 = 34451	34451	0 to 65535	Color correction array coefficient R1
CCM Radio R2	scm2=	scm2?	cm2 = 33095	33095	0 to 65535	Color correction array coefficient R2
CCM Radio G0	scm3=	scm3?	cm3 = 33625	33625	0 to 65535	Color correction array coefficient G0
CCM Radio G1	scm4=	scm4?	cm4 = 5280	5280	0 to 65535	Color correction array coefficient G1
CCM Radio G2	scm5=	scm5?	cm5 = 33095	33095	0 to 65535	Color correction array coefficient G2
CCM Radio B0	scm6=	scm6?	cm6 = 33625	33625	0 to 65535	Color correction array coefficient B0
CCM Radio B1	scm7=	scm7?	cm7 = 34451	34451	0 to 65535	Color correction array coefficient B1
CCM Radio B2	scm8=	scm8?	cm8 = 6636	6636	0 to 65535	Color correction array coefficient B2
CCM Offset R	scma=	scma?	cma=0	0	0 to 65535	Color correction array offset R
CCM Offset G	scmb=	scmb?	cmb=0	0	0 to 65535	Color correction array offset G
CCM Offset B	scmc=	scmc?	cmc=0	0	0 to 65535	Color correction array offset B
RGB/BGR PixelType	srgb=	srgb?	rgb=0	0	0	RGB/BGR pixel color arrangement order

6.4 Command Table of VC22-081CM-100A

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Reads all camera parameters.	-	?=3	-	-	-	Returns values of all parameters.
Reads the camera SN.	-	?=D	-	-	-	Returns the 16-bit SN of the camera directly.
Reads the camera ID.	-	?=E	fid=D014	-	-	Returns the camera ID.
Reads the camera FPGA version.	-	?=F	ffw=XXXX	-	-	Returns the camera FPGA version.
Reads the camera ARM version.	-	?=G	stm=XXXX	-	-	Returns the camera firmware ARM version.
Reads the DSNU and PRNU states.	-	?=9	dnu=1 pnu=1	-	-	Returns the DSNU and PRNU states.
Camera main board temperature	-	?=T	TMP=XX	-	-	Returns the motor temperature.
Reads user-defined data.	-	?=I	XXXXXXXXXXXXXXXXXXXXXXXX	-	Hexadecimal string	Reads user region data (32 characters).
Writes user-defined data 1.	WUA=	-	-	-	WUA= 4838860800000	Writes the character "2" to the user region.
Writes user-defined data 2.	WUB=	-	-	-	WUB=40000	Writes the character to the user region first. Send the WUA command, and then send the WUB command. The write operation is complete.
Offset1	soa1=	soa1?	oa1 = 0	0	0 to 255	Offset
Analog High/Low Gain	shlg=	shlg?	hlg=0	0	0 to 1	0: Hgain 1: LGain
Restore settings	sres=	sres?	res=0	0	0 to 3	Loads the user region.
Save settings	ssav=	-	-	-	1 to 3	Saves to the user region.

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
CameraLink Out mode	sout=	sout?	out=	0	0	base (1 x 2) 2 Taps
					1	medium (1 x 4) 4 Taps
					2	full (1 x 8) 8 Taps
					3	Deca (1 x 10) 10 Taps
					4	base (1 x 3) 3 Taps
Data Bit format	souf=	souf?	ouf=2	2	1	10bit data
					2	8bit data
Line period	sreq=	sreq?		500	100 to 65535 (accurate to 0.1 μs)	Line time, minimum 100 (10 μs)
Multi Exposure line Num	itm=	itm?		2	1 to 8	Supports synchronization of up to 8 groups of light sources.
Line X Exposure Time	smi1=	smi1?	smi1 = 100	100	30 to 65535 (x 0.1 μs)	Group 1 Integral time (int time + 10 < req time)
Line X Gain Value	smg1=	smg1?	smg1 = 0	0	0 to 800	Group 1 Gain
Line X Flash Pulse Out Delay	smd1=	smd1?	smd1 = 0	0	0 to 65535 (x 0.1 μs)	Group 1 Pulse output delay time of light source
Line X Exposure Time	smi2=	smi2?	smi2 = 100	100	30 to 65535 (x 0.1 μs)	Group 2 Integral time (int time + 10 < req time)
Line X Gain Value	smg2=	smg2?	smg2 = 0	0	0 to 800	Group 2 Gain
Line X Flash Pulse Out Delay	smd2=	smd2?	smd2 = 0	0	0 to 65535 (x 0.1 μs)	Group 2 Pulse output delay time of light source
Line X Exposure Time	smi3=	smi3?	smi3 = 100	100	30 to 65535 (x 0.1 μs)	Group 3 Integral time (int time + 10 < req time)

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Line X Gain Value	smg3=	smg3?	smg3 = 0	0	0 to 800	Group 3 Gain
Line X Flash Pulse Out Delay	smd3=	smd3?	smd3 = 0	0	0 to 65535 (x 0.1 μs)	Group 3 Pulse output delay time of light source
Line X Exposure Time	smi4=	smi4?	smi4 = 100	100	30 to 65535 (x 0.1 μs)	Group 4 Integral time (int time + 10 < req time)
Line X Gain Value	smg4=	smg4?	smg4 = 0	0	0 to 800	Group 4 Gain
Line X Flash Pulse Out Delay	smd4=	smd4?	smd4 = 0	0	0 to 65535 (x 0.1 μs)	Group 4 Pulse output delay time of light source
Line X Flash Pulse Out Width	smw1=	smw1?	smw1 = 50	0	0 to 65535 (x 0.1 μs)	Group 1 Pulse output width of light source
Line X Flash Pulse Out Width	smw2=	smw2?	smw2 = 50	0	0 to 65535 (x 0.1 μs)	Group 2 Pulse output width of light source
Line X Flash Pulse Out Width	smw3=	smw3?	smw3 = 50	0	0 to 65535 (x 0.1 μs)	Group 3 Pulse output width of light source
Line X Flash Pulse Out Width	smw4=	smw4?	smw4 = 50	0	0 to 65535 (x 0.1 μs)	Group 4 Pulse output width of light source
Sensor Exposure Delay	smid=	smid?	smid=100	100	0 to 65535 (x 0.1 μs)	Exposure delay
Flash Pulse Output Polarity	smfp=	smfp?	smfp=0	0	0 to 1	Pulse output polarity of light source
CameraLink DVAL Enable	sdvl=	sdvl?	sdvl=1	1	0 to 1	CameraLink DVAL signal active
Image mode	smod=	smod?	mod=0	0	0	Sensor image
Synchronization mode	ssyn=	ssyn?	ssyn=1	1	2	Test pattern
					1	Free run

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
FPN Computing coeff	sdfd=	sdfd?	dfd=0	0	2	Trigger and register control exposure
					1	Automatically calculates the FPN coefficient.
FPN recall	s+f=	-	+f=1	0	0 to 3	Loads FPN parameters from Flash.
FPN storage	s-f=	-	-	1	1 to 3	Saves FPN parameters to Flash.
FPN Enable	sdnu=	sdnu?	dnu=1	1	0 to 1	Enables/Disables FPN.
PRNU ROI XOffset	sxst=	sxst?	xst=0	0	0 to 8000	Horizontal offset of image ROI output
PRNU ROI Width	swid=	swid?	wid=8192	8192	0 to 8192	Horizontal width of image ROI output
PRNU Computing coeff	sdfp=	sdfp?	dfp=0	0	1	Automatically calculates the PRNU coefficient.
PRNU recall	s+p=	-	+p=1	0	0 to 3	Loads PRNU parameters from Flash.
PRNU storage	s-p=	-	-	1	1 to 3	Saves PRNU parameters to Flash.
PRNU Enable	spnu=	spnu?	pnu=1	1	0 to 1	Enables/Disables PRNU.
Bright	sbri=	sbri?	bri=32	32	1 to 127	Adjusts the brightness.
Contrast	scon=	scon?	con=32	32	1 to 127	Adjusts the contrast.
Flip Horizontal (Mirror)	sxfl=	sxfl?	xfl=0	0	0 to 1	Pixel readout direction
Window XOffset	sros=	sros?	ros=0	0	0 to 10200	Horizontal offset of image ROI output
Window Width	srow=	srow?	row=8192	8192	0 to 8192	Horizontal width of image ROI output

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Gamma	sgma=	sgma?	gma=100	100	20 to 1000	Gamma coefficient x 100
Gamma Enable	sgme=	sgme?	gme=0	0	0 to 1	Enables/Disables Gamma.
CameraLink Speed	scsd=	scsd?	scsd=1	1	0: 65 MHz 1: 85 MHz	CameraLink output clock frequency

6.5 Command Table of VC22-162CM-050A, VC22-166CC-017, and VC22-163CC-017

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Reads all camera parameters.	-	?=3	-	-	-	Returns values of all parameters.
Reads the camera SN.	-	?=D	-	-	-	Returns the 8-bit SN of the camera directly.
Reads the camera ID.	-	?=E	fid=D015	D015	D015	Returns the camera ID.
Reads the camera FPGA version.	-	?=F	ffw=1001	-	-	Returns the FPGA version.
Reads the camera ARM version.	-	?=G	stm=1001	-	-	Returns the ARM version.
Reads the DSNU and PRNU states.	-	?=9	dnu=0 pnu=0	-	-	Returns the DSNU and PRNU states.
Camera main board temperature	-	?=T	TMP=45	-	-	TMP=45
Reads user-defined data.	-	?=I	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	-	Hexadecimal string	Reads user region data (32 characters).
Writes user-defined data 1.	WUA=	-	-	-	WUA=4 838860800 0 0 0	Writes the character "2" to the user region.

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Writes user-defined data 2.	WUB=	-	-	-	WUB=4 0 0 0 0	Writes the character to the user region first. Send the WUA command, and then send the WUB command. The write operation is complete.
CameraLink Speed	scsd=	scsd?	scsd=1	1	0: 65 MHz 1: 85 MHz	CameraLink Speed
Analog Gain	sang=	sang?	ang=0	0	0 to 2	0: x1 1: x2 2: x4
Offset1	soa1=	soa1?	oa1 = 0	0	0 to 255	Sensor Offset
Global Gain	sgnu=	sgnu?	gnu=0	0	0 to 255	Digital gain
Analog High/Low Gain	shlg=	shlg?	hlg=0	0	0 to 1	0: Hgain 1: LGain
Restore Settings	sres=	sres?	res=0	0	0	Factory default
					1 to 4	User region
Save Settings	ssav=	-	-	-	1 to 4	User region
CameraLink Out Mode (black-white)	sout=	sout?	out=0	0	0	Base (1 x 2) 2 Taps
					1	Medium (1 x 4) 4 Taps
					2	Full (1 x 8) 8 Taps
					3	Deca (1 x 10) 10 Taps
					4	Base (1 x 3) 3 Taps
CameraLink Out Mode (color)	sout=		out=1	1	1	Base(3Tap_1X)
					2	Bedium(6Tap_1X)
					3	Full(8Tap_1X)
					4	Deca(10Tap_1X)
Data Bit Format	souf=	souf?	ouf=2	2	2	8bit data
Integration Time	sint=	sint?	int=800	800	500 to 65535 (0.1μs)	Integral time
Line Period	sreq=	sreq?	req=500	500	166 to 65535 (0.1μs)	Line time
Image Mode	Image mode	smod?	mod=0	0	0	Sensor Image
					2	Test Pattern

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Synchronization Mode	ssyn=	ssyn?	syn=1	1	1	Free Run
					2	Trigger and register control exposure
					3	ITC One Trig (trigger pulse width control exposure)
FPN Computing coeff	sdfd=	sdfd?	dfd=0	0	1	Automatically calculates the FPN coefficient.
FPN Recall	s+f=	-	+f=0	0	0 to 4	Loads FPN parameters from Flash.
FPN Storage	s-f=	-	-	1	1 to 4	Saves FPN parameters to Flash.
FPN Enable	sdnu=	sdnu?	dun=0	0	0 to 1	Enables/Disables FPN.
PRNU ROI XOffset	sxst=	sxst?	xst=0	0	0 to 8000	Horizontal offset of image ROI output
PRNU ROI Width	swid=	swid?	wid=8192	8192	0 to 8192	Horizontal width of image ROI output
PRNU Computing Coeff	sdfp=	sdfp?	dfp=0	0	1	Automatically calculates the PRNU coefficient.
PRNU Recall	s+p=	-	+p=0	0	0 to 4	Loads PRNU parameters from Flash.
PRNU Storage	s-p=	-	-	1	1 to 4	Saves PRNU parameters to Flash.
PRNU Enable	spnu=	spnu?	pnu=0	0	0 to 1	Enables/Disables PRNU.
Bright	sbri=	sbri?	bri=64	64	1 to 127	Adjusts the brightness.
Contrast	scon=	scon?	con=64	64	1 to 127	Adjusts the contrast.

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
Trigger Source	stgs=	stgs?	tgs=0	0	0	Camera internal trigger
					1	CameraLink CC1 trigger
					2	Camera Line1 trigger
Trigger Active	stga=	stga?	tga=0	0	0	Falling edge triggered
					1	Rising edge triggered
					2	High level triggered
					3	Low level triggered
Trigger Delay	stdl=	stdl?	tdl=0	0	0 to 65535	TriggerDelay
Trigger Debounce Width	stdb=	stdb?	tdb=0	0	0 to 65535	Trigger debouncing width
Window XOffset	sros=	sros?	ros=0	0	0 to 10200	Horizontal offset of image ROI output
Window Width	srow=	srow?	row=10240	10240	0 to 10240	Horizontal width of image ROI output
Flip Horizontal(Mirror)	sxfl=	sxfl?	xfl=0	0	0 to 1	Pixel readout direction
Gamma	sgma=	sgma?	gma=100	100	20 to 1000	Gamma coefficient x 100
Gamma Enable	sgme=	sgme?	gme=0	0	0 to 1	Enables/Disables Gamma.
Scan Direction	sscd=	sscd?	scd=0	0	0 to 1	Scan direction (0: Forward; 1: Reverse)
The following parameters are applicable for color cameras only.						
Spatial Alignment	sssa=	sssa?	ssa=416	416	0 to 65535	Color spatial correction coefficient (multiplied by 32 times)
Auto WhiteBalance	sdwb=	sdwb?	dwb=0	0	0 to 1	White balance coefficient statistics
WhiteBalance Enable	sawb=	sawb?	awb=1	1	0 to 1	Enables/Disables white balance.

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
WhiteBalanceRadio Red	swbr=	swbr?	wbr=297	297	1 to 1024	White balance coefficient of red component
WhiteBalanceRadio Blue	swbg=	swbg?	wbg=466	466	1 to 1024	White balance coefficient of blue component
WhiteBalance Region	swbs=	swbs?	wbs=6	6	bit[0 to 3]/1 to 15	White balance region selection (evenly divided into 4 regions horizontally)
CCM Enable	scme=	scme?	cme=0	0	0 to 1	Enables/Disables color correction.
CCM Radio R0	scm0=	scm0?	cm0 = 6106	6106	0 to 65535	Color correction array coefficient R0
CCM Radio R1	scm1=	scm1?	cm1 = 34451	34451	0 to 65535	Color correction array coefficient R1
CCM Radio R2	scm2=	scm2?	cm2 = 33095	33095	0 to 65535	Color correction array coefficient R2
CCM Radio G0	scm3=	scm3?	cm3 = 33625	33625	0 to 65535	Color correction array coefficient G0
CCM Radio G1	scm4=	scm4?	cm4 = 5280	5280	0 to 65535	Color correction array coefficient G1
CCM Radio G2	scm5=	scm5?	cm5 = 33095	33095	0 to 65535	Color correction array coefficient G2
CCM Radio B0	scm6=	scm6?	cm6 = 33625	33625	0 to 65535	Color correction array coefficient B0
CCM Radio B1	scm7=	scm7?	cm7 = 34451	34451	0 to 65535	Color correction array coefficient B1
CCM Radio B2	scm8=	scm8?	cm8 = 6636	6636	0 to 65535	Color correction array coefficient B2
CCM Offset R	scma=	scma?	cma=0	0	0 to 65535	Color correction array offset R
CCM Offset G	scmb=	scmb?	cmb=0	0	0 to 65535	Color correction array offset G

Description	Parameter Setting Command	Parameter Reading Command and Response		Default Value	Value Range	Function
		Write Command	Response			
CCM Offset B	scmc=	scmc?	cmc=0	0	0 to 65535	Color correction array offset B
RGB/BGR PixelType	srgb=	srgb?	rgb=0	0	0	RGB/BGR pixel color arrangement order
Flip Horizontal (Mirror)	sxfl=	sxfl?	xfl=0	0	0 to 1	Pixel readout direction (0: Forward; 1: Reverse)

6.6 Procedure of PRNU and DSNU Commands

1. Set the correction area: Run the swid= command to set the horizontal width of the correction area. Run the sxst= command to set the horizontal offset of the correction area.
2. DSNU calculation: Block the lens to ensure the camera captures a completely black image. Run the sdnu=1 command to enable DSNU and run the sdfd=1 command to perform DSNU correction once and wait for the operation to complete. Upon success, run the s-f= to save the parameters and run the s+f= command to load the parameters.
3. RNU calculation: Ensure the illumination is uniform with moderate brightness, avoiding any overexposure. If using white paper for PRNU, keep the paper moving to ensure the camera captures a uniformly gray-white image. Run the spnu=1 command to enable PRNU and run the sdfp=1 command to perform PRNU correction once and wait for the operation to complete. Upon success, run the s-p= to save the parameters and run the s+p= command to load the parameters.

7 Certification and Standard Compliance

7.1 Compliance with CE, RoHS, and KC Certifications

The product is CE, RoHS and KC certified. The following table lists the certifications, directives, and standards that the product may comply with. For details about the acquired certificates, see the certification marks on the product nameplate.

Certification	Directive		Standard
CE certification and RoHS certification	EMC Directive	2014/30/EU	EN 61000-6-4 EN 61000-6-2
	RoHS Directive	2011/65/EU amended by (EU) 2015/863	EN IEC 63000
KC certification	-	-	KN 61131-2



Figure 7-1 KC certification

Note

To ensure optimal EMC performance of the camera, the housing must be grounded.

7.2 Referenced Standards and Specifications

- EN 55032 "Electromagnetic compatibility of multimedia equipment - Emission requirements"
- EN 55035 "Electromagnetic compatibility of multimedia equipment - Immunity requirements"

8 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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